11. 0.28g of aluminium reacted completely with oxygen gas. Calculate the volume of oxygen used. (molar gas volume is 24000cm^3 Al = 2.7) (3mks)

12. Describe you would prepare a pure sample of zinc carbonate starting with zinc oxide. (3mks)

13. Equal volumes of 2m monobasic acids D and E were each reacted with excess magnesium ribbon. The table shows the volumes of gas produced after 2 minutes. (4mks)

Acid	Volume of gas (cm^3)
D	30
E	70

Explain the difference in the volumes of gas produced. (2mks)

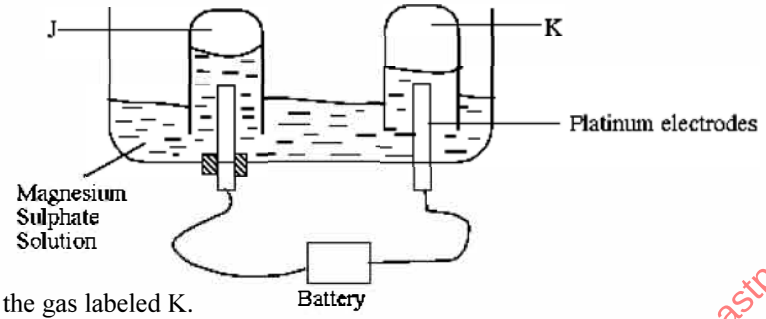
14. The thermo chemical equations below shows the formation of hydrogen peroxide under standard conditions;

$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(g)}$ $\Delta H^{\theta}_f = -133KJ\ mol^{-1}$

$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(l)}$ $\Delta H^{\theta}_J = -188kJ\ mol^{-1}$

Calculate the molar heat of vaporization of hydrogen peroxide. (2mks)

15. 50cm^3 of 1m magnesium sulphate was electrolysed using the set up represented by the diagram below;



I Identify the gas labeled K. (½ mk)

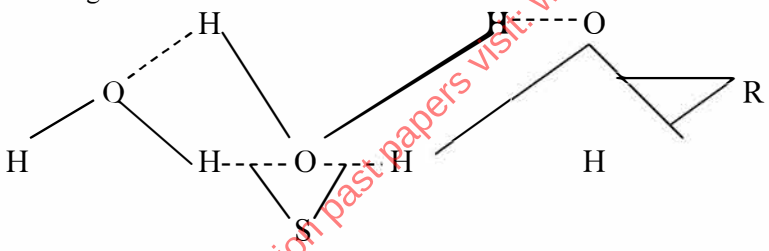
II Write an equation for the reaction that liberates gas J. (1mk)

III What happens to the concentration of the magnesium sulphate during electrolysis. Explain (1½mk)

16. i) What is the half life? (1mk)

ii) Xg of a radioactive element was reduced to 12.5g in 15.6years. If the half life of the element is 5.2years. Calculate the value of X. (2mks)

17. a) The diagram below shows a structure of water molecules.



Name the bonds labeled

R - (½mk)

S - (½mk)

b) Using dot (.) and cross (x) diagram sho bonding in;

i) Potassium chloride (K = 19 Cl = 17)

ii) Carbon tetrachloride

C = 6 Cl = 17

18. i) In an experiment to determine solubility of solid P in water at 25^{0}C, the following results were obtained.

Mass of empty evaporating dish – 24.2g

Mass of evaporating dish + saturated solution = 40.4g

Mass of evaporating dish + dry solid P = 28.4g

Using the information above calculate the solubility of solid P at 25^{0}C in g/100g of water. (2mks)

ii) State one precaution observed when carrying out the experiment in (i) above 1 (1mk)

19. i) Name two conditions that accelerate rusting. (1mk)

ii) State two ways rusting can be prevented. (2mks)

20. The molecular formular of a hydrocarbon C_7H_{16}. The hydrocarbon can be converted into two other hydrocarbons as shown below by the equation below.

$$C_7H_{16} \xrightarrow{\text{Catalyst F}} CH_4 + \text{Substance G}$$

Name i) the process shown by the equation above (1mk)

ii) Catalyst F (1mk)

iii) State one chemical test for substance G (1mk)

21. A solution of bromine in water is a chemical reaction in equilibrium. The reaction involved is represented by the equation below;

$Br_{2(aq)} + H_2O_{(l)} \rightarrow 2H^{+(aq)} + Br^-_{(aq)} + OBr^-_{(aq)}$

Yellow — Colourless

State and explain the observation made when concentrated sulphuric (IV) acid is added to the mixture at equilibrium. (2mks)

22. The table below shows solutions and their PH values.

Solution	PH value
L	2.0
M	7.0
N	14.0

i) Select two solutions that will react with calcium metal. Give a reason. (2mks)

ii) Which solution is that of sodium chloride solution? (1mk)

23. During the extraction of aluminium, cryolite is added to molten aluminium oxide.

i) State the function of cryolite during the process (1mk)

ii) Give two reasons why aluminium is used in making overhead cables. (2mks)

24. Study the standard reduction potentials below and answer the questions that follow;

The letters are not actual symbols of the elements

Half cell	E∋volts
$P^{2+}_{(aq)} + 2e \rightarrow P_{(s)}$	- 0.76
$R^{2+}_{(aq)} + 2e \rightarrow R_{(s)}$	- 2.37
$S^{+}_{(aq)} + 1e \rightarrow S_{(s)}$	+ 0.80
$T^{2+}_{(aq)} + 2e \rightarrow T_{(s)}$	- 0.14

i) Select the element which is the strongest reducing agent. Give a reason. (1mk)

ii) Select two half cells when combined would produce the largest e.m.f (1mk)

iii) Calculate the e.m.f of the electrochemical cell formed when the two half cells in (ii) above are combined. (1mk)

25. State two uses of nitrogen gas. (2mks)

26. When iron fillings are added to aqueous copper (II) sulphate solution a reaction takes place.

State three observations made during the reaction. (2mks)

27. A colourless solution was suspected to be water. Give one chemical and one physical best that can be used to show that the colourless solution is water. (2mks)

i) Chemical test: - (1mk)

ii) Physical test: - (1mk)

28. Study the table below and answer the question that follow. The letters do not represent the actual symbols of the element.

Formula of ion	Electron configuration
W^{2+}	2
V^{2-}	2.8
X^{3+}	2.8
U^{2+}	2.8
Y^{-}	2.8.8

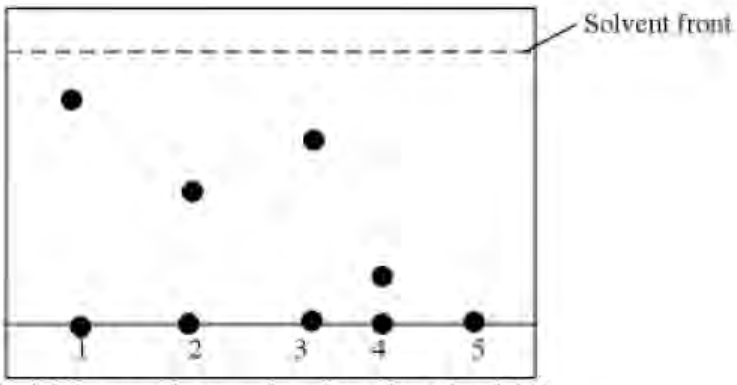
a) Select elements found in;

i) the same group (1mk)

ii) period three (1mk)

b) What is the family name given the group members to which element Y belongs (1mk)

29. The diagram below represents a paper chromatogram of pure inks marked 1, 2, 3 and 4. 5 is a mixture that contains inks 1 and 4 only.



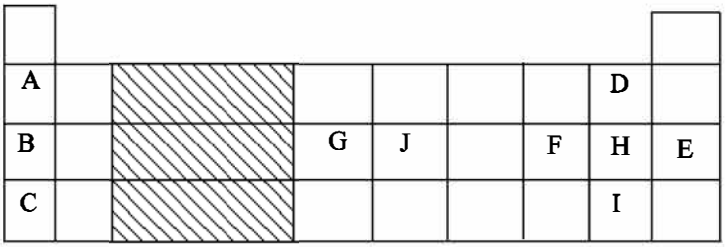
a) Give a reason why ink 1 moves faster to the solvent front than ink 2. (1mk)

b) Name two factors that determine chromatography. (1mk)

c) Show on the chromatogram diagram the chromatography of K. (1mk)

KIRINYAGA
SCHOOL BASED FORM 4 EXAMINATIONS JULY – AUGUST 2017
233/2
CHEMISTRYPAPER 2
(Theory)
TIME: 2 HRS

1. The figure below represents a section of the periodic table. Study it and answer questions (a) to (h). Note that the letters do not represent the actual symbols of the elements.



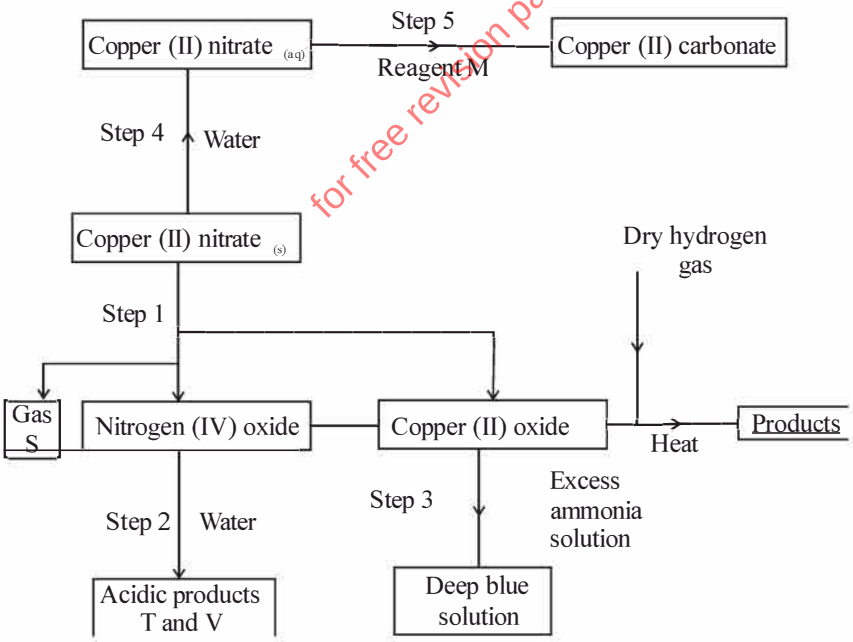
a) Consider elements D. H and I
   i) Give the chemical family of these elements. (1 mk)
   ii) How do their ionic size compare. (1mk)
   iii) Compare and explain the reactivity of the three elements. (2mks)

b) i) Write the electronic configuration of;
   Element H (1mk)
   ii) The ion of element G. (1mk)

c) A molecule of one of the elements is shown below. (2mks)

   i) Identify this element from the section of the periodic table and give its actual symbol and name. (2mks)
   ii) Explain why this element has a higher boiling point compared to that of oxygen. (2mks)
   iii) Write an equation to show the reaction between the element named above with oxygen. (1mk)
   iv) Predict the pH of the oxide of the above element when in water. Explain. (2mks)

2. The flow chart below shows some reactions starting with copper (II) nitrate. Study it and answer questions that follow.



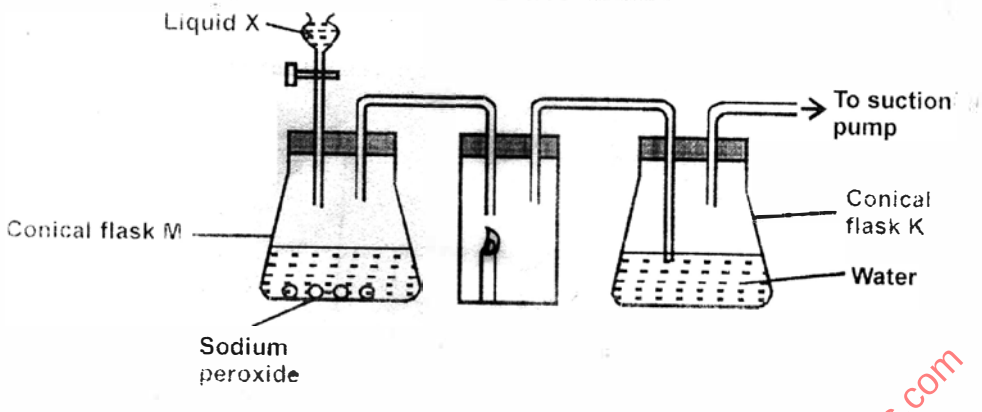
a) i) State the condition necessary in step 1. (1mk)
   ii) Identify (4mks)
   Reagent M
   Gas S

Acidic products Tand V

iii) Write the formula of the complex ion formed in step 3. (1mk)

iv) Write the equations for the reaction in
Step 1
Step 2

3. a) The diagram below shows a set up that was used to prepare oxygen gas and passing it over a burning candle. The experiment was allowed to run for some time.



i) Name liquid X (1mk)

ii) Suggest the pH of the solution in conical flask K. Explain (2mks)

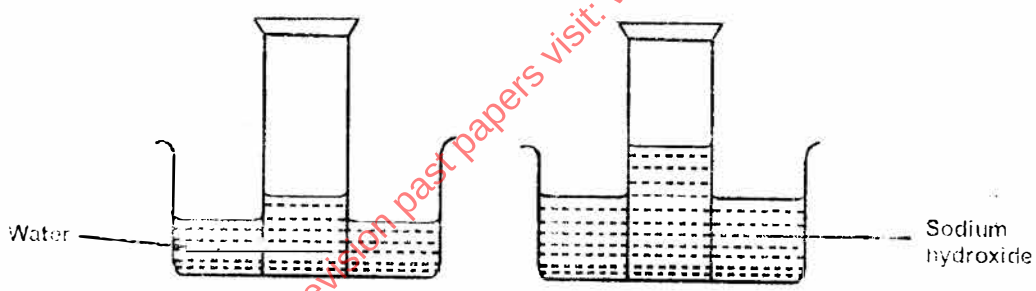
iii) Write an equation for the reaction taking place in the conical flask M. (1mk)

b) State and explain the two observations made when hydrogen sulphide is bubbled into the solution containing iron (III) chloride. (2mks)

c) i) Describe a simple chemical test that can be used to distinguish between carbon (IV) oxide and carbon (II) oxide gases. (3mks)

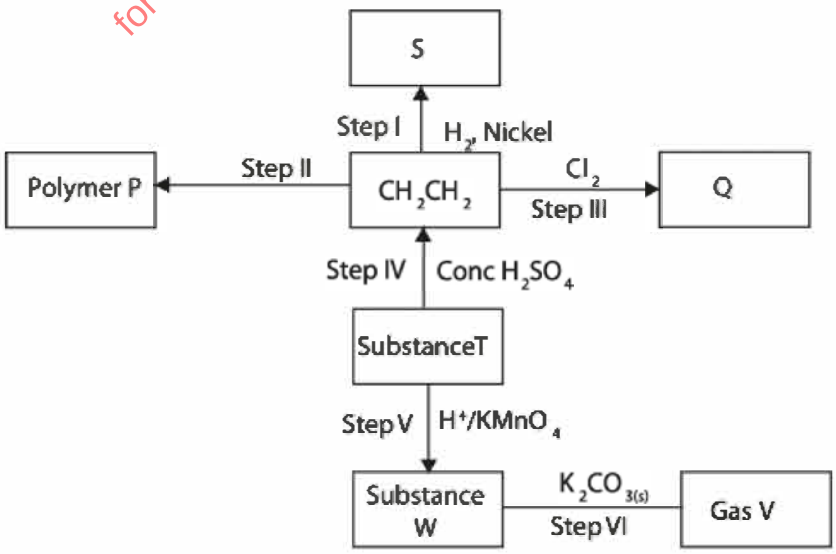
ii) Give one use of carbon (II) oxide. (1mk)

d) A form two student inverted a gas jar full of carbon (IV) oxide over water and sodium hydroxide solution as shown below.



Explain the observations made. (2mks)

4. Study the flow chart below and answer the question that follows:



a) Identify the following:

i) Substance W…… (1mk)

ii) Gas V…….. (1mk)

b) Name the processes involved in the following steps

i) Step I……. (1mk)

ii) Step III……. (1mk)

c) i) What type of reaction is taking place in step V? (1mk)

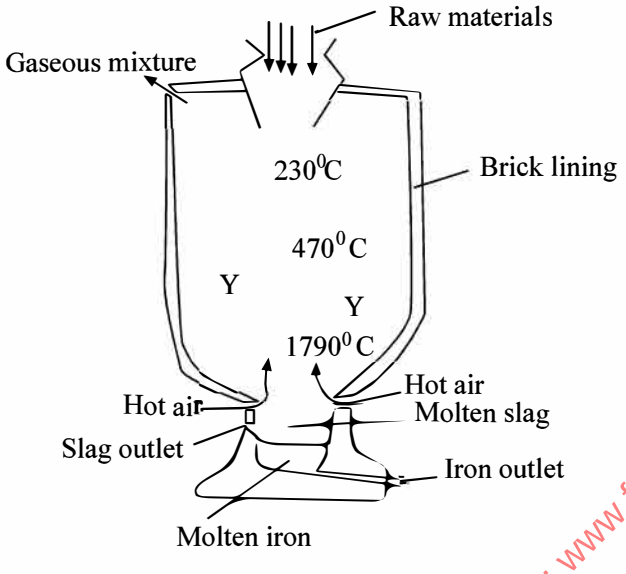
ii) Draw the structure and give their IUPAC name for the following compounds.

Compound	Structure	Name
Q		
P		

(4mks)

d) Write the equation that took place in step III. (1mk)

5. Iron is obtained from hematite using a blast furnace shown in the diagram below;



a) Name the **four** raw materials required for the production of iron;

b) Write an equation for the reaction in which carbon (IV) oxide is converted into carbon (II) oxide. (1mk)

c) Explain why the temperature in the region marked Y is higher than of the incoming air. (1mk)

d) State two physical properties of molten slag that allows it to be separated from molten iron as shown above. (2mks)

e) Iron from the blast furnace contains about 5% carbon

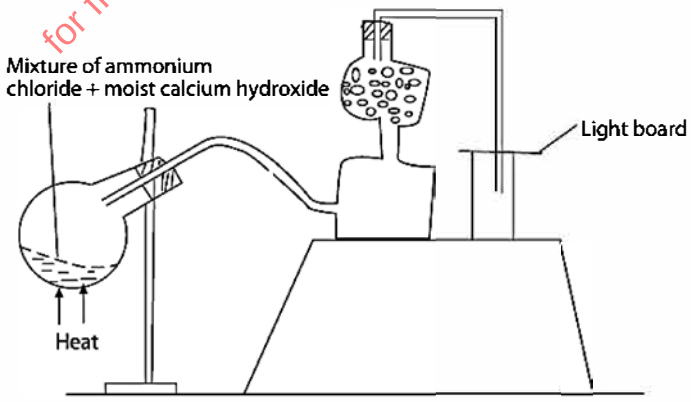
i) Describe how the carbon content is reduced. (2mks)

ii) Why is it necessary to reduce the carbon content? (1mk)

f) Give a reason why the melting point of iron obtained from the blast furnace is 120^{0}C while that of pure iron is 1535^{0}c. (1mk)

g) State two uses of steel. (2mks)

6. a) A student set up the apparatus as shown in the diagram below to prepare and collect dry ammonia gas.



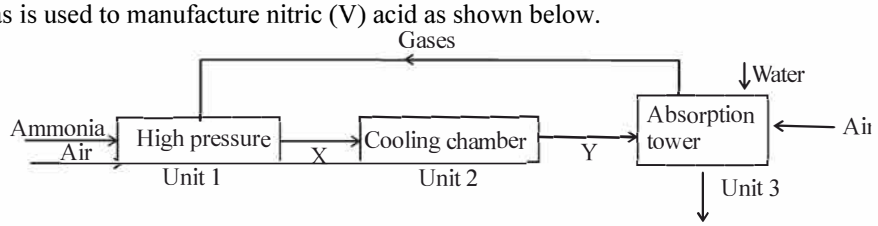
i) Identify three mistakes in the set up and give a reason why each is mistake. (3mks)

ii) Name a suitable drying agent for ammonia. (1mk)

iii) Write an equation for the reaction that occurred when a mixture of ammonium chloride and calcium hydroxide was heated. (1mk)

iv) Describe one chemical test for ammonia gas. (1mk)

b) Ammonia gas is used to manufacture nitric (V) acid as shown below.



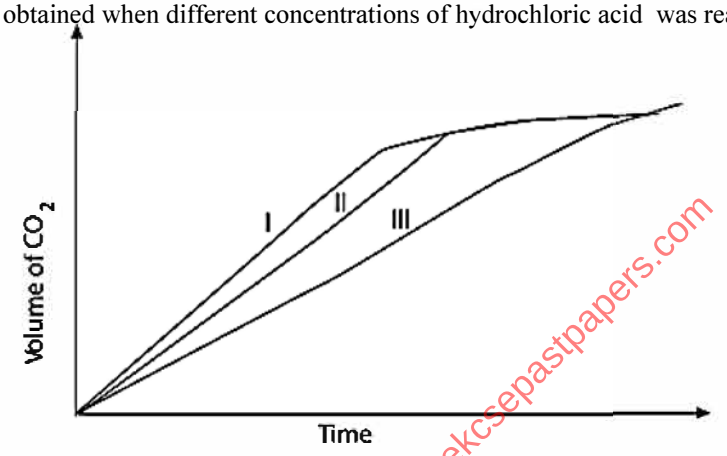
i) This process requires the use of a catalyst in which unit is the catalyst used? (1mk)

ii) Identify compound X and Y. (2mks)

iii) Using oxidation number explain why the conversion of ammonia to nitric (V) acid is called catalytic oxidation of ammonia. (3mks)

iv) Ammonia reacts with nitric (v) acid to form ammonium nitrate fertilizer. Calculate the percentage composition of nitrogen in ammonium nitrate. (N = 14, O = 16, H = 1)

7. a) Below is a graph that was obtained when different concentrations of hydrochloric acid was reacted with equal amount of calcium carbonate.



The concentration of hydrochloric acid were 0.8M, 0.5M and 0.1M. The calcium carbonate was in powder form. Match the graphs with concentrations.

Graph I…… (1mk)

Graph III…… (1mk)

b) A state of equilibrium between dichromate (VI) and chromate ions is established as shown in the equation below.

$Cr_2O_{7(aq)} + 2OH^-_{(aq)} \rightleftharpoons 2CrO_{42-(aq)} + H_2O_{(l)}$

Orange Yellow

i) What is meant by dynamic equilibrium? (1mk)

ii) State and explain observation made when a few pellets of potassium hydroxide are added to the equilibrium mixture. (2mks)

c) An experiment was done using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce $50cm^3$ of the gas for every experiment was recorded in the table below.

Conc. of HCL in Mol/litre	2.0	1.75	1.50	1.25	1.00	0.75	0.50	0.25
Time in sec(s)	8.8	10.0	11.7	13.5	17.5	22.7	35.5	70.0
$Sec^{-1}\ \frac{1}{t}$								

i) Complete the table above. (2mks)

iii) Plot a graph of rate $\frac{1}{Time}$ against concentration. (4mks)

i) Determine from your graph the concentration needed to produce $50cm^3$ of hydrogen gas, when time is 15 seconds. (1mk)

KIRINYAGA
233/3
Chemistry Practical
SCHOOL BASED FORM 4 EXAMINATIONS JULY – AUGUST 2017
Confidential

In additiion to the fittings and apparatus found ina a Chemistry Laboratory each student will require the following.

1. 1.5g of solid T
2. 250cm^3 of solution B
3. 150cm^3 of solution R
4. 3 conical flasks
5. 100cm^3 measuring cylinder
6. Distilled water in a wash bottle
7. Burette
8. Pipette
9. Filter funnel
10. Filter paper
11. Spatula
12. 25cm^3 measuring cylinder
13. Solid S
14. 5 test tubes in a rack
15. 1 boiling tube
16. Test tube holder
17. Universal indicator paper
18. pH chart
19. Liquid A
20. Ethanol
21. Red and blue litmus paper

Access to

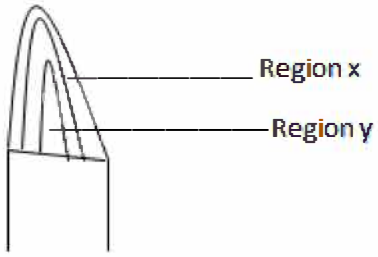
1. Phenolphthalein indicator
2. Means of heating
3. Universal indicator solution
4. Ammonia solution
5. Potassium Iodide solution
6. Barium nitrate solution
7. Aqueous nitric (V) acid
8. Acidified potassium manganate (VII) solution
9. Bromine water
10. Acidified potassium dichromate (VI) solution

NOTES

1. Solid T is Benzoic acid
2. Solution B is 0.02M NaOH
3. Solution R is 0.01MH_2SO_4
4. Solid S is hydrated Aluminiumsulphate$AL_2(SO_4)_3$. $6H_2O$.
5. Liquid A is distilled water.

CENTRAL KENYA NATIONAL SCHOOLS (CEKENAS)
223/1
CHEMISTRY PAPER 1
JULY 2017
2 HOURS
FORM 4 END OF TERM 2 EVALUATION EXAM

1. The diagram below shows a non-luminous flame



a). A wooden splint was placed across regions X and Y respectively. Draw labeled diagrams showing the effect observed when wooden splint is placed across each region (2 mks)

b). It's advisable to leave your flame in luminous flame state when not in use. Explain (1 mk)

2. The table below shows PH values of solutions A, B, C and D

Solution	PH
A	3.0
B	13.0
C	8.5
D	7.0

a) Identify a solution which has

i). More Hydrogen ions (1 mk)

ii). More Hydroxide ions (1 mk)

b) Which solution will react with lead(ii) Oxide. Explain (2 mks)

3. a). State one factor that determines stability of an atom (1 mk)

b). Radioactive polonium – 216 decay as shown below

$$^{216}_{90}PO \rightarrow {}^{208}_{84}Pb + MxnB$$

i). Find the value of M and n (1 mk)

ii). If after 112 days $^{1}/_{16}$ of polonium remained, calculate the half – life of polonium. (2 mks)

4. 280cm3 of Nitrogen gas diffuse through a porous plug in 70 seconds. How long will it take 400cm3 of Carbon (iv) Oxide gas to pass through the same porous plug(C=12, N=14, O=16) (3 mks)

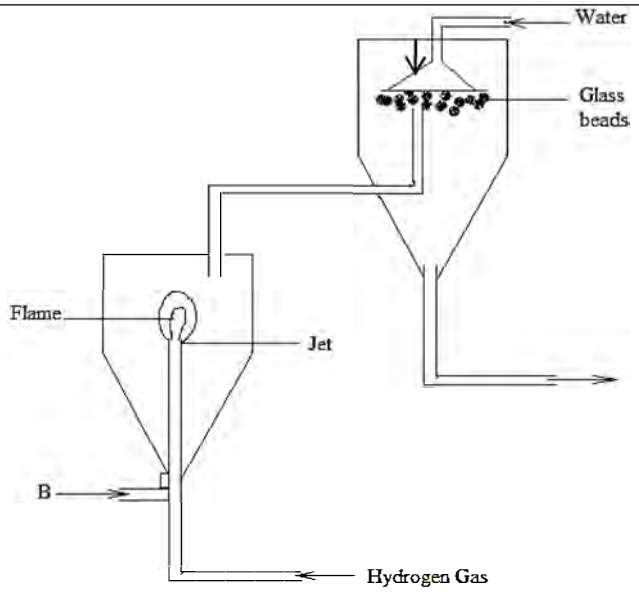
5. A state of equilibrium between dichromate (vi) and chromate ions is established as shown below

$$\underset{\text{Orange}}{Cr_2O7(aq)} + 2OH^-(aq) \rightleftharpoons 2CrO^{2-}{}_4(aq) + \underset{\text{(Yellow)}}{H_2O(l)}$$

a) What is meant by dynamic equilibrium? (1 mk)

b) State and explain observation made, when a few pellets of Potassium Hydroxide are added to equilibrium mixture (2 mks)

6. The diagram below represents large scale manufacture of hydrochloric acid



i) State the role played by glass beads? (1 mk)
ii) Name B (1 mk)
iii) Chlorine reacts with hydrogen sulphide according to the equation below
$H2S(g) + Cl2(g) \rightarrow 2HCl(g) + S(s)$
From the equation above, identify the oxidising agent using oxidation numbers (2mks)

7. a). Define the following terms (2 mks)
i). Normal Salt
ii). Efflorescent Salt
b). State two disadvantages of evaporating a solution to dryness during crystallization (2 mks)

8. Write balanced chemical equations for effect of heat on the following salts (2 mks)
$Na_2Co_3\ 10H_20(s)$ heat $\rightarrow$
$Pb(N0_3)2(s)$ heat $\rightarrow$

9. $25cm^3$ of a solution of Potassium Carbonate, neutralized $26.8cm^3$ 0.1M HCl. Calculate the molarity of the carbonate. (3 mks)

10. Use bond energy value given below to answer question that follow

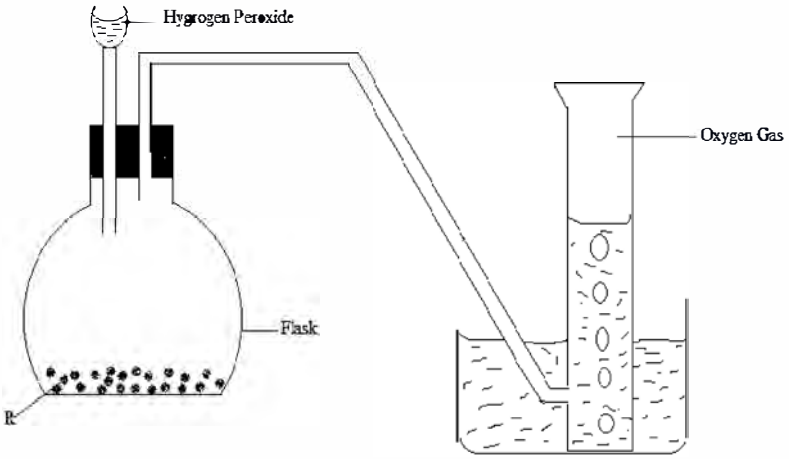
BONDS	BOND ENERGY vy/ml
H – H	432
C = C	610
C – C	346
C - H	413

i) Determine the enthalpy change for conversion of butene to butane by hydrogenation (3 mks)
ii) Sketch an energy level diagram for above enthalpy change. (2 mks)

11. a). Diamond is an allotrope of carbon, distinguish between allotropes and isotopes (2 mks)
b). State two properties of graphite, that makes it a suitable electrode. (2 mks)

12. A sample of sodium chloride is contaminated with sulphur powder. Briefly explain how pure sample of sodium chloride can be obtained from the mixture. (3 mks)

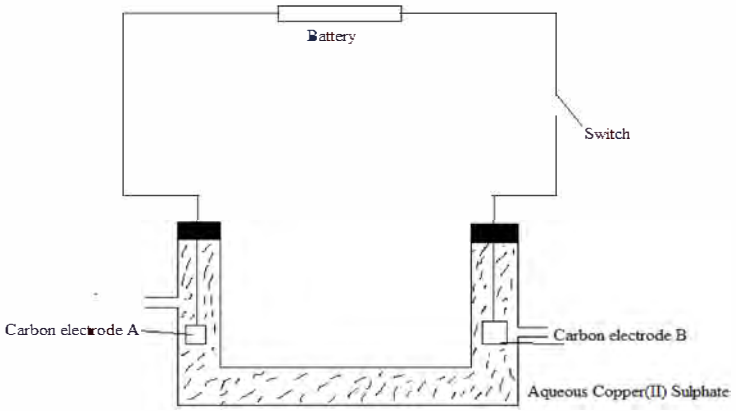
13. The diagram below shows a set up that was used to prepare pure oxygen gas



i) Name solid R (1 mk)
ii) What is the purpose of solid R (1 mk)

iii) Write balanced chemical equation for reaction in the flask. (1 mk)

14. Aqueous copper(II) sulphate was electrolyzed using the set up below

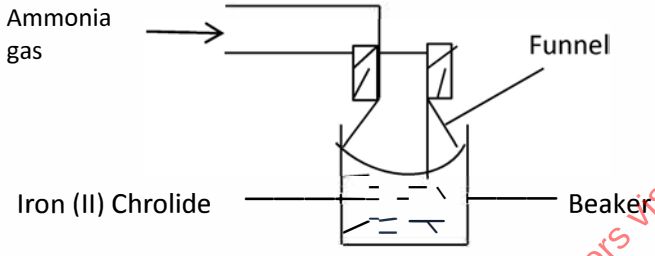


a). i). When the switch was closed, a gas was produced at electrode B, which electrode is Anode? ($^1/_2$ mk)
ii). Write the half equation for reaction at electrode B ($^1/_2$ mk)
iii). State the observation at electrode A (1 mk)

b). If carbon dectrode is replaced with copper electrode; Write the half equation at Anode (1 mk)

15. The empirical formulae of a compound is CH_2 and its molecular mass is 42
i) What is the molecular formulae of this compound? (1 mk)
ii) To which group of hydrocarbons does the compound belong (1 mk)
iii) Draw the structural formulae of the fourth member of this series and give its IUPAC name (1 mk)

16. The diagram below is used to show how ammonia gas reacts with Iron(ii) Chloride solution



i) State the observation made in beaker after a few minutes (1mk)
ii) Explain why funnel is used to deliver the ammonia into solution (1 mk)

17. a). A mass of 40g of saturated solution of Potassium Chlorate at 25^0c yields 14g of Potassium Chlorate when evaporated to dryness. Calculate the solubility of Potassium Chlorate at 25^0c (2 mk)
b). State one advantage of hard water (1 mk)

18. The ionization energies for elements A, B and C are shown in the table below

Element	A	B	C
Ionization energy (kj/mol)	519	418	494

i) What is meant by ionization energy (1 mk)
ii) Which element is the strongest reducing agent. Explain (2 mks)

19. Water from town in Kenya is suspected to contain chloride ions but not sulphate ions. Describe how presence of chloride ions in water can be shown. (2 mks)

20. Dinitrogen tetra oxide exist in equilibrium with nitrogen dioxide as shown by equation below

$$\underset{\text{Pale-yellow}}{N_2O_4(g)} \rightleftharpoons \underset{\text{brown}}{2NO_2(g)}$$

Given that the forward reaction absorbs heat, what would be observed and the effect of the following on equilibrium mixture?

a). Increase in temperature
Observation (1 mk)
Effect (1 mk)

21. Both ions Y^{2-} and Z^{2+} have electron configuration 2:8:8:
a). Write electron arrangement for Y,Z (1mark)
b). Draw the structure of Atom of Z, given that it has 20 neutrons (1 mk)

22. A solution of hydrogen chloride in methylbenzene does not react with carbonates. However on adding water and then shaking, the resulting mixture, there is vigorous effervescence. Explain the above observation. (3 mks)

23. The form 2 students of Ainabokoi Secondary School reacted elements as shown in the table below

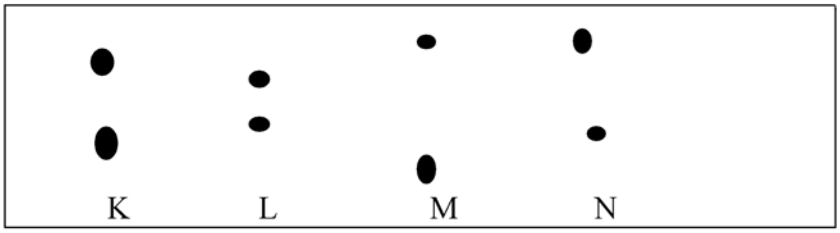
Element	Reaction with Oxygen	Reaction with H2O
X	Formed acidic oxide	No reaction
Y	Formed basic oxide	Formed a soluble hydroxide and gave off hydrogen gas
Z	Formed acidic Oxide	Dissolved to form acidic solution

Which element is likely to be

i). Metal (1 mk)

ii). Non – Metal (1 mk)

24. Kibet, Lagat and Maiyo are international atheletles. Paper chromatography was used to test for preserve of illegal drugs in their blood. The diagram below shows chromatogram with illegal drug labeled N.



a). Who among them tested positive for the illegal drug? Explain (2 mks)

b). What is solvent front (1 mk)

25. The table below shows ammeter reading recorded when 2M sulphuric (vi) Acid and 2M ethanoic Acid were tested separately.

Electrolyte	Current (A)
2M Sulphuric Acid	8.1
2M Ethanoic Acid	2.5

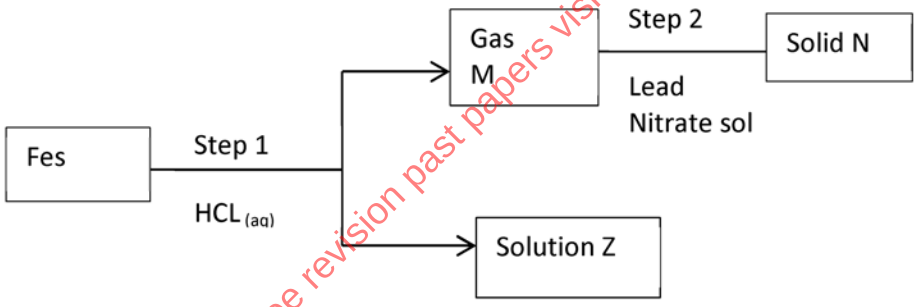
Explain the difference in the ammeter readings (2mks)

26. The structure below represents a sweeting smelling compound

$$CH_3 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - O - CH_2CH_2CH_3$$

Give the names of two organic compounds that can be used to prepare this compound in the laboratory. (2 mks)

27. Study the flow diagram below and use it to answer the questions below



i) Identify

a). Gas M (½ mk)

b). Solid N (½ mk)

ii) State observation made in step 2 (1 mk)

iii) Explain why gas M cannot be dried using concentrated sulphuric (vi) Acid (1 mk)

28. A piece of polished magnesium ribbon was burnt in nitrogen forming a white powder. The white powder was then added water and a gas that turned red litmus paper blue was evolved. Write down the equation that evolved the gas. (1 mk)

CENTRAL KENYA NATIONAL SCHOOLS (CEKENAS)
223/3
CHEMISTRY PAPER 2
THEORY
JULY 2017
2 ¾ HOURS

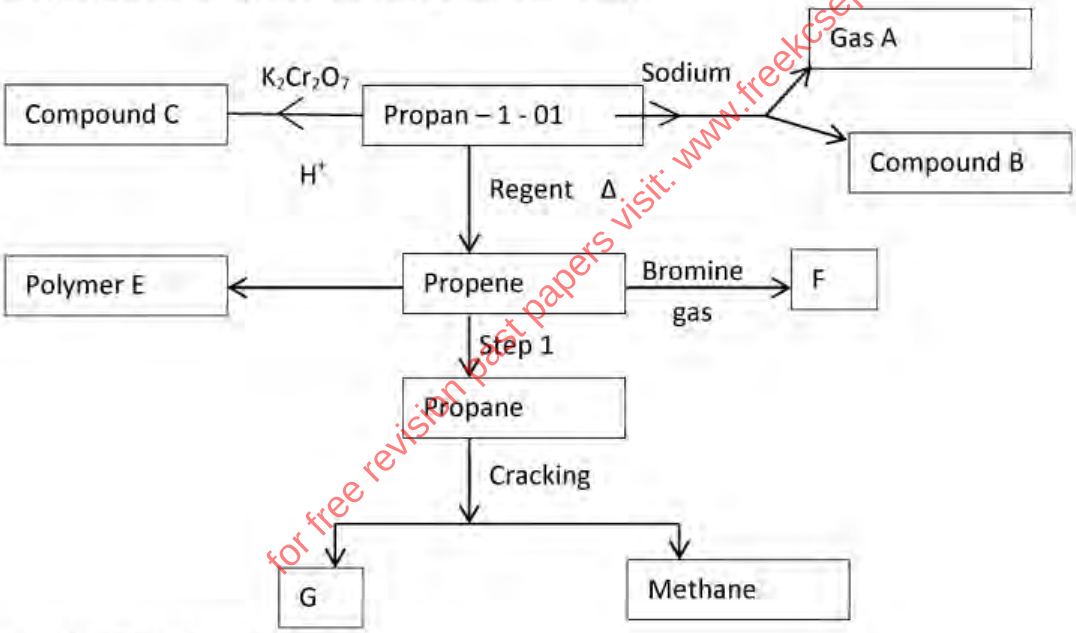
1. In an experiment of diluting concentrated sulphuric (vi) acid, 2 cm3 of acid were carefully poured into a plastic cup containing exactly 40cm^3 of distilled water with a room temperature of 20^{0}c. the mixture was stirred with a thermometer; the highest temperature noted was 35^{0}c. (density of acid = 1.84g/cm^3 while that of solution is assumed to be 1g/cm^3. The acid is 98% pure, S.H.C. =4.2J/g/k H = I S = 32 O = 16)

a). i). Determine the number of moles of the acid that dissolved (2 mks)
ii). Determine the enthalpy change for the reaction. (2mks)
iii). Determine the enthalpy change when one more of the acid is dissolved in water. (2 mks)

b). The following are standard enthalpies of formation for some compounds.
$C_3H_{8(g)}$ $\Delta H^{\Theta} = -104$ KJ moL^{-1}
$C3H7CL_{(g)}$ $\Delta H^{\Theta} = -105$ KJ moL^{-1}
$HCL_{(g)}$ $\Delta H^{\Theta} = -92$ KJ moL^{-1}
Calculate the enthalpy change for the reaction below (3 mks)
$Cl_{2(g)} + C_3H_{8(g)} \rightarrow C_3H_7Cl_{(g)} + HCL_{(g)}$

2. Name the following compounds (3 mks)
a) i). $CH_3(CH_2)_2\ CH_2OK$
ii). $CH_3\ CH\ CH_2\ COOH$ (CH3 branch)
iii). $CH_3CH_2CH_2COOCH_2CH_3$

b). Study the scheme below and answer the questions that follow



i) Identify product B,F (2marks)
ii) Name the compound C (1 mk)
iii) State the conditions for step 1 (1 mk)
iv) Name the process leading to formation of compound C (1 mk)
v) Write an equation for the reaction leading to the formation of methane. (1 mk)
vi) Identify reagent D. (1 mk)
vii) Draw the structure of polymer E. (1 mk)

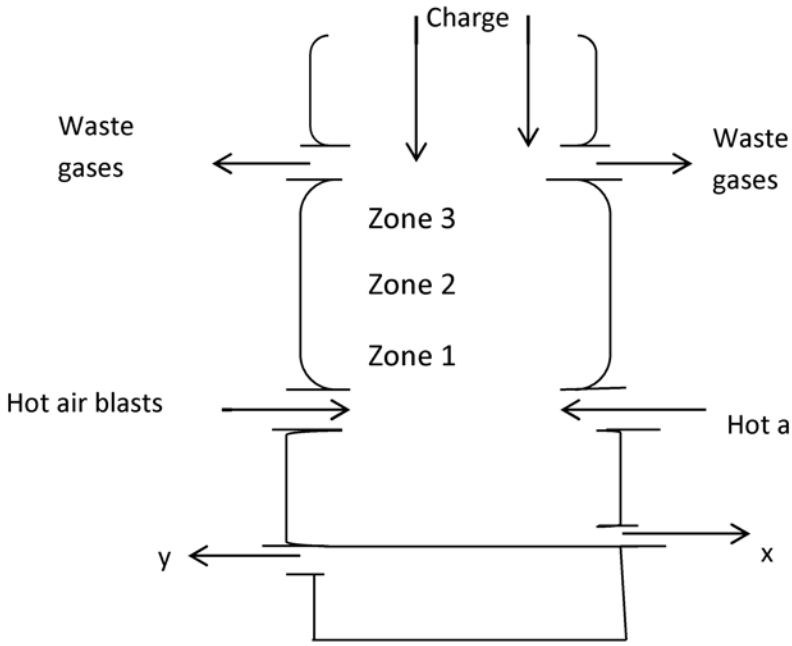
3. The grid below is a section of the periodic table (letters used are not actual symbpls) use it to answer questions that follow.

G											A
					T			J			
S	F			R	Q			B	E		
D	L							C			

i) Select the most electro-negative element. (1 mk)
ii) The boiling point of the oxide of Q is much higher than that of the oxide of T. Explain the difference (2 mks)

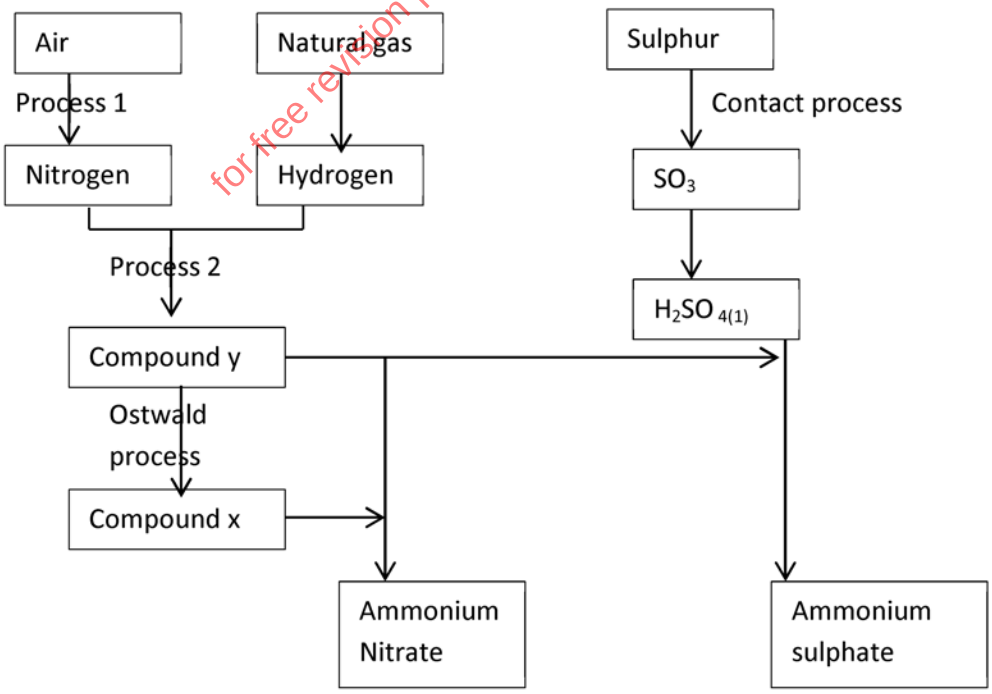
iii) Identify with a reason the chemical family to which F and L belong. (2 mks)
iv) Use dot (.) and cross (x) diagram to show bonding in the compound formed when F reacts with B. (1 mk)
v) State and explain the nature of chloride of R when it is dissolved in water to form an aqueous solution. (2 mks)
vi) Compare the atomic radius of elements D and L. (2 mks)
vi) The elements S and D belong to group I, which element is more reactive, explain. (2 mks)

4. The diagram below shows a blast furnace in the extraction of iron from haematite.



i) Name other ores that can be used to extract iron. (2 mks)
ii) Name the components of the charge. (3 mks)
iii) Identify two components of the waste gases. (2 mks)
iv) Give the identity of X and Y. (2 mks)
v) Identify the reducing agents in the blast furnace. (2 mks)
vi) Write the chemical equation for the reduction of haematite to iron metal using the main reducing agent. 1 mk)
vii) Which zone is the hottest? Explain. (2 mks)

5. The flow chart below represents some industrial processes leading to the formation of two nitrogenous fertilizers.

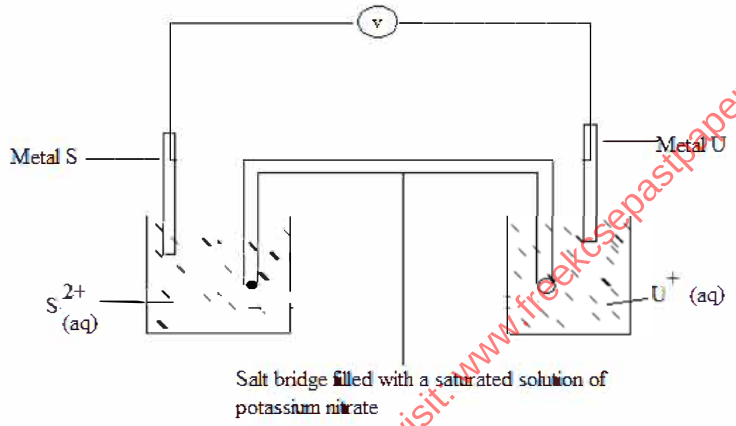


a) Name the process labeled 1,2 (2 mks)
b) Name the catalyst used in (3 mks)
   a). Process 2
   b). Ostwald's process
   c). Contact process
c) Name each of compounds X and Y (1 mk)
d) Other than the catalyst named in (b) above, state two optimum conditions for process labeled 2. (1 mk)
e) Briefly describe process 1 that leads to production of nitrogen from air. (2 mks)
f) State two uses of ammonium nitrate (2 mks)

6. a) The table below gives standard electrode potentials for the metals represented by the letters R, S, T and U. study and answer the questions that follow.

METALS	Standard Electrode Potential (Volts)
R	- 0.34
S	- 0.85
T	+ 0.34
U	- 0.76

   i) Identify the metal which is the strongest reducing agent (1 mk)
   ii) Which metal can be displaced from a solution of its salts by all the other metals in the table? Give a reason (2 mks)
   b. Metal S and U were connected to form a cell as shown in the diagram below.



   i) Write the equation for the cell above (1 mk)
   ii) Calculate the e.m.f, for the cell above (1 mk)
   iii) On the diagram, indicate with an arrow the direction in which electrons would flow on the diagram above (1 mk)
   iv) State one function of the salt bridge. (1 mk)

c. In an experiment to electroplate a copper spoon with silver, a current of 0.5 A was passed for 18 minutes.
   i) Draw a well labeled diagram showing how the copper spoon was electroplated. (2 mks)
   ii) Calculate the amount of silver deposited on the spoon. (If = 96500 coulombs Ag=108) (2 mks)
   iii) Other than electroplating state one use of electrolysis (1 mk)

7. In an experiment to determine the rate of a reaction, 2g of Calcium Carbonate were reacted with excess 2 M hydrochloricacid. The volume of Carbon (iv) oxide evolved was recorded at regular intervals of one minute for seven minutes. The results are as shown in the table.

TIME (MINUTES)	1	2	3	4	5	6	7
Volume of CO_3 (g) cm_3	170	296	405	465	480	480	480

   i) Plot a graph of time in minutes on the horizontal axis against volume of carbon (iv) Oxide on the vertical axis(3 mks)
   ii) Write the ionic equation for the reaction that took place (1 mk)
   iii) Determine the rate of reaction at 3 minutes (2 mks)
   iv) What is the significance of the shape of the curve between minute five to seven (1 mk)
   v) On the same axes, sketch the curve obtained if IM hydrochloric acid was used instead of 2M hydrochloric acid. Mark the curve W (1 mk)
   vi) Other than concentration, state other factors that would affect the rate of production of carbon(IV) oxide gas in the above experiment (2 mks)

CEKENAS
FORM 4 END OF TERM 2 EVALUATION EXAM
CHEMISTRY P
RACTICAL
233/3
CONFIDENTIAL

1. Solution Z, 0.5m sulphuric (vi) acid
2. Solid W, 0.12g Magnesium turnings
3. Solution Y, 0.2 M Sodium Hydroxide
4. 50ml burette
5. 100ml plastic beaker
6. Thermometer ($0 - 100^0$c
7. Stopwatch
8. 250ml volumetric flasks
9. 500ml distilled water
10. 25 ml pipette
11. Pipette filler
12. 250ml conical flasks (two)
13. 2 labels
14. Phenolphthalein indicator
15. Solid Q, mixture of 0.5g lead(ii)nitrate and 0.5 g copper(i) carbonate
16. Solid R is 0.2g sucrose
17. Blue and red litmus papers
18. Test tube holder
19. Bunsen burner
20. 10ml measuring cylinder
21. One boiling tube
22. Filter funnel
23. Filter paper
24. 5 test tubes
25. Spatula
26. 0.2g Sodium Hydrogen carbonate
27. A small piece of Aluminium

Access to:
2M Hydrochloric acid
Acidified Potassium Manganite (VII) solution
Dil. Nitric (V) Acid
2M Ammonia solution
2M Sodium hydroxide

CEKENAS
223/3
CHEMISTRY PAPER 3
PRACTICAL
JULY 2017
2 ¼ HOURS

1. You are provided with:-
- Sulphuric VI acid solution Z
- Magnesium turning solid W
- 0.2m sodium hydroxide solution Y

You are required to determine the concentration of sulphuric VI acid in mole per dm^3

Procedure A

i) Using a burette, place $50cm^3$ of sulphuric VI acid solution Z in 100ml plastic beaker.
ii) Stir the solution gently with a thermometer and record its temperature after every half minute.
iii) At exactly 1 ½ minutes place solid W into the solution and stir the mixture gently with the thermometer. Measure the temperature of the mixture after every half-minute and record the values in the table 1 below
iv) Retain the mixture for use in procedure B

Table 1 (4 mks)

Time in minutes	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7
Temperature ^0c															

a) Plot a graph of temperature (Y-axis) against time on the grid provided (3 mks)
b) Using the graph determine the highest change in temperature(ΔT) (mk)
c) Calculate the heat change for the reaction given that the specific heat capacity of the mixture is 4.2 $kJ/g^{-1}/k^{-1}$ and that the density of solution is $1g/cm^3$ (2 mks)
d) Given that the molar heat of reaction of sulphuric VI acid solution Z with solid W is $-323kJ/mol^{-1}$. Calculate the number of moles of sulphuric VI acid that were used during the reaction (2 mks)

Procedure B

i) Rinse the burette thoroughly and fill it with Sodium Hydroxide solution Y.
ii) Transfer all the contents of the 100ml beaker used in procedure A into a 250 ml volumetric flask.
iii) Add distilled water to make up to the mark. Label this solution V.
iv) Using pipette and pipette filter, place $25.0cm^3$ of solution V into a 250ml conical flask.
v) Add three drops of phenolphthalein indicator and titrate against Sodium hydroxide solution Y.
vi) Record your results in table 2. Repeat titration two more times and complete table 2.

Table 2 (4 mks)

	I	II	III
Final burette reading (cm^3)			
Intial burette reading (cm^3)			
Titre cm^3			

Calculate

a) Average volume of solution Y used.
b) The number of moles of
   i). Solution Y used (1 mk)
   ii). Sulphuric VI acid in $25.0 cm^3$ of solution V (1 mk)
   iii). Solution VI acid in $250 cm^3$ of solution V (1 mk)
c) Calculate;-
   i). The total number of moles of sulphuric VI acid in $50cm^3$ of solution Z (2 mks)
   ii). The concentration of the original sulphuric VI acid, solution Z in moles per litre. (1 mk)

1. You are provided with solid Q. Carry out the following tests and write your observations and inferences in the space provided.

a. Place solid Q into a boiling tube. Add about $10cm^3$ of distilled water and shake thoroughly. Filter the mixture. Wash the residue with distilled water. (Retain the residue for use in part (b) below.

i). To about $2cm^3$ of the filtrate, add sodium hydroxide solution drop wise until in excess

Observations	Inferences

(1 mk) (1 mk)

ii). To about $2cm^3$ of filtrate, add ammonia solution drop wise until in excess

Observations	Inferences

(1 mk) (1 mk)

iii). To about 2 cm^3 of the filtrate, add 2 cm^3 of dilute hydrochloric acid.

Observations	Inferences

(½ mk) (½ mk)

iv). To about 2 cm^3 of the filtrate, add 5 drops of sodium hydroxide. Add 2 piece of aluminum foil to the mixture and shake. Warm the mixture and test any gas produced with both the blue and red litmus paper.

Observations	Inferences

(2 mks) (1 mk)

b. i). Place a little of residue into a test tube, add about 5 cm^3 of dilute nitric (v) acid into the residue.

Observations	Inferences

(1 mk) (1 mk)

ii). To about 2 cm^3 of the solution formed, add 2 drops of acidified \potassium Manganate (VII) solution

Observations	Inferences

(1 mk) (½ mk)

iii). To about 2 cm^3 of the solution formed, add ammonia solution dropwise until in excess

Observations	Inferences

(1 mk) (½ mk)

2. You are provided with solid R. Carry out the tests below and record your observations and inferences in the spaces provided.

i) Place one third spatulaful of solid R and ignite it using a non-luminous flame.

Observations	Inferences

(1 mk) (1 mk)

ii) Place the remaining solid R into a test tube. Add about 5cm^3 of distilled water and shake well

a. To about 2cm^3 of solution formed, add drops of acidified potassium manganite (Vii) solution and warm.

Observations	Inferences

(1 mk) (1 mk)

b. To about 2cm^3 of the solution, add sodium hydrogen carbonate proVIded.

Observations	Inferences

(1 mk) (1 mk)

KIGUMO
233/1
CHEMISTRY
PAPER 1 - THEORY
2 HOURS

1. A Bunsen burner can produce the given flame below

i) Identify this flame (1mk)
ii) Name parts of the flame labeled P and Q (1 Mark)
iii) Draw a diagram to represent a wooden splint that was quickly slipped in region P and quickly removed before it caught a flame.

2. a) Define the term isomer (1 mk)
b) Draw two isomers of butane and name them (2 mks)

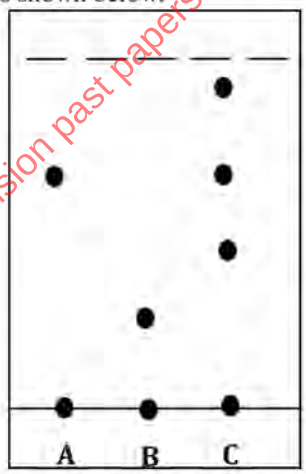
3. The table below gives the melting points and ionization energies of elements X, Y and Z. They are arranged in exact order in which they occur in the periodic table. The letters are not the actual symbols of the elements.

Element	Melting point (^{0}c)	First Ionization energy (kJmol$^-$)
X	180	520
Y	98	496
Z	64	419

i) Are these elements members of a period or a group? (1mk)
ii) Which of these elements is the strongest reducing agent (1mk)

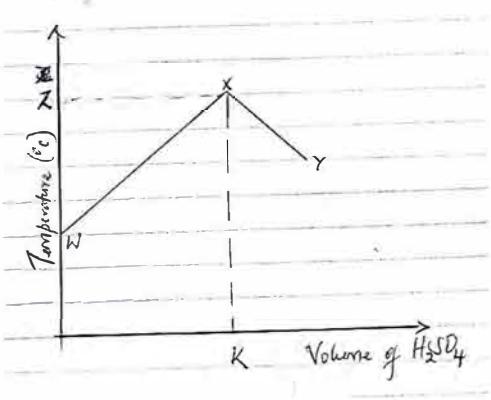
4. 100 cm^3 of Sulphur (IV) oxide takes twenty seconds to diffuse through a porous plate. What volume of oxygen gas would diffuse through the same plate in thirty seconds under similar conditions (3mks)
(S = 32, O = 16)

5. Spots of pure pigments A, B and mixture C were placed on a filter paper and allowed to dry. The results obtained were developed on a paper chromatogram as shown below.



i) Indicate on chromatogram the component of mixture C which is more soluble in the solvent used.
ii) Which of the pure pigments was not a component of C (1 mk)

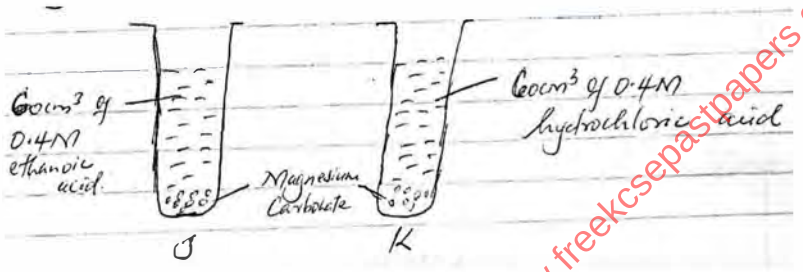
6. 100cm^3 of 1M sodium hydroxide solution was placed in a beaker wrapped in a cotton wool roll. 10cm^3 portion of 1M Sulphuric (VI) acid were added at a time and the mixture was stirred with a thermometer and the highest temperature was recorded. The data was analyzed using a graph which was shown below.



a) What is the significance of
   i) Point X (1mk)
   ii) Volume K (1mk)

b) To determine the heat change the equation Δ H= mc ΔT is used, show how you would get the value of ΔT from the above graph (1 mk)

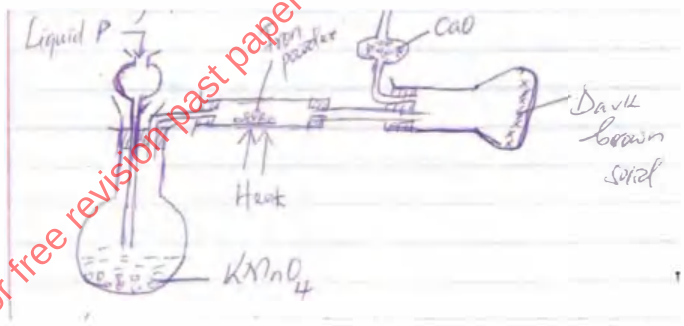
7. 4g of magnesium carbonate were placed into boiling tubes J and K as shown below.



i) Write down the equation taking place in boiling tube J (1mk)

ii) Explain why the volume of carbon (IV) oxide gas liberated in boiling tube K is greater that in boiling tube J after 1 minute.(the reaction is incomplete) (2mks)

8. The set-up below was used to prepare Chlorine gas and react it with iron metal powder. Study it and answer the questions that follow.

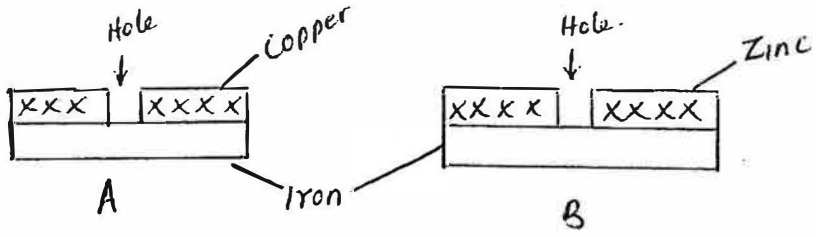


   a) Identify the dark brown solid (1mk)
   b) Name liquid P
   c) Explain the importance of using calcium oxide in the drying bulb rather than using anhydrous calcium chloride (4mks)

9. 480 cm^3 of carbon (IV) oxide were liberated when T grams of copper (II) carbonate were heated until there was no further change. If the volume was measured at r.t.p determine the value of T.
   (Cu=64.0, C=12, o=16, M.G.V = 24litres) (3mks)

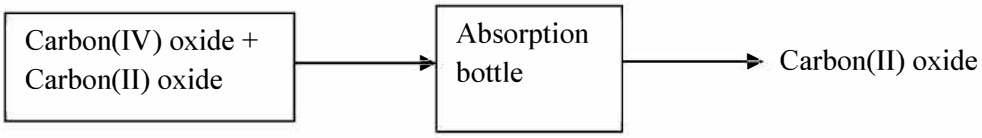
10. The atomic number of phosphorus is 15. Write the electronic configuration of phosphorus in the following.
   a) H_3PO_3 (1mk)
   b) H_3PO_4 (1mk)

11. Below are cross-sections of two pieces of Iron coated with copper and zinc respectively.



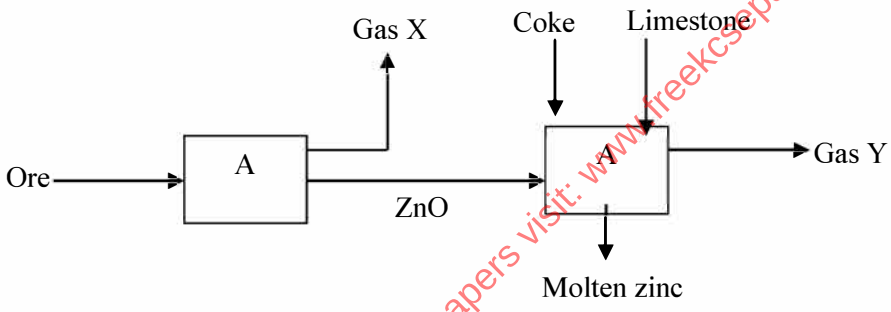
Which piece would not rust when the holes were filled with water and left with water for some time. (2mks)

12. Hydrogen sulphide gas was bubbled into an aqueous solution of iron(III) chloride.
    a) State and explain the observations made (2mks)
    b) Write an equation for the reaction that took place. (1mk)
13. When 10g of a mixture of potassium chloride and anhydrous sodium sulphate is dissolved in water and excess barium chloride added, 6.9g o barium sulphate is precipitated. Calculate the composition of the mixture by mass. (K= 39, Cl = 35.5, Na = 23, S = 32, Ba = 137) (3mks)
14. The flow chart below shows part of the process of preparing and collecting carbon (II) oxide.

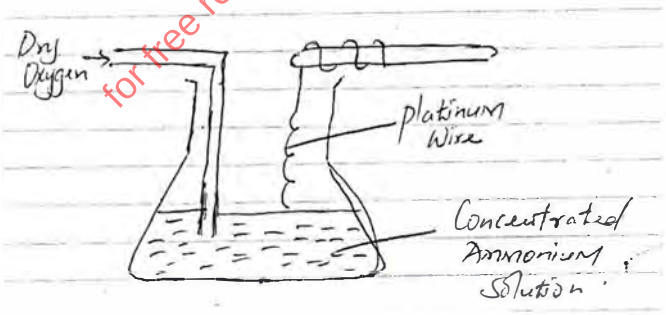


a) Name two reagents that are reacted to produce both carbon (IV) oxide and carbon (II) oxide. (1mk)
b) Write an equation for the reaction that take place in the absorption bottle (1mk)

15. A sample of hydrated metal oxide, $Y_2O_2.3H_2O$ with a mass of 11.7g was heated until all the water evaporated. Its final mass was 7.65g. Determine atomic mass of Y. (Y is not the actual symbol of the metal) (H= 1, O = 16) (3mks)
16. A student prepared two different soaps in a science trade fair. The soaps had the following structures.
    a) $CH_3(CH_2)_6COONa$
    b) $CH_3(CH_2)_{15}COONa$
    i) Which is a better cleansing agent? Give a reason for your answer. (2mks)
    ii) What is the actual role of soap? (1mk)
17. Below is a sample flow chart showing extraction of zinc metal

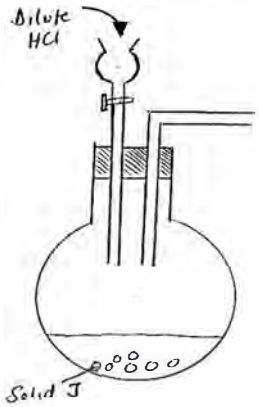


    i) Name chamber A
    ii) Identify gas X
    iii) Write a balanced chemical equation to show what happens in chamber B (1mk)
18. Draw the structure of carbon diamond and explain why it is hard yet it is not a metal (2mks)
19. The set-up below was used to study the reaction between ammonia and air in presence of platinum catalyst.



    a) The platinum wire continues to glow without further heating. Explain. (1mk)
    b) Write equations for the reactions representing
    i) The formation of the brown fumes. (1mk)
    ii) Catalytic oxidation of ammonia. (1mk)
20. Randon $^{222}_{88}Ra$ undergoes 3 alpha decays to form Lead $^{210}_{82}Pb$. It took 18 days cfor the original mass to reduce to 3.125%
    a) Write the nuclear equation for the reaction. (1mk)
    b) Calculate the half life of Randon (1mk)
21. Describe a simple test that you would use to distinguish between $CH_3CH_2CH_2COOH$ and $CH_3CH_2CH_2CH_2OH$ (2mks)

22. The diagram below is an incomplete set-up for preparation of hydrogen sulphide in the laboratory.



a) Complete the set-up. (1mk)
b) Write an equation for preparation of the gas. (1mk)

23. a) Describe how Sodium sulphate, solid lead carbonate dilute nitric acid and distilled water can be used to prepare lead sulphate solid. (2mks)
b) Write an ionic equation that produced lead sulphate in the above reactions. (1mk)

24. Study the table below and answer the questions that follow.

Solution	A	B	C	D
pH values	2.3	7.1	6.7	13.6

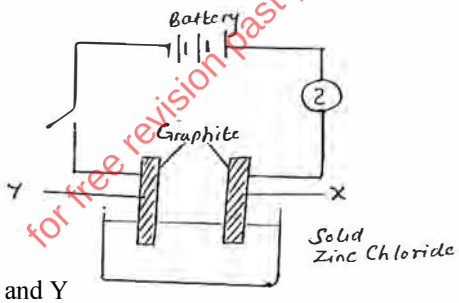
i) Which solution is likely to be
a) Acid rain? (1mk)
b) Potassium hydroxide. (1mk)
ii) a substance U reacted with both solutions A and D. what is the nature of the substance U? (1mk)

25. Hydrogen has a very low density and it was once thought that this property would be of great importance in air transport. Explain why this idea has not lived to its expectations (2mks)

26. In an experiment to establish the equilibrium between chromate and dichromate ions is as shown below.
$2CrO4^{2-}_{(aq)} + 2H^{+}_{(aq)} \rightarrow Cr2O7^{2-}_{(aq)} + 2H_2O_{(l)}$
a) What would be observed when sodium hydroxide is added to the system? (1mk)
b) Explain your observation in (a) above. (2mks)

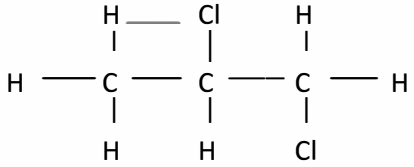
27. 6.84g of aluminium sulphate was dissolved in $150cm^3$ of water. Calculate the molarity of sulphate ions in the solution (RFM of aluminium sulphate= 342). (3mks)

28. The following set-up was used by a form three student to electrolyse molten zinc chloride



a) Name terminal X and Y
b) After closing the switch the bulb did not light. Explain this observation. (1mk)

29. Chlorine reacted with compound Q to form a compound with a structural formula



Write the structural formula of Q (1mk)

30. A current of 0.4A was passed through molten lead(II) chloride for 30 minutes. Determine the mass of lead deposited (Pb=207, 1F = 96500C) (3mks)

31. The Solvay process is used in the manufacture of sodium carbonate
a) State one by-product in the Solvay process.
b) State how waste is kept minimum in this process.

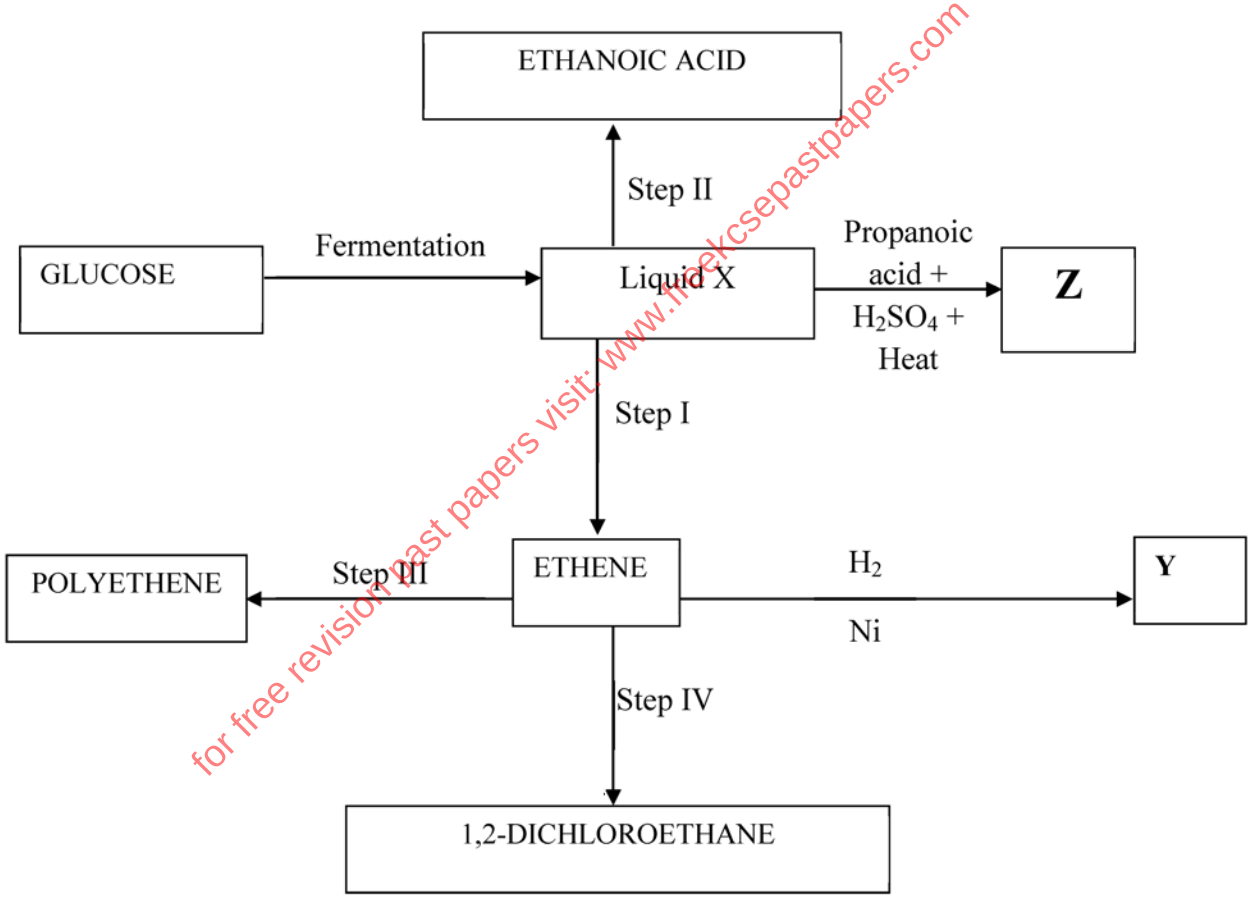
KIGUMO
CHEMISTRY
233/2
PAPER TWO
TERM II 2017

1. The figure below is an extract of the periodic table. Study it and answer the questions that follow

I				**M**			**P**	
	K		**L**		**O**			**R**
J				**N**			**Q**	

a) Identify and explain the element which is:
i) The most reactive non-metal (2mks)
ii) The most reactive metal (2mks)
b) i) State the chemical family into which elements **I** and **J** belong. (1mk)
ii) Compare the electrical conductivity of elements K and L. (2mks)
iii) Compare the size of ionic and atomic radius of element P. (2mks)
c) Write a chemical equation to show how element K reacts with steam. (1mk)

2. .



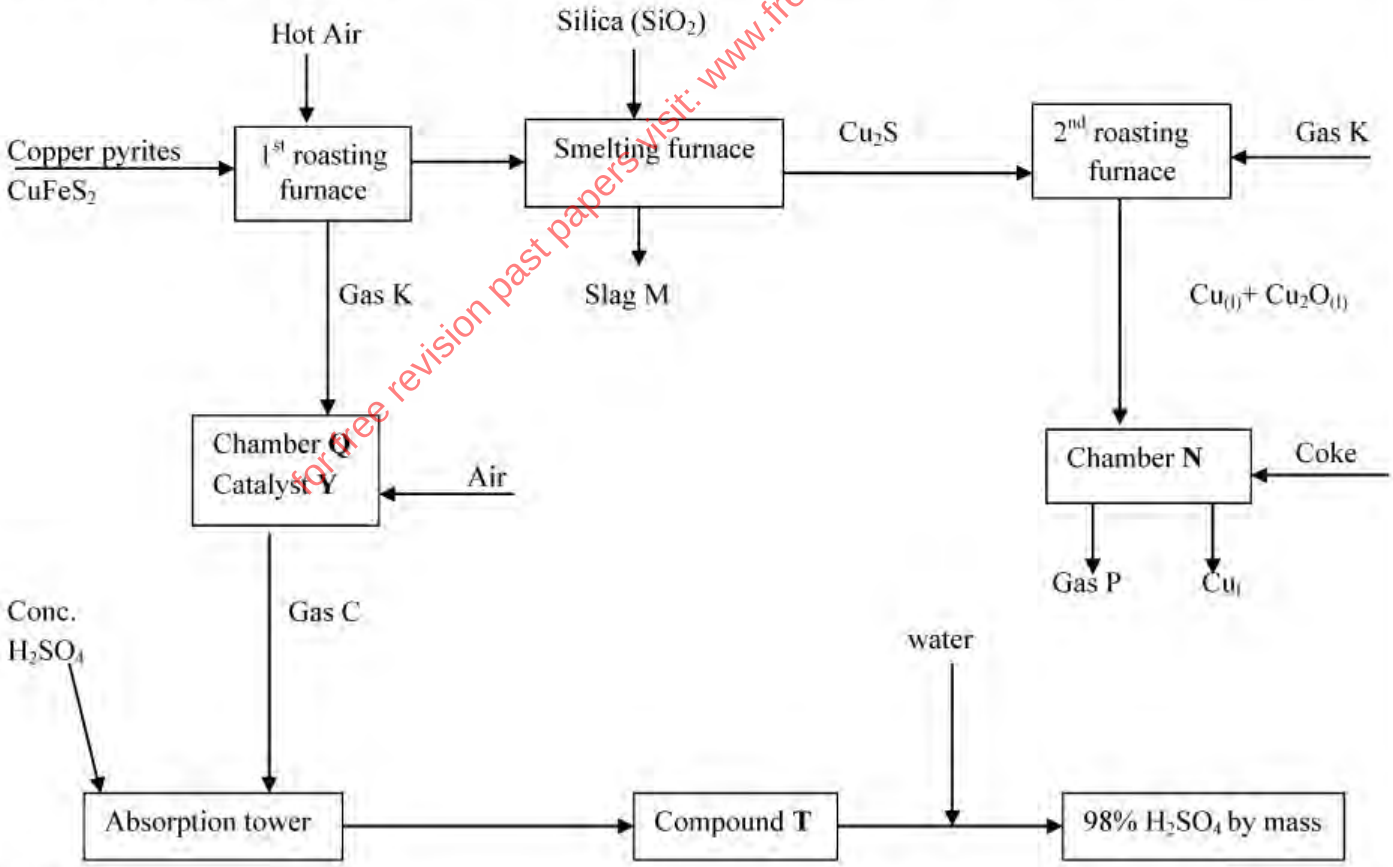
a) i) Identify liquid X (1mk)
ii) State how the concentration of liquid X can be increased. (1mk)
iii) State one use of liquid X (1mk)
b) i) state the type of reaction taking place in step II (1mk)
ii) What reagent and condition is required in step II? (2mks)
c) i) Name substance Z. (1mk)
ii) State the chemical reaction that results in formation of substance Z. (1mk)
d) i) Identify substance Y. (1mk)
ii) To which groups of hydrocarbons does Y belong? (1mk)
e) i) Name the chemical reaction in step III. (1mk)
ii) Write a chemical equation to show the reaction taking place in step IV. (1mk)
f) State the conditions for polymerization to occur. (2mks)
3. The standard electrode potentials of some half cells are given below:

		E^{0}(v)
$M^{2+}_{aq} + 2e$	$\rightleftharpoons M_s$	-0.74
N^{3+} aq + 3e	$\rightleftharpoons N_s$	-0.72
P^{2-} aq +2e	$\rightleftharpoons P_s$	-0.12
$2Q^{-}$ aq + 2e	$\rightleftharpoons Q_{2g}$	0.00
R^{2+} aq + 2e	$\rightleftharpoons R_s$	+0.36
S_2 aq + 2e	$\rightleftharpoons 2S^{-}$	+1.09

a) Identify:
i) The strongest oxidizing agent (1mk)
ii) The strongest reducing agent. (1mk)
b) Calculate the e.m.f of the electrochemical cell constructed from half cells in a (i) and (ii) above 2mks)
c) Which is the reference electrode? Explain. (2mks)
d) i) A current of 2.0A was passed through copper(II) sulphate solution for 5 minutes. Calculate the change in mass at the cathode. (Cu = 64, 1F = 96500C) (3mks)
ii) Explain what would be observed on the blue copper (II) sulphate solution if carbon electrodes were used (2mks)

4. a) i) Write an equation to show the reaction that occurs when concentrated hydrochloric acid and manganese (IV) oxide react (2mks)
ii) State the role of manganese (IV) Oxide in the reaction. (1mk)
iii) Name the reagent that can be used to dry chlorine (1mk)
b) i) Name the substance formed when Iron(II) Chloride reacts with chlorine. (1mk)
ii) 12.6g of Iron(II) Chloride were converted into 16.12g of the substance in b(i) above. Calculate the volume of chlorine gas used.(Cl=35.5, Fe=56, MGV=24L) (3mks)
c) Under certain conditions, sodium hydroxide and chlorine gas react to form sodium chlorate (I)
i) State the conditions. (2mks)
ii) How does sodium Chlorate (I) bleach? (1mk)

5. The flow chart below outlines some of the processes involved during extraction of copper from copper pyrites Study it and answer the questions that follow.



a) Identify
i) Gas K (1mk)
ii) Gas P (1mk)
b) Write Equations For the reactions which take place in the
i) 1st roasting furnace (1mk)
ii) Absorption tower. (1mk)
c) i) Write the formulae of the cation present in slag M. (1mk)

ii) What name is given to the reaction that takes place in chamber N? Give a reason for your answer (2mks)

d) i) Name catalyst Y. (1mk)

ii) State two uses of Sulphuric (VI) acid. (1mk)

iii) Write a chemical equation to show the reaction between compound T and water. (2mks)

6. a) In an experiment to determine the enthalpy of displacement of coppere by zinc 50cm^3 of 0.2M copper (II) sulphate solution was reacted with excess zinc powder. The following observations were made:
Initial temperature of copper(II) sulphate solution = 21^{0}c
Final temperature of copper (II) Sulphate solution = 29^{0}c
(density of the solution = 1.0g/cm^3, c=4.2j/g/k)
Calculate:

i) Temperature change. (1mk)

ii) Mass of the solution used (1mk)

iii) Heat evolved during the reaction. (2mks)

iv) Molar heat of displacement. (2mks)

v) Why was zinc used in excess? (1mk)

b) i) State one factor considered when choosing a fuel. (1mk)

ii) The equation of formation of butanol is shown below.

$$4C_{(s)} + 5H_{2(g)} + \tfrac{1}{2} O_{2(g)} \rightarrow C_4H_9OH_{(l)}$$

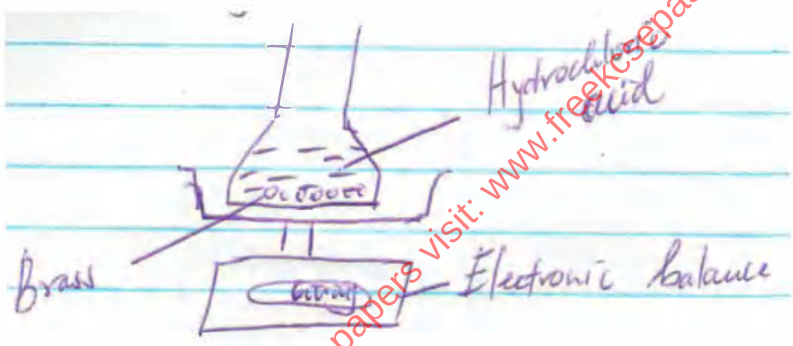
Using the information below calculate the molar enthalpy of formation of butanol. (3mks)

$C_{(s)} + \tfrac{1}{2} O_{2(g)} \rightarrow CO_{2(g)}$

$H_{2(g)} + \tfrac{1}{2} O_{2(g)} \rightarrow H_2O_{(g)}$

$C_4H_9OH_{(l)} + \tfrac{1}{2} O_{2(g} \rightarrow 4C\ O_{2(g)} + 5H_2O_{(g)}$

7. The diagram below shows a set of apparatus used by a student to study the reaction between brass (an alloy of zinc and copper) and dilute hydrochloric acid.



She took 120g of powdered brass and reacted it with excess hydrochloric acid. The readings on the balance were recorded at regular intervals. The results are given in the table below.

Time(sec)	Reading on the balance	Total loss in mass(g)
0	600	0.00
20	599.5	0.50
40	599.12	0.88
60	598.84	1.16
80	598.66	1.34
100	598.54	1.46
120	598.50	1.50
140	598.50	1.50
160	598.50	1.50

a) Plot a graph of loss in mass(g) (y-axis) against time. (3mks)

b) Use your graph to answer questions that follow.

i) Calculate the rate of reaction at the 50th second. (2mks)

ii) Sketch the curve that would be obtained if the experiment was repeated at higher temperature (1mk)

iii) Calculate the mass of zinc contained in the alloy (H= 1.0, Zn = 65.0) (3mks)

iv) Why is brass ground into powder for this experiment? (1mk)

v) What are the contents of the flask at the end of the experiment? (2mks)

KIGUMO SUBCOUNTY CLUSTER EXAMS
CHEM PP3
CONFIENTIAL

Each student will require

1. $100cm^3$ of solution X
2. $150cm^3$ of solution Y
3. $60cm^3$ of 0.1M $BaCl_2$
4. Pipette
5. Burette
6. Solid P
7. 2 filter papers
8. Filter funnel
9. One boiling tube
10. 6 test tubes
11. Metallic spatula
12. 3 conical flasks
13. Red and blue litmus papers
14. Distilled water in a wash bottle
15. Test tube holder
16. 20 cm^3 measuring cylinder
17. Solid A
18. Approximately 2g of $NaHCO_3$

Access to:

1. 2M NaOH supplied with a dropper
2. 2M $Pb(NO_3)$ supplied with a dropper
3. 2M HNO_3 supplied with a dropper
4. 2m NH_3 supplied with a dropper
5. Acidified $KMnO_4$ supplied with a dropper
6. Acidified $K_2Cr_2O_7$ supplied with a dropper
7. Phenolphthalein indicator
8. Methyl orange indicator
9. Means of heating

Instructions :

- Solution X is prepared by mixing 8g NaOH and 10.6g of anhydrous Na_2CO_3 in a litre of solution
- solution Y is 0.4M HCl
- Solid P is prepared by mixing ammonium chloride and zinc carbonate in the ratio of 1:1(mass to mass). Each student requires approximately 2g.

Solid A is ground asprin tablets. Each student requires approximately 1g.

KIGUMO
CHEMISTRY
PAPER 3
233/3
PRACTICAL
END TERM – TERM II 2017
2 ¼ HOURS

1. You are provided with the following:
   - Solution X which is a mixture of sodium hydroxide and anhydrous sodium carbonate dissolved in a litre of solution
   - Solution Y which is 0.4M hydrochloric acid
   - Barium Chloride solution.

   You are required to determine the concentration of both sodium hydroxide and sodium carbonate in moles per litre.

   PROCEDURE I
   - Use a pipette to transfer 25.0cm^3 of solution X into a conical flask.
   - Fill the burette with solution Y
   - Carry out titration using methyl orange indicator. Record your results in table I below. Repeat the procedure to obtain concordant readings

Table I

Titration	1	2	3
Final burette reading(cm^3)			
Initial burette reading(cm^3)			
Volume of solution Y used (cm^3)			

(4mks)

a) Calculate
i) Average volume (V_1) of solution Y used.
ii) Moles of hydrochloric acid which reacted

PROCEDURE II

Using a pipette transfer 25.0cm^3 of solution X into a clean conical flask. Measure exactly 15.0cm^3 of barium chloride solution using a measuring cylinder and add it to solution X in the conical flask. Swirl the mixture gently. To the mixture, add 3 drops of phenolphthalein indicator.

Fill the burette with solution Y.

- Carry out titration and record your results in the table II below. Repeat the procedure to obtain concordant readings

Table II

Titration	1	2	3
Final burette reading(cm^3)			
Initial burette reading(cm^3)			
Volume of solution Y used (cm^3)			

(4mks)

a) Calculate the average volume (V_2) of the solution Y used (1mk)

NB: When Barium Chloride is added to solution X the following reaction occurs:

$Na_2CO_{3(aq)} + BaCl_{2(aq)} \rightarrow 2NaCl_{(aq)} + BaCO_{3(s)}$

This removes all the sodium carbonate from the mixture leaving sodium hydroxide to react with hydrochloric acid (solution Y)

b) Calculate
i) Moles of HCl which react with NaOH (1mk)
ii) Moles of NaOH which react with HCl solution Y (1mk)
iii) Molarity of NaOH (2mks)
iv) Moles of solution Y which reacted with Na_2CO_3 in procedure I (1mk)
v) Moles of sodium carbonate which reacted with HCl solution Y (1mk)
vi) Morality of Na_2CO_3 (2mks)

2. You are provided with solid P. Carry out the tests described below and record your observations and inferences in the spaces provided.

a) Put all the solid P in a boiling tube. Add 10cm of distilled water and shake the mixture. Carry out filtration and retain both the filtrate and residue.

Observation (1mark)	Inferences (1mark)

b) Divide the filtrate into two portions

i) To the first portion, add 4 drops of sodium hydroxide. Shake the mixture, warm it and test the gas produced using moist litmus papers

Observation (1mark)	Inferences (1mark)

ii) To the second portion add 2 drops of lead nitrate solution. Shake the mixture then warm it gently.

Observation (1mark)	Inferences (1mark)

c) Scrape the residue with a spatula and put it in a test tube. Add 5.0 cm^3 of dilute nitric acid and divide the resulting solution into two portions.

Observation (1mark)	Inferences (1mark)

i) To the first portion, add sodium hydroxide drop wise until in excess

Observation (1mark)	Inferences (1mark)

ii) To the second portion, add ammonia solution drop wise until in excess

Observation (1mark)	Inferences (1mark)

3. You are provided with solid A. carry out the tests below and record your observations and inferences in the spaces provided.

a) Ignite half spatulaful of A over non-luminous flame.

Observation (1mark)	Inferences (1mark)

b) Place the remaining solid in a test tube. Add 6cm^3 of distilled water and shake the mixture vigorously. Divide the resulting mixture into 3 portions.

i) To the first portion add two drops of acidified potassium manganate (VII)

Observation (1mark)	Inferences (1mark)

ii) To the second portion add 2 drops of acidified potassium dichromate (IV) and warm.

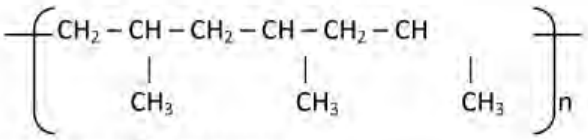
Observation (1mark)	Inferences (1mark)

iii) To the third portion add all the sodium hydrogen carbonate provided

Observation (1mark)	Inferences (1mark)

MURUKA KANDARA
FORM 4
CHEMISTRY THEORY
PAPER 1
JULY / AUGUST – 2017
TIME: 2 HOURS

1. A polymer has the following structure.



(a) Draw the structure of the monomer. (1mk)
(b) A sample of the polymer is found to have molecular mass of 6426. Determine the number of monomers present. (C = 12, H = 1). (2mks)

2. Name the catalyst used in:
(a) the decomposition of hydrogen peroxide. (1mk)
(b) the conversion of vegetable oil into margarine. (1 mk)

3. (a) Using dots (·) and crosses (x), draw the dimer structure of aluminium chloride and name the bonds. (2mks
b) State and explain the observation made when sodium carbonate powder is dropped into a solution of aluminium chloride. (1mks)

4. Determine the heat of solution of potassium fluoride given that its lattice energy is +801KJ/mole and the heats of hydration of potassium and fluoride ions are -322 and -506KJ/mole respectively. (3mks)

5. During the extraction of aluminium, a current of 0.2 amphere was passed for one hour through the molten aluminium oxide.
(a) Write equations for the reaction that took place at the cathode. (Al = 27, 1F = 96500C). (1mk)
(b) Calculate the mass of aluminium produced. (2mks)

6. (a) Define Gay – Lussac's law. (1 mk)
(b) 30 cm^3 of ethane were mixed with 100 cm^3 of oxygen and the mixture was sparked to complete reaction all the volumes were measured at a pressure of one atmosphere and a temperature of 25 °C, calculate the volume the residual gas under room temperature. (2 mks)

7. The following table shows the pH values of solutions A, B, C and D.

Solution	A	B	C	D
pH	3	7	10	14

(i) Which solution is likely to be that of iron (III) chloride? (1 mk)
(ii) Which solution has the highest concentration of hydroxide? Explain. (2 mks)

8. The table below gives information of four elements by letters A, B, C and D. study it and answer the questions that follow. The letters do not represent the actual symbol of the elements.

Element	Electron arrangement	Atomic radius (nm)	Ionic radius nm
A	2.8.2	0.136	0.065
B	2.8.7	0.097	0.181
C	2.8.8.1	0.203	0.133
D	2.8.1	0.174	0.097

(a) Which two elements have similar properties? Explain. (2 mks)
(b) Why is the ionic radius of element B greater than its atomic radius? (1 mk)

9. Starting with Lead (II) oxide, describe how you can prepare a sample of lead (II) sulphate. 3mks

10. When hydrogen gas is passed over Lead (II) oxide in a combustion tube, Lead (II) oxide is reduced.
(a) Write an equation for the above reaction. (1 mk)
(b) What observations were made in the combustion tube when the reaction was complete? (2 mk)

11. Explain why potassium is kept in paraffin while phosphorous is kept in water (2mks)

12. Sulphur is soluble in ethanol but not in water while common salt is soluble in water but not in ethanol
a) Explain why sulphur is not soluble in water (1mk)
b) Explain how a pure sample of sodium chloride can be obtained from a mixture of the two (1mk)

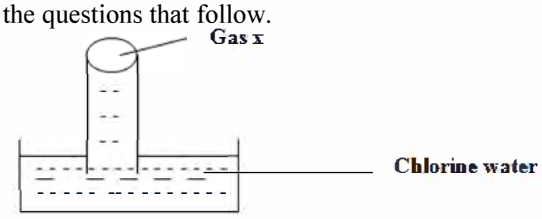
13. Ammonia gas is prepared by Haber's process according to the equation below

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)} + Heat$

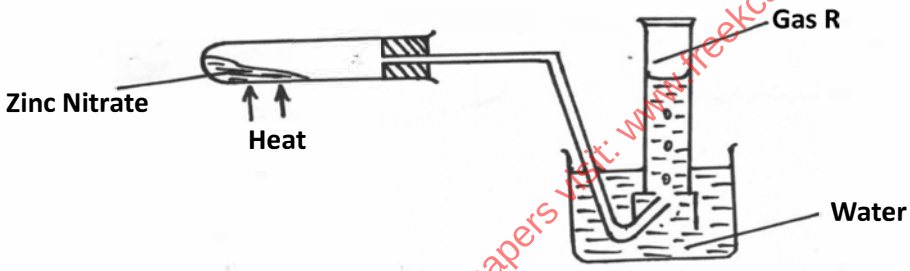
Complete the table below by stating the effect of equilibrium when the following conditions are applied. Give explanation in each case

Condition	Effect on equilibrium	Explanation
a) Pressure increased	½ mk	1mk
b) Temperature increased	½ mk	1mk

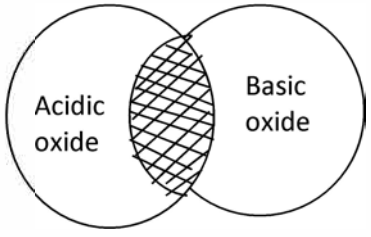
14. State what would be observed if concentrated sulphuric (VI) acid is added to
    a) Sugar crystals. (1mk)
    b) Hydrated copper (II) sulphate solution (1mk)
    c) What type of reaction has taken place above (1mk)
15. Name three sub – atomic particles found in an atom and state where they are found (3mks)
16. The solubility of potassium nitrate is 85g/100g of water at 50°c and 32g/100g of water at 25°c.
    a) Define the term solubility. (1mk)
    b) Calculate the mass of the crystals formed if a saturated solution of potassium nitrate in 50g of water at 50°c is cooled to 25°c. (2 marks)
17. Study the set-up below and answer the questions that follow.



    a) Name gas **x** (1 mark)
    b) State the condition which is not indicated on the diagram for gas **x** to be formed. (1mark)
18. Calculate the mass of sulphur which on complete combustion would yield 7dm^3 of sulphur (iv) oxide measured at 182°c and 722 mm Hg pressure (0=16, S=32, molar gas volume = 24dm^3 at r.t.p) (3 marks)
19. a) State and explain the observations made when fluorine gas is bubbled through sodium bromide solution. (2 marks)
    b) When excess ammonia solution is added to a solution of copper (ii) ions, a deep blue solution forms. Write the formula of the complex ions formed. (1 mark)
20. The following reaction is in equilibrium in a closed container
    $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2\ SO_{3\ (g)}\ \Delta H$= -ve
    State giving reasons how an increase in temperature would affect the amount of sulphur (VI) oxide gas (2mark)
21. Study the diagram below and use it to answer questions that follows

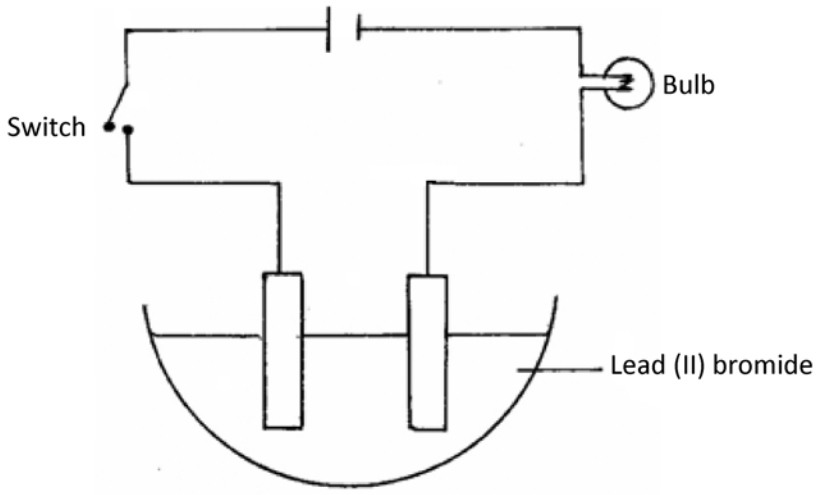


    (i) Identify gas R (1mk)
    (ii) What changes would be observed in the test-tube (1mk)
    (iii) Explain the nature of the solution formed in water after sometimes (2mks)
22. Explain the following observations
    (i) Electrical conductivity of metals decreases with an in increase in temperature (2mks)
    (ii) Ionization energy decreases down the group in group I (2mks)
23. M grams of a radioactive isotope decayed to 5 grams in 100 days. The half-life of the isotope is 25 days.
    (i) What is meant by half-life (1mk)
    (ii) Calculate the initial mass of the radioactive isotope (2mks)
24. Concentrated hydrochloric acid is used for removing oxides from metals (pickling). Explain why concentrated nitric (V) acid cannot be used for the same purpose (2mks)
25. The diagram below shows acidic and basic oxides fit into the general family of oxides



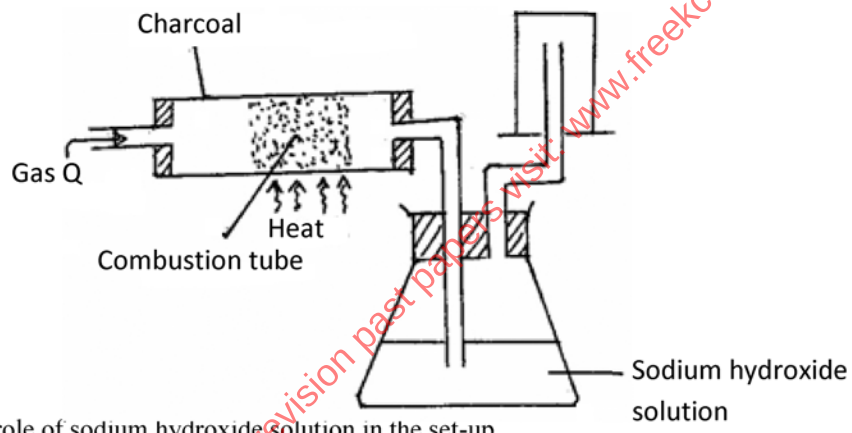
    (i) State the name given to the type of oxides that would be placed in the shaded region (1mark)
    (ii) Give the names of oxides that could be placed in the shaded region (3mark)
26. Explain the following observations.
    (a) A beaker with lime water, when left exposed develops a layer of a white solid on the surface. (1 mark)
    (b)Calcium chloride powder, when left exposed gradually turn into a colourless solution. (1mark)

27. The diagram **below** shows a set-up intended for the electrolysis of molten lead (II) bromide.



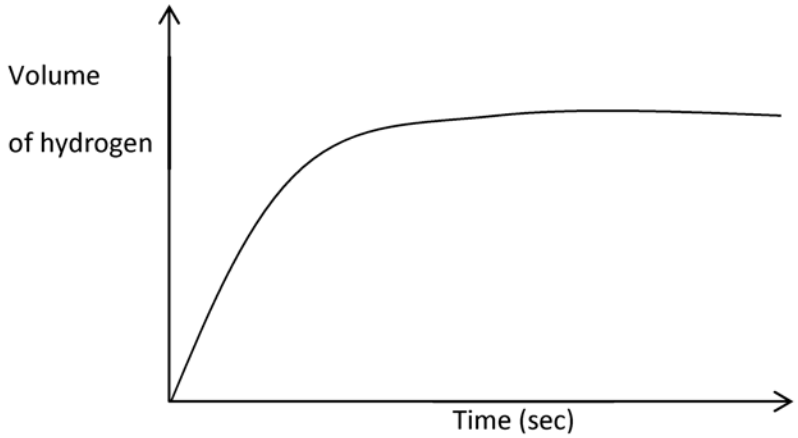
(a) Label on the diagram: (i) anode (½ mark)
(ii) cathode (½ mark)
(b) Indicate on the diagram the direction of flow of electrons. (1 mark)
(c) State the observations made at the
(i) anode (½ mark)
(ii) cathode (½ mark)

28. The diagram **below** shows an experimental set-up for preparing carbon (II) oxide. Study it and answer the questions that follow.



(a) State the role of sodium hydroxide solution in the set-up. (1 mark)
(b) State the reason why carbon (II) oxide is collected in the manner indicated. (1 mark)
(c) Describe a simple test that can be used to distinguish between carbon (II) oxide and carbon (IV) oxide. (1 mark)

29. In an experiment to monitor the rate of reaction of zinc and hydrochloric acid a student recorded the volume of hydrogen produced at regular time intervals and obtained the graph shown **below**.



(a) On the same set of axes sketch the curve expected if the experiment is repeated with a few crystals of copper (II) sulphate added to the reactants. (1 mark)
(b) Explain the shape of your curve. (1 mark)

MURUKA KANDARA
FORM 4
CHEMISTRY THEORY
Paper2
July / August – 2017
Time: 2 Hours

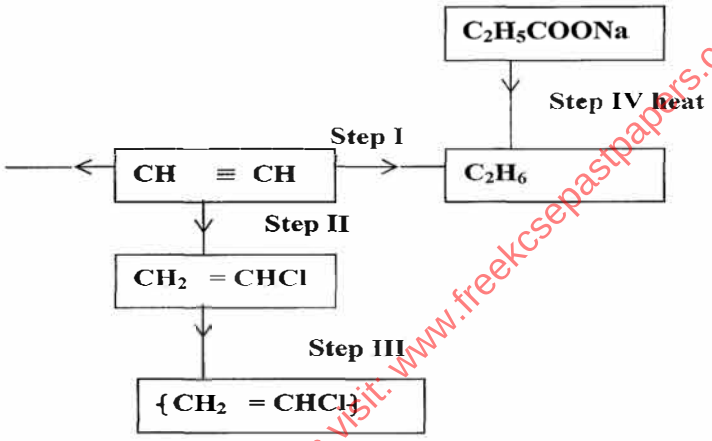
1. (a) Give the names of the following compounds.
   (i) $CH_3CH_2CH_2OH$ (1 mk)
   (ii) CH_3CH_2COOH (1 mk)

   (b) Study the information in the table below and answer the questions that follow.

No. of carbon atoms per molecule	Relative molecular mass of hydrogen
2	28
3	42
4	56

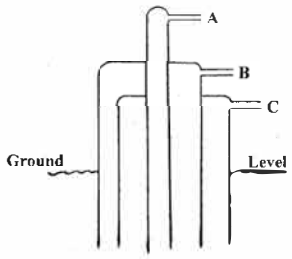
   (i) Write the general formula of the hydrocarbons in the table. (1 mk)
   (ii) Predict the relative molecular mass of the hydrocarbon with 5 carbon atoms (1mk)
   (iii) Determine the molecular formula of the hydrocarbon in (ii) and draw its structural formula. (2 mks)

   (c) Study the scheme given below and answer questions that follow.



(i) Name the reagent used in
Step I (1 mk)
Step II (1 mk)
Step IV (1 mk)
(ii) Write an equation for complete combustion of CH ≡ CH (1 mk)
(iii) Explain **one** disadvantage of the continued use of items in step III. (1 mk)

2. (a) The diagram below represents the extraction of sulphur by the frasch process.

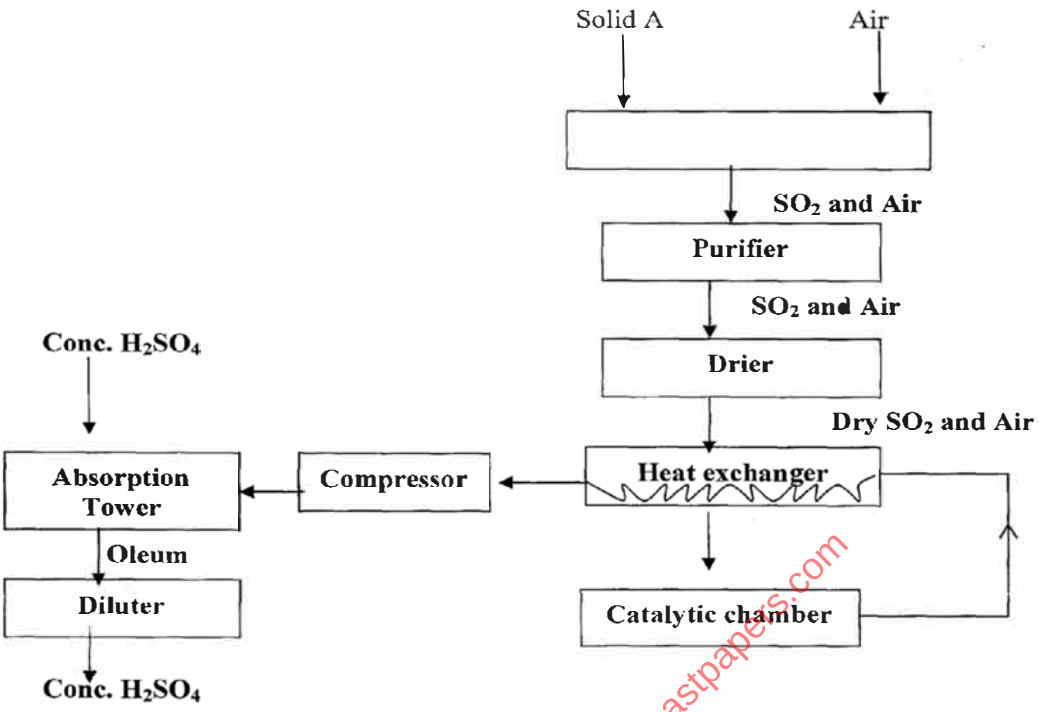


(i) Identify and state the use of the substances that pass through tubes A and C. (2mks)
(ii) Rhombic and monoclinic are Allotropes of sulphur. They are inter convertible as shown below.

$$\text{Rhombic} \overset{96^{\bullet}C}{\rightleftharpoons} \text{Monoclinic}$$

I. What does the temperature 96°C represent. (1 mk)
II. State the differences in crystalline appearances between rhombic and monoclinic crystals. (1 mk)

(b) The following scheme represents the steps followed in the contact process, study it and answer the questions which follow.



(i) Name **three** possible identities of solid A. (1 mk)
(ii) Name **two** impurities removed by the purifier. (1 mk)
(iii) Why is it necessary to remove impurities? (1 mk)
(c) The following chemical equation shows a reaction taking place in the catalytic chamber/converter.

$$2SO_{2S} + O_{2(g)} \rightleftharpoons 2SO_{3\,(g)} \qquad D\,H^{o} = -197kjmol^{-1}$$

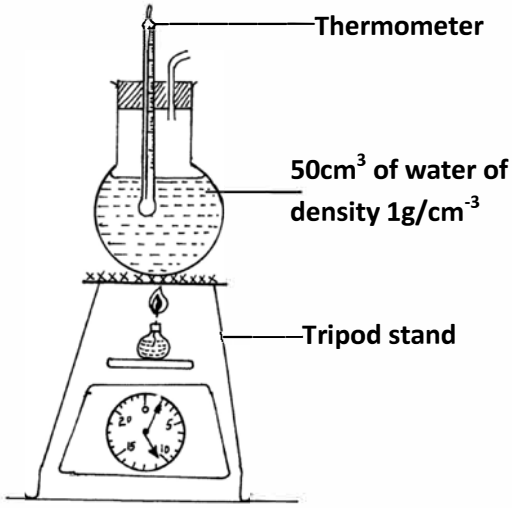
(i) How would the following factors affect the production of sulphur (IV) oxide.
I Increase in temperature. (1 mk)
II Decrease in pressure (1 mk)
(ii) Name the catalyst which is commonly used in this process and why? (1 mk)
(iii) State and explain one environmental effect of sulphur (IV) oxide in the atmosphere. (2mks)

3. The table below shows some elements of the periodic table and their atomic numbers, atomic masses and melting points. The letters are not the actual symbols of the elements.

Element	B	C	D	E	F	G	H	I	J	K
Atomic No.	7	8	19	15	2	9	6	16	12	11
Atomic mass	14	16	39	31	4	19	12	32	40	23
Melting point ^0C	-209	-218	63.7	44	-272	-223	Vary	113	669	98

(a) Select two elements with oxidation state of -3. (1mk)
(b) Which elements represents the most powerful reducing agent. Explain. (2mks)
(c) How does the atomic radii of D compare with that of K. Explain. (2mks)
(d) How do you compare the electrical conductivity of elements J and K. Give your reason. (1mk)
(e) Select two elements which when reacted with element G form a compound that conducts electricity both in molten and in aqueous state. (2mk)
(f) Explain why the melting point of H has not been given a specific value. (1mk)
(g) In which group and period do D and G belong? (2mks)
D Group _____
Period _____
G Group _____
Period _____
(h) Explain why the melting point of element K is higher than that of D. (1mk)
(i) Select one element stored in
(a) Water _____ (1mk)
(b) Paraffin _____ (1mk)

4. The following set – up was made in an experiment by a group of form four students. The readings of the balance before and after experiment were indicated in the diagram below. Given that the initial temperature of water was 26.7^0C respectively. The specific heat capacity of water is $4200Jkg^{-1}k^{-1}$



Determine:

a) Temperature change that occurred (1mk)
b) Amount of ethanol used (1mk)
c) Moles of ethanol used (2mks)
d) Amount of heat gained by water (2mks)
e) Molar enthalpy of combustion of ethanol (2mks)
f) Use the following thermochemical processes to answer the questions that follow;

$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ $\Delta Hc = -125kJmol^{-1}$

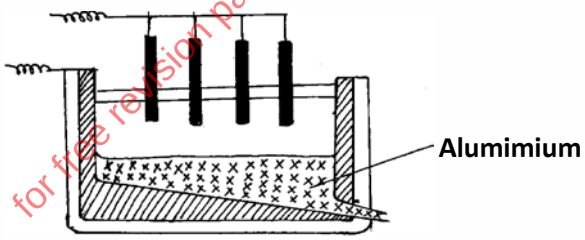
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta Hc = -393kJmol^{-1}$

$H_{2(g)} + ½\ O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta Hc = -286kJmol^{-1}$

i) Draw an energy level diagram representing the formation and combustion processes of propane, carbon and hydrogen (2mks)

ii) Hence or otherwise, determine the heat of formation of propane (2mks)

5. The extraction of aluminium from its ore takes place in two stages, purification state and electrolysis stage. The diagram below shows the set up for the electrolysis stage.



(a) (i) Name the ore from which aluminium is extracted. (1mk)
(ii) Name the impurity which is removed at the purification stage. (1mk)

(i) Label on the diagram each of the following:-
Anode (1mk)
Cathode (1mk)
Region containing electrolyte. (1mk)

(ii) The melting point of aluminium oxide is 2054^oC, but electrolysis is carried out between 800^oC - 900^oC.
I. Why is electrolysis not carried out at 2054^oC. (1mk)
II What is done to lower the temperature? (1mk)
III Give **two** properties that makes aluminium be collected as shown in the diagram. (2mks)

(b) A typical electrolysis cell uses a current of 40,000 amperes. Calculate the mass in kg of aluminium produced in one hour. (3mks) IF=96500c, Al=27

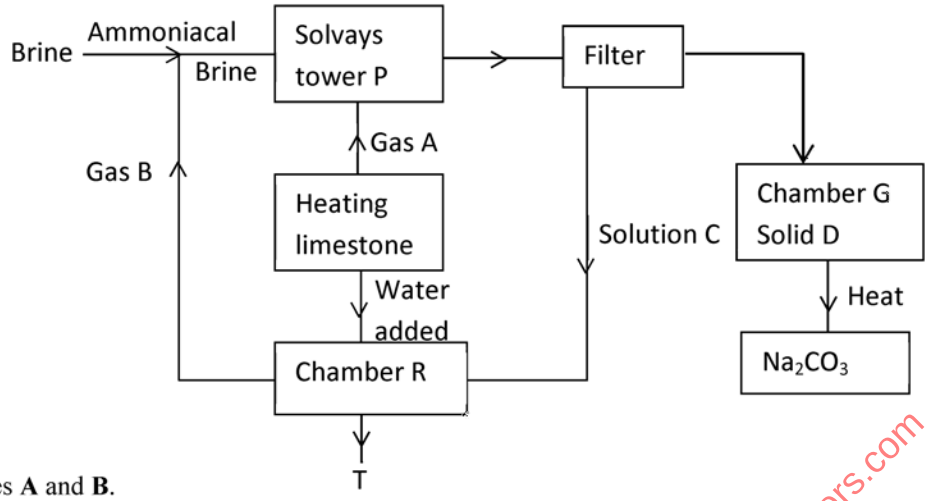
6. (a) In a paper chromatography sample A was found to be more soluble than sample B. Sample C had the same solubility a sample A, while sample D was most sticky of all the samples. Mixture K contained samples B and D only. In the space provided below draw the chromatogram of A,B,C,D and mixture K (3 ½ mks)

(b) Using propanone describe how you can separate a mixture containing iodine crystals and common salt (2 ½ mks)

(c) Mixture of magnesium powder and zinc (II) oxide will react vigorously when heated but no reaction occurs when a mixture of magnesium oxide and zinc powder is heated

(i) Explain the observations made (1mk)
(ii) Write the equation for the reaction between magnesium and zinc (II) oxide (1mk)
(iii) From the reaction above identify the oxidizing agent (1mk)

7. The diagram **below** shows the process of manufacturing sodium carbonate using ammonia soda process. Study it and answer the questions that follow.



(a) Name gases **A** and **B**. (2 marks)
(b) Name liquid **C** and solid **D**. (2 marks)
(c) Write equations of the reactions in: (2 marks)
Tower **P**.
Chamber **R**.
(d) Name the product **T** formed at chamber **R** and give one of its uses. (2 marks)
(e) Explain using ionic equations how sodium carbonate is used to soften hard water. (2 marks)

MURUKA KANDARA
FORM 4
LIST OF REQUIREMENTS

In addition to the laboratory apparatus and fittings, each student should have

1. $150cm^3$ of 0.2M Hcl labeled solution M
2. $150cm^3$ of sodium hydroxide made by dissolving 8.8g per litre
3. 0.5g of sodium carbonate decahydrate labeled solid P
4. Methyl orange indicator
5. 3 conical flasks
6. Pipette
7. Burette
8. labels
9. $250cm^3$ beaker
10. $100cm^3$ measuring cylinder
11. Complete resort stand
12. $50cm^3$ 2M sodium hydroxide labeled S1
13. Thermometer
14. $80cm^3$ 2m Hcl labeled S2
15. About 0.3g of Aluminium Sulphate

Access to

- 0.2M sodium hydroxide supplied with a dropper
- 0.2 M ammonium solution supplied with a dropper
- 0.1M Potassium Iodide supplied with a dropper
- 0.2M Barium chloride supplied with a dropper

MURUKA KANDARA
FORM 4
CHEMISTRY PRACTICAL
Paper 3
July / August – 2017
Time: 2 Hours

1. You are provided with:
- Solution M; Hydrochloric acid
- Solution N, containing 8.8g per litre of sodium hydroxide
- Solid P, 0.5g of an impure carbonate.

You are required to determine the,
(a) Concentration of solution N in moles per litre
(b) Percentage purity of the carbonate, solid P.

PROCEDURE I

Fill the burette with sodium hydroxide, solution N. Pipette 25cm^3 of hydrochloric acid solution M into a conical flask. Add 2-3 drops of methyl orange indicator and titrate (the colour of the indicator changes from pink to orange). Record your results in table 1 below. Repeat the titration two more times and complete the table.

Table 1.

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution N used (cm^3)			

(4 marks)

(a) Calculate:
(i) Average volume of solution N used. (1 mark)
(ii) Concentration of N in moles per litre (Na=23, O= 16, H=1) (1 mark)
(iii) Concentration of solution M in moles per litre. (3 marks)

PROCEDURE II

Using a measuring cylinder, measure out 100cm^3 of solution M into a 250cm^3 beaker. Add all of solid P into the beaker containing solution M. Swirl the mixture and allow the reaction to proceed for about **4 minutes**. Label the solution obtained here as **Q**. Fill the burette with sodium hydroxide solution N. Pipette 25cm^3 of solution Q into a conical flask. Add 2-3 drops of methyl orange indicator and titrate. Record your results in table 2 below. Repeat the titration two more times and complete the table.

Table 2

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution N used (cm^3)			

(4 marks)

(b) Calculate:
i) Average volume of solution N used. (1 mark)
ii) Moles of hydrochloric acid in 25cm^3 of solution Q. (2 marks)
iii) Moles of hydrochloric acid in 100cm^3 of Q. (1 mark)
iv) Moles of hydrochloric acid in 100cm^3 of original hydrochloric acid, solution M. (1 mark)
v) Moles of hydrochloric acid that were used up in the reaction with solid P. (1 mark)
vi) Moles of the carbonate that reacted with hydrochloric acid. (1 marks)
c) Given that the relative formula mass of the carbonate is 106, calculate the;
i) Mass of the carbonate that reacted. (1 mark)
ii) Percentage purity of the carbonate, solid P. (1 mark)

2. You are provided with:
2M sodim hydroxide solution S_1 and a solution of a monobasic acid S_2.
You are required to determine the molarity of S_2.
Procedure.
a) Place 50cm^3 of the 2M sodium hydroxide into a 200cm^3 plastic beaker insulated with tissue paper. Measure the temperature of this solution and record it in the table below.
b) To the sodium hydroxide solution in (a) above add 10cm^3 of solution S_2 while stirring and record the maximum temperature obtained after each addition. Record your results in the table below.

Table.

Total volume of S_2 added (cm^3)	Total volume of mixture (cm^3)	Final temperature (°C)
0	50	
10	60	
20	70	
30	80	
40	90	
50	100	
60	110	
70	120	
80	130	

(2 marks)

i) On the graph paper provided plot a graph of temperature against volume of acid S_2. (3 marks)
ii) What does the highest temperature on your graph show? (1 mark)
iii) What volume of S_2 will neutralize $50cm^3$ of 2M sodium hydroxide? (1 mark)
iv) Calculate the molarity of solution S_2. (2 marks)
v) Determine the molar heat of neutralization. (Specific heat capacity $=4.2jg^{-1}K^{-1}$, assume density of solution is $1g/cm^3$) (2 marks)

3. You are provided with a sample of solid N. Carry out the tests below and record your observations and inferences in the spaces provided. Place the whole of solid N into a boiling tube and add about $10cm^3$ of distilled water and shake well to dissolve. Use about $1cm^3$ portions of the solution for the tests below.

Observations (1mark)	Inferences(1mark

(i)Using the first portion, add sodium hydroxide drop wise until in excess.

Observations (1mark)	Inferences(1mark

(ii) To the second portion, add ammonia solution dropwise until in excess.

Observations (1mark)	Inferences(1mark

(iii) To the third portion, add 3 drops of potassium iodide.

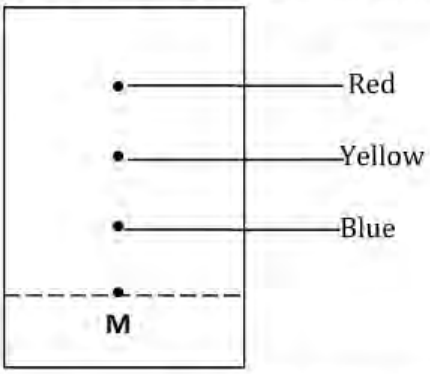
Observations (1mark)	Inferences(½ mark

iv) To the fourth portion, add 3 drops of barium chloride followed by about $5cm^3$ of solution

Observations (1mark)	Inferences(1mark

TRIAL 233/1
CHEMISTRY
PAPER 1
(THEORY)
TIME: 2 HOURS
JULY/AUGUST

1. (a) What are miscible liquids *(1mark)*
   (b) Name the process used to separate ethanol/water mixture that have boiling points that are close to one another. *(1mark)*
2. The chromatography below shows the constituents of a flower extract using an organic solvent:-



   (a) Name a possible organic solvent you can use for this experiment *(1 mark)*
   (b) State **one** property that makes the red pigment to move the furthest distance from M. *(1 mark)*
3. (a) Complete the table below to show the colour of the given indicator in acidic and basic solutions. *(2 marks)*

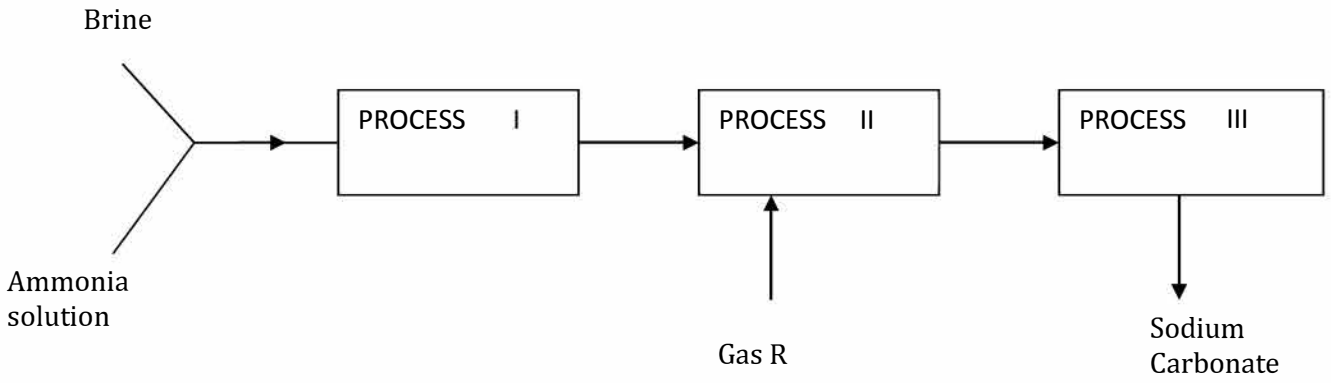
Indicator	Colour in	
	Acidic Solution	Basic Solution
Methyl Orange		Yellow
Phenolphthalein	Colourless	

   b) How does the pH value of 0.1M potassium hydroxide solution compare with that of 0.1M aqueous ammonia? Explain. *(1 mark)*
4. The table below describes the reaction of some metals with water.

Metal	**Reaction**
Calcium	Reacts rapidly with cold water producing many bubbles of gas.
Magnesium	Reacts very slowly with cold water but reacts rapidly with steam.
Rubidium	Reacts very rapidly with cold water producing many bubbles of gas and will explode.
Zinc	Only reacts with steam when powdered form and heated very strongly.

   Arrange these metals in order of their reactivity beginning with the most reactive. *(2 marks)*
5. Hydrogen gas is passed over heated copper (II) oxide in a combustion tube. Hydrogen gas is a reducing agent.
a) Write the chemical equation that takes place when hydrogen gas is passed over heated copper (II) oxide. *(1 mark)*
b) Draw a simple set up to show how hydrogen gas is passed over heated copper (II) oxide in a combustion tube. *(2 marks)*
6. Name Elements **Q, S, T, U R** and **P** belong to the same period in the periodic table. The ions formed by the atoms of the elements are given below Q^{2+}, U^{-}, T^{2-}, R^{3+}, P^{+} and S^{3-}
a) Arrange the elements in order of increasing atomic size. *(1 mark)*
b) Suggest a reason why elements **P** and **Q** cannot react with each other to form a compound. *(1 mark)*
7. Using dots and crosses diagrams draw the structure of the following molecules.
a) Hydrogen sulphide (H_2S) *(1 mark)*
b) Ethane (C_2H_6) *(1 mark)*
c) Magnesium Chloride *(1mark)*
8. Hydrogen oxide has a higher boiling point than hydrogen sulphide even though hydrogen sulphide has a higher relative molecular mass. ***Explain.*** *(3 marks)*
9. With reference to iodine, distinguish between covalent bonds and van der waals. *(3 marks)*

10. Below is a simplified scheme of Solvay process. Study it and answer the questions that follow:

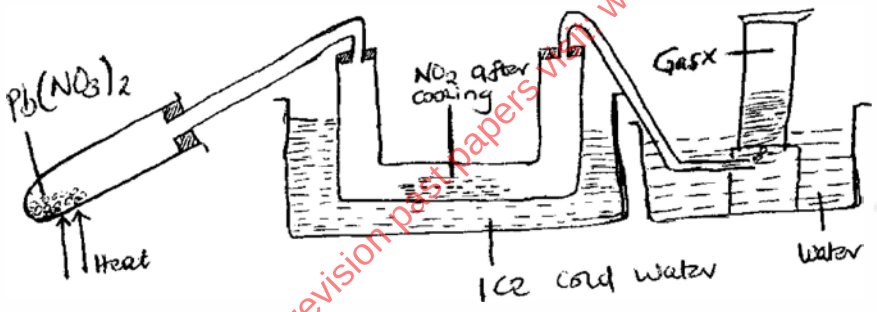


a) Identify gas R. *(1 mark)*
b) Write an equation for the process III. *(1 mark)*
c) Give **one** use of sodium carbonate. *(1 mark)*

11. In an experiment an unknown mass of anhydrous sodium carbonate was dissolved in water and the solution made up to 250cm^3. 25cm^3 of this solution neutralized 20cm^3 of 0.25M nitric acid. (Na = 23.0 C = 12.0 O = 16.0)
Calculate:
(a) Moles of Nitric acid used. *(1 mark)*
(b) Moles of sodium carbonate in 25cm^3 of the solution. *(1 mark)*
(c) Mass of unknown sodium carbonate used *(2 marks)*

12. a) State Graham's law of diffusion. *(2 marks)*
b) The time taken for a certain volume of gas R to diffuse through a small hole is 6 minutes. Under similar conditions on equal volume of oxygen took 7.5minutes to diffuse through the same hole. Calculate the relative molecular mass of R. (O = 16) *(2marks)*

13. The diagram below represents a set up that can be used to prepare and collect Nitrogen (iv) oxide.



a) Write the chemical equation for the reaction that takes place in Heating Pb $(NO_3)_2$. *(1 mark)*
b) Name Gas **X.** *(1 mark)*
c) What observations would be made:
(i) in the boiling tube? (1 mark)
(ii) In the u-tube on cooling. *(1 mark)*

14. Calculate the volume of oxygen liberated at the anode when current of 3 amperes is passed through magnesium sulphate solution for 45 minutes and 30 seconds?
Molar gas volume at r.t.p = 24 litres Faraday constant = 96500C. *(3 marks)*

15. 7.36 g of a compound of Hydrogen and Oxygen decomposed to produce 6.93 g of oxygen and the rest hydrogen. If the molecular mass of the compound is 34 grams determine the molecular formular of the compound. *(3 marks)*

16. Draw a well labeled diagram for the preparation of dry chlorine using manganese IV oxide. *(3 marks)*

17. Use oxidation numbers to show that the above reaction is redox. *(3 marks)*
$2H_2S_{(g)} + SO_{2(g)} \rightarrow 3S_{(s)} + 2H_2O_{(l)}$

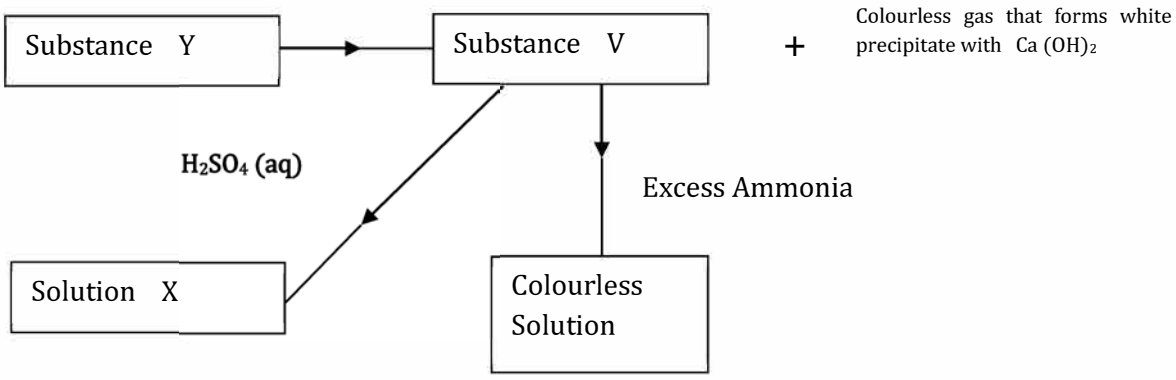
18. Describe how the pH of anti-aid (actual) powder can be determined in the laboratory *(3 marks)*

19. Draw and name of isomers of the butane. *(2 marks)*

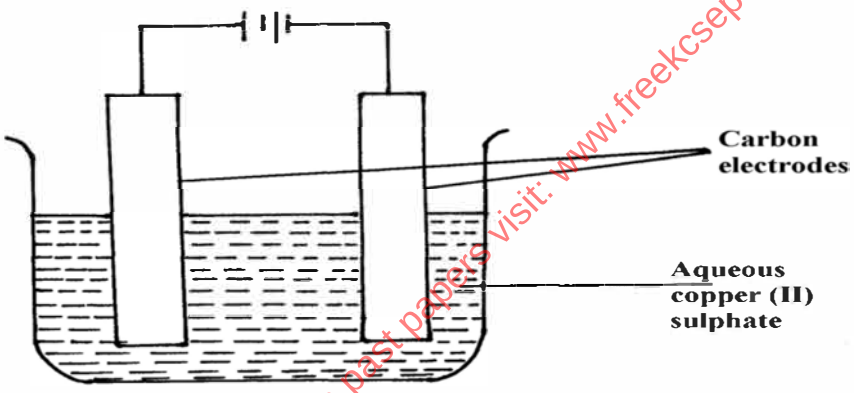
20. When a few drops of bromine are added to hexane, a deep red solution is formed. No reaction occurs if the mixture is kept in the dark, but in sunlight the red colour slowly disappears and a misty gas is given off.
(a) Identify the misty gas formed in this reaction. *(1 mark)*
(b) Write an overall equation for the reaction of one mole of bromine with one mole of hexane under these conditions. *(1 mark)*

21. State the difference between the bleaching activity of chlorine and sulphur (iv) oxide. *(2 marks)*

22. Study the flow chart below and answer the questions that follow.



a) Identify substances Y and V *(2 marks)*
b) Write a chemical equation that lead to formation of solution X. *(1 mark)*
23. Describe a chemical test that can be used to distinguish between ethanol and ethanoic acid. *(2 marks)*
24. A solution was made by dissolving 15g of impure sodium hydroxide in water and making it to 500cm^3 solution. If 40cm^3 of this solution neutralized exactly 26cm^3 of 1.0 M nitric (iv) acid, calculate the percentage purity of sodium hydroxide.
(Na = 23, O = 16, H = 1 Cl = 35.5) *(3 marks)*
25. Motoro carried out the following experiment to study electrolysis of copper (II) sulphate. Study it and answer the question t hat follow.



Write ionic equations taking place at
i) Anode *(1 mark)*
ii) Cathode *(1 mark)*
iii) Comment of the pH of the solution after sometimes. *(1 mark)*
26. Element K (not actual symbol) has isotope composition as follows.

Isotope	Abundance %
10k	18.69
5k	81.31

Calculate the Relative Atomic Mass. *(2 marks)*
27. A student wanted to determine the solubility of potassium nitrate at a certain temperature. He obtained the following results.
Mass of evaporating dish = 12.72g
Mass of evaporating dish + saturated solution = 34.10g
Mass of evaporating dish + salt = 17.00g
Calculate the solubility of potassium nitrate from the results above. *(3 marks)*
28. With reference to atomic number of one, explain why hydrogen can be placed in either group 1 or group VII of the periodic table *(2 marks)*
29. (a) Define the term ionisation energy? *(1 mark)*
(b) State and explain two factors that determine the value of ionization energy of a given element. *(2 marks)*
30 Describe with the help of ionic equation, a confirmatory test for presence of chloride ion, using silver nitrate solution. *(2 marks)*

TRIAL 233/2
CHEMISTRY
PAPER 2
(THEORY)
TIME: 2 HOURS
JULY/AUGUST

1. a) The table below shows the elements in the same group of the periodic table and their average atomic radii, measured in the usual atomic measurements. The symbols do not represent the actual symbols of elements.

Element	Atomic radius
P	0.18
Q	0.22
R	0.14

(i) If the elements are in group 1, which element would most likely be potassium? *(1 mark)*

(ii) Using the letters given, which element has the highest ionisation energy? Give a reason for your answer *(1 mark)*

b) The table below shows some properties of substances V, W, X and Z. Study them and answer the questions that follow. Letters do not represent the actual symbols of the substances.

Elements	Solubility in Water	Boiling Point	Electrical conductivity	
V	Insoluble	2955	Good	Good
W	Soluble	1413	Poor	Good
X	Insoluble	-90	Poor	Poor
Z	Insoluble	4827	Poor	Poor

i) Which substance is likely to have giant atomic structure? Explain. *(2 marks)*

ii) Identify the particles responsible for conduction of electricity in V in solid and in molten states.
Solid state _____ *(1 mark)*
Molten _____ *(1 mark)*

iii) Which substance has electrovalent bond? Explain *(1 mark)*

iv) Which substance is a gas at room temperature. Explain. *(1 mark)*

c) The table below shows some properties of halogens. Use it to answer the questions below.

Halogen	Atomic radius (nm)	Appearance	Boiling point (^{0}C)
Fluorine	0.064	Pale yellow gas	- 188
Chlorine	0.094	Greenish - yellow gas	- 35
Bromine	0.114	Brown liquid	59
Iodine	0.133	Shiny dark solid	184

i) State and explain the trend in boiling points down the group *(2 marks)*

ii) State what would be observed when bromine water is added to potassium iodide solution. *(1 mark)*

iii) Give a reason why iodide sublimes. *(1 mark)*

2. A form two student was asked to prepare a sample of copper (II) sulphate crystals using the procedure below.
- Measure 100cm^3 of 2M sulphuric (VI) acid then warm. Add excess copper (II) oxide powder.
- Filter the resulting mixture.
- Heat the filtrate and leave it overnight.

(a) Why was the acid heated before the start of the reaction? *(1 mark)*

(b) Why was excess copper (II) oxide used. *(1 mark)*

(c) What was observed when copper (II) oxide was added to the warm acid? *(2 marks)*

(d) Write and equation for the reaction that took place in (c) above. *(1 mark)*

(e) Give reasons for carrying out the following processes.
I. Filtration of the mixture. *(1 mark)*
II. Heating the filtrate and leaving it overnight. *(2 marks)*

(f) Explain how dry crystals of copper (II) sulphate are finally obtained. *(1mark)*

(g) State and explain the observations that would be made when concentrated sulphuric (IV) acid is added to the crystals formed in (f) above in a test tube. *(2 marks)*

(h) Write the formula of the complex ion formed with excess ammonia solution is added to copper (II) sulphate solution. *(1 mark)*

(i) Explain why it would not be possible to prepare copper sulphate salt by reaction of dilute sulphuric (IV) acid with copper metal? *(1 mark)*

3. (a) Give the systematic names of the following compounds.
(i) $CH_3CH_2CH_2OH$ *(1 mark)*
(ii) CH_3CH_2COOH *(1 mark)*

(b) Study the information in the table below and answer the questions that follow.

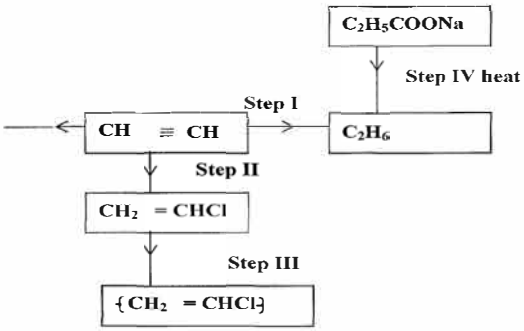
No. of carbon atoms per molecule	Relative molecular mass of hydrogen
2	28
3	42
4	56

i) Write the general formula of the hydrocarbons in the table. *(1 mark)*

ii) Predict the relative molecular mass of the hydrocarbon with 5 carbon atoms. *(1 mark)*

iii) Determine the molecular formula of the hydrocarbon in (ii) and draw its structural formula. *(2 marks)*

(c) Study the scheme given below and answer questions that follow.



i) Name the reagent used in

Step I ---------- *(1mark)*

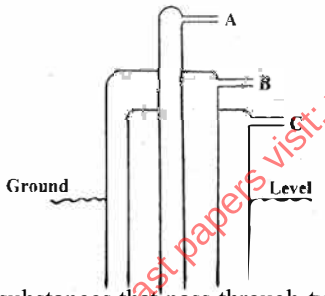
Step II ---------- *(1mark)*

Step III---------- *(1mark)*

ii) Write an equation for complete combustion of CH ≡ CH. *(1mark)*

iii) Explain one disadvantage of the continued use of items in step III. *(1 mark)*

4. The diagram below represents the extraction of Sulphur by the Frasch process.



i) Identify and state the use of the substances that pass through tubes A and C. *(2 marks)*

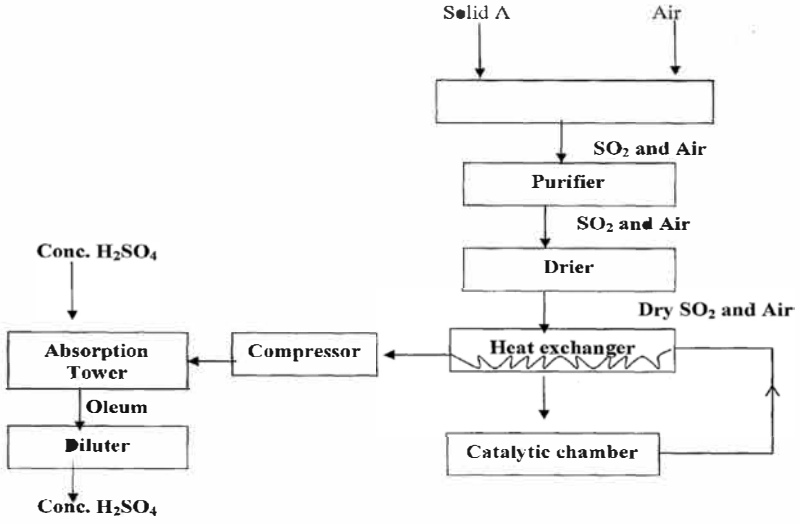
ii) Rhombic and monoclinic are Allotropes of sulphur. They are inter convertible as shown below.

Rhombic $\overset{96\,^{\circ}C}{\rightleftharpoons}$ Monoclinic

I. What does the temperature 96°C represent. *(1 mark)*

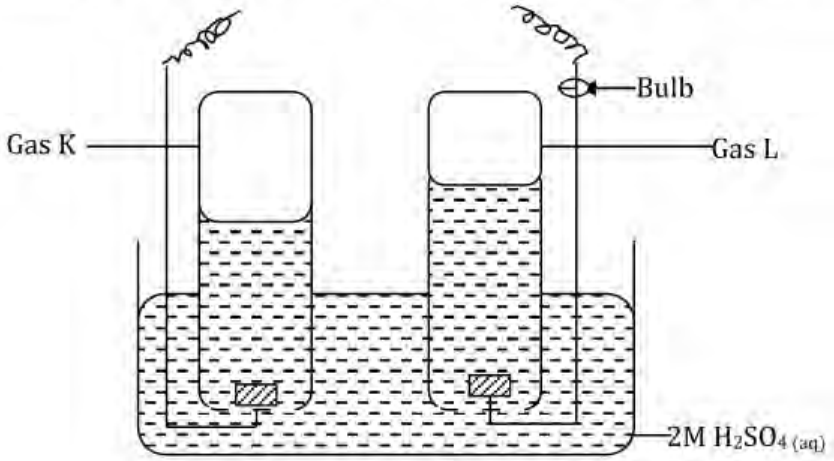
II. State the differences in crystalline appearances between rhombic and monoclinic crystals. *(1 mark)*

(b) The following scheme represents the steps followed in the contact process, study it and answer the questions which follow.



i) Name **two** possible identities of solid **A**. *(1 mark)*
ii) Name **two** impurities removed by the purifier. *(1 mark)*
iii) Why is it necessary to remove impurities? *(1 mark)*

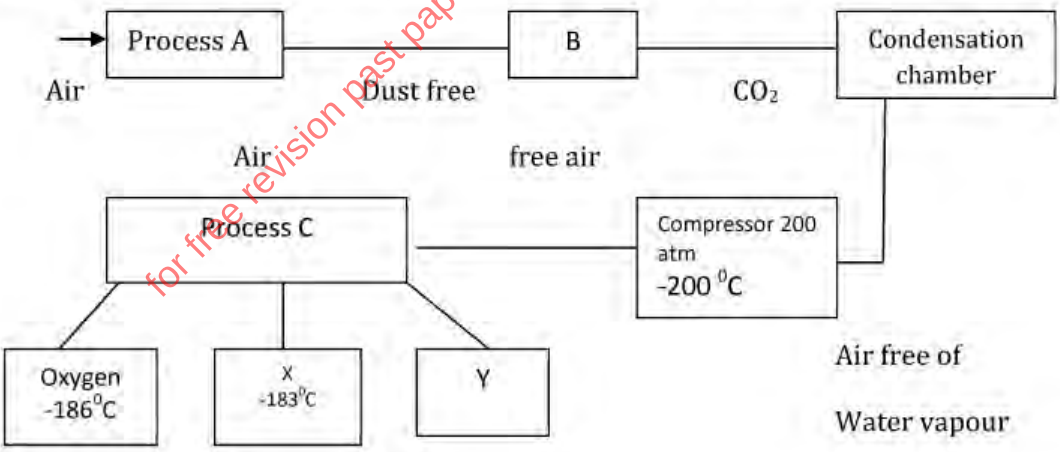
5. (I) Sulphuric (VI) acid was electrolysed using inert electrodes as shown on the diagram below



(a) Write the equations for the reactions taking place on the electrodes *(2 marks)*
Anode:----------
Cathode: ----------
(b) How can gas K be identified? *(1 mark)*
(c) Explain the difference in the volumes of the gases produced at the electrode? *(2 marks)*
(d) Give **two** reason why electroplating is a necessity. *(2 marks)*

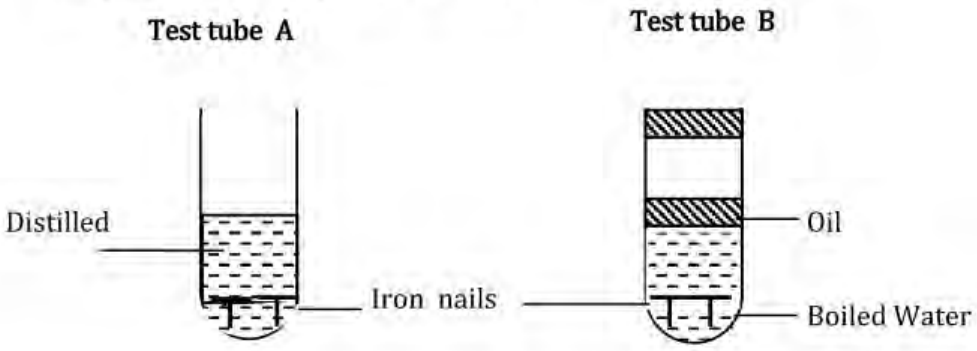
(II) During electrolysis of a metal sulphate, 0.18g of the metal was deposited when a current of 3.2A passed for 10 minutes.
(a) Calculate the quantity of electricity used in Faradays (1F=96000C) *(1 mark)*
(b) If the metal ion has the formula M^{3+}, calculate the R.A.M of metal M. *(2marks)*
(c) When the same quantity of electricity of electricity was passed through a nitrate salt of metal Z of R.A.M 108, 2.16g of Z was deposited.
(i) Find the formula of the ion of metal Z *(2 marks)*
(ii) Write the formula of the carbonate of element Z. *(1mark)*

6. Oxygen is obtained on large scale by fractional distillation of air as shown on the flow chart below.



(a) i) Identify processes. A and C *(2 marks)*
ii) Identify gases: X and y *(1 mark)*
Explain why Carbon (IV) oxide and water are removed before liquefaction of air. *(1 mark)*
(b) State two uses of Argon. *(2 marks)*

(c) The diagram below shows a set up used to investigate the process of rusting.
Study it and answer the questions that follow.



State and explain the observation made on the iron nails in test tube B at the end of the experiment. *(3 marks)*

(d) Name **two** conditions that accelerate rusting. *(2 marks)*

7. a) Use the bond energies given in the table below to calculate the enthalpy change for the reaction. *(2marks)*

Bond	C – H	C –Br	Br – Br	H - Br	C-C
Bond energy KJ/mol	413	280	193	365	343

$C_2H_{6(g)} + Br_{2(g)} \rightarrow C_2H_5Br_{(g)} + HBr_{(g)}$

b) Hydrogen peroxide decomposes according to the equation below:
$H_2O_{(l)} \rightarrow H_2O_{(l)} + \frac{1}{2} O_{2(g)}$; $\Delta H = -98KJ/mol$.
If 6.8g of hydrogen peroxide contained 75cm^3 of solution with water were completely decomposed, determine the rise in temperature due to the reaction.(Specific heat capacity of water =4.2Jg^{-1}K^{-1} , density of water = 1g/cm^3 , O = 16 , H = 1).
(2 marks)

c) On the space provided below sketch the cooling curve that would be obtained when a boiling tube containing water at 80^{0}C is immersed in a freezing mixture maintained at -10^{0}C. *(3 marks)*

d) Butane C_4H_{10} cannot be prepared directly from its elements but its standard heat of formation ($\Delta H^{\theta}f$) can be obtained directly. The following heats of combustion are given.

$\Delta H^{\theta}c$ carbon (s) = -393KJ/mol

$\Delta H^{\theta}c\ H_2(g)$ = -286KJ/mol

$\Delta H^{\theta}c\ C_4H_{10}$ = -2877KJ/mol

i) Draw an energy circle diagram linking the heat of formation of butane with its heat of combustion and the heat of combustion of its constituents elements. *(2 marks)*

ii) Calculate the heat of formation of butane $\Delta H^{\theta}f(C_4H_{10})$. *(2marks)*

e) Given that the lattice enthalpy of potassium chloride is +690KJ/mol and hydration enthalpies of K^+ and Cl^- are -322KJ and -364KJ respectively. Calculate the enthalpy of solution of potassium chloride. *(2 marks)*

TRIAL
CONFIDENTIAL
CHEMISTRY
Paper 3
PRACTICAL
Requirements for candidates

In addition to apparatus, chemicals and fittings found in a Chemistry laboratory, each candidate should be provided with.

1. About $90cm^3$ of solution M
2. About $90cm^3$ of solution N
3. About $75cm^3$ of solution X
4. About $80cm^3$ of solution Y.
5. One Burette
6. One pipette ($25cm^3$)
7. One $100cm^3$ measuring cylinder
8. At least 2 conical flasks
9. Stirring rod
10. One $10cm^3$ measuring cylinder
11. One $200cm^3$ beaker
12. Tissue paper
13. One thermometer (0 - 110°C)
14. One test tube holder
15. 12 clean test-tubes
16. About 2g of solid Z
17. About 2.0g of solid Q
18. About 2ml Ethanol in a stoppered test tube

Access to

1. Distilled water
2. Lead (II) nitrate
3. 2M sodium hydroxide - with dropper
4. 2M aqueous ammonia - with dropper
5. 0.25M Barium nitrate with dropper
6. Bunsen burner (source of heat)
7. Acidified $KMnO_4$
8. Universal indicator and it's pH scale

NOTES:

1. Solution M is made by accurately weighing 3.95g of potassium Manganate (VII) and dissolving it in 400ml of 1M H_2SO_4 and making up to solution to 1litre mark.
2. Solution N is prepared by dissolving 49.0g ammonium ferrous sulphate, $(NH_4)_2SO_4$. $FeSO_4.6H_2O$ and dissolving it in 400ml distilled water and making it up to 1litre mark.
3. X is prepared by dissolving 36g of Sodium hydroxide pellets in about $800cm^3$ of distilled water and diluting to one litre of solution.
4. Y is prepared by dissolving 63g of oxalic acid in about $600cm^3$ of distilled water and diluting to one litre of solution.
   (NB: if oxalic acid does not dissolve easily in cold water, use warm water and allow it to cool overnight)
5. Solid Q is zinc chloride
6. Solid Z is benzoic acid

TRIAL
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)
TIME: 2½ HOURS
JULY/AUGUST

1. **(I)** You are provided with:

- *Solution **M** containing 3.95g Potassium Manganate (vii), ($KMnO_4$) per litre of solution.*
- *Solution **N**, containing 49.0g of ammonium ferrous Sulphate $(NH_4)_2SO_4.FeSO_4 6H_2O$ per litre of solution.*

You are required to determine the reacting mole ratio of manganate (VII) Ions, MnO_4 with Iron (II) ions Fe^{2+}.

PROCEDURE 1:

Using and pipette filter transfer 25.0cm^3 of solution N into a conical flask. Titrate with solution M in the burette. No indicator is required for this experiment. Record your results in the table below.

Repeat the procedure to obtain the accurate volumes.

Table I

	1st	2nd	3rd
Final burette readings cm^3			
Initial burette readings cm^3			
Volume of solution M used cm^3			

(4 marks)

a) Determine the average volume of solution **M** used. *(1 mark)*

b) Calculate:

i) The concentration of solution **M** in moles per litre. (K = 39, Mn = 55, O = 16). *(1 mark)*

ii) The number of moles of solution **M** in the volume in (a) above. *(1 mark)*

iii) The concentration in moles per litre of solution **N**. *(1 mark)*

iv) The number of moles of solution N that reacted with solution **M** in this experiment. *(1 mark)*

c) Given that 1 mole of solution **M** gives 1 mole of MnO_4^- ions and 1 mole of solution **N** gives 1 mole of Fe^{2+} ions. Calculate the reaction mole ratio of Fe^{2+} ions to MnO_4^- ions. *(1 mark)*

(II) You are provided with:

- 0.9M of sodium hydroxide solution **X**
- 0.5M of oxalic acid solution **Y**

You are required to determine the molar heat of neutralization of sodium hydroxide

PROCEDURE II:

Place six test tubes in a test tube rack. Using a 10cm^3 measuring cylinder, measure 10cm^3 of solution **Y** and place them into each of the test tubes.

Measure 50cm^3 of solution **X** using a measuring cylinder and place into 200cm^3 beaker. Measure the temperature of solution **X** in the beaker and record the steady value in table II below. Put the first portion of the 10cm^3 of solution **Y** from the test tube into the beaker containing 50cm^3 of solution **X**. Stir the mixture carefully using a thermometer and record the highest temperature in table II below.

Pour the second portion of solution Y **into the mixture in the beaker**, stir and record the highest temperature of this mixture in the table II. Continue this procedure using the remaining portions of solution Y to complete table II.

(i) Table II

Total volume of Y added (cm^3)	0	10	20	30	40	50	60
Volume of X (cm^3)							
Temperature (^0C)							

(4marks)

(ii) On the grid provided, plot a graph of temperature (Y axis) against volume of solution Y added. *(3 marks)*

(iii) From the graph, find:

(a) The volume of solution Y required to neutralize 50cm^3 of sodium hydroxide solution X *(½ mark)*

(b) The highest temperature change (Δ T) *(½ mark)*

(iv). Calculate the heat change of reaction (Assume density of mixture = 1g/cm^3 and specific heat capacity= 4.2$Jg^{-1}k^{-1}$) *(2 marks)*

(v) Find the number of moles of sodium hydroxide solution X used *(1 mark)*

(vi) Determine the molar heat of neutralization of sodium hydroxide, solution X *(2 marks)*

1. You are provided with solid Q. Carry out the test below and record your observations and inferences in the spaces provided. Place the entire solid in a boiling tube. Add about $10cm^3$ of distilled water. Shake until all the solid dissolves. Divide the solution into four portions.

i) To the first portion, add aqueous sodium hydroxide drop wise until in excess.

Observation	Inference
(1mark)	*(1mark)*

ii) To the second portion, add aqueous ammonia drop wise until in excess.

Observation	Inference
(1mark)	*(1mark)*

iii) To the third portion, add 3 drops of barium nitrate solution

Observation	Inference
(1mk)	*(1mk)*

iv) To the fourth portion, add about $2cm^3$ of lead II nitrate solution

Observation	Inference
(1mark)	*(1mark)*

2. Your are provided with solid Z carry out the tests below and record your observations and inferences in the spaces provided.

i) Using a metallic spatula heat half a spatula end-ful of solid Q in a non luminous Bunsen flame for sometime then remove when it ignites.

Observation	Inference
(1mark)	*(1mark)*

(ii) Put a half spatula end-ful of Z in a boiling tube, add $10cm^3$ of distilled water and shake vigorously.

Observation	Inference
(½mark)	*(½mark)*

Divide the resulting solution into two portions.

(a) To portion one, dip a piece of universal indicator paper and determine its PH.

Observation	Inference
1mark)	*(1mark)*

(b) To portion two add one or two drops of acidified potassium manganate VII solution and shake vigorously.

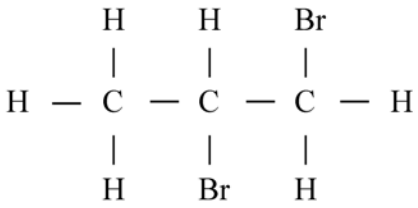
Observation	Inference
(1mark)	*(1mark)*

Put half spatula endful of Z into a boiling tube and add 5 drops of ethanol followed by 2 drops of concentrated sulphuric acid. Warm the mixture

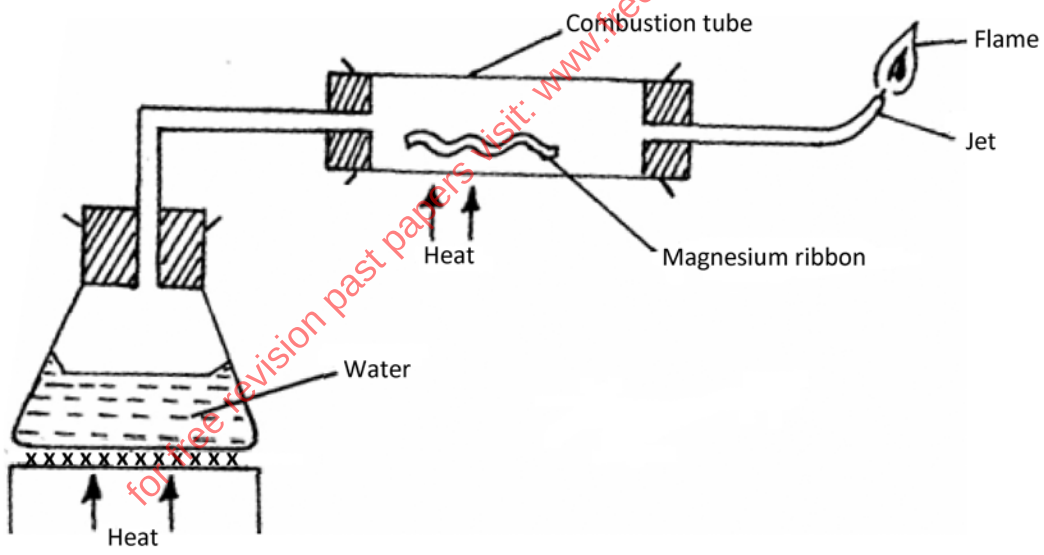
Observation	Inference
(1mark)	*(1mark)*

GITUAMBA / LAIKIPIA
233/1
Chemistry
Paper 1
June/July-2017
Time: 2 hours
Form Four Evaluation Examination 2017
Kenya certificate of secondary education (K.C.S.E)

1. In a motoring magazine, a journalist wrote "On a busy road the proportion of carbon (II) oxide has varied from 6 parts per million to 180 parts per million."
   a) Explain why the proportion of carbon (II) oxide varies as above. (1mk)
   b) By what reaction is carbon (II) oxide above formed. (1mk)
   c) What is the effect of carbon (II) oxide on blood and why does it make the gas poisonous. (1mk)
2. Bromine reacted with compound **Q** to form a compound with structural formula.



   (i) Write the structural formula of **Q**. (1 mark)
   (ii) When **Q** is reacted with concentrated sulphuric (VI) acid compound P is formed which further reacted with water to form K.
   I Identify substance K. (1 mark)
   II Write an equation to show how compound **K** reacts with sodium metal. (1 mark)
3. Steam was passed over magnesium ribbon as shown in the diagram **below**. Study it and answer the questions that follow.



   (a) State **one** precaution which should be taken before lighting the gas at the jet. (1 mark)
   (b) Write a chemical equation for the reaction taking place in the tube.
   (i) Combustion tube. (1 mark)
   (ii) Jet (burning flame). (1 mark)
4. Study the reaction below and answer the questions that follow.

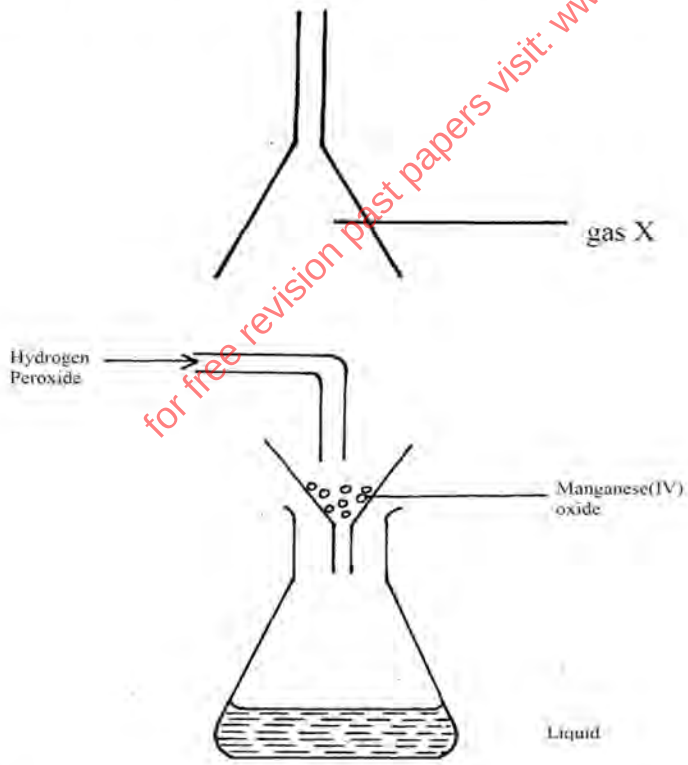
Reaction	Equation
J	$Ba_{(aq)}^{2+} + SO_{3(aq)}^{2-} \rightarrow BaSO_{3(s)}$
K	$Br_{2(g)} + 2I_{(aq)}^{-} \rightarrow 2Br_{(aq)}^{-} + I_{2(g)}$
L	$2Fe^{2+}_{(aq)} + Br_{2(g)} \rightarrow 2Fe_{(aq)}^{3+} + 2Br_{(aq)}^{-}$
M	$HSO^{-}_{4(aq)} + OH_{(aq)}^{-} \rightarrow SO^{2-}_{4(aq)} + H_2O$
N	$Fe_{(s)} + S_{(s)} \xrightarrow{\text{heat}} FeS_{(s)}$

   a) Which of these reactions indicate;
   i) A precipitate reaction (1mk)
   ii) Displacement noction (1mk)
   iii) Neutralisation reaction (1mk)

5. Given the following half cells
   $Pb^{2+}_{(aq)} / Pb_{(s)}$ $E^{\theta} = -0.13v$
   $Cu^{2+}_{(aq)} / Cu_{(s)}$ $E^{\theta} = +0.34v$
   a) Write the ionic equations for the half-cell that undergoes (2mks)
   i) Oxidation
   ii) Reduction
   b) Calculate the e.m.f of the resulting electrochemical cell. (1mk)
6. The formation of carbon (II) oxide and hydrogen from methane and steam at $750^{0}C$, is represented by the equation below.
   $CH_{4(g)} + H_2O \rightleftharpoons CO_{(g)} + 3H_{2(g)}$ $\Delta H = 206kJ$
   a) Calculate the mass of methane that reacts to produce 556kJ of heat. (C=12 O=16 H=1) (2mks)
   b) What effect does increase in pressure have on the yield of carbon (II) oxide gas? (1mk)
7. 5.34g of a salt of formula M_2SO_4 was dissolved in water. The sulphate was precipitated by adding excess banum chloride solution. The mass of the precipitate formed was 4.66g. (Ba = 56, S = 32, O = 16)
   a) Determine the moles of sulphate ion present. (1mk)
   b) Calculate the relative atomic mass of M in M_2SO_4 (2mks)
8. Study the information in the table below and answer the questions that follow. A mixture contains three solids; aluminium sulphate sugar, and camphor. The solubility of these solids in different liquids is shown in the table below.

Solid \ Liquid	Water	Alcohol	Ether
$Al_2(SO_4)_3$	Soluble	Insoluble	Insoluble
Sugar	Soluble	Soluble	Insoluble
Camphor	Insoluble	Soluble	Very soluble

   Explain how you would obtain a solid sample of sugar from the mixture. (3mks)
9. The equation below represents changes in physical states of iron metal.
   $Fe_{(s)} \rightarrow Fe_{(s)}$ $\Delta H = +15.4kJ/mol$
   $Fe_{(l)} \rightarrow Fe_{(g)}$ $\Delta H = +354\ kJ/mol$
   Calculate the amount of heat required to change 11.2g of solid iron to gaseous iron. (Fe = 56.0) (2mks)
10. The set up below was used to prepare a gas X. study it and answer the question that follow.



   Name;
   i) Gas X (1mk)
   ii) Liquid P. (1mk)
11. The following are standard electrode potential for some elements.

	E^{θ}(Volts)
$A^{2+}_{(aq)} + 2e^{-} \rightleftharpoons A_{(s)}$	-0.28
$B^{+}_{(aq)} + e^{-} \rightleftharpoons B_{(s)}$	+1.68
$C^{2+}_{(aq)} + 2e^{-} \rightleftharpoons C_{(s)}$	-0.40

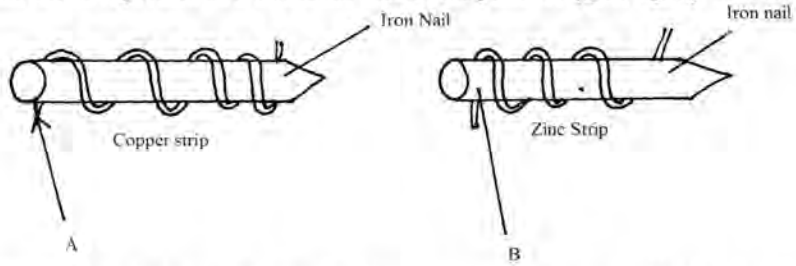
$D^{2+}_{(aq)} + 2e^- \rightleftharpoons D_{(s)}$ +0.85
$E^{2+}_{(aq)} + 2e^- \rightleftharpoons E_{(s)}$ -2.38
$F^{+}_{(aq)} + e^- \rightleftharpoons F_{(s)}$ +0.80

a) An aqueous solution containing F^+ ions is placed in a container made of C. determine whether a reaction occurs or not, showing how you arrive at your answer. (2mks)
b) Identify two half-cells which if combined give the highest e.m.f. (1mk)

12. Complete the table to show how the factor given below affect the rate of reaction between acid and magnesium and give an explanation for each effect.

Factor	Effect on rate of reaction	Explanation
Using magnesium powder instead of ribbon	(1mk)	(2mks)

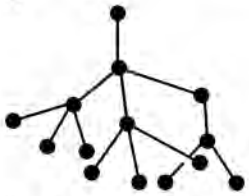
13. The diagram below represent two iron nails with some parts wrapped tightly with zinc and copper stripes respectively.



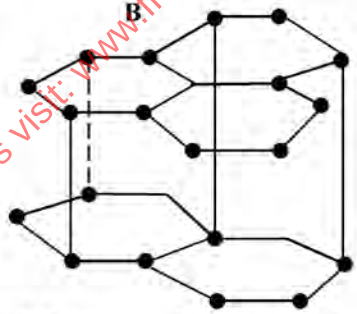
State the observations that would be made at the exposed points A and B if the wrapped nails are left in the open for several months. Explain (3mks)

14. 5.04g of a mixture of anhydrous sodium carbonate and sodium hydrogen carbonate when heated to a costant mass, gare 4.11g of residue. Calculate the percentage of anhydrous sodium carbonate in the mixture. (Na=23 O=16 H=1) (3mks)
15. State, giving reasons, the observations that would be made when concentrated sulphuric(VI) acid is added to powdered sulphur and the mixture heated. (3mks)
16. The following diagrams shows the structure of two allotropes of carbon. Study them and answer the questions that follow.

A



B

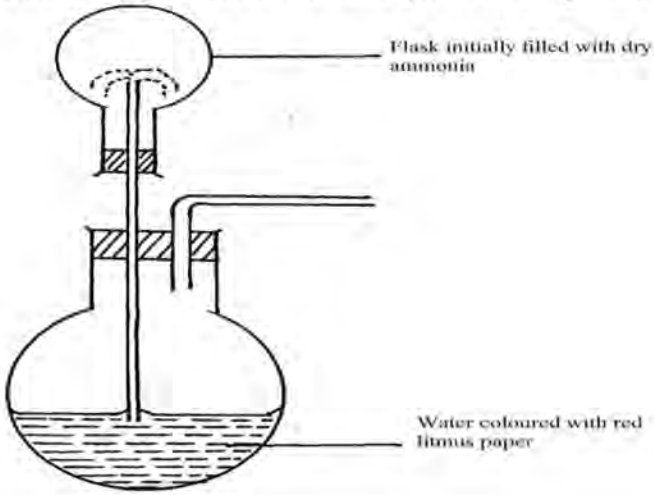


(a) Name the allotropes. A ,B (1 mark)
(b) Give **one** use of **A**. (½ mark)
(c) Which allotrope conducts electricity? Explain. (1½ marks)

17. State and explain the change in mass that occur when the following substances are separately heated in open crumbles. (3mks)

i) Copper metal
ii) Copper (II) Nitrate
iii) Anhydrous copper (II) sulphate

18. State Charles' law for gases and explain it using kinetic theory of matter. (3mks)
19. Below is a diagram for the 'fountain experiment' using ammonia gas.



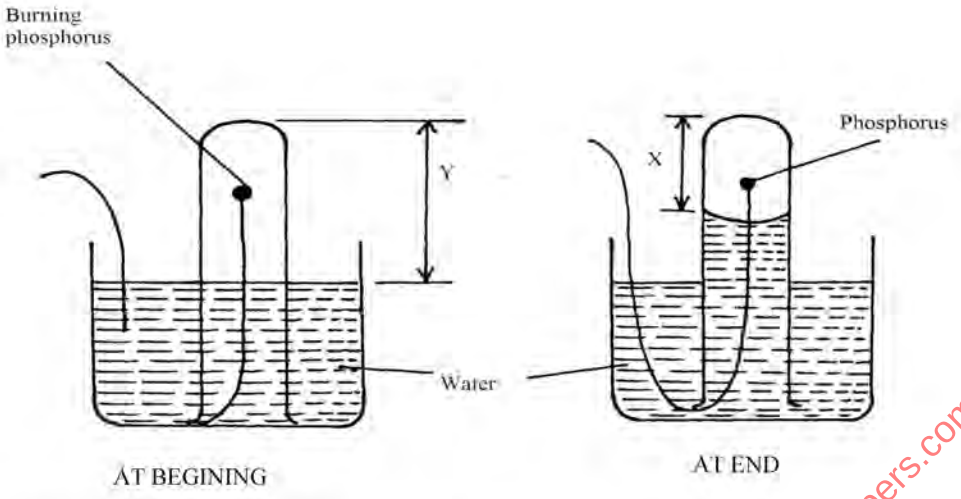
Red coloured water begins to rise up the tube from lower flask to upper flask and a "fountain" is observed in the upper flask. Red colour changes to blue.

i) Why does the colour change to blue? (1mk)

ii) Explain why the fountain effect occurs. (1mk)

iii) Why is it necessary to have two tubes in the lower flask? (1mk)

20. A student set-up the apparatus below in order to determine the percentage by volume of oxygen in air.



a) Why did water rise when the reaction had stopped? (1mk)

b) The student wrote the expression for the percentage by volume of oxygen in air as

$$\frac{y-x}{y} x100\%$$

Why was the volume of oxygen calculated using the above expression incorrect? (1mk)

c) What should have been done after the reaction had stopped in order to get a correct volume. (1mk)

21. The table below shows the two allotropes of sulphur. Using the guidelines given, state the differences between the two allotropes. (3mks)

Property	Rhombic	Monoclinic
Appearance		
Density		
Melting point (^{0}C)		

22. An element X, forms an ion ion X^{2-} with the electronic configuration 2.8.8

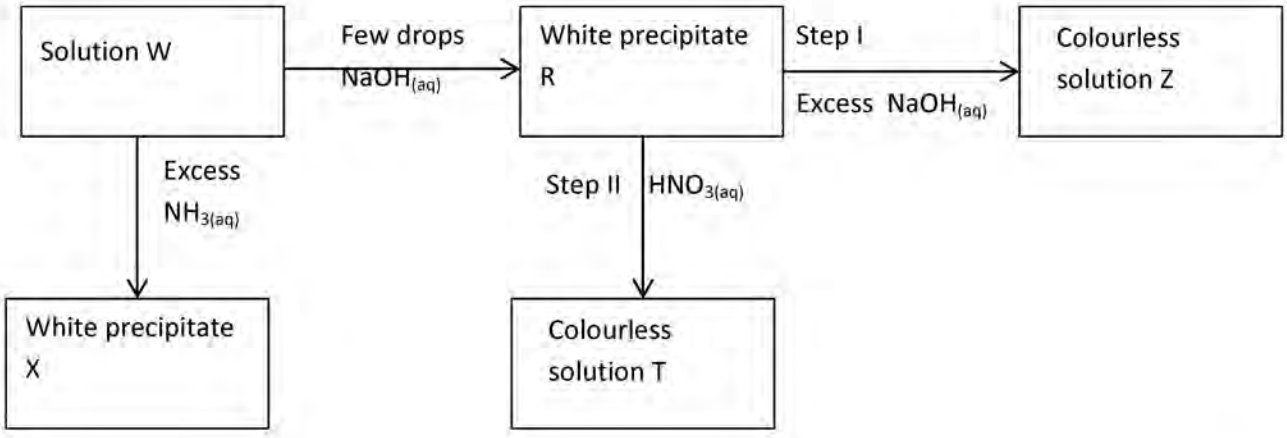
a) Write the electronic configuration of element X. (1mk)

b) An element Y is found in the 4th group of the periodic table. Draw a dot (.) and (x) diagram to show bonding in compound formed when X and Y react. (1mk)

23. State and explain two main factors considered in determining the position of an element in the periodic table. (2mks)

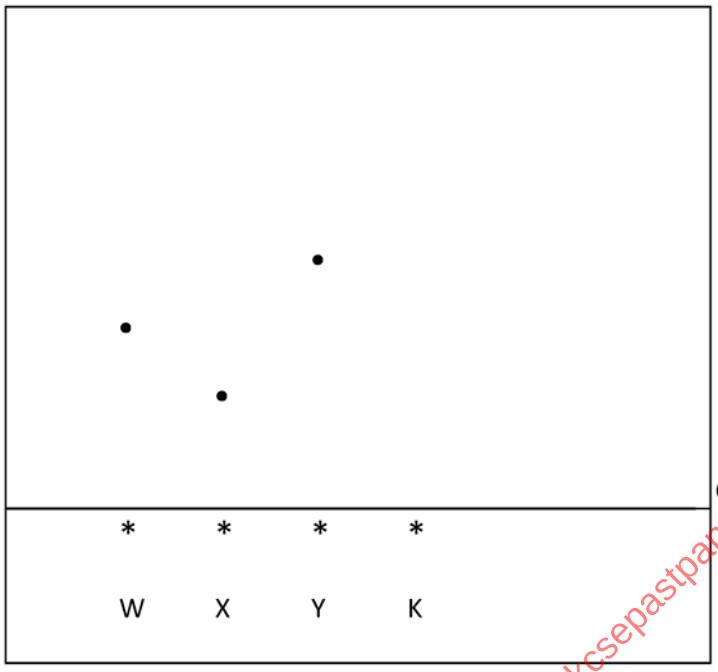
24. Explain what would be the pH of the final solution obtained after mixing equal volumes of 2M Sodium hydroxide and 2M Ethanol acid. (2mks)

25. Study the reaction scheme **below** and answer the questions that follow.



(a) What property of the white precipitate **R** is demonstrated by steps **I** and **II**. (1 mark)
(b) If the metal ion in solution **W** is divalent suggest its identity. (1 mark)
(c) Write an ionic equation for the reaction taking place in step **I**. (1 mark)

26. The diagram **below** represents a paper chromatogram of pure **W**, **X** and **Y**. A mixture **K** contains **W** and **Y** only. Indicate on the diagram the chromatogram of **K**. (2 marks)



(i) Show the solvent front. (1 mark)

27. Study the information given below and use it to answer the questions that follow.

Substance (oxide)	Reaction with acids	Melting point (^{0}C)
J	No reaction	-30
K	Reacts explosively	1190
L	No reaction	1728
M	Reacts readily	3075

Select
i) An oxide with giant atomic structure. (1mk)
ii) An oxide which dissolves in water to form an acidic solution. (1mk)

28. When 94.5g of hydrated barium hydroxide $Ba(OH)_2.nH_2O$ were heated to constant mass, 51.3g of anhydrous barium hydroxide were obtained. Determine empirical formula of the hydrated barium hydroxide. (Ba = 137 O = 16 H = 1) (3mks)

29. Reagent bottles labelled H_2SO_4, K_2CO_3 and NaCl had labels accidentally removed. A packet of blue litmus paper is lying near a long with a rack of test-tubes, without using any other material explain how you would go about labeling the bottles correctly. (3mk)

GITUAMBA / LAIKIPIA
233/2
Chemistry
Paper 2 (theory)
June / July 2017
2 hours

1. The table below gives information on four elements by letters A, B, C and D. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Electronic arrangement	Atomic radius (nm)	Ionic radius (nm)
A	2.8.2	0.136	0.065
B	2.8.7	0.099	0.181
C	2.8.8.1	0.203	0.133
D	2.8.8.2	0.174	0.099

(a) Which **two** elements have two similar chemical properties? Explain. (2 Marks)
(b) What is the most likely formula of the oxide of B? (½ Mark)
(c) Which element is a non-metal? (1 Mark)
(d) Which one of the elements is the strongest.
(i) Reducing agent? (1 Mark)
(ii) Oxidising agent? (1 Mark)
(e) Explain why ionic radius of D is less than that of C. (1 Mark)
(f) Explain why the ionic radius of B is bigger than its atomic radius (1 Mark)
(g) Give the chemical family to which the element.
(i) A and D belong (½ Mark)
(ii) B belong (½ Mark)
(iii) C belong (½ Mark)
(h) State any **two** uses of element B. (Mark)

2. (a) At25°C 50g of substance X were added to 100g of water to make a saturated solution.
What is meant a saturated solution? (1mk)
(b) The table **below** gives the solubilities of substance X at different temperatures.

Temperature °C	14	24	33	40	46	52
Solubility g/100g H_2O	24	36	50	62	72	90

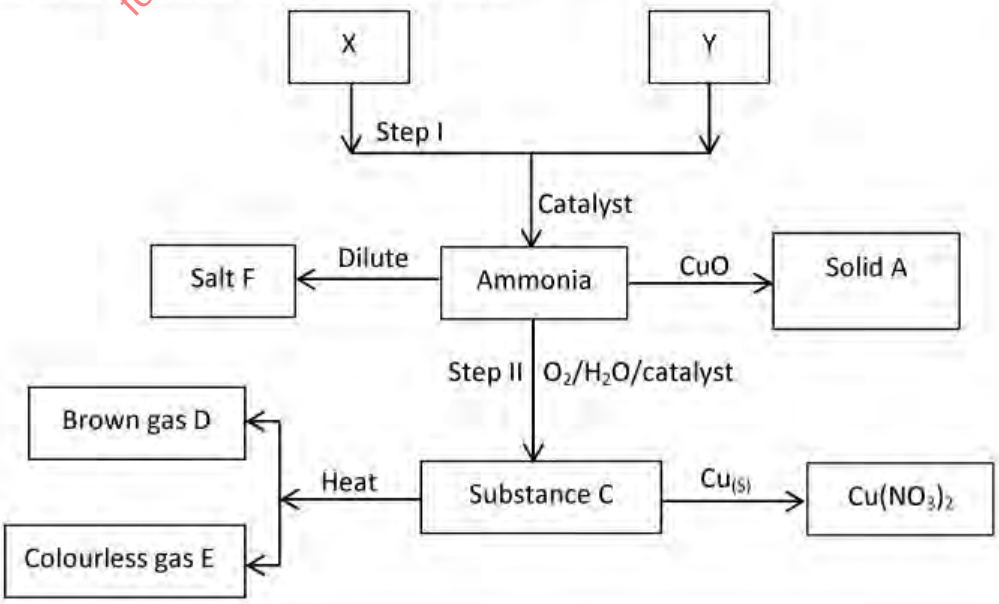
(i) Plot a graph of the solubility of substance X (vertical axis) against temperature. (3mks)
(ii) Using the graph.
I determine the solubility of substance X at 20°C. (2mks)
II determine the mass of substance X that remained undissolved given that 90g of substance X were added to 100cm³ of water and warmed to 35°C. (2mks)
III Calculate the molarity of the solution at 30°C. (Relative formula mass of X = 122.5). (3mks)

(c) In an experiment, soap solution was added to three separate samples of water. The table **below** shows volumes of soap solution required is form lather with 1000cm³ of each sample of water before and after boiling.

	Sample		
Volume of soap before water is boiled (cm³)	25.0	5.0	10.0
Volume of soap after water is boiled (cm³	25.0	5.0	5.0

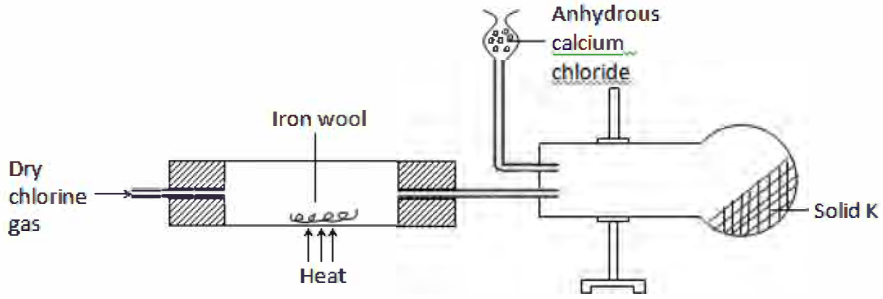
(i) Which water was likely to be soft? Explain. (2mks)
(ii) Explain the change in volume of soap solution used in sample III. (1mk)

3. Study the scheme **below** and answer the questions that follow.



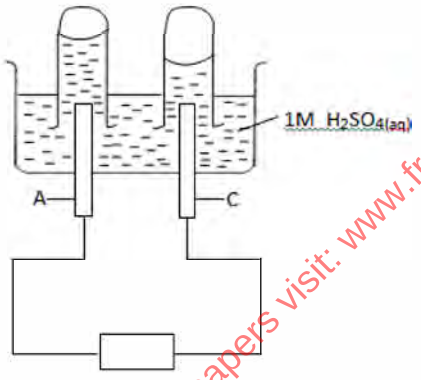
(a) State the sources of the substance **X** and **Y**. (2 marks)
(b) Identify the catalyst used in step **I** and how it is made to be effective. (1 mark)
(c) Name the substance **A**, **B**, **C** and **E**. (2 marks)
(d) Write the chemical equations that shows:
(i) The formation of substance **C**. (1 mark)
(ii) The reaction between substance **C** and copper metal. (1 mark)
(e) State **one** economic use of substance **F**. (1 mark)

II **Below** is a set-up in the preparation of a particular salt. Study it and answer the questions that follow.



(a) Explain the observation made in the combustion tube when dry hydrogen chloride gas is passed instead of dry chlorine. (2 marks)
(b) Identify solid **K**. (1 mark)
(c) What property makes solid **K** to be collected in the flask as shown **above**? (1 mark)

4. Study the given diagram and answer the questions that follow:



(a) Name **A** and **C**. (1 mark)
(b) (i) Give **one** element that is the most appropriate to be used a electrodes. (1 mark)
(ii) Explain your answer in b(i) (1 mark)
(c) (i) Comment on the concentration of the electrolyte at the end of the experiment. (1 mark)
(ii) Explain your answer in c(i). (1 mark)
(d) (i) Arrange the following anions in the order of increasing ease of discharge during electrolysis:
$NO_3^-, OH^-, SO_4^{2-}, I^-, Cl^-, Br^-$ (1 mark)
(ii) Dilute magnesium sulphate solution was electrolysed using copper electrodes.
Write an ionic equation to show the reaction occurring at the: (2 marks)
Anode:
Cathode:
(e) An electric current of 2.5 amperes was passed through molten lead (II) bromide for 40 minutes. Calculate the volume of bromine vapour that would be produced (Faraday's constant = 96,500 coulombs, molar volume = 24.0dm³). (3 marks)

5. (a) Use the information below to answer the questions that follow.

$Ca_{(S)} + \frac{1}{2}O_{2(g)} \rightarrow CaO_{(S)}$ ΔH = -635 KJ mol⁻¹

$Ca_{(S)} + O_{2(g)} \rightarrow CaO_{2(g)}$ ΔH = -394 KJ mol⁻¹

$Ca_{(S)} + e_{(S)} + \frac{3}{2}O_{2(g)} \rightarrow CaCO_{3(S)}$ ΔH = -1207 KJ mol⁻¹

Calculate the enthalpy change for the reaction.

$CaO_{(S)} + CO_{2(g)} \rightarrow CaCO_{3(S)}$ (3mks)

(b) State **one** factor that should be considered when choosing a fuel for cooking. (1mk)

(c) The following data was obtained during an experiment to determine the molar heat of combustion of ethanol.

Volume of water used	= 500cm³
Initial temperature of water	= 25°C
Final temperature of water	= 44.5°C
Mass of ethanol + lamp before burning	= 121.5g
Mass of ethanol + lamp after burning	= 120.0g

Calculate the :-

(i) Heat evolved during the experiment (density of water = 1g/cm³, specific heat capacity of water = 4.2Jg⁻¹⁻¹K¹). (1mk)

(ii) Molar heat of combustion of ethanol (C = 12, O = 16, H = 1). (2mks)

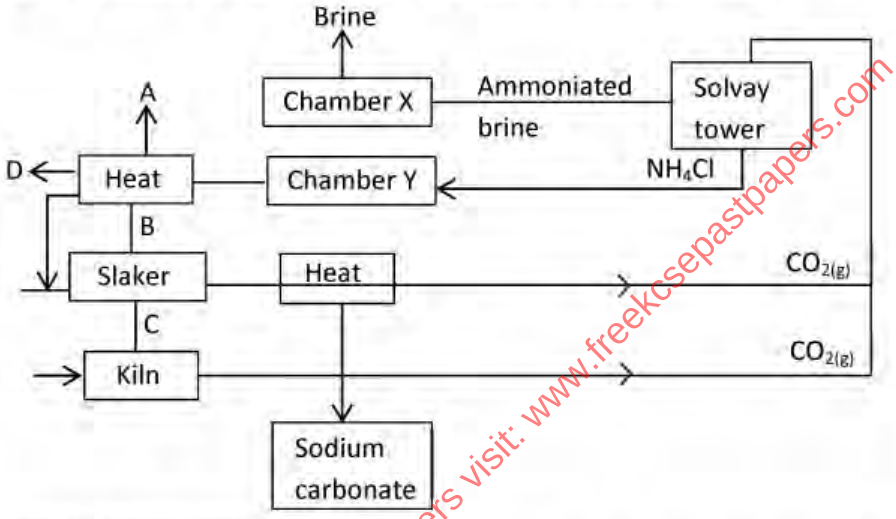
(d) Write the thermo equation for the complete combustion of ethanol. (1mk)

(e) At 298K and one atmosphere pressure, graphite changes into diamond according to the equation.

$$C_{(graphite)} \rightarrow C_{(diamond)} \qquad \Delta H = +2.9 \text{ KJ/mol}$$

In the space provided, sketch a simple energy level diagram for the above change. (3mks)

6. The flow **below** represents the main steps in the preparation of sodium carbonate.



(a) Name the substance labeled. A,B,C,D (2 marks)

(b) Cold water is made to circulate around chamber **X**. What does this suggest about the reaction between **A** and brine. (½ mark)

(c) What process takes place in chamber **Y**? (½ mark)

(d) Name **two** by-products that are recycled in this process. (1 mark)

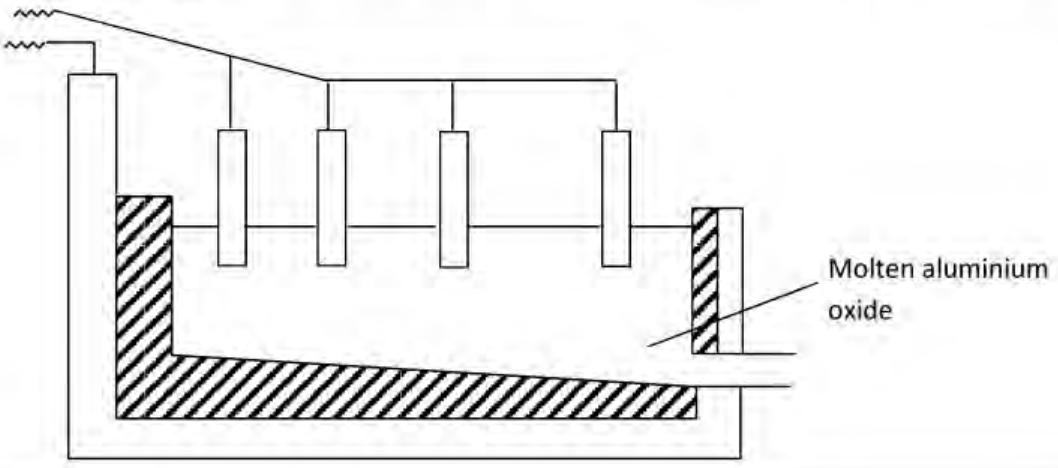
(e) Why is recycling important. (1 mark)

(f) Write the equation for the reaction that takes place in the Solvay Tower.

(f) Assuming that there was no recycling in this process, two moles of ammonia would be required for producing one mole of an hydrous sodium carbonate. Calculate the volume of ammonia at s.t.p. that would be used to produce 10.6kg of sodium carbonate by a factory operating at 80% efficiency. (C = 12, O = 16, H = 1, Na = 23, N = 14, 1 mole of gas occupies 22.4dm³ at s.t.p). (4 marks)

(h) Give **3** industrial uses of sodium carbonate. (3 marks)

7. The extraction of aluminium from its ore takes place in two stages, purification stage and electrolysis. The diagram **below** shows the set up for the electrolysis stage.



(a) Name the ore from which aluminium is extracted. (1 mark)
(b) Name **one** impurity which is removed at purification stage. (1 mark)
(c) Write equation for the reactions that take place at:
(i) The anode. (1 mark)
(ii) The cathode. (1 mark)
(d) Explain why the anode has to be replaced from time to time. (1 mark)
(e) The melting point of aluminium oxide is 2054°C but electrolysis is done between 800°C - 900°C.
(i) Why is electrolysis not carried out at 2054°C. (1 mark)
(ii) What is done to lower the temperature of the electrolysis cell to 800°C - 900°C. (1 mark)
(i) The aluminium which is produced is tapped off as liquid. What does this imply about its melting point? (1 mark)
(f) State **two** use of aluminium and the property related to this use. (2 marks)

GITUAMBA / LAIKIPIA
SUPER PRE-KCSE EXAM 1
233/3
CHEMISTRY PRACTICAL
Paper 3
June July 2017
CONFIDENTIAL

Requirements

In addition to the equipment, apparatus and chemicals in an ordinary chemistry laboratory, each candidate requires the following:-

- Means of labeling
- 5 g Solid **A**
- 100 ml solution **B**
- 40 ml solution **C**
- 70 ml solution **D**
- 1 g solid **E**
- 1 g solid **F**
- Metallic spatula
- Six dry test tubes
- boiling tube
- Burette
- Pipette
- Pipette filler
- Methyl orange indicator
- 100ml measuring cylinder
- 250 ml volumetric flask
- distilled water in a wash bottle
- 1 g sodium hydrogen carbonate

Access to:-

- Bunsen burner
- Acidified potassium manganate (VII)
- Bromine water
- 2 M sodium hydroxide
- 1 M barium nitrate
- 2 M nitric V acid
- Acidified potassium dichromate (VI)
(solutions supplied with a dropper)

Notes:

Solid **A** is a mixture of anhydrous sodium carbonate and sodium chloride in the ratio 7:3 (weighed accurately)

- Solution **B** is 0.2 M HCl
- solution **C** is 2 M Sodium hydroxide
- Solution **D** is 2 M HCl
- Solid **E** is ascorbic acid
- Solid **F** is sodium sulphite

GITUAMBA / LAIKIPIA
233/3
GITUAMBA SUPER EXAM
Examination
Chemistry Practical
Paper 3
June/July 2017
Time: 2¼ hours

1. You are provided with
- 10g of solid **A** which is a mixture of sodium carbonate and sodium chloride.
- 0.2 M HCl solution **B**

You are required to
- Determine the concentration of sodium carbonate in the mixture.
- Percentage of sodium chloride in the mixture.

Procedure
Transfer the entire solid into a 250 Ml volumetric flask. Add about 100cm^3 of distilled water. Shake to dissolve. Top up with more distilled water to make up to the mark. Label this solution **A2.** Using a pipette and a pipette filler, transfer 25 cm^3 of this solution into a conical flask. Repeat the procedure two more times to complete table 1

Table 1

	I	II	III
final burette reading (cm^3)			
initial burette reading(cm^3)			
volume of solution B used (cm)^3			

(a) Calculate
(i) The average volume of solution **B** used (1mark)
(ii) The number of moles of HCl in the average titre (1 mark)
(b) Write an equation for the reaction (1mark)
(c) calculate the number of
(i) Moles of sodium carbonate in 25cm^3 of solution **A2** **(1 mark)**
(ii) The moles of sodium carbonate in 250 cm^3 of solution A2 (1 mark)
(d) Determine the mass of sodium carbonate in solid A (1 mark)
(Na=23, C = 12.0, H=1.0 , O= 16)
(e) Calculate the percentage of sodium chloride in solid A (1 mark)

2. You are provided with
- Solution **D,** 2MHCl
- Solution **C** 2 M NaOH

You are required to determine the heat of neutralization

Procedure
Wrap a plastic beaker with tissue paper and secure it with a rubber band.
Use a measuring cylinder to transfer 20cm^3 of solution C into a plastic beaker.
Take its initial temperature and record it in table 2 below.
Using a clean measuring cylinder, measure 5 cm^3 of solution **B** and add it to solution *C*. Stir the mixture immediately with a thermometer and record the highest temperature in table 2
Continue adding 5 cm^3 portions of solution every time record the highest temperature attained to complete the table

Table 2

Volume of **D** add cm^3	0	5	10	15	20	25	30
Volume of **A+D** cm^3	20	25	30	35	40	45	50
Temperature of mixture ^{0}C							

(4 marks)

Plot a graph of volume of solution **D** (X-axis) against highest temperature (3 marks

a) From the graph:
(i) Determine the volume of solution **D** that reacts completely with solution **C**. (1mark)
(ii) The highest temperature changeΔ T (1 mark)
b) (i) Calculate the amount of heat evolved by the reaction (assume specific heat of capacity = 4.2Jg^{-1} K^{-1}, density of solution = 1 g/cm^3) (1 mark)
(ii) Calculate the number of moles of HCl used (1 mark)
(iii) Calculate the molar heat of neutralization of HCl 2 marks)

3. (a) You are provided with solid **E**. Carry out the following tests and write your observations and inferences in the spaces provided.

(i) Place one third of solid **E** on a metallic spatula and ignite using a Bunsen burner flame

observation (1 mark)	Inferences (1mark)

(ii) Place all the remaining solid in a boiling tube. Add 5cm^3 of distilled water. Shake to dissolve and divide it into 4 portions

(I) to the first portion add three drops of acidified potassium manganate (VII)

observation (1 mark)	Inferences (1mark)

(II) To the second add three drops bromine water.

observation (1 mark)	Inferences (1mark)

(III) To the third portion add all the sodium hydrogen carbonate provided

observation (1 mark)	Inferences (1mark)

(b) You are provided with solid **F**. Carry out the tests below and record your observations and inferences in the spaces provided. Place all the solid **F** in a boiling tube. Add 10cm^3 of distilled water. Divide into four portions.

observation (1 mark)	Inferences (1mark)

(i) To the first portion, add aqueous hydroxide drop wise until in excess.

observation (1 mark)	Inferences (1mark)

(ii) To the second portion add 5 drops of barium nitrate solution, followed by 3 drops of dilute nitric acid.

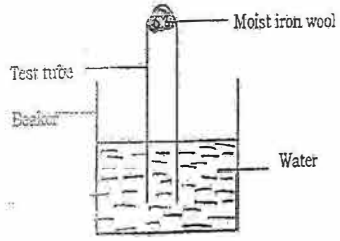
observation (1 mark)	Inferences (1mark)

(iii) To the third portion add 3 drops of acidified sodium dichromate (VI) solution

observation (1 mark)	Inferences (1mark)

IMENTI CENTRAL
233/1
CHEMISTRY PAPER 1
THEORY
FORM FOUR
JULY 2017
Time: 2hours

1. Describe an experiment on how you can separate a mixture of copper (II) oxide and solid copper (II) nitrate. (3marks)
2. The setup below was used to study some properties of air.



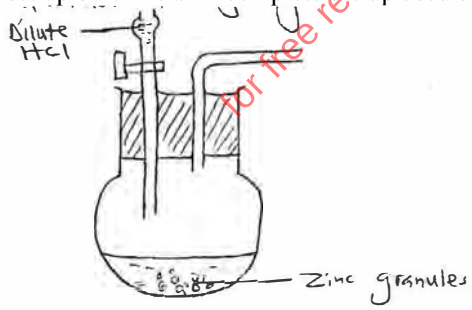
State and explain two observations that would be made at the end of the experiment. (2marks)

3. (a) State Graham's law. (1mark)
   (b) Two similar containers, one with Nitrogen (IV) oxide and other with bromine simultaneously develop leaks. After 30 seconds, the smell of nitrogen (IV) oxide is detected. How much longer will it take before bromine is detected? (N=14, O=16, Br=80) (2marks)
4. Name the main ore from which iron is extracted. (1mk)
5. The table below gives the atomic number of element W,X,Y and Z. the letters do not represent the actual symbols of the element.

Elements	W	X	Y	Z
Atomic Number	9	10	11	12

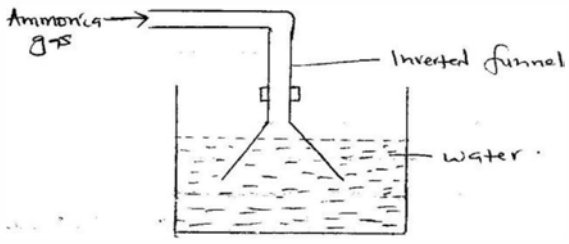
(a) Which element is reactive? Explain. (1mark)
(b) Which two elements would react most vigorously with each other? (1mark)
(c) Give the formula of the compound formed when the elements in (b) above react. (1mark)

6. (a) What is dynamic equilibrium? (1mark)
   (b) Consider the equation below.
   $Cr_2O^{2-}_{7(aq)} + 2OH^-_{(aq)} \rightleftharpoons 2CrO^{2-}_{4(aq)} + H_2O_{(l)}$
   (Orange) (Yellow)
   State and explain the observation that would be made if a few potassium hydroxides are added to the equilibrium mixture. (2marks)
7. State the disadvantage of using flower extract as an acid-base indicator. (1mark)
8. Using dots (.) and crosses(x) draw a diagram to show bonding in carbon (II) oxide. (C =12, O = 16) (2marks)
9. The set up below is an incomplete set-up used during preparation of dry hydrogen gas.



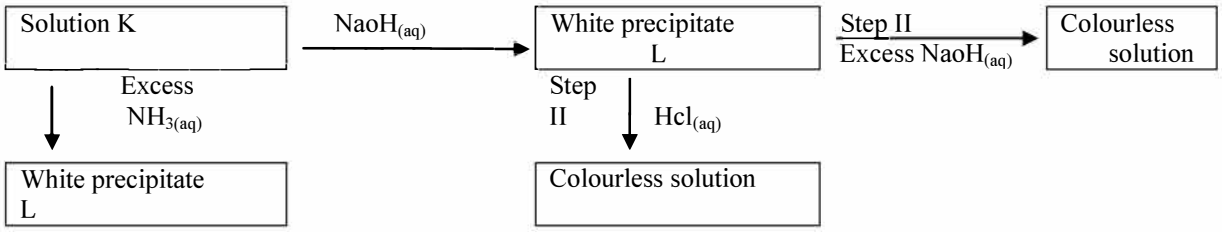
Complete the diagram to show how a dry sample of hydrogen gas can be collected. (3marks)

10. Using equation only differentiate the bleaching effect of chlorine and So_2. (2marks)
11. Explain why it is not advisable to leave a charcoal jiko burning in a poorly ventilated room. (1mark)
12. Ammonia gas is dissolved in water as shown below. Study it and answer the question.



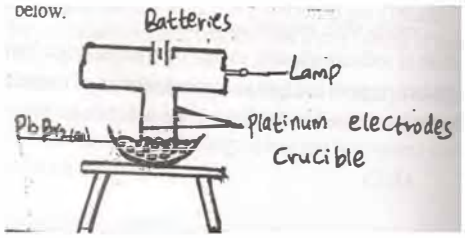
(a) Name the solution formed. (1mk)
(b) Why is ammonia dissolved as shown above? (1mk)
(c) What is the role of the inverted funnel in the experiment? (1mk)

13. Study the chart below and answer the questions that follows:



(a) Identify (i) The metal ions in solution K. (1mk)
(ii) The white precipitate L (1mk)
(b) What property of the white precipitate L is illustrated by step I and II. (1mk)

14. In an experiment to investigate the conductivity of substances, a student used the set-up shown below.

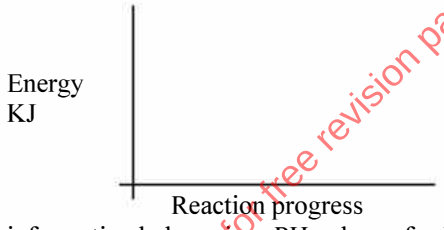


The student noted that the bulb did not light.
(a) What had been omitted in the set-up? (1mk)
(b) Explain why the bulb lights when the omission is corrected. (2mks)

15. Calculate the number of Al^{3+} ions released when $30cm^3$ of Aluminium sulphate is dissolved in water. (L=6.024 x 10^{23}) (3mks)

16. (a) Both sodium and aluminium are metals in period 3. Sodium has a melting point of 98^0C while aluminium has a melting point of 1083^0C. Explain (2mks)
(b) Compare the electrical conductivity of sodium and aluminium. Explain. (2mks)

17. Hydrogen and bromine react as per equation:
$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)} \quad \Delta H = -616KJ$
On the axis below, sketch the energy level diagram for the forward reaction above. (2mks)



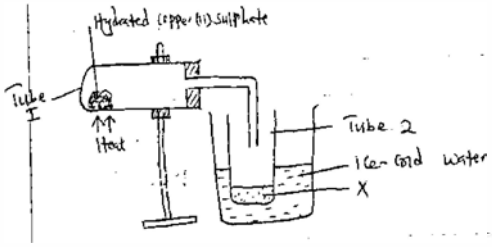
18. The information below gives PH values of solutions V, W, X , Y and Z

Solution	PH values
V	2
W	6.5
X	11
Y	14
Z	4.5

(a) Which solution is likely to be:
(i) Calcium hydroxide (1mk)
(ii) Rain water (1mk)
(b) Which solution would react most vigorously with zinc carbonate? (1mk)

19. Determine the oxidation number of sulphur (s) in SO_3^{2-} (2mk)

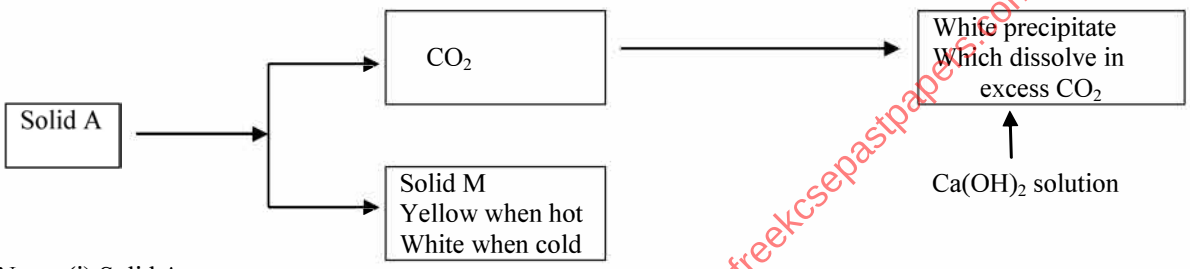
20. Study the diagram below and answer the questions that follow.



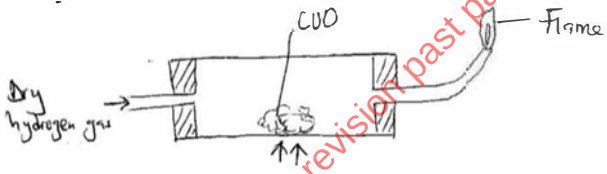
(a) Name X. (1mk)
(b) State one chemical test for X. (1mk)
(c) State the observation made in tube 1. (1mk)
21. Starting with lead (II) oxide powder, describe how lead (II) sulphate can be prepared. (3mks)
22. (a) M grams of a radioactive isotope decayed to 5g in 100 days. The half-life of the isotope is 25 days.
(i) What is meant by half-life? (1mk)
(ii) Calculate the initial mass of M of the radioactive isotope (2mks)
(b) Complete the following nuclear reaction. (1mk)

$^{215}_{85}At \longrightarrow {}^{211}_{83}Bi + ……..$

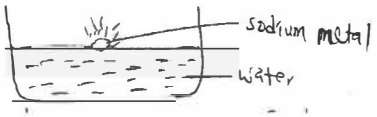
23. Study the diagram below and answer the questions that follow.



(a) Name (i) Solid A (1mk)
(ii)Solid M
(b) Write the chemical equation in :
(i) Step I (1mk)
(ii) Step II to show how the white precipitate dissolves in excess carbon (IV) oxide. (1mk)
24. Describe a chemical test that can be carried out in order to distinguish between CH_3CH_2OH and CH_3COOH (1mk)
25. The set-up below is used to investigate the properties of hydrogen.



(i) Write an equation for the reaction that occurs in the combustion tube. (1mk)
(ii) State and explain the observation made in the combustion tube. (2mks)
(iii) What property of hydrogen is being investigated? (1mk)
26. Explain the following observation.
(a) Graphite conducts electricity while diamond does not. (2mks)
(b) Sodium chloride have high melting point than carbon (IV) oxide. (2mks)
27. A piece of sodium was dropped into water in a trough as shown below.



(a) Write the chemical equation for the reaction. (1mk)
(b) What is expected PH value of the solution formed? Explain (2mks)
28. Magnesium and sulphur burn in oxygen to form different products. Magnesium form white powder while sulphur form a mixture of two gaseous products.
(i) Name the product formed when magnesium burn in oxygen. (1mk)
(ii) Write the chemical equation for the reaction that occurs when magnesium burns in oxygen. (1mk)
(iii) Write the chemical formula of the two products formed when sulphur burns in air. (2mks)
29. Element A has three isotopes ^{40}A, ^{41}A and ^{42}A in the ratio 2 : 3 : 5 respectively. Determine it relative atomic mass. (3mks)

IMENTI CENTRAL
232/2
CHEMISTRY
PAPER 2
THEORY
JULY/AUGUST 2017
2HRS

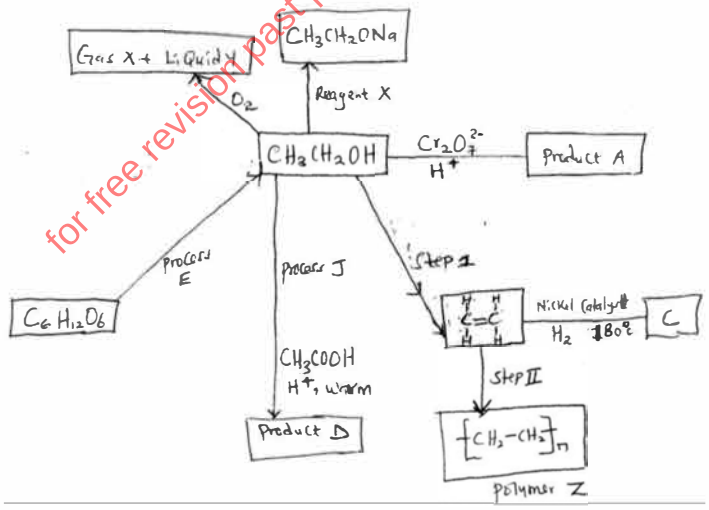
1. a) The grid below represents part of the periodic table. The letters do not represent actual symbols of the elements. Study it and answer the questions that follow.

F			P			G	H	I
	Q		J	K		L	M	
N		X - Z						

i) What type of bond would you expect in the compound formed between F and H. Explain? (2marks)
ii) (I) which of the element J and M will have a greater atomic radius? Explain. (2marks)
(II) Elements F and N are in the same group of periodic table. How do their radius compare? Explain. (2marks)
i) An element W has atomic number 15. Indicate the position it would occupy in the table above. (1mark)
ii) What is the name given to element X – Z? (1mark)
iii) P and J are termed as metalloids. What does the term metalloid mean? (1mark)
b) Study the table below and answer the questions that follow.

SUBSTANCE	M	N	O	P	Q	R
MP0C	801	1356	-101	26	-39	113
BP0C	1410	2850	-36	154	457	445
Electrical conductivity in solid	Poor	Poor	Poor	Poor	Good	poor
Electrical conductivity in molten	Good	Poor	Poor	Poor	Good	poor

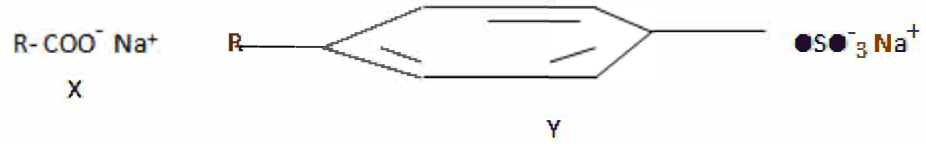
i) Explain why substance M is a good conductor in molten state and not in solid state (1mark)
ii) What is the most likely structure of substance N? (1mark)
iii) Identify with a reason, a substance that exists as a liquid at room temperature. (1mark)
2. a) Draw and name two isomers of Butene. (2marks)
b) The following reaction scheme shows reactions beginning with ethanol and its preparation methods. Study it and answer the questions that follow.



i) Name reagent Z (1mark)
ii) Name I Product A (2marks)
II Product C
III Product D
IV Product Z
iii) Name Processes. J,E (2marks)
iv) State the condition and reagent required in step `. (1mark)
Condition……
Reagent……

i) Analysis of polymers Z showed it contained relative molecular mass of 2744. Calculate the value of n. (2marks)
(C=12, H=1)

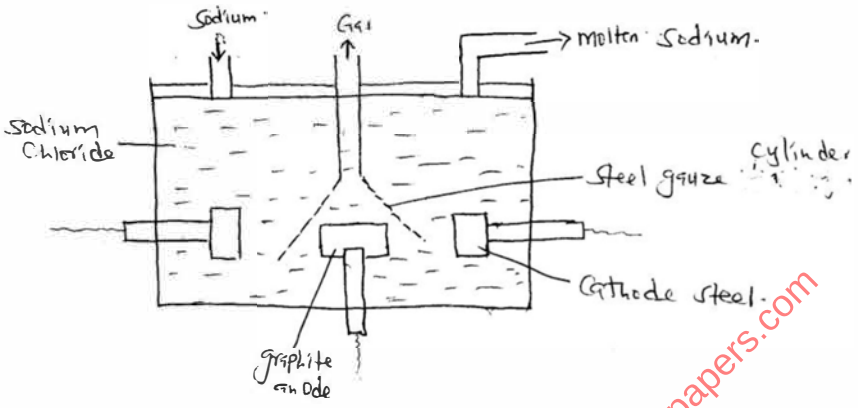
c) The structures shown below represents two cleansing agents, x and y.



X Y

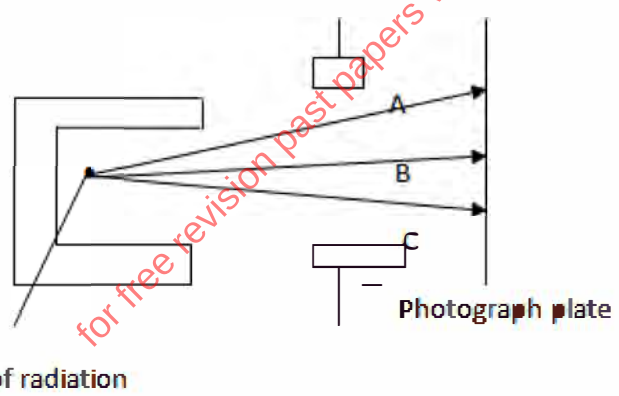
Name the cleansing agents. X ,Y (1mark)

3. a) The diagram below shows the extraction of sodium metal using the down cell. Study it and answer questions that follow.



i) Explain why in this process sodium chloride is mixed with calcium chloride. (2marks)
ii) Why is the anode made of graphite and not steel? (1mark)
iii) State one property of sodium metal that make it possible to be collected as shown in the diagram. (1mark)
iv) What is the function of steel gauze cylinder? (1mark)
v) write ionic equation for the reaction which take place at
I cathode (1mark)
II Anode (1mark)
vi) State one industrial use of sodium metal. (1mark)

b) A radioactive material emitted radiations as shown below.



i) Which radiation helium particles? (1mark)
ii) which radiation has;-
I lowest ionization agent (1mark)
II lowest penetrating power. (1mark)

c) i) Give two uses of radioactivity in medicine. (1mark)
ii) Give one danger of Radioactivity. (1mark)

4. a) A solution of sodium hydroxide was found to contain 12.4g/dm^3 of sodium hydroxide. 25cm^3 of this solution reacted with 15cm^3 of solution of sulphuric (VI) acid.
i) Find the molarity of the sodium hydroxide solution. (1mark)
ii) Calculate the number of moles of sodium hydroxide solution used. (1mark)
iii) Calculate the number of moles of the acid used. (1mark)
iv) Determine the concentration of the sulphuric (VI) acid solution in g/dm^3. (Na=23, O=16, H=1, S=32) (1mark)

b) At 30^0c the reaction between bromine and methanoic acid proceeds according to the information given below.
$Br_{2(aq)} + HCOOH_{(aq)} \rightarrow HBr_{(aq)} + H^+_{(aq)} + CO_{2(g)}$

i) On the grid below, plot a graph of concentration of Bromine against time. (3marks)

Concentration of $Br_{2(aq)}$ (Mol dm^{-3})	$9.5x10^{-3}$	$4.3x10^{-3}$	$2.1x10^{-3}$	$1.4x10^{-3}$	$1.1x10^{-3}$
Time (minutes)	0	2	4	6	8

ii) From the graph determine the rate of reaction at time't' where t=3.5 minutes. (2marks)

iii) On the same axis, sketch with a dotted line the curve that would be obtained if the reaction was carried out at 25^0c. Label the curve as 2. (1mark)

5. a) Use the standard electrode potential for A, B, C, D and F given below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

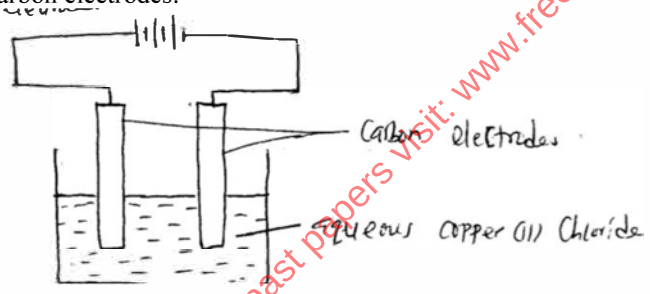
Half reaction			**Eθ Volts**
$A^{2+}_{(aq)} + 2e$	→	$Al_{(s)}$	-2.90V
$B^{2+}_{(aq)} + 2e$	→	$B_{(s)}$	-2.38V
$C^{+}_{(aq)} + e$	→	$\frac{1}{2} C_{2(g)}$	0.00V
$D^{2+}_{(aq)} + 2e$	→	$D_{(s)}$	+ 0.34V
$\frac{1}{2} Fe_q + e$	→	$F_{(aq)}$	+ 2.87V

i) Which is Eθ value for the strongest reducing agent? (1mark)

ii) In the space provided, draw a labeled diagram of the electrochemical cell that would be obtained when a half cells of element B and D are combined. (2marks)

iii) Calculate the Emf of the electrochemical cell constructed in (ii) above. (1mark)

b) The set up below was used by a student to investigate the products formed when aqueous copper (II) Chloride was electrolyzed using carbon electrodes.



i) Write the equation for the reaction that takes place at the cathode. (1mark)

ii) How would the mass of the anode change if the carbon anode was replaced with copper metal? (1mark)

c) 0.6g of metal B were deposited when a current of 0.45A was passed through an electrolyte for 72 minutes. Determine the change on the ion of B (Rmm of B=59, IF=96500C) (3marks)

d) i) State Hess's law of heat summation. (1mark)

ii) Use the thermochemical equation below to answer the questions that follow.

$C_2H_{6(g)} + \frac{7}{2} O_2 \rightarrow 2CO_{2(g)} + 3H_2O_{(g)}$ ΔH_1=-1560KJ/Mol

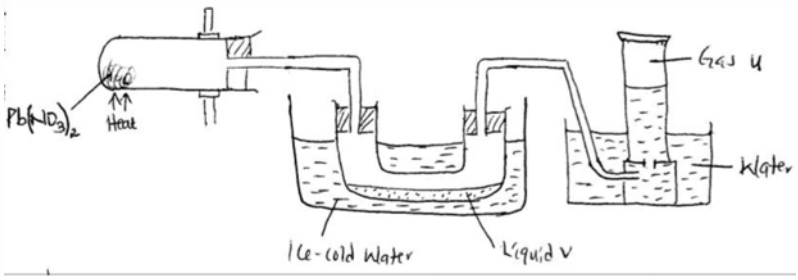
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ ΔH_2=-394KJ/Mol

$H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(g)}$ ΔH_3=-286KJ/Mol

I. Draw an energy cycle diagram that links the heat of formation of ethane with its heat of combustion of carbon and hydrogen. (1mark)

II. Calculate the standard enthalpy of formation of ethane. (2marks)

6 a) Study the set-up of apparatus below and answer the questions that follow.



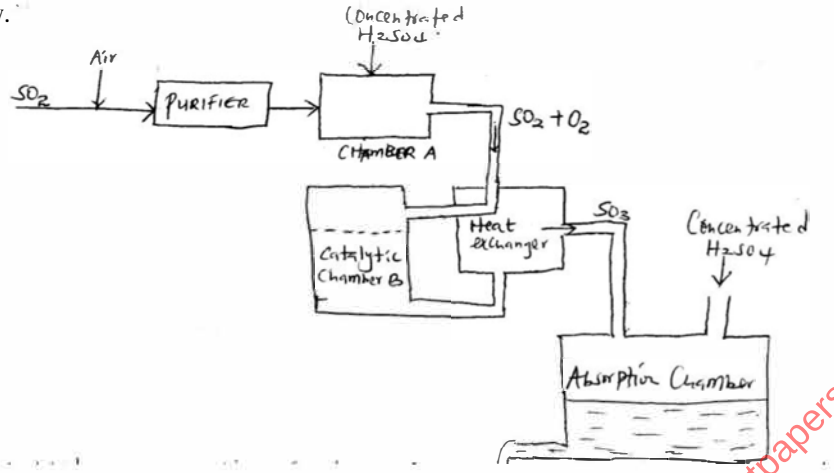
i) Identify the following. (2mark)
   I. liquid V
   II. Gas U

ii) Write equation for the reaction at;- (2marks)
   I. Boiling tube
   II. U-tube

iii) State and explain the observation made in u-tube. (1mark)

iv) Apart from gas u, name another gas formed in the boiling tube. (1mark)

b) The diagram below shows part of the processes in the manufacture of sulphuric (VI) acid. Study it and answer the questions that follow.



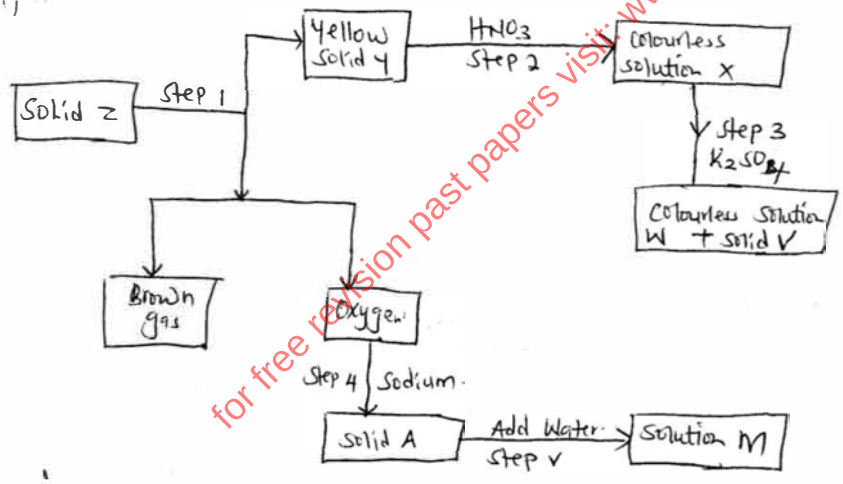
i) Write an equation for the formation of sulphur (VI) oxide from sulphuur. (1mark)

ii) What is the role of concentrated sulphuric (VI) acid in chamber A (1mark)

iii) Name one catalyst that can be used in catalytic chamber B. (1mark)

c) Explain one way in which sulphur(IV) oxide is a pollutant. (1mark)

7. a) Study the flow chart below and answer the questions that follow.



i) Identify;- (3marks)
   i) Solid Z
   ii) Solid A
   iii) Solid Y
   iv) Solution W
   v) Solution X
   vi) Solution M

ii) Write the chemical equations in;- (2marks)
   I. Step 2
   II. Step 5

iii) Write the ionic equation in step 3 and give the observation made. (2marks)

iv) Give the condition necessary in step I. (1mark)

233/3
CHEMISTRY PAPER 3
FORM FOUR
JULY/AUGUST 2017
CONFIDENTIAL

REQUIREMENT FOR CANDIDATES

Provide each candidate with the following item.

1. Solution J about $100cm^3$
2. Solution of K about $30cm^3$
3. $500cm^3$ of distilled water in a wash bottle
4. $100cm^3$ measuring cylinder
5. $250cm^3$ beaker
6. 2 labels, universal indicator, PH chart
7. 1 burette
8. 1 pipette
9. Retort stand
10. Filter funnel
11. White tile, 1 red & 1 blue litmus paper
12. $100cm^3$ plastic beaker
13. Solution of R about $60cm^3$
14. Solution of Q about $60cm^3$ about $60cm^3$
15. Thermometer
16. Solid W accurately 2.5g
17. Boiling tube
18. Piece of tissue paper
19. Six test tubes rack
20. Test tube holder
21. 1g $NaHCO_3$
22. Solid P 1g
23. Solid S 1g
24. Three conical flasks
25. 1 cm solid Y Mg ribbon

Access to:

1. Source of heat
2. 2M NaOH
3. 2M NH_4OH
4. Acidified potassium dichromate (IV)
5. Bromine water

Note:

Solution J 0.79g/l acidified $KMnO_4$
Solution K $0.125M(NH_4)_2SO_4.FeSO_4.6H_2O$
Solution R 1M NaOH
Solution Q 1M HCl
Solid W $KClO_3$
Solid P Hydrated $ZnNO_3$
Solid S 1g of oxalic acid solid

IMENTI CENTRAL
233/3
CHEMISTRY PAPER 3
PRACTICAL
JULY 2017
Time: 2hrs 15minutes

1. You are provided with:
- 0.79g/l acidified $KMnO_4$, solution J
- $0.125M(NH_4)_2SO_4.FeSO_4.6H_2O$, solution K
- 1M sodium hydroxide, solution R
- 1M Hydrochloric acid, solution Q

You are required to:
(1) Determine the mole ratio of J and K in the reaction
(2) Determine the molar heat of neutralization of sodium hydroxide

Procedure I

Measure exactly $20cm^3$ of solution K into a clean $100cm^3$ measuring cylinder. Fill the solution in the measuring cylinder to $100cm^2$ using distilled water. Transfer the solution into a clean $250cm^3$ beaker and label L. Fill the burette with solution J, pipette $25cm^3$ of solution L and titrate to a permanent purple colour. Record your results in the table below.

(a) Table (4mks)

Experiment	I	II	II
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of J used (cm^3)			

(b) Determine the average titre value (1mk)
(c) Calculate the:
(i) Moles of solution J reacted. (K = 39, Mn = 55, O = 16) (2mks)
(ii) Moles of solution L reacted (2mks)
(iii) Mole ratio of the reaction (1mk)

Procedure II

Wrap a clean 250ml plastic beaker with a tissue paper. Measure exactly $50cm^3$ of solution R using $100cm^3$ measuring cylinder and record its steady temperature below. Transfer the solution into the beaker. Rinse the measuring cylinder with distilled water. Measure exactly $50cm^3$ of solution Q and record its steady temperature. Add solution Q carefully to solution R while stirring. Record the highest temperature attained by the resulting mixture.

(a) (i) emperature of R……^0C (½ mk)
(ii) Temperature of Q……^0C (½ mk)
(iii) Highest temperature of the mixture……^0C (1mk)
(b) Calculate the:
(i) Average temperature of the two solutions before they were mixed. (1mk)
(ii) The temperature change (1mk)
(iii) The heat of the reaction (Density of solution = $1g/cm^3$, specific heat capacity = $4.2KJ/kg/^0C$) (1mk)
(iv) The molar heat of reaction of sodium hydroxide solution. (1mk)

2. You are provided with 2.5g of solid W. You are required to determine the solubility of solid W at various temperature.

Procedure

Carefully transfer all of solid W into a dry clean boiling tube and add $10cm^3$ of distilled water from a burette. Heat the boiling tube and its contents gently with shaking until all the solid dissolves. Stop heating the solution when the entire solid dissolves. (DO NOT SPILL THE SOLUTION DURING HEATING)

Place a thermometer in the solution and allow the solution to cool as you stir gently. Record the temperature at which crystals first appear in table below. (The crystals appear as small shining particles)

Using a burette, add more $2.5cm^3$ of water to the solution and heat again until the entire solid dissolves. Allow the solution to cool while stirring with thermometer and record the temperature at which crystallization occurs. Repeat the experiment each time adding $2.5cm^3$ of distilled water from the burette and complete the table.

Total volume of water (cm^3)	10.0	12.5	15.0	17.5	20.0	22.5
Mass of solid W (g)	2.5	2.5	2.5	2.5	2.5	2.5
Solubility of W in g/100g of water)						
Temperature at which crystals appear ^0C						

(a) Complete the table by filling in the row for solubility of W and temperature at which crystals appear. (4mks)
(b) On the grid provided, draw a graph of solubility of W against temperature. (3mks)
(c) Determine from the graph:
(i) The solubility of W at 75^0C. (1mk)

(ii) Temperature at which solubility is 24/100g of water. (1mk)

(d) If a solution containing 30g of W at 85^0C is cooled to 60^0C. At what temperature will crystals first appear? (1mk)

3. (a) You are provided with solid P. Carry out the test below. Write your observation and inferences in the spaces provided.

Test	Observation	Inferences
(i) Put about half of solid R into a clean dry test-tube and heat strongly. Test any fumes produced using litmus papers	(1mk)	(1mk)
(ii) Put all the remaining R into a clean test-tube and add distilled water until half-filled. Shake well and divide the solution into four portions.	(½ mk)	(½ mk)
(iii) To the first portion add 2M NaOH solution dropwise until in excess	(½ mk)	(½ mk)
(iv) To the second portion add 2M NH_3 solution dropwise until in excess	(½ mk)	(½ mk)
(v) To the 3rd portion add about 3 drops of 1M $Pb(NO_3)_2$ solution and warm	(1mk)	(1mk)
(vi) To the 4th portion add 3 drops of 1M $ba(NO_3)_2$ solution	(1mk)	(1mk)

3(b) Add about $10cm^3$ of distilled water to solid S in a test-tube. Divide the resulting solution into five portions.

(i) To the 1st portion, add solid Y.

Observation	Inferences
(½ mk)	(½ mk)

(ii) To the 2nd portion, add 3 drops of acidified $K_2Cr_2O_7$ solution and warm.

Observation	Inferences
(½ mk)	(½ mk)

(iii) To the 3rd portion, add all $NaHCO_3$

Observation	Inferences
(½ mk)	(½ mk)

(iv) To the 4th portion, add 3 drops of bromine water.

Observation	Inferences
(½ mk)	(½ mk)

(v) To the 5th portion, add 2-3 drops of universal indicator and determine the PH of the solution.

Observation	Inferences
(½ mk)	(½ mk)

KANGEMA MATHIOYA
233/1
CHEMISTRY
Paper 1 (Theory)
July 2017
Time : 2 Hours

1. Solutions can be classified as acids, bases or neutral. The table below shows solutions and their pH values.

Solution	PH values
K	1.5
L	7.0
M	14.0

a) Select any pair that would react to form a solution of pH 7. (1 mark)
b) Identify two solutions that would react with aluminium hydroxide. Explain. (2 marks)

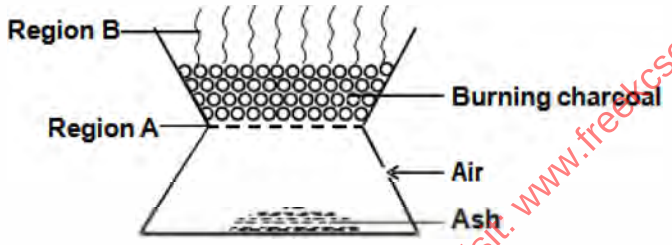
2. 9.12g of a gaseous compound contain 8g of silicon while the rest is hydrogen. Determine the empirical formula of the compound. (H = 1, Si = 28) (3 marks)

3. A fixed mass of a gas occupies $105cm^3$ at -14^oC and 650mmHg. At what temperature will it have a volume of $15cm^3$ if pressure is adjusted to 690mmHg ? (3 marks)

4. Using dots (•) and crosses (x) to represent electrons, show the bonding in fluorine molecule. (Atomic numbers; F = 9) (1 mark)

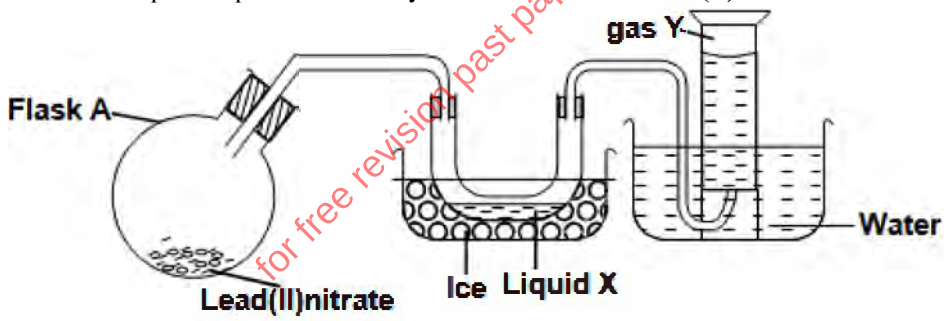
5. Starting with copper metal, describe how to prepare solid copper (II) carbonate. (3 marks)

6. The diagram below shows a 'jiko' when in use. Study it and answer the questions that follow.



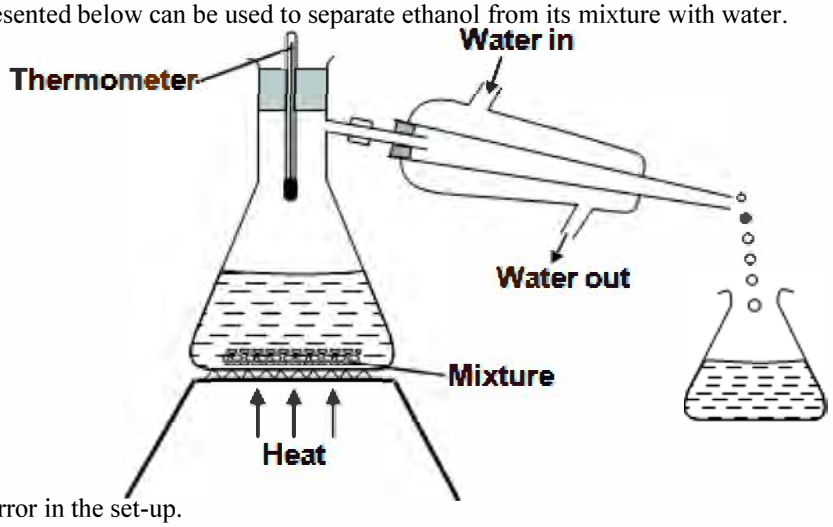
a) Identify the gas formed at region B. (1 mark)
b) State and explain the observation made at region B. (2 marks)

7. A student set up the experiment to study the effect of heat on lead (II) nitrate.



i) Identify liquid X.
ii) Describe the test for gas Y. (1 mark)
iii) Write a balanced chemical equation for the reaction in flask A. (1 mark)

8. The set-up represented below can be used to separate ethanol from its mixture with water.

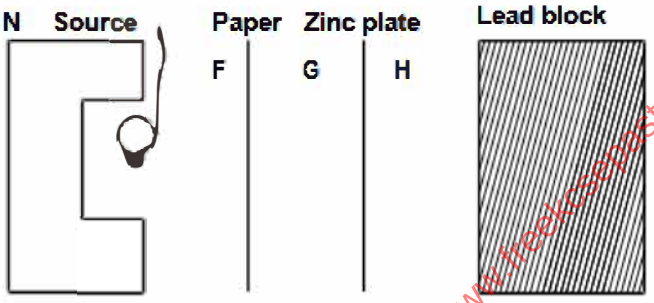


a) Identify an error in the set-up. (1 mark)

b) Name this method of separation. (1 mark)

c) What properties make it possible to separate ethanol from water by this method ? (1 mark)

9. The arrangement below was used to compare the penetrating power of emissions in a radioactive decay.



a) Name the radiation that can be detected at F, G, H. (3 marks)

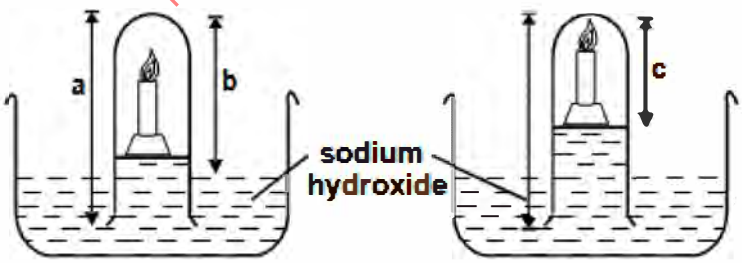
b) Name the material N and state its use. (1 mark)

c) The half-life of $^{238}_{92}U$ is 4500 years. The isotope decays by alpha emission. Write a nuclear equation for its decay to form Thorium (Th). (1 mark)

10. a) What is meant by solubility ? (1 mark)

b) In an experiment to determine the solubility of solid X in water at 30°C the following results were obtained:
Mass of evaporating dish = 26.2g
Mass of evaporating dish + saturated solution = 42.4g
Mass of evaporating dish + dry solid X = 30.4g
Using the information, determine the solubility of solid X at 30°C in g/100g water. (2 marks)

11. A Form one student set-up the following apparatus to investigate the percentage of oxygen in air.



a) i) Why is sodium hydroxide preferred to water in the above experiment ? (1 mark)

ii) Write an expression to show how the percentage of oxygen can be calculated. (1 mark)

iii) Given that the value of a = 10cm, b = 8cm and c = 6.4cm, calculate the percentage active part of air used. (2 marks)

12. 30cm^3 of 0.5M hydrochloric acid was used to neutralize 25cm^3 of sodium hydroxide solution. Determine the concentration of sodium hydroxide in grams per litre. (3 marks)
(H = 1, O = 16, Na = 23)

13. The table below gives some information about the physical properties of four substances which are represented by letters L, M, N and K.

Substance	Melting point	Heat of vaporisation	Electrical conductivity	
			Solid	Molten
L	High	High	Poor	Poor
M	High	High	Good	Good
N	High	High	Poor	Good
K	Low	Low	Poor	Poor

Select with reasons an element which is likely to be :

i) Copper metal (1 mark)

ii) Silicon (IV) oxide (1 mark)

iii) Potassium iodide (1 mark)

14. Write balanced chemical equations for reactions between chlorine and : (2 marks)

i) concentrated sodium hydroxide

ii) dilute sodium hydroxide

15. a) Hydrogen sulphide gas is bubbled through bromine water.

i) Give two observations made. (1 mark)

ii) Write an equation for the reaction that takes place. (1 mark)

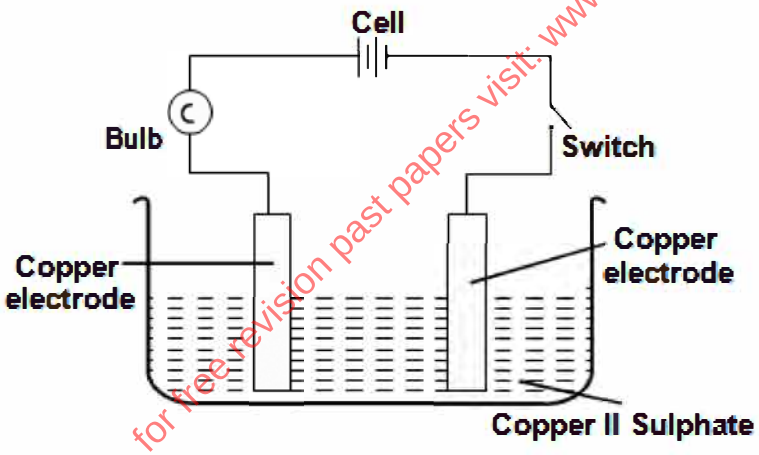
b) State the test for hydrogen sulphide gas. (1 mark)

16. a) State Gay-Lussac's law of combining volumes. (1 mark)

b) When 100cm^3 of a gaseous hydrocarbon (C_xH_y) burns in 300cm^3 of oxygen, 200cm^3 of carbon(IV) oxide and 200cm^3 of steam area formed.

Deduce the formula of the hydrocarbon. (2 marks)

17. Study the set up below for electrolysis of copper (II) sulphate using copper electrodes.



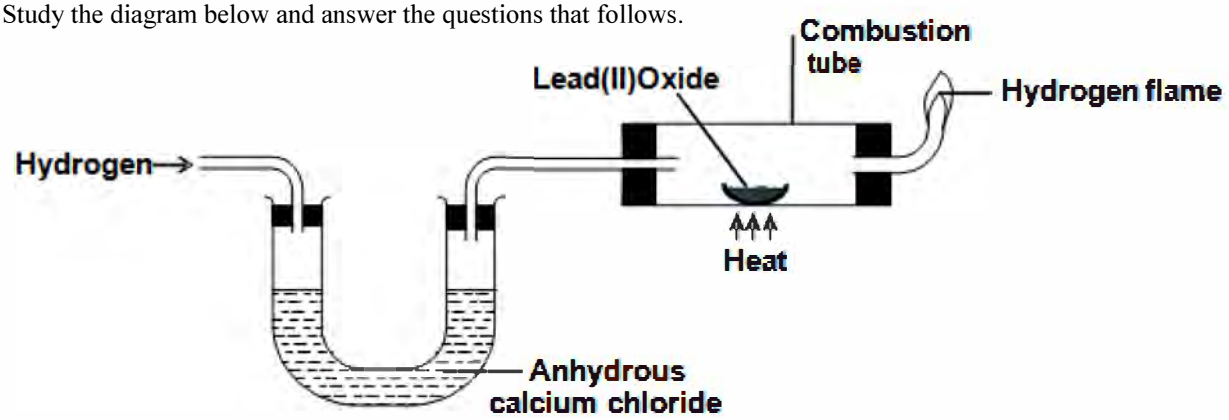
a) Write ionic equations for reactions that took place at :

I. Anode

II. Cathode (1 mark)

b) State and explain the observations made on the electrolyte. (1 mark)

18. Study the diagram below and answer the questions that follows.

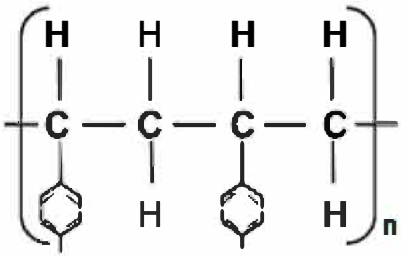


i) Write an equation for the reaction that takes place in the combustion tube. (1 mark)

ii) What property of hydrogen makes this reaction possible ? (1 mark)

iii) What would you expect to happen if sodium oxide (Na_2O) was used instead of lead (II) oxide ? Explain. (1 mark)

19. The formula given below represents a portion of a polymer.



a) Give the name of the polymer. (1 mark)

b) State one disadvantage of continued use of this polymer. (1 mark)

20. 16g of ethanol (C_2H_5OH) were completely burnt in air. The heat evolved caused the temperature of 600cmof water to change from 20°C to 85°C. Calculate the molar enthalpy of combustion of ethanol. (H = 1, C = 12, O = 16). Specific heat capacity of water = $4.2KJKg^{-1}K^{-1}$). (3 marks)

21. A mixture contains ammonium chloride, silver chloride and lead (II) chloride. Describe how each of the substance can be obtained from the mixture. (3 marks)

22. Two elements A and B have electronic configurations 2.8.3 and 2.6 respectively.

a) To which group and period does element B belong ? (1 mark)

b) If the two react, what is the formula of the compound they form ? (1 mark)

23. The table below represents elements P, Q, R and S. Study it and answer the questions that follow. (The letters are not the actual symbols of the elements)

Element	Atomic number	Atomic radius (nm)	Ionic radius (nm)
P	13	0.121	0.061
Q	14	0.101	0.043
R	17	0.099	0.181
S	18	0.023	-

a) Explain why the atomic radius of element P is greater than that of element R. (1 mark)

b) Explain why the atomic radius of element R is less than its ionic radius. (1mark)

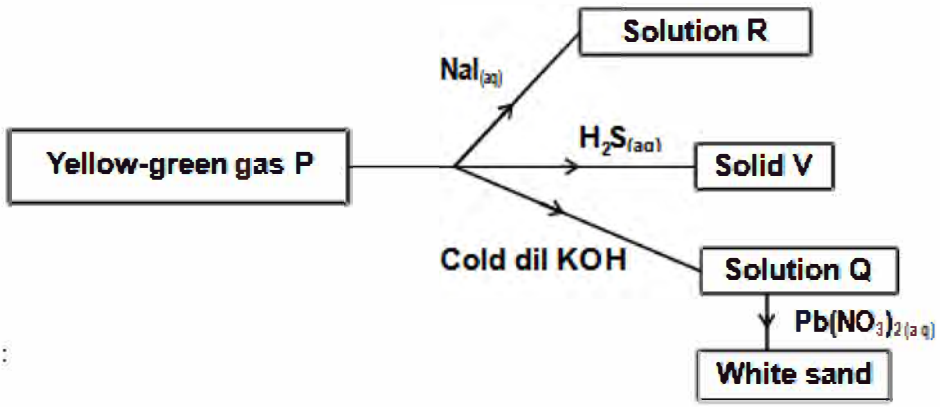
c) Using dots (•) and crosses (x) show bonding in the compound formed between elements Q and R. (1 mark)

24. A piece of burning magnesium ribbon was placed in a gas jar full of nitrogen gas. The product Q formed was then reacted with water.

a) Write the chemical formula for the product Q. (1 mark)

b) Write the equation for the reaction between product Q and water. (1 mark)

25. Study the flow chart below and answer the questions that follow.



Identify :

i) Solid V (1 mark)

ii) Solution R (1 mark)

iii) Solution Q (1 mark)

26. a) Define hard water. (1mark)

b) The structure below represents two cleansing agents.

R-COO-Na^+ B

Which of the above cleansing agent would be suitable for washing in hard water ? Give a reason. (2 marks)

27. Hydrogen iodide is a product formed when hydrogen reacts with iodine according to the equations.

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ $\Delta H = +52.0KJ/mole$

Explain how the following would affect the yield of hydrogen iodide.

a) Increase the temperature. (1 mark)

b) A decrease in pressure of the system. (1 mark)

c) State the Le Chatelier's principle. (1 mark)

28. An element X has a relative atomic mass of 88. When a current of 0.5 amphere was passed through a fused chloride of X for 32 minutes10 seconds, 0.44g of X was deposited.

i) Determine the charge of element X. (1 Faraday = 96500C) (3 marks)

ii) Write the formula of the hydroxide of X. (1 mark)

29. The basic raw material for extraction of aluminium is bauxite.

a) Name the method that is used to extract aluminium from bauxite. (1 mark)

b) Cryolite is used in the extraction of aluminium from bauxite. State its role. (1 mark)

c) Aluminium is a reactive metal yet utensils made of aluminium do not corrode easily. Explain this observation. (1 mark)

MATHIOYA KANGEMA
233/2
CHEMISTRY
Paper 2
(Theory)
July 2017
Time: 2 Hours

1. **a)** State two factors to consider when choosing fuel for cooking. (2 marks)

b) On burning a fuel, the molar heat of combustion obtained is found to be lower than the theoretical value. State two sources of the deviation. (1 mark)

c) Below are results obtained in an experiment to determine the enthalpy of solution of sodium hydroxide.
Mass of plastic beaker = 10g
Mass of plastic beaker + distilled water = 110.15g
Mass of plastic beaker + distilled water + NaOH = 116.35g
The table below shows the temperature at fixed times after mixing sodium hydroxide and water.

Time secs	0	30	60	90	120	150	180	210
Temp. °C	15	21	29	28	27	26	25	25

i) Plot a graph of temperature against time. (3 marks)
ii) From your graph, determine the maximum temperature attained. (1 mark)
iii) Determine the temperature change of the reaction. (1 mark)
iv) Calculate the number of moles of sodium hydroxide used in the experiment. (1 mark)
(Na = 23, H = 1, O = 16)
v) Use your results to determine the molar heat of solution of sodium hydroxide.
(Density of the solution = $1g/cm^3$, specific heat capacity of the solution is $4.18KJk^{-1}mol^{-1}$) (2 marks)
vi) What is molar heat of solution ? (1 mark)

2. **a)** Study the table below and answer the questions that follows. The letters are not the actual symbols of elements.

Element	No. of protons	Melting point °C	Boiling point °C
P	11	98	890
Q	12	650	1110
R	13	690	2470
S	14	1410	2360
T	15	442/590	280
U	16	113/119	445
V	17	-101	-35
W	18	-189	-186

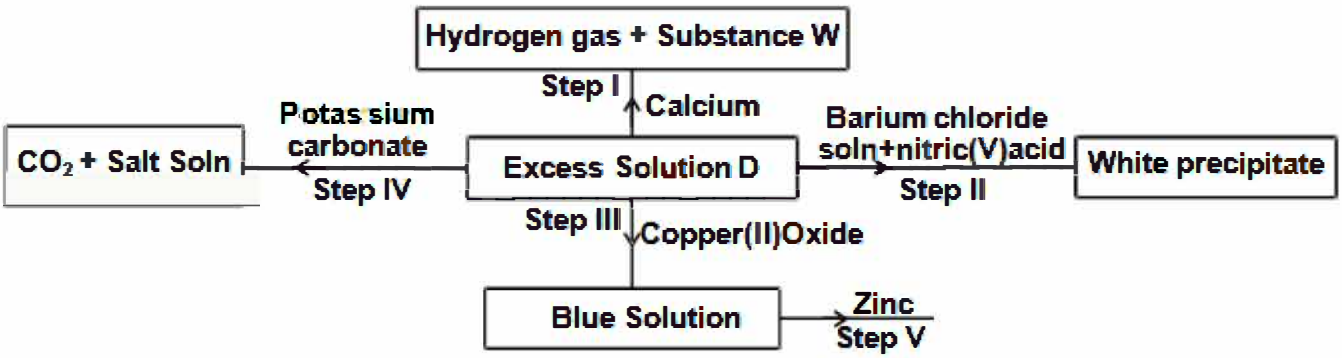
i) State and explain the trend in melting point in P, Q and R. (2 marks)
ii) Explain why the melting point of elements S is the highest. (1 mark)
iii) Why do elements E and F have two melting points ? (1 mark)
iv) Write down the chemical formula between R and the sulphate ion. (1 mark)
v) Name the chemical family to which element W belong to. (1 mark)
vi) What is the nature of oxides represented by elements R and U respectively. (1 mark)

b) The grid below is part of the periodic table. Use it to answer the questions that follows. (The letters are not the actual symbols)

						A	B
						F	
C	D				G		E
	H						

i) Write down the formula of the compound formed between C and A. (1 mark)
ii) Show the position of element Q in the periodic table having atomic number 15. (1 mark)
iii) Explain how atomic radius of C and F compare. (1 mark)
iv) Using dots (•) and crosses (x) to represent electrons, show bonding in the chloride of H. (2 marks)

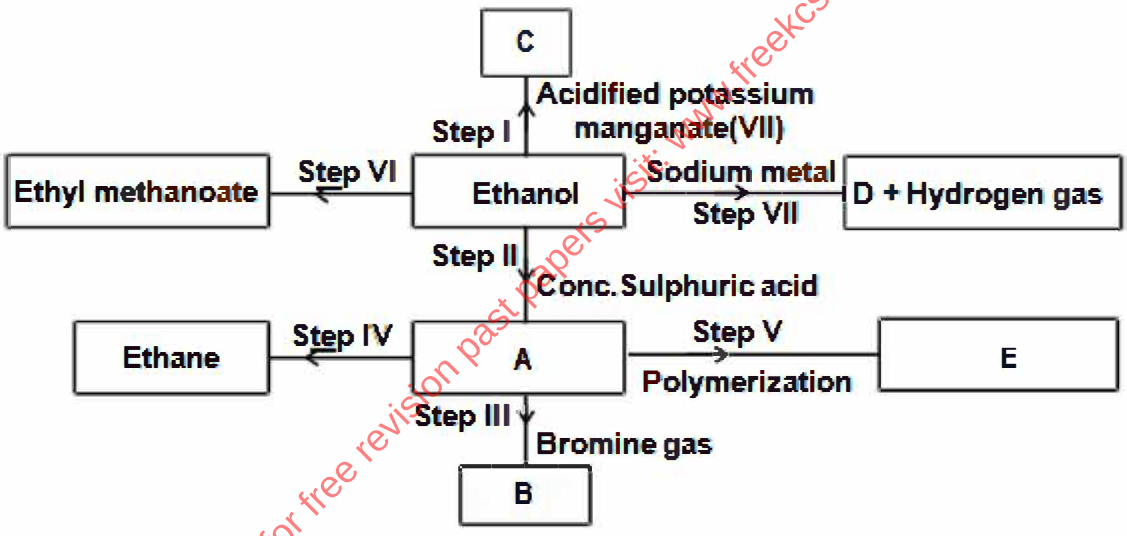
3. **a)** The scheme below shows some of the reactions of solution D. Study it and answer the questions that follows.



i) Give a possible cation present in solution D.
ii) Write an ionic equation for the reaction in step II. (1 mark)
iii) What observations would be made in step V ? (1 mark)
iv) Why is the total volume of hydrogen gas produced in step I found to be very low although calcium and solution D are in excess ? (2 marks)
v) State one use of substance W. (1 mark)
b) Starting with sodium chloride, describe how a pure sample of lead (II) chloride can be prepared in the laboratory. (2 marks)
c) i) State a property of anhydrous calcium chloride which makes it suitable for use as a drying agent for chlorine gas. (1 mark)

ii) Name another substance that can be used to dry chlorine gas. (1 mark)

4. **a)** Study the flow chart below and answer the questions that follows.



i) What observation will be made in step I. (1 mark)
ii) Name the following: (2marks)
I. Substance E
II. Substance D
iii) Name the type of reaction that occurs in : (2 marks)
Step II
Step IV
iv) Give the reagent and conditions necessary for step (VI) to obtain the given product. (1 mark)
Reagent
Condition
v) Describe a chemical test that can be carried out to show the identity of compound C. (2 marks)
vi) Give the formula for substance B. (1 mark)
b) When one mole of ethanol is completely burnt in air, 1370KJ of heat is released. Given that one litre of ethanol is 780g, calculate the amount of heat energy released when one litre of ethanol is completely burnt. (C = 12.0, H = 1.0, O = 16.0) (2 marks)

5. Study the information given below on standard electrode potentials for some half reactions and use it to answer the questions that follows.

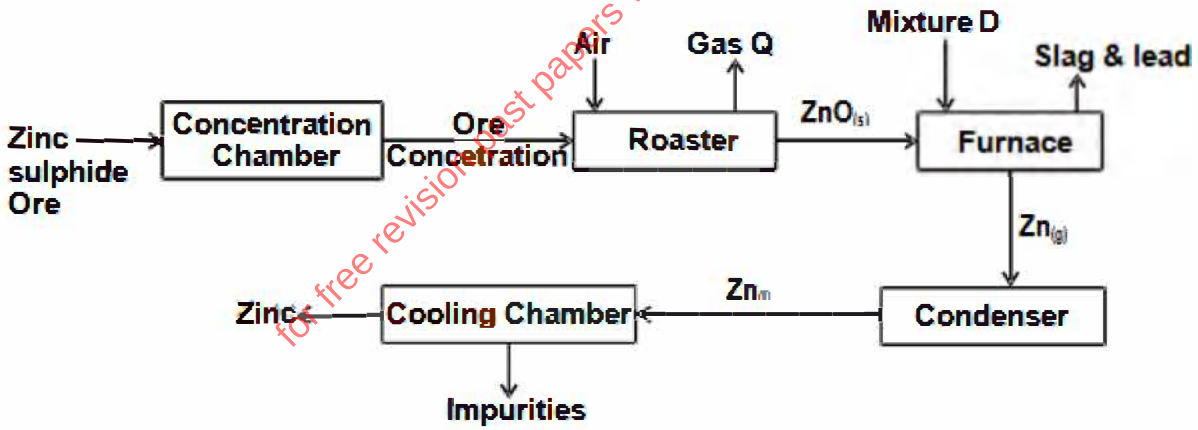
	E^{θ} / volts
$Ce^{4+}_{(aq)} + e^- \rightarrow Ce^{3+}_{(aq)}$	+1.61
$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$	+0.77
$I_{2(aq)} + 2e^- \rightarrow 2I^-_{(aq)}$	+0.54
$Fe^{2+}_{(aq)} + 2e^- \rightarrow Fe_{(s)}$	-0.44
$Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(s)}$	-0.76
$J^{3+}_{(aq)} + 3e^- \rightarrow J_{(s)}$	X

a) Identify the strongest reducing agent. (1 mark)
b) Which substance in the table is suitable to oxidise iodide ion to iodine ? (1 mark)
c) Study the cell representation below and answer the questions that follow.

$Zn_{s)} / Zn^{2+} \overset{KNO_3}{//} Fe^{2+}_{(aq)} / Fe_{(s)}$

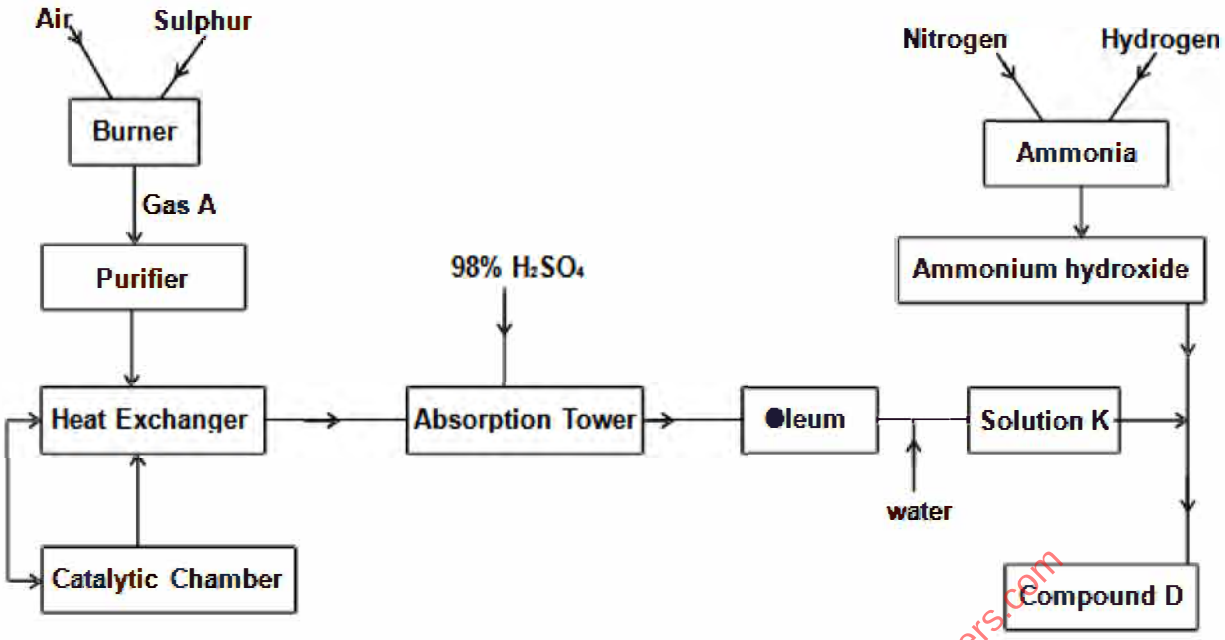
i) Identify the anode and the cathode. (1 mark)
Anode
Cathode.
ii) If the two half cells are connected externally, write an equation for the reaction taking place in zinc half cell. (1 mark)
iii) Calculate the e.m.f of the cell. (1 mark)
iv) State the purpose of the salt bridge in the cell. (1 mark)
v) Explain what would happen if $KCl_{(aq)}$ is used in the salt bridge instead of KNO_3 in a case where $Pb_{(s)} / Pb^{2+}_{(aq)}$ is one of the half cells. (2 marks)
vi) Draw on electrochemical cell to represent the cell in c(ii) above. (3 marks)
vii) If the e.m.f of the cell $J_{(s)} / J^{3+}(aq) / I_{2(s)} / 2I^-(aq)$ is +1.32V, calculate the value of $J^{3+}(aq) / J_{(s)}$. (1 mark)

6. The flow chart below illustrate the extraction of zinc. Study it and answer the questions that follow.



a) i) Name the ore from which zinc is extracted. (1 mark)
ii) Give the formula of the main component in the ore named above. (1 mark)
iii) Name gas Q (1 mark)
b) What is the method commonly used for the concentration of the ore you named in (a) above. (1 mark)
c) Give the equation for the main reaction that takes place in the furnace. (1 mark)
d) Beside $ZnO_{(s)}$ name the other two substances that are fed into the furnace. (1 mark)
e) Name the major impurity that is removed in the cooling chamber. (1 mark)
f) Suggest with reasons two other factories that could be set near the zinc extraction plant. (2 marks)
g) Give two detrimental effects on the environment that may result from the extraction of zinc. (2 marks)
h) Name two uses of zinc. (1 mark)

7. Below is a chart showing the commercial production of compound D. Study it and answer the questions that follow.



a) Write an equation for the reaction that takes place in the burner.
b) Why is it important to purify the products from the burner before being used in the stages that follow? (1 mark)
c) Give one function of heat exchange. (1 mark)
d) Give two reasons why Vanadium (V) oxide is preferred to platinised asbestos in the process. (2 marks)
e) i) Name gas A
ii) Why is water not used in place of concentrated sulphuric (VI) acid in the absorption tower? (1 mark)
f) Name substances K and D. (2 marks)
g) Explain the environmental effects of gas A if released to the atmosphere.

KANGEMA MATHIOYA
233/3
CHEMISTRY
Paper 3
(Practical)
July 2017
Time: 2¼ Hours

1. You are provided with :
- 2.0g of dibasic acid H_2X labelled solid P
- Solution Q containing 1.2g of sodium hydroxide in 250cm^3 of the solution
- Phenolphthalein indicator

You are required to:
- Prepare 250cm^3 of solution using solid P
- Determine the value of X in the formula H_2X

Procedure I
Place all solid P in 250cm^3 beaker
Add about 150cm^3 of distilled water to the beaker, stir until all the solid dissolves.
Transfer the solution into 250cm^3 volumetric flask. Top up with distilled water to the mark and label it solution P.
Using a 100cm^3 measuring cylinder transfer 100cm^3 of the solution P into 250cm^3 beaker.
Preserve the rest in the volumetric flask for procedure II
Pipette 25cm^3 of solution Q into a clean conical flask. Add 2-3 drops of phenolphthalein indicator.
Fill the burette with solution P from the beaker.
Titrate until the pink colour disappears
Repeat two more times and record the results in the table below.

Table I

Titration	1	2	3
Final volume of Q (cm³)			
Initial volume of Q (cm³)			
Volume of ● used (cm³)			

a) Calculate the average volume of solution P used. (1 mark)
b) Calculate the molarity of solution Q. (Na = 23, O = 16, H = 1) (1½ marks)
c) How many moles of sodium hydroxide were in the pipette volume ? (1 mark)
d) How many moles of acid, solution P reacted with 25cm^3 of solution Q. (1½ marks)
e) Calculate the molarity of solution P. (1 mark)
f) Determine the value of X in the formula H_2X. (H = 1) (3 marks)

Procedure II
You are provided with :
- Acidified potassium manganate VII solution L
- Solution P, dibasic acid, H_2X
- A stopwatch / clock
- Thermometer

You are required to determine how the rate of reaction of potassium manganate (VII), solution L with the dibasic acid, solution P varies with change in temperature.
Using a 10cm^3 measuring cylinder, place 2.0cm^3 portions of solution L into 5 test tubes on a test tube rack
Clean the measuring cylinder and use it to place 10.0cm^3 of solution P into a boiling tube.
Prepare a waterbath by placing about 200cm^3 of water in a beaker and heat it.
Insert a thermometer in solution P in the boiling tube and place the boiling tube in the water bath until the solution attains a temperature of 40^{o}C.
Remove the boiling tube from the waterbath and add the first portion of solution L and start the stopwatch at the same time.
Record the time taken for the purple colour of the mixture to decolourise in table II below.
Repeat the experiment by using 10.0cm^3 of solution P at temperature of 50^{o}C, 60^{o}C, 70^{o}C and 80^{o}C respectively.
Record the time in each case in the table below.

Table II

Temperature of solution					
Time for colour to decolourise (sec)					
$\frac{1}{t}$ sec $^{-1}$					

(5 marks)

b) Plot a graph of $^1/_t$ (y-axis) against temperature. (3 marks)
c) From the graph determine the time taken to decolourise the mixture if it is at a temperature of 65°C. (2 marks)
d) How does the rate of reaction of potassium manganate (VII) with oxalic acid vary with temperature. (1 mark)

2. You are provided with solid G. Carry out the tests below. Write your observations and inferences in the spaces provided.
a) Place one half of solid G in a clean dry test tube and heat it strongly. Test any gases produced with blue and red litmus papers.

Observations (1 mk)	Inferences (1mk)

b) Place the other half of solid G in a boiling tube. Add about 10cm^3 of distilled water and shake until all the solid dissolves. (Use the solution for tests (i), (ii), (iii) and (iv)

i) To about 1cm^3 of the solution in a test tube, add two drops of universal indicator to the mixture obtained and then determine the PH of the mixture.

Observations (1 mk)	Inferences (1mk)

ii) To about 2cm^3 of the solution in a test tube. Add aqueous ammonia dropwise until excess.

Observations (1 mk)	Inferences (1mk)

iii)To 2cm^3 of the solution in a test tube, add three or four drops of solution T (aqueous hydrogen peroxide)

Observations (1 mk)	Inferences (1mk)

iv)To about 1cm^3 of the solution in a test tube, add four or five drops of barium nitrate solution. Shake the mixture then add about 1cm^3 of dilute nitric (V) acid and allow the mixture to stand for about 2 minutes.

Observations (1 mk)	Inferences (1mk)

3. You are provided with solid M. Carry out the test below. Write your observations and inferences in the spaces provided.
a) Place about one third of solid M on a metallic spatula and burn it using a Bunsen burner.

Observations (½ mk)	Inferences (½ mk)

b) Place the remaining of solid M in a test tube. Add about 6cm^3 of distilled water and shake the mixture well. (Retain the mixture for use in test (c)

Observations (1 mk)	Inferences (1mk)

c) i) To about 2cm^3 of the mixture add a small amount of solid sodium hydrogen carbonate.

Observations (1 mk)	Inferences (1mk)

ii) To about 1cm^3 of the mixture add 1cm^3 of acidified potassium dichromate (VI) and warm.

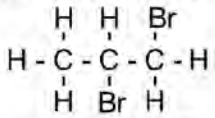
Observations (½ mk)	Inferences (½ mk)

iii) To about 2cm^3 of the mixture, add two of acidified potassium manganate (VII)

Observations (1 mk)	Inferences (1mk)

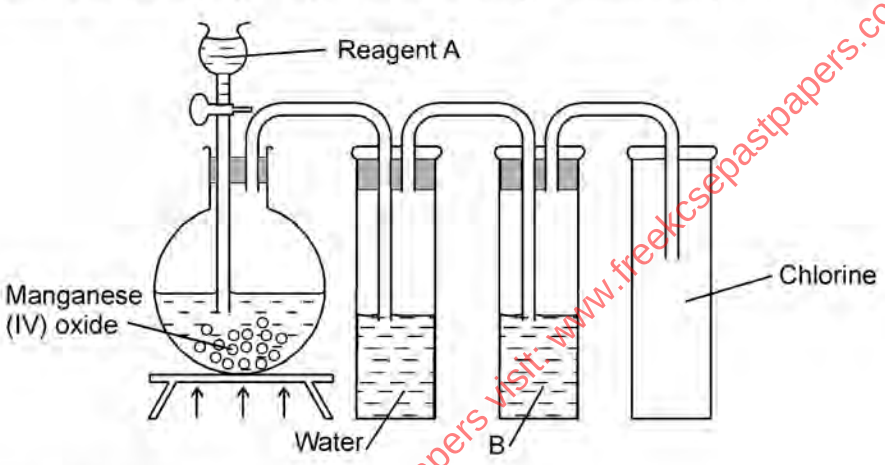
WESTLANDS GRAPHICS
233/1
CHEMISTRY
Paper 1
July 2017
Time 2 hours
FORM FOUR END OF TERM TWO EXAM - 2017
Kenya Certificate of Secondary Education

1. When chlorine reacts with compound P the compound below was formed.



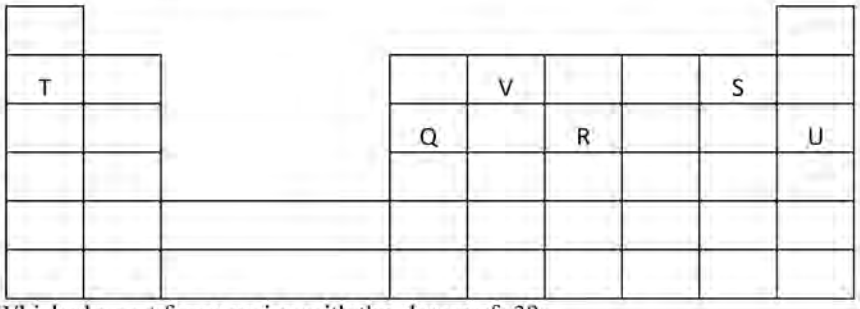
i) Write the structural formula of P. (1 mark)
ii) When P is reacted with concentrated sulphuric (VI) acid, compound R is formed which further reacted with water to form compound K
I. Identify substance K. (1 mark)
II Write an equation to show how compound K reacts with potassium metal. (1 mark)

2. The set up below was used to prepare dry chlorine gas. Study and answer the questions that follow.



a) Name reagent A and substance B. (1mark)
b) A warm red phosphorous was lowered into the gas jar of chlorine using a deflagrating spoon.
i) State any one observation made in this experiment. (½ mark)
ii) Identify the substance formed in the above reaction (½ mark)
c) Both substances in (ii) above undergo hydrolysis when exposed to air. Write an equation to show how anyone of them undergoes hydrolysis. (1 mark)

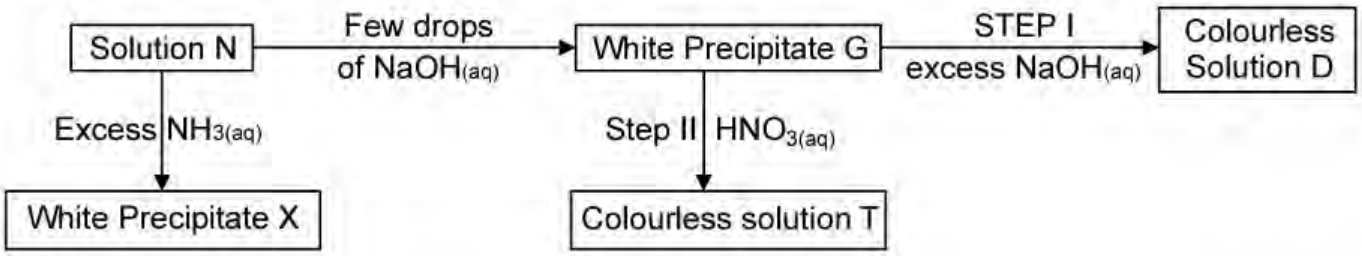
3. The grid below shows part of the periodic table Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.



a) Which element forms an ion with the charge of -3? (1 mark)
b) What is the nature of oxide formed by Q ? (1 mark)
c) Using crosses (×) or dots (•) show how the ion of S is formed. (1 mark)

4. 80g of a saturated Calcium chloride was prepared at 25°C. Calculate the mass of calcium chloride and mass of water used to prepare a saturated solution given that the solubility of calcium chloride at 25°C is 72g / 100g of water. (2 marks)

5. Study the scheme below and answer the questions that follow.



a) What property of the white precipitate G is demonstrated by steps I and II. (1 mark)
b) If the metal ion in solution N is divalent, suggest its identify. (1 mark)
c) Write an ionic equation for the reaction taking place in step I. (1 mark)

6. In terms of structure and bonding, explain why silicon (IV) oxide exists as a solid of high melting point while sulphur (IV) oxide exists as a gas. (2 marks)

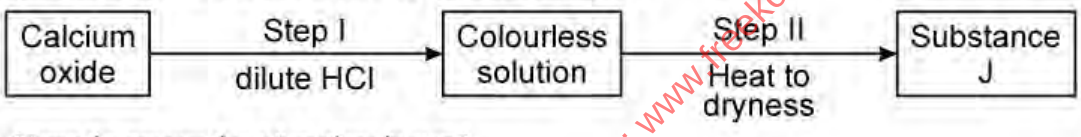
7. Element R is in period 2 of the periodic table and forms a stable ion, R^{2-}
a) State the atomic number of element D which is directly below R in the periodic table. (1 mark)
b) Compare the reactivity of R and D chlorine. (2 marks)

8. $20.0cm^3$ of a solution containing $5.6g/dm^3$ of potassium hydroxide reacted exactly with $24.0cm^3$ of dilute sulphuric (IV) acid solution, using methyl orange as indicator. Calculate the molarity of the sulphuric (VI) acid. (K= 39, O=16, H=1) (3 marks)

9. When lead (II) nitrate and magnesium sulphate react, a white precipitate is formed.
i) Identity the white precipitate. (1 mark)
ii) Write an ionic equation for the reaction. (1 mark)

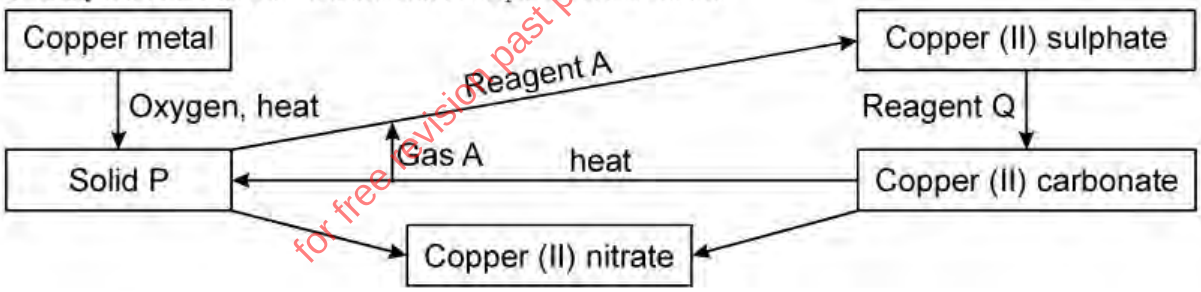
10. State and explain using equations the changes in masses that occur when metallic copper and copper (II) carbonate are heated separately in open crucibles. (3 marks)

11. Study the flow chart below and answer the questions that follow.



I. Name the process that takes place in step I. (1 mark)
II. State one commercial use of substance J. (1 mark)
III. Explain what would happen in step I if dilute sulphuric (VI) acid was used instead of dilute hydrochloric acid. (1 mark)

12. Study the flow chart below and answer the questions that follow.



i) Identify
a) Gas A (½ mark)
b) Reagent Q. (½ mark)
c) Solid P (½ mark)
d) Reagent X (½ mark)
ii) Write an equation for the reaction between copper (II) sulphate and reagent Q. (1 mark)

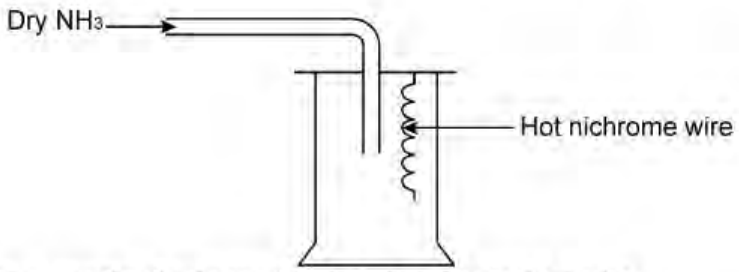
13. a) Define the terms oxidizing and reducing agents in terms of electron transfer. (1 mark)
b) When magnesium powder is added to an aqueous solution of copper (II) sulphate and stirred, the blue colour fades and a brown solid is deposited. Write the two half equations and the overall equation for this reaction. (2 marks)

14. Study the ionic equation below and answer the questions that follow.

$$Cr_2O^{2-}_{7(aq)} + OH^-_{(aq)} \rightleftharpoons 2CrO^{2-}_{4(aq)} + H^+_{(aq)}$$

a) Determine the oxidation number of chromium in the following ions: (2 marks)
   i) $Cr_2O^{2-}_7$
   ii) CrO^{2-}_4
b) Is this a redox reaction? Explain. (1 mark)

15. The set up below shows the catalytic oxidation of ammonia. Study it and answer the questions that follow.



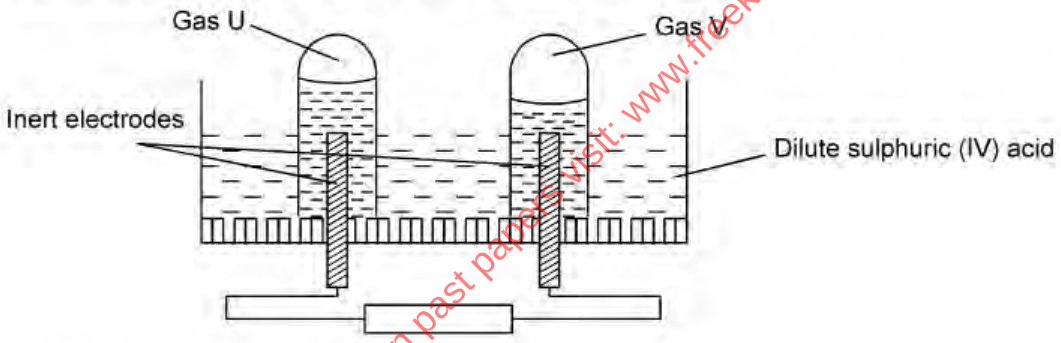
i) Write an equation for the reaction that takes place in the gas jar. (1 mark)
ii) Why is it necessary to have a hot nichrome wire in the gas jar? (1 mark)
iii) Write the formula of the complex ion formed when excess ammonia gas is passed through a solution contained Zn^{2+} ion. (1 mark)

16. Use the bond energy values given below to answer the question that follows.

Bond	Bond energy ($Kjmol^{-1}$)
H - H	432
C = C	610
C - C	346
C - H	413

Determine the enthalpy change for the conversion of butene to butane by hydrogen gas. (3 marks)

17. The figure below shows the electrolysis of dilute sulphuric (VI) acid.



i) On the diagram, label the cathode and anode. (1 mark)
ii) Name the gases U,V (1 mark)
iii) Write the half cell equation for the reaction taking place a the anode (1 mark)

18. Below is part of the Thorium decay series.

$$^{232}_{90}Th \xrightarrow{(i)} {}^{228}_{88}Ra \xrightarrow{(ii)} {}^{228}_{89}Ac \xrightarrow{(iii)} {}^{228}_{90}Th \xrightarrow{(iv)} {}^{224}_{88}Ra$$

i) Write an overall equation for the conversion of $^{232}_{90}Th$ to $^{224}_{88}Ra$ (1 mark)
ii) Give any two medical uses of radioisotopes. (1 mark)

19. Explain the following observations.
a) When lead (II) carbonate reacts with dilute hydrochloric acid, very little carbon (IV) oxide is produced. (1 mark)
b) When hydrogen chloride gas is dissolved in water, the solution formed turns blue litmus paper red but there is no effect on blue litmus paper when the gas is dissolved in carbon tetrachloride. (CCl_4) (2 marks)

20. D grams of potassium hydroxide were dissolved in distilled water to make 100cm³ of solution. 50cm³ of the solution required 50cm³ of 2.0M nitric acid for complete neutralisation. Calculate the mass D of potassium hydroxide. (3 marks)

$$KOH_{(aq)} + HNO_{3(aq)} \rightarrow KNO_{3(aq)} + H_2O_{(l)} \quad (RFM\ of\ KOH = 56)$$

21. An element Q has a relative atomic mass of 88. When a current of 0.5A was passed through the fused chloride of Q for 32 minutes and 10 seconds, 0.44g and Q were deposited at the cathode. Determine the charge on an ion of Q. (1 Faraday = 96500C) (3 marks)

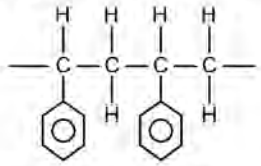
22. The chemical equation below are the main reactions in large scale manufacture of Sodium carbonate.

$$NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} \rightarrow NH_4HCO_{3(aq)}$$

$$NH_4HCO_{3(aq)} + NaCl_{(aq)} \rightarrow NaHCO_3NH_4Cl_{(aq)}$$

a) Explain how the two products, $NaHCO_3$ and NH_4Cl are separated. (1 mark)
b) i) How is sodium carbonate finally obtained? (1 mark)
ii) Explain how ammonia is recovered and recycled? (1 mark)

23. The formula given below represents a portion of polymer.

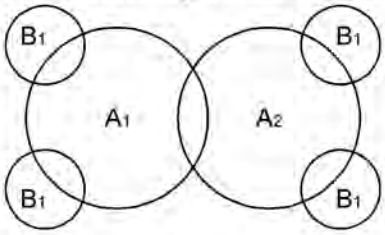


a) Give the name of the polymer. (1 mark)
b) Draw the structure of the monomer used to manufacture the polymer. (1 mark)

24. Zinc is normally extracted from its natural ores, such as zinc blende (ZnS) and calamine ($ZnCO_3$).
a) Why is it not advisable to refer to these ores as zinc sulphide and zinc carbonate? (1 mark)
b) The 1st step in the extraction process is roasting of ores. Write equations for reactions taking place when the two ores are roasted. (2 marks)
c) Which of the two ores is recommended to be used as source of zinc metal ? Give a reason. (1 mark)

25. How would you distinguish between lead ions and zinc ions? (2 marks)

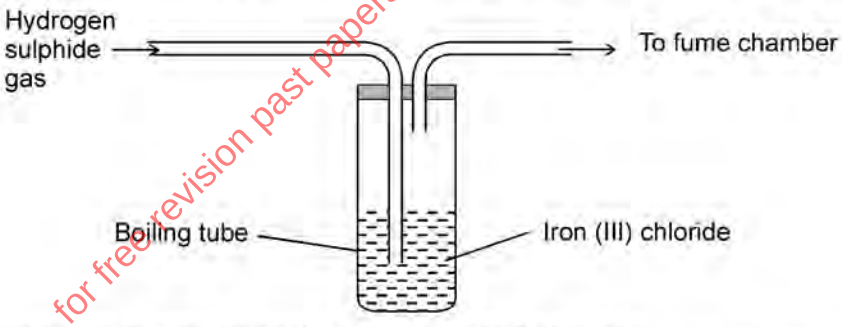
26. A student during an organic chemistry lesson drew a dot (•) and cross (×) diagram for a hydrocarbon as follows.



a) Identify two atoms labelled. A_1 B_1 (1 mark)
b) Name the type of bond existing between A_1 and A_2 (1 mark)
c) In which homologous series does the above hydrocarbon belong? (1 mark)

27. During the extraction of aluminium, a current of 0.2 amperes was passed for one hour through the molten aluminium oxide.
a) Write an equation for the reaction that took place at the cathode. (Al =27, IF = 96500C) (1 mark)
b) Calculate the mass of aluminium produced. (2 marks)

28. The diagram below represents a laboratory experiment to investigate the reaction between hydrogen sulphide and aqueous iron (II) chloride.



a) Write a chemical equation for the reaction which takes place in the boiling tube. (1 mark)
b) What adjustment need to be made in the above ser-up if the laboratory does not have a fume chamber. (1 mark)
c) Describe a laboratory chemical test for a sample of hydrogen sulphide gas. (1 mark)

29. Explain why during the extraction of metals, copper can be extracted by the electrolysis of copper (II) sulphate solution, while aluminium cannot be extracted by electrolysis of aluminium sulphate solution. (2 marks)

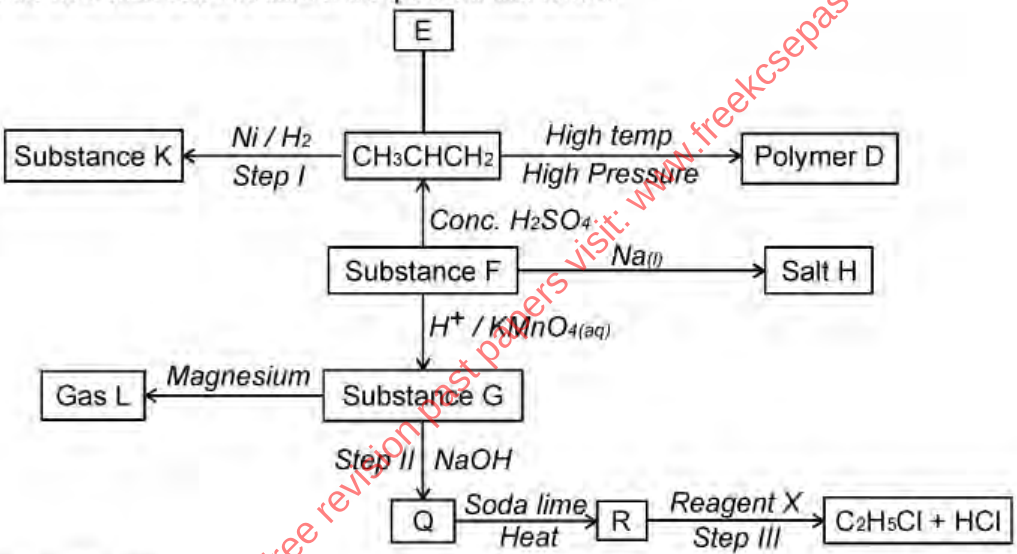
WESTLANDS GRAPHYCS
233/2
CHEMISTRY
Paper 2
July 2017
Time 2 hours

1. The grid below represents part of the period table. The letters are not the actual symbol of the elements. Use it to answer the questions that follow.

A								
							N	C
R	E		Q	M	K		P	S
							J	
T								L

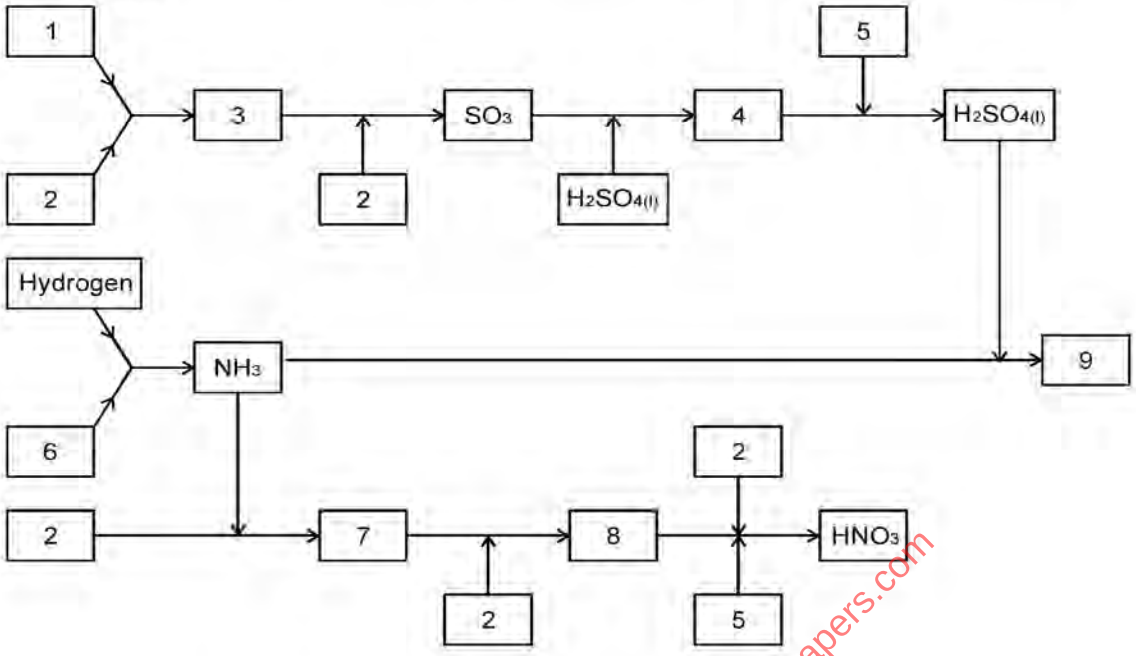
a) Name the chemical family to which element E belong in the periodic table. (1 mark)
b) State one use of element R. (1 mark)
c) Write equations for the reactions between
   i) Q and N (1 mark)
   ii) Chloride of M and water. (1 mark)
d) Compare the atomic sizes of the elements in period 3. Give a reason for your answer. (2 marks)
e) Explain why the boiling point of M(2,680°C) is higher than that of K (281°C) (2 marks)
f) Compare the pH of the aqueous solutions formed when oxides of R and E are dissolved in water. Explain. (2 marks)
g) Select the least reactive element in group VII. Explain. (1 mark)
h) Select an element in group VIII which is likely to from a fluoride. (1 mark)

2. Use the flow chart below to answer the questions that follow.



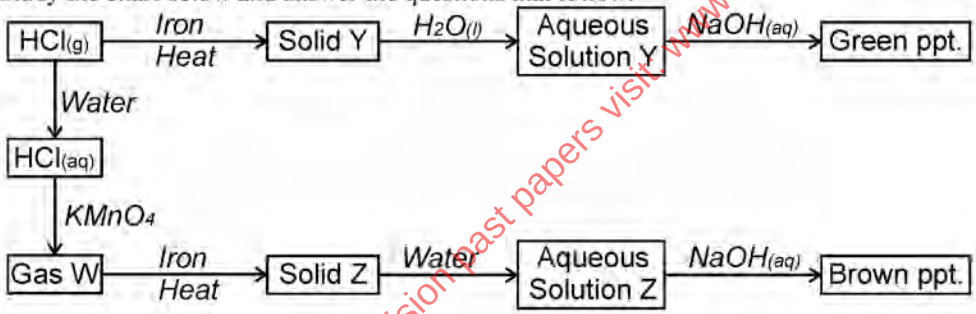
a) Name the following
   i) Gas L (1 mark)
   ii) Salt H (1 mark)
   iii) Substance K. (1 mark)
b) Name the process involved in the following steps.
   i) Step I (1 mark)
   ii) Step II (1 mark)
   iii) Step III (1 mark)
c) Write a chemical equation for the complete combustion of substance F. (1 mark)
d) Name the conditions and reagents in step III
   i) Condition. (1 mark)
   ii) Reagents (1 mark)
e) Calculate the mass of salt Q that would be formed by using 21.9kg of G when it reacts with excess sodium hydroxide (C=12, H=1.0, Na=23, O=16.0) (3 marks)
f) Draw the structure of polymer D. (1 mark)
g) State one use of the above polymer. (1 mark)

3. The chart below shows some of the chemicals needed for the production of sulphuric (VI) acid, ammonia gas, nitric (V) acid and ammonium products.



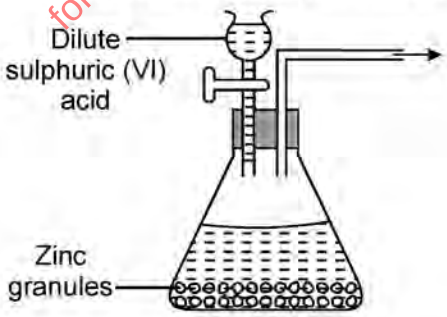
a) Name the chemicals that should be in chambers 1, 2, 5 and 6. (2 marks)
b) State three conditions required to convert the chemical substance in chamber 3 to $SO_{3(g)}$ (1 mark)
c) Write the balanced chemical equations with conditions where necessary for the reactions that produce chemical substances in chambers 4, 7, 8 and 9. (4 marks)

Study the chart below and answer the questions that follow.



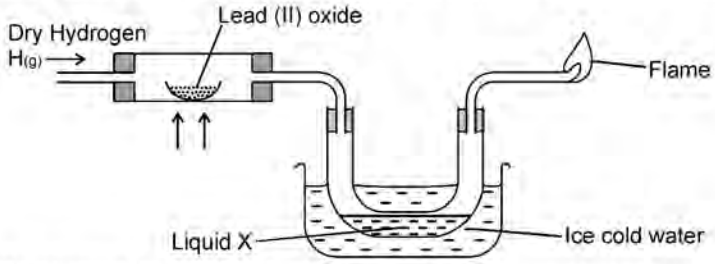
Identify substance W, Y and Z. (3 marks)

4.a) The set up below was used to prepare hydrogen gas. Complete the diagram to show how a dry sample of the gas can be collected.



b) Writ an equation for the reaction producing hydrogen gas. (1 mark)
c) What observation would be made if calcium metal was used in place of zinc granules in the set up above ? Explain. (2 marks)

d) Dry hydrogen gas was passed over heated lead (II) oxide in a combustion tube as shown below.



i) State and explain the observation made in the combustion tube. (2 marks)

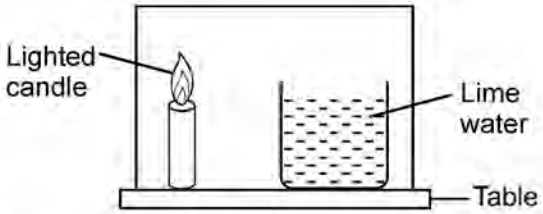
ii) W rite an equation for the reaction that took place in the combustion tube. (1 mark)

e) Identify liquid X. (1 mark)

f) Give one chemical test that can be used to prove the identify of liquid X. (2 marks)

g) When a magnesium oxide is used in place of copper (II) oxide, no liquid is formed in the U-tube dipped in ice cold water. Explain. (1 mark)

h) Study the arrangement below and answer the questions that follow.



State and explain what will be observed after sometime. (3 marks)

5. a) What is meant by molar heat of neutralization. (1 mark)

b) A series of experiments were carried out to investigate the changes in temperature that occur when different volumes of 2M sodium hydroxide were added to various volumes of 1M solution of unknown acid A. The apparatus used are shown in the diagram below.

The results obtained were recorded as in the table below.

Experiment	1	2	3	4	5	6	7
Volume of acid A in the beaker in (cm^3)	10	15	20	25	30	35	40
Volume of 2M sodium hydroxide added in cm^3	40	35	30	25	20	15	10
Initial temperature 0^C	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Final temperature 0^C	29.0	33.0	37.0	37.5	36.0	33.5	31.0
Temperature change							

i) Complete the table above (1 mark)

ii) Plot a graph of temperature change against volume of sodium hydroxide. (3 marks)

iii) From the graph determine the highest temperature change. (1 mark)

iv) From the graph determine the volume of sodium hydroxide solution required for complete. neutralization. Volume of sodium hydroxide. (1 mark)

v) Calculate the moles of sodium hydroxide required to neutralize acid A completely (from (iv) above.) (1 mark)

vi) Heat change for reaction in (iv) above (2 marks)
$\Delta H = MC\Delta T$ (Take C = $4.2Jg^{-1}C^{-1}$) density of the solution = $1g/cm^3$

vii) Molar heat change for neutralization of sodium hydroxide. (2 marks)

viii) Why is it advisable to use a plastic beaker which is small? (1 mark)

ix) The molar enthalpies of neutralization for dilute hydrochloric acid and dilute nitric (V) acid are -57.2kJ/Mol while that of ethanoic acid is -55.2kJ/Mol. Explain this observation. (2 marks)

6. Study the standard electrode potentials for the elements given below and answer the questions that follow. The letters do not represent the actual symbols of the elements

		E$^{\ominus}$
$Q_{2(g)} + 2e^-$	$2Q^-_{(aq)}$	+2.87
$B_{2(g)} + 2e^-$	$2B^-_{(aq)}$	+1.36
$S^{2+}_{(g)} + 2e^-$	$S_{(s)}$	+1.23
$2T^-_{(aq)} + 2e^-$	$T_{2(g)}$	0.00
$U^{2-}_{(aq)} + 2e^-$	$V_{(s)}$	-0.13
$V^{2+}_{(aq)} + 2e^-$	$V_{(s)}$	-0.76

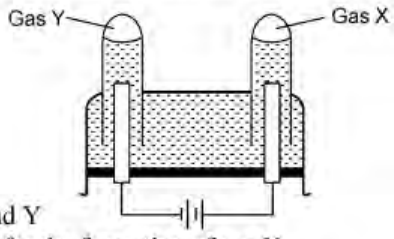
a) What is the E$^{\ominus}$ value of weakest reducing agent? (1 mark)

b) Which element is likely to be hydrogen? Give a reason for your answer. (1 mark)

c) Draw a diagram for the cell that would be obtained when the half cell of elements S and V are combined. (3 marks)

d) Calculate the e.mf of the electrochemical cell in a (iii) above. (1 mark)

e) The diagram below represents the electrolysis of dilute sulphuric (VI) acid.



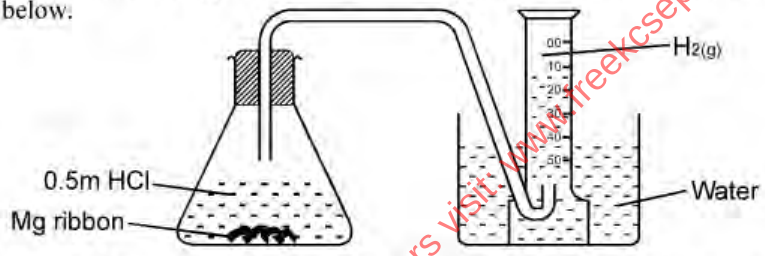
Name the gases X and Y (1 mark)

f) Write ionic equation for the formation of gas X. (1 mark)

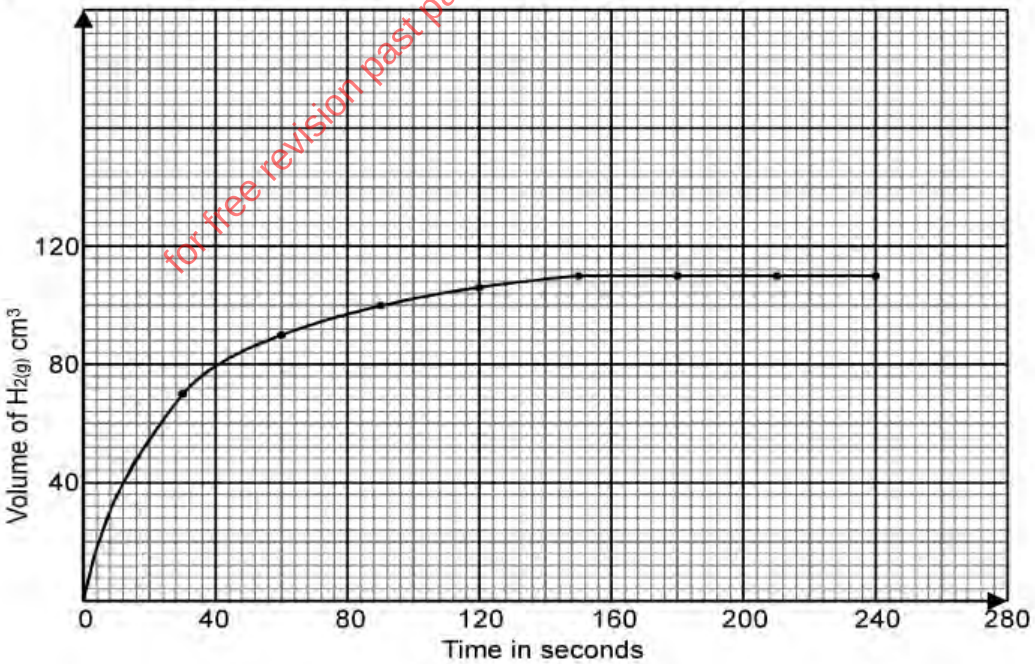
g) At what electrode does reduction take place? Explain your answer. (1½ marks)

h) Name the most suitable electrodes for this experiment. Explain your answer. (1½ marks)

7. A form four class assembled the apparatus below to investigate observations made when a reaction progresses by setting up the experiment below.



A graph of the volume of the hydrogen gas produced against time in seconds is provided in the grid below.



a) Determine the average rate of the production of the hydrogen gas between t = 20, and t = 70 seconds. (2 marks)

b) By showing clearly on the graph, determine the rates of reaction of magnesium and hydrochloric acid at
i) t = 40 seconds. (2 marks)
ii) t = 120 seconds (2 marks)

c) What conclusion can you make from your answer in b(i) and (ii) above? (1 mark)

WESTLANDS GRAPHYCS
233/3
CHEMISTRY
Paper 3
July 2017
Time 2¼ hours

CONFIDENTIAL INSTRUCTIONS

1. Solution J is 0.8M copper II nitrate solution
2. Solution K is 0.1M sodium thiosulphate solution
3. Solution L is 50g of potassium iodide dissolved in1 litre of distilled water
4. Solution N is 1.42M sodium hydroxide solution
5. Solution M is prepared by taking 1g of starch powder and dissolving it in about $10cm^3$ of hot/boiling distilled water and mixing it uniformly into a paste. Add $90cm^3$ of hot boiled water into the paste and mix it uniformly by stirring.
6. Substance P is one spatula full of hydrated magnesium sulphate crystals per student.
7. Substance Q is about 0.5g of malleic acid per student

Apparatus:

1. 50ml burette
2. 25.0ml pipette
3. Pipette filler
4. Stand (complete)
5. Thermometer (10°C to 100°C)
6. Test tube rack
7. About 8 test tubes
8. Two boiling tubes
9. Two 100ml beakers
10. Bunsen burner (source of heat)
11. Wash bottle with distilled water
12. Access to 0.1M barium nitrate
13. 2M nitric V acid (access to)
14. 2M sodium hydroxide (access to)
15. Sodium hydrogen carbonate (spatulaful)
16. Metallic spatula
17. 0.025M $KMnO_4$ (access to) (acidified with $300cm^3$ of 2M H_2SO_4 in 1L)
18. 10ml measuring cylinder

Solutions

J - $100cm^3$ per student
K - $80cm^3$ per student
L - $40cm^3$ per student
N - $40cm^3$ per student
M - $10cm^3$ per student

WESTLANDS GRAPHYCS
233/3
CHEMISTRY
Paper 3
July 2017
Time 2¼ hours

1. You are provided with
- Solution J containing copper II ions
- Solution K, 0.1M sodium thiosulphate
- Aqueous potassium iodide, solution L
- Solution N, Sodium hydroxide
- Starch indicator, solution M

You are required to determine the:
- Concentration of copper II ions in solution J
- Enthalpy change of reaction between copper II ions and hydroxide ions.

Procedure 1

a) Using a pipette and pipette filler, place 25cm³ of solution J in a 250ml volumetric flask. Add distilled water to make up to the mark. Label this as solution J_2. Retain solution J for use in procedure II.

b) Place solution K in a burette, using a clean pipette and pipette filler, place 25.0cm³ of solution J_2 in a 250ml conical flask. Add 10cm³ of potassium iodide, solution L. Shake well, then add 2cm³ of starch indicator, solution M. Titrate until a blue-black colour appears and continue titrating until the blue black colour just disappears. Record your readings in table 1 below.

c) Repeat step (b) two more times and complete table 1.

	I	II	III
Final burette reading (cm³)			
Initial burette reading (cm³)			
Volume of solution K used (cm³)			

Table 1. (4 marks)

Calculate the

i) Average volume of solution K used. (1 mark)

ii) Moles of sodium thiosulphate used. (1 mark)

iii) Concentration in moles per litre copper (II) ions in solution J given that the number of moles of copper (II) ions in 25.0cm³ of solution J_2 are the same as the moles of sodium thiosulphate used. (2½ marks)

Procedure II.

a) Using a clean burette, place 5.0cm³ of solution N into each of six (6) test tubes.

b) Using a 100ml measuring cylinder, place 20cm³ of solution J in a 100ml plastic beaker. Measure the temperature of solution J and record it in table 2 below.

c) To the solution J in the beaker add sodium hydroxide, solution N from one of the test tubes. Stir the mixture with thermometer and record in table 2, the maximum temperature reached continue with step (d) immediately.

d) Add the sodium hydroxide solution N from another testtube to the mixture obtained in (c) above. Stir and record the maximum temperature reached in table 2. Continue adding the sodium hydroxide, solution N from each of the four test-tubes, stirring the mixture and recording the maximum temperatures each time and complete table 2.

Volume of sodium hydroxide solution N added (cm³)	0	5	10	15	20	25	30
Maximum temperature (°C)							

Table 2 (4½ marks)

i) On the grid provided plot a graph of temperature (vertical axis) against volume of sodium hydroxide, solution N added. (3 marks)

Using the graph, determine the

i) Volume of sodium hydroxide, solution N that reacted completely with 20cm³ of solution J. (2 marks)

ii) Temperature change, ΔT for the reaction. (1 mark)

iii) Enthalpy change of the reaction per mole of copper (II) ions (3 marks)
(Heat capacity = $4.2Jg^{-1}k^{-1}$, density of the mixture = $1.0gcm^{-3}$)

2. You are provided with substance P. Carry out the tests below and write your observations and inferences in the spaces provided.

a) Describe the appearance of substance P. (1 mark)

b) Place about one-third of substance P in a dry test-tube and heat strongly.

Observations (1 mark)	Inferences (1 mark)

c) Place the remaining amount of substance P in a boiling tube. Add about 10cm³ of distilled water and shake well. Retain the mixture for tests in (d) below

Observations (1 mark)	Inferences (1 mark)

d) Use about 2cm³ portion of the mixture obtained in (C) for (i) to (iii) below.

i) Add two to three drops of barium nitrate solution to the mixture.

Observations (1 mark)	Inferences (1 mark)

ii) Add five drops of dilute nitric (V) acid to the mixture.

Observations (1 mark)	Inferences (1 mark)

iii) Add to the mixture, aqueous sodium hydroxide dropwise until in excess.

Observations (1 mark)	Inferences (1 mark)

e) Give the formula of the cation and anion present in substance P.

Cation .....(½ mark)

Anion .....(½ mark)

3. You are provided with an organic substance Q. Carry out the following tests and record your observations and inferences in the spaces provided.

a) Place about one-third of substance Q on a metallic spatula and ignite it.

Observations (1 mark)	Inferences (1 mark)

b) Place the remaining amount of substance Q in a boiling tube and add 10cm³ of distilled water. Heat the mixture and allow it to boil for about 30 seconds. Divide the mixture while still hot into two portions.

i) To the first portion, add solid sodium hydrogen carbonate provided.

Observations (1 mark)	Inferences (1 mark)

ii) To the second portion, add two or three drops of acidified potassium manganate (VII)

Observations (1 mark)	Inferences (1 mark)

COMPLIANT PREPARATORY EXAMINATION

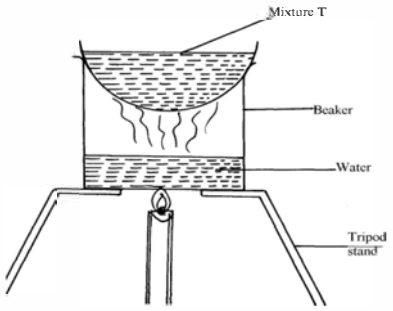
233/1

CHEMISTRY (THEORY)

PAPER 1

2 HOURS

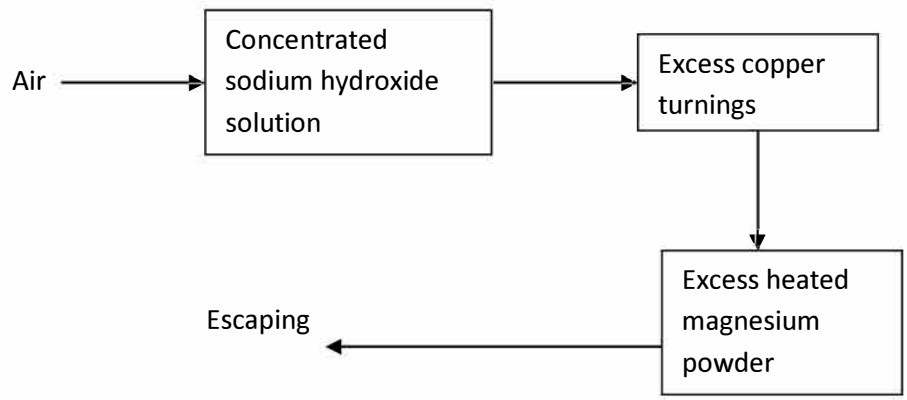
1. An oxide of element **G** has the formula as G_2O_3.
   (a) State the valency of element **G.** (1 mark)
   (b) In which group of the periodic table is element **G**? (1 mark)
2. The set-up below was used to separate a mixture.



   (a) Name the apparatus missing in the set-up. (1 mark)
   (b) Give **one** example of mixture T. (1 mark)
   (c) What is the name of this method of separation? (1 mark)
3. Name the process which takes place when:
   (a) Solid Carbon (IV) oxide (dry ice) changes directly into gas. (1 mark)
   (b) A red litmus paper turns white when dropped into chlorine water. (1 mark)
   (c) Propene gas molecules are converted into a giant molecule. (1 mark)
4. The information below gives **pH** values of solutions **V, W, X, Y Z.**

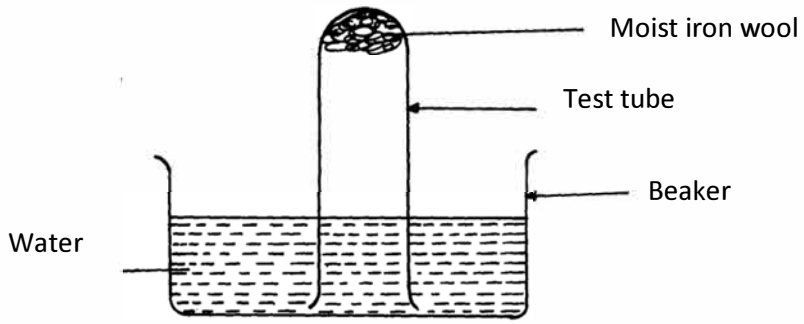
Solution	pH values
V	2
W	6.5
X	11
Y	14
Z	4.5

   (a) Which solution is likely to be:
   (i) Calcium hydroxide? (1 mark)
   (ii) Rain water? (1 mark)
   (b) Which solution would react most vigorously with Zinc carbonate? (1 mark)
5. Explain why very little Carbon (IV) oxide gas is evolved when dilute sulphuric (VI) acid is added to lead (II) carbonate. (1 mark)
6. Air was passed through several reagents as shown below:



(a) Write an equation for the reaction which takes place in the chamber containing magnesium powder. (1 mark)
(b) Name **one** gas which escapes from the chamber containing magnesium powder. Give a reason for your answer. (2 marks)

7. The set-up below was used to study some properties of air.



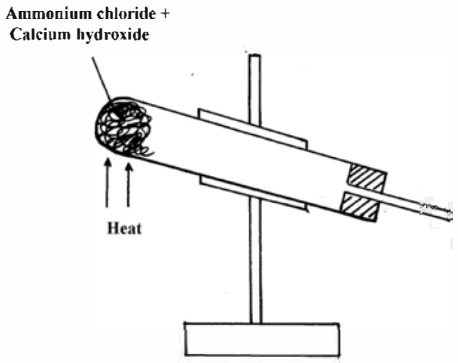
State and explain **two** observations that would be made at the end of the experiment. (2 marks)

8. Below is a list of oxides.
   MgO, N_2O, K_2O, CaO and Al_2O_3
   Select:-
   (a) A neutral oxide. (1 mark)
   (b) A highly water soluble basic oxide. (1 mark)
   (c) An oxide which can react with both sodium hydroxide solution and dilute hydrochloric acid. (1 mark)
9. (a) Hydrogen can reduce copper (II) Oxide but not aluminium oxide. Explain. (1 mark)
   (b) When water reacts with potassium metal, the hydrogen produced ignites explosively on the surface of water.
   i) What causes this ignition? (1 mark)
   ii) Write an equation to show how this ignition occurs. (1 mark)
10. In an experiment an unknown mass of anhydrous sodium carbonate was dissolved in water and the solution made up to 250 cm^3. 25cm^3 of this solution neutralized 20 cm^3 of 0.25 M nitric acid. Calculate the mass of unknown sodium carbonate used. (3 marks)
    (Na = 23.0, C = 12.0, O = 16.0)
11. An element **M** has two naturally occurring isotopes, ^{63}**M** and ^{65}**M**. Calculate the percentage of each isotope if the relative atomic mass of **M** is 63.55. (2 marks)
12. Carbon and silicon belong to the same group of the periodic table, yet Carbon (IV) oxide is a gas while silicon (IV) oxide is a solid with a high melting point. Explain this difference (2 marks)
13. The table below gives information about the ions T^+ and Z^{2-}.

Ion	T^+	Z^{2-}
Electron arrangement	2.8	2.8.8
Number of neutrons	12	16

    (a) Determine the relative formula mass of the compound formed between **T** and **Z.** (2 marks)
    (b) State **two** conditions under which the compound in (a) above would conduct electricity. (1 mark)
14. An ion of oxygen is larger than oxygen atom. Explain. (2 marks)
15. (a) Work out the oxidation number of phosphorous in H_3PO_3. (1 mark)
    (b) Study the equation below:
    $Mg_{(s)} + 2H_2O_{(l)} \rightarrow Mg(OH)_{2\,(aq)} + H_{2\,(g)}$
    Which species has undergone oxidation? Explain. (2 marks)
16. Starting with Lead (II) carbonate explain how you would prepare a pure sample of Lead (II) sulphate. (3 marks)
17. Draw a dot (•) and cross (×) diagram to show bonding in:-
    (a) Ammonium ion, NH_4^+ (N = 7.0, H = 1.0) (1 mark)
    (b) Silane, SiH_4 (Si = 14.0, H = 1.0) (1 mark)
18. Sodium carbonate decahydrate crystals, $Na_2CO_3.10H_2O$, were left exposed in the atmosphere on a watch glass for two days.
    (a) State the observation made on the crystals after two days. (1 mark)
    (b) Name the property of salts investigated in the above experiment. (1 mark)
19. (a) What is meant by the term solubility of salts? (1 mark)
    (b) Calculate the solubility of a salt given that 15 g of the salt can saturate 25 cm^3 of water. (1 mark)
20. (a) State the Graham's law. (1 mark)
    (b) A 100 cm^3 of Carbon (IV) oxide gas diffused through a porous partition in 30 seconds.
    How long would it take 150 cm^3 of Nitrogen (IV) oxide to diffuse through the same partition under the same conditions?)
    (C = 12.0, N = 14.0, O = 16.0) (2 marks)

21. The diagram below represents an in complete set-up for preparation of a dry sample of gas R.

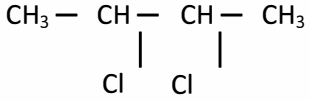


(a) Complete the set-up to show how a dry sample of gas **R** is collected. (2 marks)
(b) Write a chemical equation for the reaction that produces gas **R**. (1 mark)

22. When sulphur powder is heated to over 400 °C the following changes are observed:-
At 113 °C it melts into light brown liquid. The liquid then darkens to become reddish-brown and very viscous at 160 °C. Above 160°C the liquid becomes almost black. Near the boiling point (444 °C) the liquid becomes mobile. Explain these observations. (3 marks)

23. A gas cylinder contains about 1.12dm^3 of butane measured at 0° and 1atm. Given that 25% of heat is lost, what is the maximum volume of water at room temperature which can be boiled to 100°C in order to make some coffee?
$C_4H_{10(g)} + 6\ ½\ O_{2(g)} \rightarrow 4CO_{2(g)} + 5H_2O_{(l)}$; $\Delta H^\theta = -3{,}000$ kJmol^{-1} (3 marks)
(Specific heat capacity of water = 4.2J g^{-1}°C^{-1}, density of water 1gcm^{-3} Molar gas volume 22.4 at s.t.p)

24. (a) Compound **W** reacted with chlorine to form compound **X** only. The structural formula of **X** is shown below:



Give the structural formula and name of compound **W**. (1 mark)
(b) Draw the structure of 1-chloro-2, 2-dimethylpropane. (1 mark)

25. Given this reaction; $RNH_2 + H_2O \rightleftharpoons RNH_3^+ + OH^-$
Identify the acid in the forward reaction. Explain. (2 marks)

26. In an experiment, soap solution was added to three samples of water. The results below show the volume of soap solution required to lather with 500 cm^3 of each water sample before and after boiling.

	Sample 1	Sample 2	Sample3
Volume of soap used before water boiled	26.0	14.0	4.0
Volume of soap after water boiled	26.0	4.0	4.0

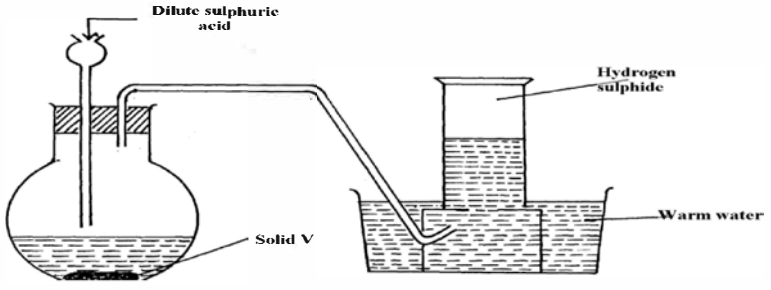
(a) Which water samples are likely to be soft? (1 mark)
(b) Explain the change in volume of soap solution used in sample 2. (1 mark)

27. Study the electrode potentials in the table below and answer the question that follow:
(Letters are not the actual symbols of elements)

	(E^θ /Volts)
$H^{2+}_{(aq)} + 2e^- \rightarrow H_{(s)}$	+0.34
$Z^{2+}_{(aq)} + 2e^- \rightarrow Z_{(s)}$	- 2.38
$G^{+}_{(aq)} + e^- \rightarrow G_{(s)}$	+0.80
$T^{2+} + 2e^- \rightarrow T_{(s)}$	-2.87

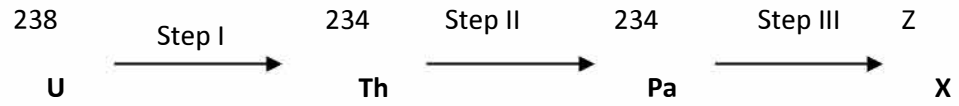
(a) Which **one** is the strongest reducing agent? (1 mark)
(b) Write the ionic equation for the reaction that takes place when **Z** is dipped in a solution of G^+ ions. (1 mark)
(c) Calculate the E^θ cell value of the reaction in **(b)** above. (1 mark)

28. The set-up below was used to prepare and collect hydrogen sulphide gas. Study it and answer the questions that follow.



(a) Name solid **V**. (1 mark)
(b) Write chemical equation of the reaction taking place in the flask. (1 mark)
(c) Give a reason why warm water is used in the set-up. (1 mark)

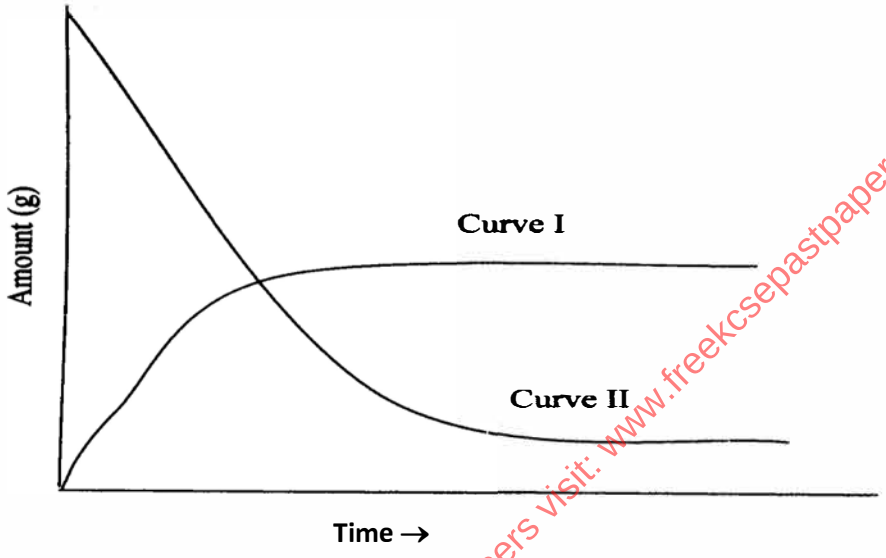
29. The following is a part of Uranium decay series.



(a) Which particle is emitted in step **I**? (1 mark)
(b) If a beta particle is emitted in step **III,** find **Z** and **A**. (1 mark)
(c) If the activity of **Th**-234 is reduced to 25% in 48 hours, find its half-life. (1 mark)

30. The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reactions:

$CaCO_{3\,(s)} + 2HCl_{\,(aq)} \rightarrow CaCl_{2\,(aq)} + H_2O_{\,(g)} + CO_{2\,(g)}$



(a) Which curve shows the amount of calcium chloride varying with time? (1 mark)
(b) Explain why the two curves become horizontal after a given period of time. (1 mark)
(c) Sketch on the graph how **curve II** would appear if the experiment was repeated using a more dilute hydrochloric acid solution. (1 mark)

31. Heated iron can react with both chlorine gas and hydrogen chloride gas.
(a) Write equations for the two reactions. (2 marks)
(b) Chlorine gas has no effect on dry blue litmus paper. Explain. (1 mark)

COMPLIANT PREPARATORY EXAMINATION
233/2
CHEMISTRY (THEORY)
PAPER 2
2 HOURS

1. (a) (i) The table below shows the volume of oxygen obtained per unit time when hydrogen peroxide was decomposed in the presence of manganese (IV) Oxide. Use it to answer the questions that follow:-

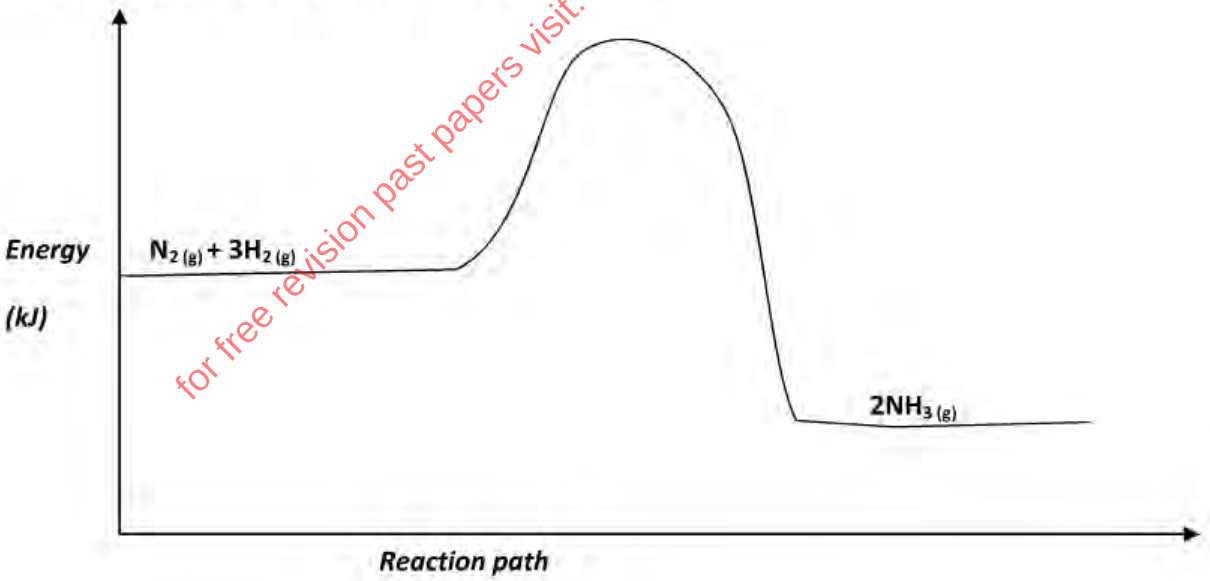
Time in seconds	Volume of Oxygen evolved (cm^3)
0	0
30	10
60	19
90	27
120	34
150	38
180	43
210	45
240	45
270	45
300	45

i) Plot a graph of volume of oxygen gas against time. (3 marks)
ii) Determine the rate of reaction at time 156 seconds. (1 mark)
iii) From the graph, find the time taken for 18 cm^3 of oxygen to be produced. (1 mark)
iv) Write a chemical equation to show how hydrogen peroxide decomposes in the presence of manganese (IV) Oxide. (1 mark)

(a) Nitrogen and hydrogen react reversibly according to the equation:-

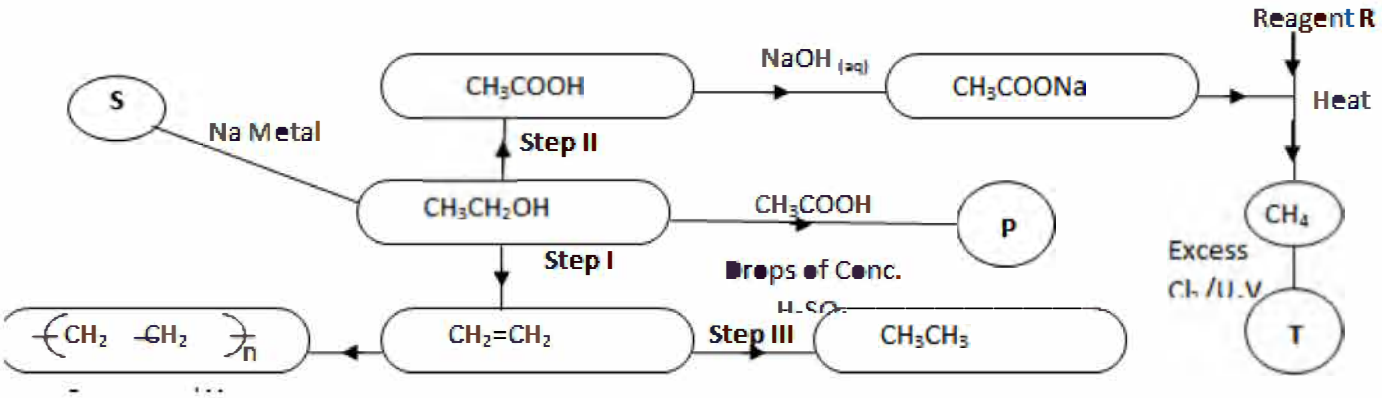
$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)};\ \Delta H = -92\ kJmol^{-1}$$

The energy level diagram for the above reaction is shown below:-



i) How would the yield of ammonia be affected by:
I. Increase in temperature? Give reason. (1½ marks)
II. In increase in pressure? Give reason. (1½ marks)
ii) How does a catalyst affect reversible reaction that is already at equilibrium? (1 mark)
iii) On the above diagram, sketch the energy level diagram that would be obtained when iron catalyst is added to the reaction. (1 mark)
iv) A factory uses nitric acid and ammonia gas as the only reactant for the preparation of the fertilizer if the daily production of the fertilizer is 4800 Kg. Calculate the mass of ammonia gas used daily. (N = 14.0, O= 16.0, H = 1.0) (2 marks)

2. (a) The structure below shows some reactions starting with ethanol. Study it and answer the questions that follow:



i) Write the formula of the organic compounds **P** and **S.** (1 mark)

ii) Name the type of reaction and the reagent(s) for the reactions in the following step:-

I) Step I (1 mark)

II) Step II (1 mark)

III) Step III (1 mark)

iii) Name reagent **R** (1 mark)

iv) Draw the structural formula of **T** and give its name. (1 mark)

v) I) Name compound **U**…… (1 mark)

II) If the relative molecular mass of **U** is 42000, determine the value of n. (C = 12, H = 1) (1 mark)

c) State why C_2H_4 burns with a more smoky flame than C_2H_6. (1 mark)

d) 3.52 g of Carbon (IV) oxide and 1.40 g of water are produced when a mass of a hydrocarbon is completely burnt in oxygen. Determine the empirical formula of the hydrocarbon. (H = 1.0, C = 12.0, O = 16.0) (3 marks)

3. The grid below represents part of the periodic table. (The letters do not represent actual symbols of the elements). Study it and answer the questions that follow:-

F			P			G	H	I
	Q		J	K		L	M	
N		X - Z						

a) What type of bond would you expect in the compound formed between **H** and **F**? Explain. (2 marks)

b) i) Which of the elements **J** and **M** will have a greater atomic radius? Explain. (2 marks)

ii) How would you expect the ionization energy of **F** and **N** to compare? Explain (2 marks)

c) An element **W** has atomic number **6**. Indicate the position it would occupy in the grid above. (1 mark)

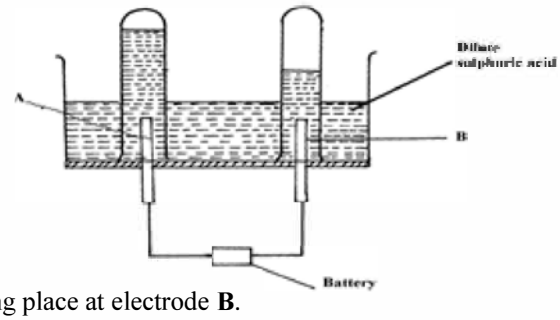
d) What is the name given to elements **X – Z**? (1 mark)

e) Why is **J** used in electric cables whereas **Q** is not? (1 mark)

f) **P** and **J** are termed as metalloids. What does the term metalloid mean? (1 mark)

g) How would you expect the reactivity of **H** and **M** to compare? Explain. (2 marks)

4. (a)The diagram below represents a set-up that can be used for the electrolysis of dilute sulphuric acid.



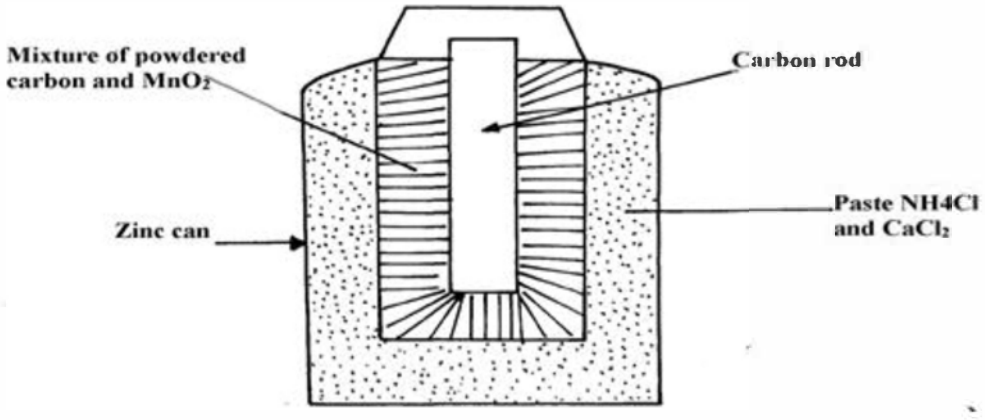
i) Name the electrodes **A** and **B.** (1 mark)

ii) Write an equation for the reaction taking place at electrode **B**. (1 mark

iii) What happens to the concentration dilute sulphuric acid as the reaction continues? Explain. (2 marks)

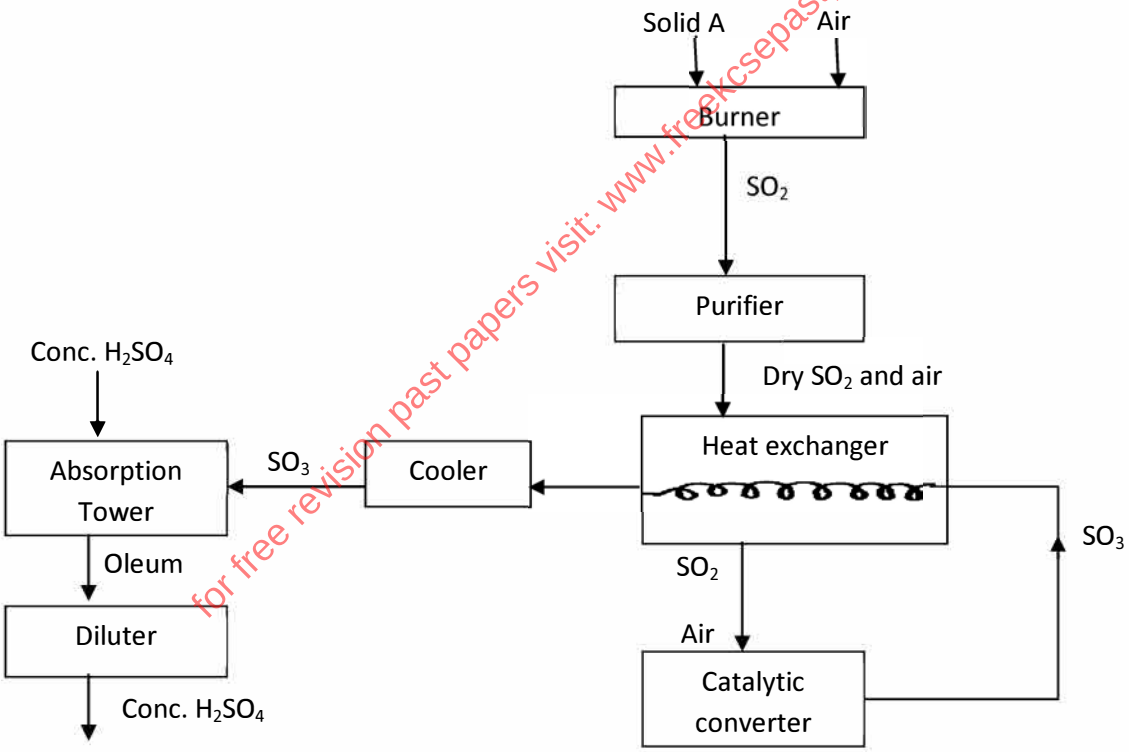
(b) When nitrate solution of a certain metal **X** was electrolysed, 1.174g of metal **X** was deposited by a current of 4 amperes flowing for 16 minutes. Determine the formula of the metal nitrate. (1F= 96,500 C, R.A.M of **X** = 59) (3 marks)

(c) The diagram below shows a Le'Clanche cell (Dry cell).



(i) What is the function of the following substances in the above cell?
I. MnO_2 (1 mark)
II. $CaCl_2$ (1 mark)
ii) Write the equation of a reaction that occurs at the negative terminal. (1 mark)
iii) A paste rather than dry form of ammonium chloride is used. Explain. (1 mark)
iv) What is the main disadvantage of this type of cell? (1 mark)

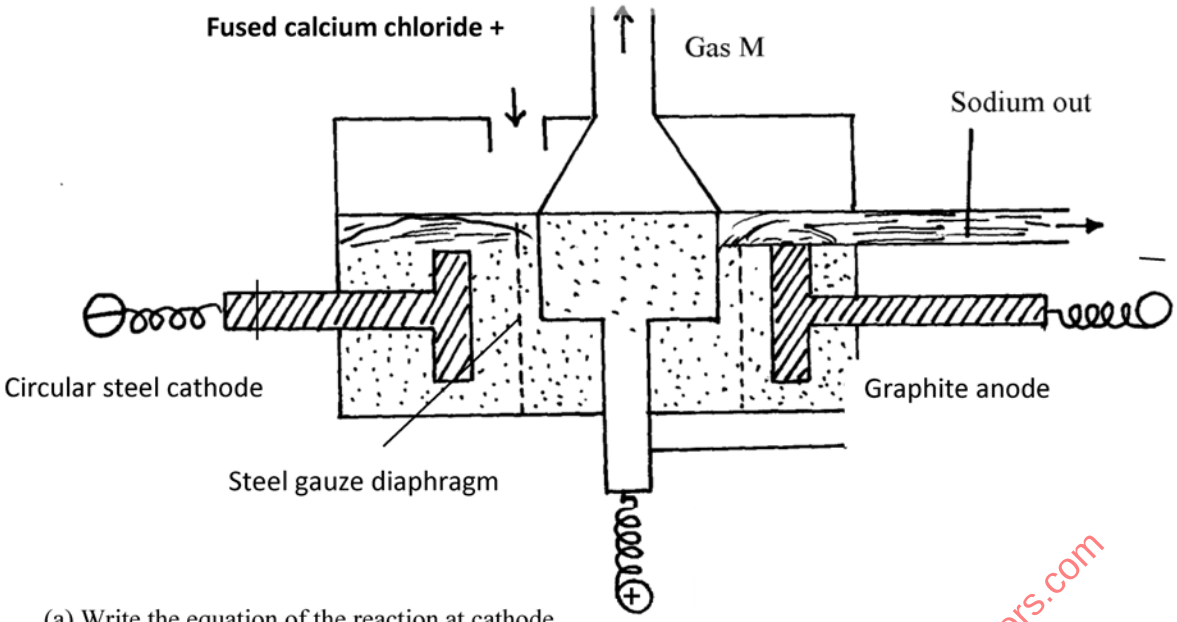
5. a) The scheme below represents the steps followed in the contact process. Study it and answer the questions that follow.



(i) Name **two** possible identities of solid **A.** (1 mark)
(ii) Name **one** impurities removed by the purifier. (1 mark)
(iii) Why is it necessary to remove impurities? (1 mark)
(iv) Write down the equation of the reaction taking place in the converter. (1 mark)
(v) Name the **two** catalysts that can be used in the converter. (1 mark)
(vi) What is the function of heat exchanger? (1 mark)
vii) Sulphuric (VI) Oxide is not dissolved directly into water to form H_2SO_4? Explain. (1 mark)
viii) (I) State the effect of SO_2 in the environment. (1 mark)
(II) How can the pollution in **(viii) (I)** above be controlled? (1 mark)
ix) Give **one** use of sulphuric (VI) acid. (1 mark)

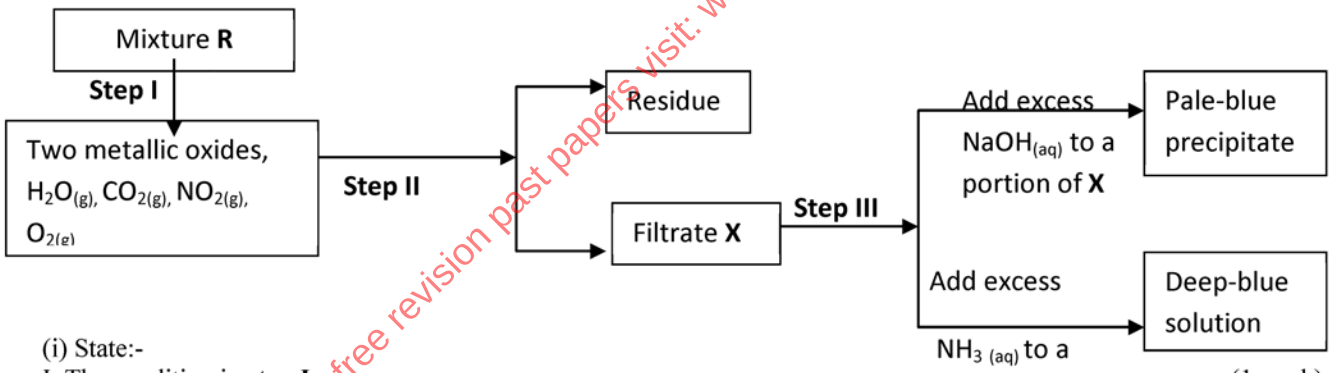
b) Commercial H_2SO_4 acid has a density of 1.8 gcm^{-3} and purity of 98 percent.
i) Calculate the molarity of this acid. (H = 1.0, S = 32.0, O = 32.0) (1½ marks)
ii) Determine the volume of commercial H_2SO_4 acid in (a) above that can be used to prepare 500 cm^3 of 0.2 M H_2SO_4 solution. (1½ marks)

6. The following diagram represents extraction of sodium by the Down's cell. Study it and answer the questions that follow.



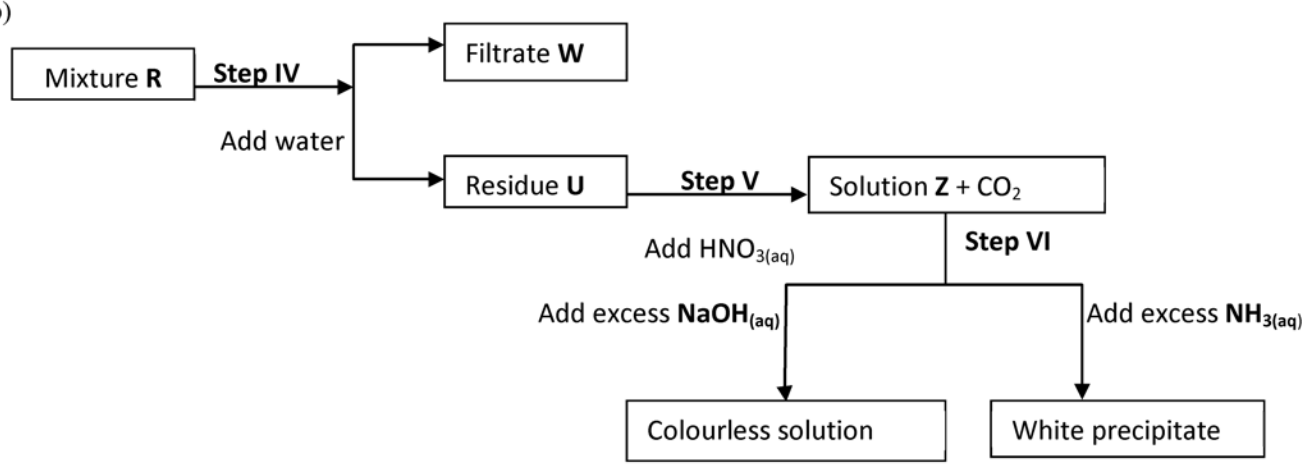
(a) Write the equation of the reaction at cathode. (1 mark)
(b) Why is the anode made of graphite in this case instead of steel which is a better conductor of electricity? (1 mark)
(c) State the function of Steel gauze diaphragm. (1 mark)
(d) Give reasons why large quantities of electricity is required for this process. (1 mark)
(e)Why is it necessary to add calcium chloride to the electrolyte? (1 mark)
(f) Write a chemical equation for the reaction between sodium metal and water. (1 mark)
(g) Give one use of gas M. (1 mark)

7. (a) The flow charts below show an analysis of a mixture **R** that contains two salts. Study the analysis and answer the questions that follow:-



(i) State:-
I. The condition in **step I.** (1 mark)
II. The process in **step II.** (1 mark)
(ii) A small portion of mixture **R** is added to dilute nitric (V) acid in a test-tube. What would be observed? (1 mark)
(iii) Write an equation for the reaction between the cation in filtrate **X** and ammonia solution. (1 mark)
(iv) Explain how water vapour in **step I** could be identified. (1 mark)

(b)



(i) State and explain the conclusion that can be made from **step IV** only. (2 marks)
(ii) Name the anion present in residue **U**. (1 mark)
(iii) Identify the solute present in filtrate W. (1 mark)
(iv) From the flow chart in **(a)** and **(b);** Write the formulae of cations present in mixture **R.** (1 mark)

COMPLIANT PREPARATORY **EXAMINATION**
233/3
CHEMISTRY
PRACTICAL
CONFIDENTIALINSTRUCTIONS

Provide each student with the following items:

Thermometer (-10 ^{0}C - 110 ^{0}C)
Six clean dry test-tubes
About 100 cm^3 solution labeled **P**
About 100 cm^3 solution labeled **Q**
About 100 cm^3 solution labeled **R**
250 cm^3 plastic beaker
Phenolphthalein indicator supplied with a dropper
Two conical flasks
Burette (50 cm^3)
Pipette (25 cm^3)
100 cm^3 measuring cylinder
Pipette filler
0.5 g of solid **T**
2.5 g of solid **W** (weighed accurately)
Means of labeling
White tile
Distilled water
Stand
A piece of tissue paper
Rubber band
Means of heating
Boiling tube
Test tube holder
Red and Blue litmus paper

Access to:
0.1 M $Pb(NO_3)_2$ with a dropper
1 M HCl, with a dropper
1 M H_2SO_4 solution, with a dropper
2 M NaOH solution, with a dropper

NB:
Solid **T** - Barium nitrate
Solid **W** - Potassium chlorate, $KClO_3$
Solution **P** - 0.2 M Hydrochloric acid
Solution **Q** - 1 M Sodium hydroxide solution
Solution **R** - 1 M Hydrochloric acid solution

COMPLIANT PREPARATORY EXAMINATION
233/3
CHEMISTRY PRACTICAL
PAPER 3
TIME: 2 ¼ HOURS

You are provided with:
- Solution **P**, 0.2 M monobasic acid, HA
- Solution **Q**, sodium hydroxide solution
- Solution **R**, 1 M hydrochloric acid solution

You are required to:
Standardise solution **Q**.
Determine the relative mass of A in the formula HA.
Determine the molar heat of neutralisation of sodium hydroxide.

Procedure I:
Pipette 25 cm^3 of **Q** into a clean dry 250 ml beaker. Measure accurately 100 cm^3 of distilled water using a 100 cm^3 measuring cylinder and add it to solution **Q** in the beaker. Shake well and label this as solution **S**.
Pipette 25 cm^3 of solution **S** into a clean dry conical flask. Add 2 to 3 drops of Phenolphthalein indicator and titrate with solution **P**. Record your results in the table I below.
Repeat the procedure twice to obtain accurate results.

Table I

Titration number	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **P** used (cm^3)			

(4 marks)

(a) i) Determine the average volume of solution **P** used. (1 mark)
ii) Find the moles of solution **P** used. (1 mark)
iii) Find the moles of solution **S** in 25 cm^3 of the diluted solution. (1 mark)
iv) Determine the number of moles of sodium hydroxide contained in the 125 cm^3 of diluted solution **S**. (1 mark)
v) Determine the molarity of the original sodium hydroxide, solution **Q**. (1 mark)
vi) Given that solution **P** contains 7.3 g/l, calculate the value of A in the formula HA. (H = 1.0) (2 marks)

Procedure II:
Wrap a clean 250 ml plastic beaker with a tissue paper. Use a rubber band to hold firmly the tissue paper on the beaker. Measure exactly 50 cm^3 of solution **R** using 100 cm^3 measuring cylinder and record its steady temperature below. Transfer the solution into the beaker.
Rinse the measuring cylinder with distilled water. Measure exactly 50 cm^3 of solution **Q** and record its steady temperature. Add solution **Q** carefully to solution **R** while stiring. Record the highest temperature attained by the resulting mixture.

b) i) Temperature of **R** = ----------^0C (½ mark)
ii) Temperature of **Q** = ----------^0C (½ mark)
iii) Highest temperature of the mixture = ----------^0C (1 mark)

c) Calculate the:
i) Average temperature of the two solutions before they were mixed. (1 mark)
ii) The temperature change. (1 mark)
iii) The heat of the reaction. (Density of the solution = 1 g/cm^3, specific heat capacity = 4.2 $kJKg^{-1o}C^{-1}$) (1 mark)
iv) The molar heat of reaction of sodium hydroxide solution, **Q**. (1 mark)

2. You are provided with 2.5 g of solid **W**.
You are required to determine the solubility of solid **W**, at various temperatures.
Procedure:
Carefully transfer all of solid **W** into a dry clean boiling tube and add 10 cm^3 of distilled water from a burette. Heat the boiling tube and its contents gently with shaking until all the solid dissolves. Stop heating the solution when the entire solid dissolves. (**Do not spill the solution during heating**)
Place a thermometer in the solution and allow the solution to cool as you stir gently. Record the temperature at which crystals first appear in table 2. (The crystals appear as small shining particles)
Using the burette, add more 2.5 cm^3 of water to the solution and heat again until the entire solid dissolves. Allow the solution to cool while stiring with thermometer and record the temperature at which crystallization occurs.

Repeat the experiment each time adding 2.5 cm^3 of distilled water from the burette and complete table 2.

Table 2

Total volume of water (cm^3)	10.0	12.5	15.0	17.5	20.0	22.5
Mass of solid **W** (g)	2.5	2.5	2.5	2.5	2.5	2.5
Solubility of **W** in g/100g of water						
Temperature at which crystals appear (^oC)						

a) Complete the table by filling in the row for solubility of **W** and temperature at which crystals appear. (4 marks)

b) On the grid provided, draw a graph of solubility of **W** versus temperature. (3 marks)

c) Determine from the graph;

i) Temperature at which solubility is 24/100g of water. (1 mark)

ii) The solubility of **W** at 75 ^oC. (1 mark)

d) If a solution containing 30 g of **W** at 85 ^oC is cooled to 60 ^oC;

i) At which temperature will crystals first appear? (1 mark)

ii) What would be the total mass of the crystals obtained when the solution finally cools to 60 ^oC? (1 mark)

3. You are provided with solid **T**. Carry out the tests below, write your observations and inferences in table 3.

Table 3

Test	Observations	Inferences
(i) Put about half of solid **T**, into a clean, dry test tube and heat strongly.	(1mk)	(1mk)
(ii) Put all the remaining **T** into a clean test-tube and add distilled water until half-full. Shake well and divide the solution into four portions.	(1mk)	(1mk)
(iii) To the 1st portion add about five drops of 1M H_2SO_4 solution.	(1mk)	(1mk)
(iv) To the 2nd portion add 2 M NaOH solution drop-wise until in excess.	(1mk)	(1mk)
(v) To the 3rd portion add about five drops of 1M HCl solution.	(1mk)	(1mk)
(vi) To the 3rd portion add about five drops of 0.1M $Pb(NO_3)_2$ solution.	(1mk)	(1mk)

SUNSHINE
233/1
FORM 4
CHEMISTRY
PAPER 1
TIME: 2 HOURS

1. a) Explain why hydrogen has oxidation states of +1 and -1 in its compounds. (1mark)
   b) A piece of cover slip was weighted before and after a student made a mark on it using a pencil like of pure graphite. The masses were as shown below.
   Mass of cover slip before the mark = 1.804g
   Mass of cover slip after the mark was made = 1.9053g
   Determine the number of carbon atoms used to draw the circle. (C = 12, L = 6.02×10^{23}) (2 marks)
2. a) State the conditions under which copper reacts with sulphuric (VI) acid and give one equation for the reaction. (2 marks)
   b) When zinc granules are dropped into two separate solutions of dilute sulphuric (VI) and concentrated sulphuric (VI) acid, effervescence of a colourless gas occurs in each case. Give equations to represent the reactions that take place. (2 marks)
3. The symbols for two isotopes of iron are shown below
   and
   i) How do this two isotopes differ in their atomic structure (1mark)
   ii) Determine the number of neutrons present in one atom of (1mark)
   iii) Determine the number of electrons in one atom of Fe^{3+} (1mark)
4. (i) Distinguish between a weak acid and a strong acid giving an example of each. (2 marks)
   (ii) Identify an acid in the forward reaction given by the equation below: (1 mark)

$$4\,(aq) \qquad (l) \qquad 4\,(aq) \qquad (aq)$$

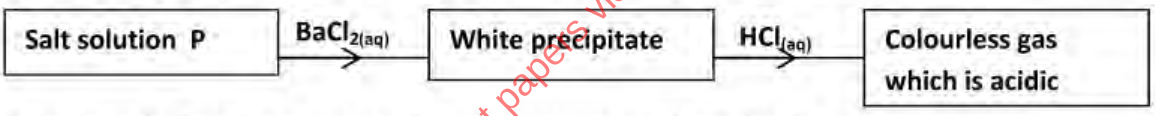
5 During the electrolysis of dilute sulphuric (VI) acid the volume of hydrogen gas collected is twice the volume of oxygen gas. Using half equations justify the above statement. (2mks)

6. The following table gives the melting points of oxides of elements in period 3. Study it and answer the questions that follow:-

Formula of oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3
Melting point (°C)	1190	3080	2050	1750	560	-73

   (i) Explain the difference in melting points of MgO and P_4O_{10} (2marks)
   (ii) Name the compound in the above table that will dissolve both in dilute hydrochloride acid and dilute sodium hydroxide. (1mark)

7. Study the scheme below and use it to answer the questions that follows.

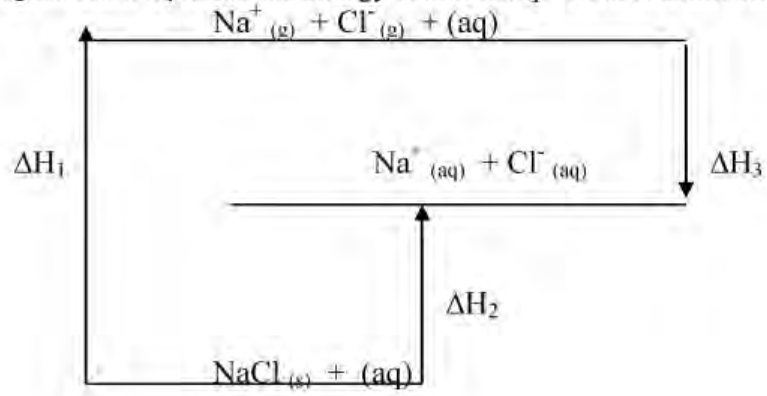


   Write down the formulae of two possible anions present in salt solution **P**. (2mks)

8. Hydrogen sulphide is a highly toxic and flammable gas and is usually prepared in the fume chamber.
   a) Name any two reagents that can be used to prepare hydrogen sulphide in the laboratory. (1mk)
   b) Hydrogen sulphide could be used to produced sulphur as shown in the equation below:
   $2H_2S_{(g)} + SO_{2(g)} \rightarrow 3S_{(s)} + 2H_2O_{(l)}$
   In the equation above, identify the reducing agent and give a reason for your answer. (1mk)
   c) Other than Vulcanisation of rubber, identify any other uses of Sulphur. (1mk)

9. Dry powdered sodium hydrogen carbonate can be used to extinguish electrical fires.
   With aid of equations, explain how sodium hydrogen carbonate plays this role. (2 marks)

10. The diagram below represents the energy relationship when sodium chloride is dissolved in water.



(a) Write an expression to show how ΔH_1, ΔH_2 and ΔH_3 are related. (1 mark)

(b) State the name of enthalpy change represented by

I) ΔH_3 (1 mark)

II) ΔH_1 (1 mark)

11. Describe how a dry sample of barium sulphate could be prepared in the laboratory starting with sodium sulphate solution, barium carbonate and 50% dilute nitric (V) acid. (3 marks)

12. Study the bond energies given below to answer the question that follows.

Bond	Bond energy ($kJmol^{-1}$)
H – H	432
C = C	610
C – C	346
C – H	413

Butene can be converted into butane in the equation:

$CH_3CH_2CH = CH_2 + H_2 \rightarrow CH_3CH_2CH_2CH_3$

Determine the enthalpy change in the reaction. (3marks)

13. The following table shows the P^H values of solutions **A B** and **C**

Solution	A	B	C
pH	2	7	11

(a) Which solution is likely to be magnesium chloride. Give a reason. (1mk)

(b) Identify the solution in which a sample of aluminium chloride is likely to be when dissolved in water. Explain (2mks)

14. The structure below represents two cleansing agents, L_1 and L_2.

$L_1 \rightarrow$ $R - CH_2 - CH_3$ with $OSO_3^- Na^+$

$L_2 \rightarrow R - COO^- Na^+$

(i) Identify each of the two cleansing agents, L_1 and L_2. (2 marks)

(ii) State a disadvantage of each of the above cleansing agents. (2 marks)

15. A volume of $15cm^3$ of ethane gas (C_2H_4) was exploded with $50cm^3$ of oxygen. If both volumes were measured at the same temperature and pressure, calculate the volume of the resulting gaseous mixture.

(i) Write the equation of the reaction for the combustion of ethane. (1mark)

(ii) Calculate the volume of gaseous mixture. (2marks)

16. Two papers **A** and **B** were placed at different levels of a non-luminous flame. Paper **A** was placed at the lowest part of the flame while **B** was placed at the tip.

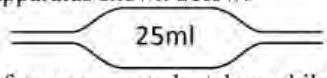
(a) Indicate **below** the observations made on each paper. (2 marks)

Paper **A**

Paper **B**

(b) Explain the observations made on paper **A**. (1 mark)

17. (a) Name the apparatus shown **below**. (1 mark)



(b) Sate **one** safety measure to be taken while using the apparatus shown. (1 mark)

(c) State the use of this apparatus in the laboratory. (1 mark)

18. A $25cm^3$ bubble of methane gas was trapped at the bottom of the North Sea bed at a temperature of -13^oC under a pressure of 1100kPa. The bubble was dislodged and rose to the surface at a pressure of 100kPa and a temperature of 15^oC. Calculate the volume of the bubble at the surface. (2 marks)

19. Water gas and producer gas are collectively known as fuel gases. Producer gas is a mixture of carbon (II) oxide and nitrogen gas.

a) Name the components of water gas. (1 mark)

b) State one advantage of using water gas over producer gas. (1 mark)

c) Write the overall equation for the combustion of water gas. (1mark)

20. One of the ways ice is removed from the road surface to improve road safety during severe winters in Europe etc. is by spreading salts on the frozen surfaces.

(a) How does this work? (1 mark)

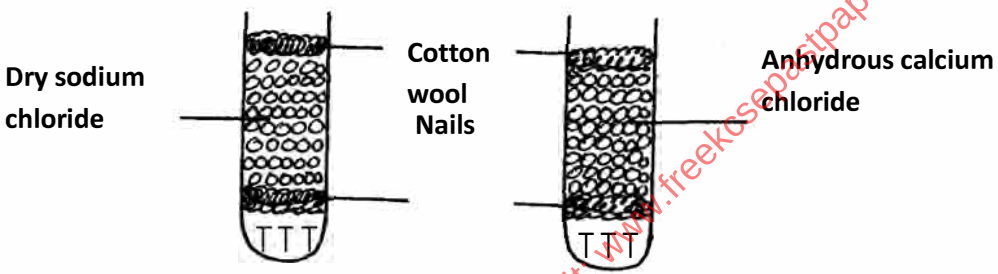
(b) Name an application of the above in the Chemical Industry. (1 mark)

21. State why one feels colder when ethanol is put on one's skin than when it is water put (1mark)

22. (i) What is a fume chamber. (1mark)

(ii) State 2 uses of fume chamber in a school laboratory (2marks)

23. Lithium burns in oxygen to form the ionic compound lithium oxide.
    (i) State the colour of the flame when lithium burns. (1mark)
    (ii) Write the formula of each of the ions in lithium oxide. (2marks)
    Lithium ion .....
    Oxide ion .....
24. In industry, ethene is converted to ethanol by reacting it with steam in the presence of a catalyst.
    (i) Name the catalyst used. (1mark)
    (ii) Ethanol can also be made by fermentation. Describe how this is done. (2marks)
    (iii). Ethanol is converted to ethyl ethanoate by warming it with ethanoic acid in the presence of a catalyst. How can a student detect the formation of ethyl ethanoate in this reaction? (1mark)
25. Sodium hydroxide reacts with both iron(II) chloride and with iron(III) chloride. Describe how you could use sodium hydroxide solution to distinguish between solid samples of iron(II) chloride and iron(III) chloride. Give brief details of what you would do and what you would observe in each case (3marks)
26. When chlorine is added during the water purification process, the water becomes acidic.
    i) Why is chlorine added during water purification process (1mark)
    ii) Sugest why lime water is added after chlorination (1mark)
27. Describe how hydrochloric acid and lime water can be used to test for the presence of carbonate ions in an unknown solution. (2marks)
28. In a class experiment, a student prepared Nitrogen (IV) oxide gas in order to investigate its properties.
    a) Name the reagents used in the preparation of Nitrogen (IV) oxide gas. (2marks)
    b) State one property of Nitrogen (IV) oxide gas that facilitates its transportation to industries. (lmark)
29. Study the diagram below and answer the questions that follow.



    a) State and explain the observations made after two weeks. (2marks)
    b) Give **one** reason for Silver plating an Iron spoon (1mark)

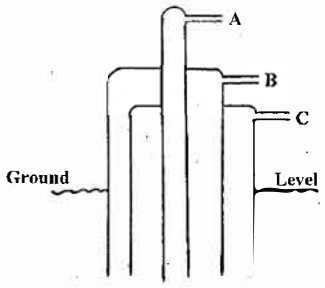
SUNSHINE SECONDARY SCHOOL
233/ 2
CHEMISTRY PAPER 2
(Theory)
2017
TIME: 2 HRS

1. Study the table below and answer the questions that follow. The letters do not represent the actual symbols of the element.

Formula of ion	Electronic configuration
E^{2+}	2
D^{-}	2.8
Cl^{-}	2.8.8
B^{3+}	2.8

(a) Select elements found in:
(i) The same group (1mk)
(ii) Period three (1 mk)
(iii) What is the family name given to the group number to which element **B** belongs (1mk)
(b) With reasons compare the atomic radius of elements **B** and **A**. (2 mks)
(c) State **two** industrial uses of element **B**. (2 mks)
(d) With reasons, compare the reactivity of **E** and **A**. (2 mks)
(e) Write the formula of the compound formed when **D** and **A** react. (1mk)
(b) What type of bond is formed when element E reacts with oxygen. Give a reason or your answer. (2mks)

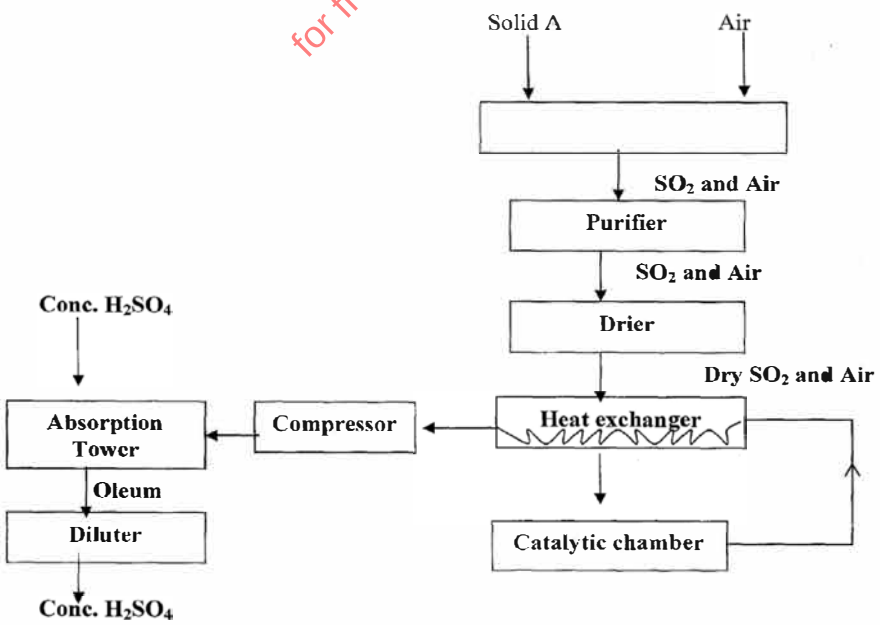
2. (a) The diagram below represents the extraction of sulphur by the frasch process.



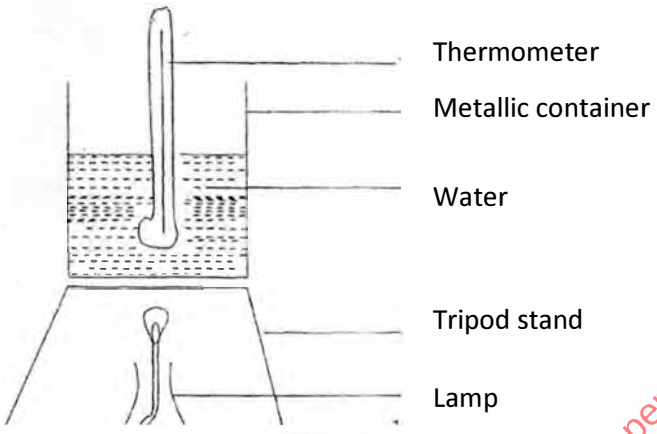
(i) Identify and state the use of the substances that pass through tubes A and C (4mks)
(ii) Rhombic and monoclinic are Allotropes of sulphur. They are inter convertible as shown below.

$$\text{Rhombic} \underset{}{\overset{96\ ^{\circ}C}{\rightleftharpoons}} \text{Monoclinic}$$

What does the temperature 96°C represent. (1 mk)
iii) State the difference in crystalline appearance between rhombic and monoclinic crystals. (1 mk)
(b) The following scheme represents the steps followed in the contact process, study it and answer the questions which follow.



a) Name **two** possible identities of solid A. (l mk)
(ii) Name **two** impurities removed by the purifier. (1mk)
(iii) Why is it necessary to remove impurities? (1mk)
iv) Write the chemical equations for the reactions taking place. (2mks)
a) Catalytic chamber
b) Absorption tower
v) Explain why SO_3 is absorbed in concentrated sulphuric (VI) acid instead of water. (1mk)
3. (a) i) Apart from ethanol, name two liquid fuels. (1mk)
ii) State **two** factors that should be considered when choosing a fuel for cooking. (2mks)



During the experiment, the data given below was recorded.
Volume of water = $500cm^3$
Initial temperature of water = 25.0°C
Final temperature of water 46.5°C
Mass of ethanol + lamp before burning 125.5g
Mass of ethanol + lamp after burning = 124.0g
Calculate;
(i) Heat evolved during the experiment (Density of water = lg/cm^3, specific heat capacity of water = 4.2J/g/k. (3mks)
(ii) Molar heat of combustion of ethanol (C 12.0, 0 = 16.0, H = 1.0) (2mks)
(iii) Write the thermochemical equation for the complete combustion of ethanol. (1 mk)
(iv) The experiment value of molar heat of combustion of ethanol obtained in (b) (ii) above is lower than the theoretical value. Give **two** reasons for this variation. (2mks)
(v) Why is the water in the container continuously stirred with thermometer? (1mk)
b) The hydration energy of Al^{3+} and Cl^- are $-4690 kJmol^{-1}$ and $-364kJmol^{-1}$ respectively. The heat of solution of aluminium chloride is $-332kJ\ mol^{-1}$.
i) Draw an energy cycle diagram to represent the above information. (1mk)
ii) Calculate the lattice energy of aluminium chloride (2mks)
3. a) A current of 0.75 Amperes was passed through a solution of chromium for one hour and four minutes in the process of electroplating an iron spoon. The mass of chromium deposited on the spoon was 0.52g (1F = 96500C, Cr = 52)
i) Calculate the quantity of electricity passed. (1mk)
ii) Deduce the charge of the Chromium ion. (3mks)
iii) How many moles in chromium were deposited? (1 mk)
iv) Draw a well labeled diagram to show how the spoon was electroplated (3mks)
b) Below is a simplified diagram of a Down's cell used for the manufacture of Sodium metal. Study it and answer the questions that follow.
a) Name the substance the anode is made of (1mk)
b) Explain your answer in (a) above (1mk)
c) What is the role of the diaphragm in Down's cell (1mk)
d) In Down's cell for the manufacture of Sodium metal, Calcium chloride salt is added to lower the melting point from 800^0C to 600^0C. Explain why it is necessary to lower the melting point (1mk)
4. Complete the diagram to show how dry hydrogen chloride gas is collected. (2marks)
(b) Identify liquid **Q** (1mark)
(c) Write a balanced equation for the reaction that produces hydrogen chloride gas in the above experiment (1mark)
(d) State the effect of dry hydrogen chloride gas on
(i) Dry blue litmus paper (1mark)
(ii) Wet blue litmus paper (1mark)
(e) Calculate the volume of hydrogen chloride gas produced if 120g of sodium chloride was used with excess of liquid Q at S.T.P .(Na=23,Cl=35.5,H=1.0,S=3)molar gas volume = 22.4 litres at s.t.p). (3marks)

(f) State and explain the observations made when hydrogen chloride gas is bubbled through silver nitrate solution. (2marks)

5. Below gives a summary of a small part of organic chemistry. Use it to answer the accompanying questions.

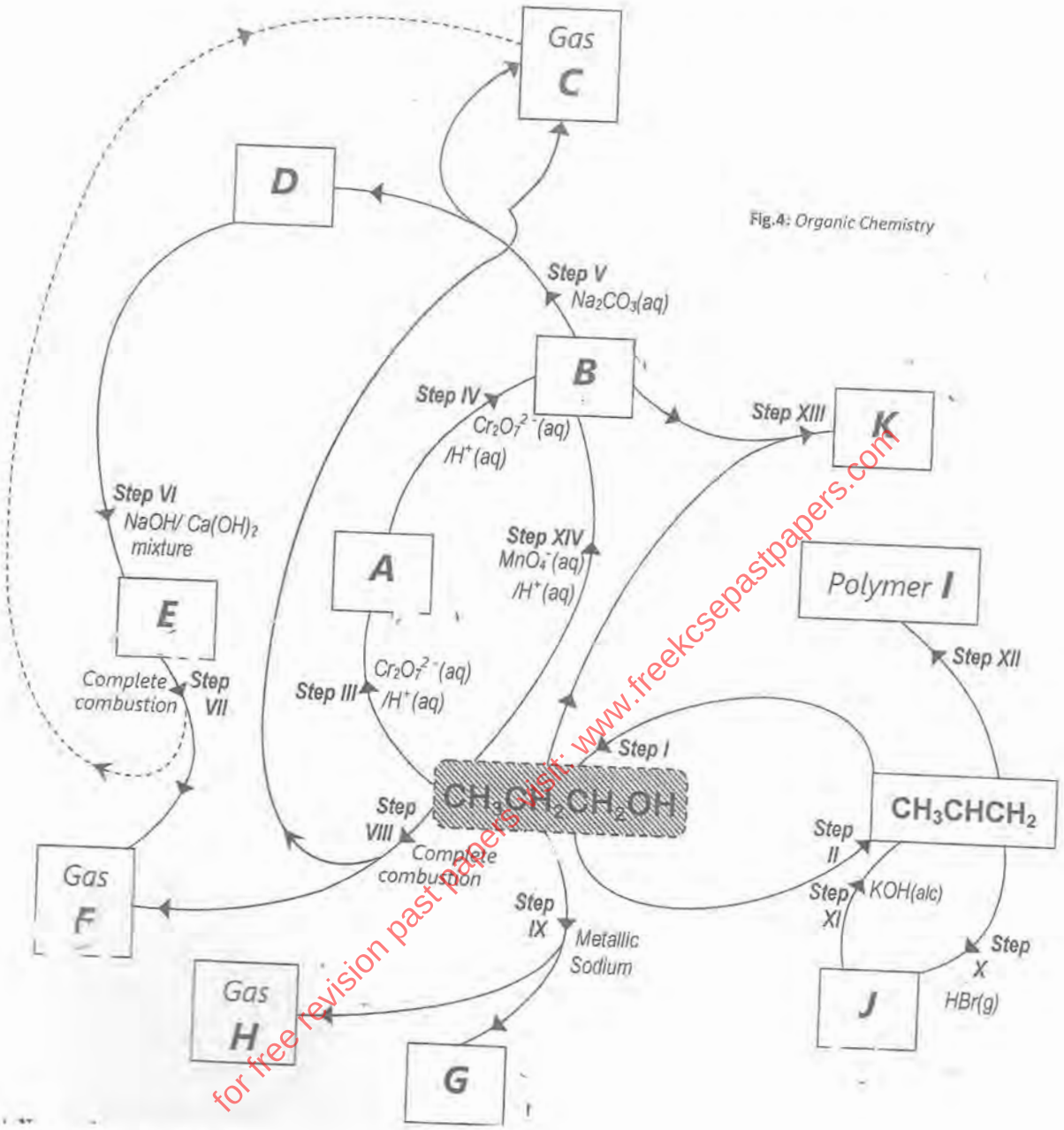


Fig.4: *Organic Chemistry*

a) Name the species labelled:

i) A
ii) B
iii) Gas C
iv) D
v) E
vi) Gas F
vii) G
viii) Gas H

b) i) step I:
ii) step II:
iii) step III:
iv) step VI
v) step X:
vi) step III:

c) Draw the structure and give the name K (2mks)

d) Name polymer I and draw a part of its structure showing 3 repeating units. (2mks)

e) Write the equation showing step VI. (1mk)

f) Explain the observations that would be made during step XIV. (2mks)

g) Name the possible isomers of J. (2mks)

h) Attempt an equation for step XI. (1mk)

SUNSHINE SECONDARY SCHOOL
233/3
CHEMISTRY
PAPER 3
CONFIDENTIAL

1. About 50cm^3 of solution V
2. About 50cm^3 of solution K
3. 1.89g of solid P oxalic acid accurately weighed and placed in a stopped container.
4. Thermometer
5. 5 dry test tubes in a test tube rack
6. Spatula
7. Bunsen burner
8. About 120cm^3 of solution M
9. About 90cm^3 of solution F
10. Liquid X-ethanol
11. Solid Q – 1g of solid zinc sulphate
12. Blue and red litmus papers.
13. A boiling tube.
14. Glass rod

Access to;

a) Bunsen burner
b) 2M sodium hydroxide with a dropper
c) 2M Ammonium hydroxide
d) Barium nitrate solution
e) Lead nitrate solution
f) Dilute nitric v acid
g) Methyl orange with a dropper.
h) Phenolphthalein indicator in a bottle dropper
i) About 15cm3 of liquid X
j) Acidified potassium dichromate (VI) with a dropper.
k) Acidified potassium mangate (vii)
l)

1. Solution V is a prepared by dissolving 63g of oxalic acid to make one litre of solution.
2. Solution K is prepared by dissolving 16g of sodium hydroxide pellets to make one litre of solution.
3. Solution M is prepared by dissolving 17cm^3 of concentrated hydrochloric acid to make one litre of solution.
4. Solution F is prepared by dissolving 15.3g of hydrated sodium hydrogen carbonate to make one litre of solution.

SUNSHINE SECONDARY SCHOOL
233/3
CHEMISTRY
PAPER 3
PRACTICAL
2017
$2^{1}/_{4}$HRS

1 You are provided with:
Solution M 0.2M hydrochloric acid,
Solution F containing 15.3g per litre of basic compound $G_2X.H_2O$.
You are required to determine the relative atomic mass of G.

PRECEDURE:
Place solution M in a burette ,pipette 25cm^3 of solution F into a 250cm^3 conical flask. Add two drops of methyl orange indicator and titrate. Record your results in the table below. Repeat the procedure two more times and complete table I.
Table I

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution M used (cm^3)			

(4mks)

a) What is the average volume of solution M.? (1mk)
b) Given that one mole of F reacts with 2moles of M. Calculate the;
i) Number of moles the basic compound,G_2X, $10H_2O$ in the volume of solution F used. (2mks)
ii) Concentration of solution F in moles per litre. (2mks)
iii) Relative formula mass of the basic compound, $G_2X.10H_2O$. (1mk)
iv) Relative atomic mass of G (Relative formula Mass of X=60 , atomic mass of H=1.0 , O=16.0). (1mk)

2 You are provided with:
1 1.89g of solid P, solid P is adiabatic acid H_2X.
2 0.5M Solution of the dibasic acid , H_2X , Solution V.
3 Sodium hydroxide, Solution K.
You are required to determine:
a) i) the molar heat of solid P.
ii) the heat of reaction of one mole of the dibasic acid with sodium hydroxide.
b) Calculate the heat of reaction of solid H_2X with aqueous sodium hydroxide.

PROCEDURE I.
Place 30cm^3 of distilled water into a 100ml beaker. Measure the initial temperature of the water and record it in the table II below. Add all the solid P at once; stir the mixture carefully with the thermometer until all the solid dissolves. Measure the final temperature reached and records it in the table II

Table II

Final temperature (^{o}c)	
Initial temperature (^{o}c)	

(2mks)

a) Determine the change in temperature ΔT_1 (1 mk)
b) Calculate the:
i) Heat change when H_2X dissolves in water, (Assuming the heat capacity of the solution is 4.2Jg^{-1}K^{-1} and density is 1g/cm^3) (2mks)
ii) Number of moles of the acid that were used. (Relative formula mass of H_2X is 126) (1mk)
iii) Molar heat of solution ΔH_1 solution of the acid H_2X. (1mk)

PROCEDURE II.
Place 30cm^3 of solution V into a 100cm^3 beaker. Measure the initial temperature and record it in table III below. Measure 30cm^3 of sodium hydroxide, solution K. Add all of the 30cm^3 of t of solution K at once to V in the beaker. Stir the mixture with the thermometer. Measure the final temperature reached and record it in table III.

Table III.

Final temperature (^{o}C)	
Initial temperature (^{o}C)	

(1 ½ mks)

a) Determine the change in temperature, ΔT_2. (½ mk)
b) Determine the:
i) Heat change for the reaction (Assume the heat capacity of the solution is 4.2Jg^{-1}k^{-1} and density is 1g/cm^3 (2mks)
ii) Number of moles of the acid used (H_2X). (1mk)
iii) Heat of reaction , ΔH_2 of one mole of the acid H_2X with sodium hydroxide
(1mk)
d) Given that,

ΔH_1 is the heat for reaction $H_2X_{(s)} \xrightarrow{water} 2H^+_{(aq)} + X^{2-}_{(aq)}$

ΔH_2 is the heat for the reaction $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$

Calculate ΔH_3 for the reaction $H_2X_{(s)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + X^{2-}_{(aq)}$ (2mks)

QUESTION 3A

a) You are provided with solid Q. Carry out the test indicated below and record your observations and deductions in the table below.

i) Place a spatula full of Q in a boiling tube. Add about $10cm^3$ of distilled water and shake. Divide the resultant mixture into 4 portions.

Observation	Deductions
(1mk)	(1mk)

b) To the first portion add Barium nitrate solution followed by dilute nitric acid.

Observation	Deduction
(2mks)	(1mk)

c) To the second portion add 2-3 drops of sodium hydroxide till in excess.

Observation	Deduction
(2mks)	(1mk)

d) To the third portion add 2-3 drops of ammonia solutions till in excess.

Observation	Deduction
(2mks)	(1mk)

e) To the 4^{th} portion add $Pb(NO_3)_2$ solution

Observation	Deduction
(1mk)	(1mk)

QUESTION 3B

You are provided with liquid X. You are required to carry the test below.

a) Place about $1cm^3$ of substance X in a test tube. Add a small piece of sodium carbonate solid.

Observation	Deduction
(1mk)	(1mk)

b) To about 3cm3 of X in a boiling tube, add acidified potassium chromate (vi) and warm.

Observation	Deduction
(1mk)	(1mk)

c) To about 3cm3 of X add acidified potassium manganate (vii)

Observation	Deduction
(1mk)	(1mk)

NAKA EVALUATION TEST.
Kenya Certificate of Secondary Education (K.C.S.E)

233/1
CHEMISTRY
PAPER 1
THEORY
TIME: 2 HOURS

1 Two papers A and B were placed at different levels of a non-luminous flame. Paper A was placed on the lowest part of the flame while B was placed at the tip.

a) Indicate below the observations made on each paper. (2mks)

Paper A. Paper B.

b) Explain the observations made on paper A. (1mk)

2 The table below shows the number of drops of soap solution needed to lather with $10cm^3$ of water.

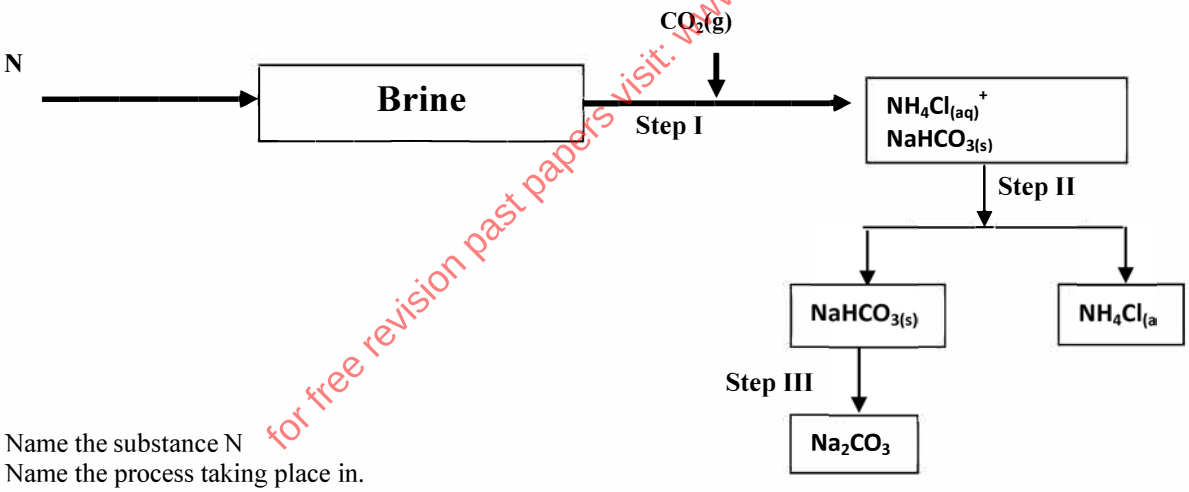
Sample	Cold water	Heated water
A	5	5
B	6	2
C	2	2

a) Identify the anions likely to be in: A and B. (2marks)

b) State **TWO** methods used in removing permanent hardness of water.(1mk)

3 $20cm^3$ of sodium hydroxide solution containing $8.0g/dm^3$ were required for complete neutralization of 0.18g of a dibasic and H_2X.Calculate the relative molecular mass of the acid. (3mks)

4 The flow chart below shows some of the stages in the manufacture of the sodium carbonate by the Solvay process. Use it to answer the questions that follow;



a) Name the substance N (1mk)

b) Name the process taking place in.

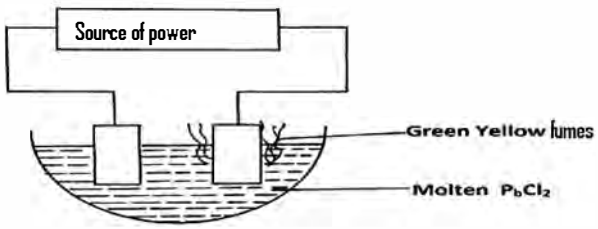
i) Step II (1mk)

ii) Step III (1mk)

c) Write an equation for the reaction producing Sodium Carbonate. (1mk)

5 The solubility of copper (II) Sulphate at 75^0_C is 55g/100g of water and 19g/100g of water at 15^0_C.What mass of crystals would be deposited if a saturated solution in 150g of water is cooled from 75^0_C to 15^0_C. (3mks)

6 Use the set up below to answer the questions that follow.



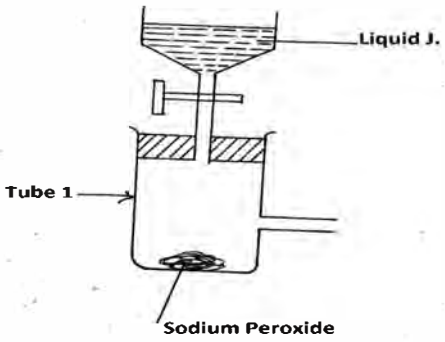
a) On the diagram label the cathode. (1mk)

b) Write the equation of the reaction on the cathode. (1mk)

7 What is fuel? (1mk)

a) Given that the enthalpy of combustion of methane is 890KJmol^{-1} and that of ethanol is 1368KJmol^{-1}.Which of the two is a better fuel? Explain. (2mks)

8 The diagram below represents parts of a set up for preparing and collecting a dry sample of oxygen gad.



a) Complete the diagram. (1mk)
b) Write the equation for the reaction in tube 1. (1mk)
c) State **ONE** commercial use of the oxygen gas. (1mk)

9 The table below shows some elements and their atomic numbers. The letters do not represent the actual symbols of the elements. (1mk)

Element	X	Y	Z	R	S	Q	T
Atomic Number	11	10	20	13	14	4	8

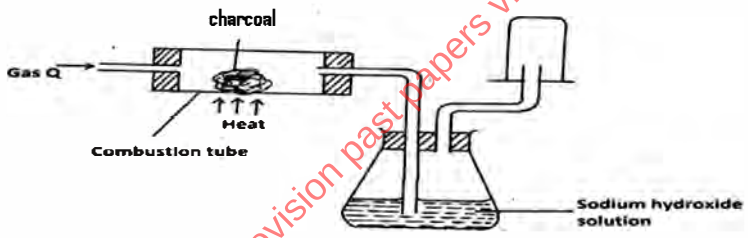
a) From the given letters of elements select two elements with the same chemical properties. (1mk)
b) Write the formulae of a compound formed when element S reacts with element T. (1mk)
c) Identify the most stable element. (1mk)

10 A dynamic equilibrium between dichromate and chromate ions is established as shown in the equation below.

$Cr_2O_7^{2-}{}_{(aq)} + 2OH^-_{(aq)} \rightleftharpoons 2CrO_7^{2-}\text{-}(aq) + H_2O_{(l)}$

a) What is meant by a dynamic equilibrium. (1mk)
b) State and explain the observation that would be made if a few pellets of sodium hydroxide are added to the equilibrium mixture. (2mks)

11 The diagram below shows an experimental set up for preparing Carbon (II) Oxide. Study it and answer the questions that follow.



a) State the role of sodium hydroxide solution in the set up. (1mk)
b) State the reason why Carbon (II) Oxide is collected in the manner illustrated (1mk)
c) Describe a simple test that can be used to distinguish between carbon (II) oxide and carbon (IV) oxide. (1mk)

12 a) State the Graham's law of diffusion. (1mk)
b) A sample of unknown compound Z is shown by analysis to contain sulphur and oxygen. The gas requires 28.3seconds to diffuse through aperture into a vacuum. An identical number of oxygen molecules pass through the same aperture in 20seconds.Determine the molecular mass of Z. (O=16,S=32). (2mks)

13 Explain why aluminum chloride is fairly soluble in organic solvents while anhydrous magnesium chloride is in soluble. (2mks)

14 a) Define half-life of radioisotopes. (1mk)
b) X grammes of a radioisotopes takes 100days to decay to 20g.If half-life of the same element is 25days, Calculate the initial mass X of the radioisotope. (2mks)

15 Explain why the $_PH$ of 0.1M hydrochloric acid is 1.0 while that of 1.0M ethanoic acid is 5.0. (2mks)

16 Write down the property of concentrated Sulphuric (VI) acid shown in the following reactions.

a) $H_2C_2O_4.2H_2O_{(l)} \xrightarrow{\text{conc. } H2SO4} 2H_2O_{(l)} + CO_{2(g)} + CO_{(g)}$
Property. (1mk)

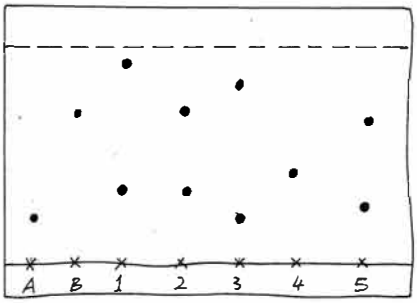
b) $C_{(s)} + 2H_2SO_{4(l)} \longrightarrow CO_{2(g)} + 2H_2O(l) + SO_{2(g)}$
Property. (1mk)

18 When excess chlorine gas is bubbled through dilute sodium hydroxide solution, the resulting solution acts as a bleeching agent.

a) Write an equation for the reaction between chlorine gas and sodium hydroxide. (1mk)

b) Explain how the resulting solution acts as a bleeching agent. (2mks)

19 During Olympics, urine sample of five short distance runners were taken and tested for the presence of two illegal steroids by paper chromatography. Methanol was used as the solvent. A chromatogram from the test appeared as shown below. Study the chromatogram and answer question that follow.



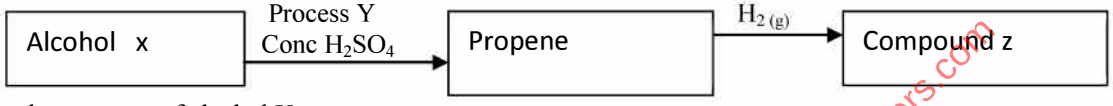
KEY

SPOT A - STEROID A
SPOT B – STEROID B
SPOT 1 - ATHLETE 1
SPOT 2 - ATHLETE 2
SPOT 3 – ATHLETE 3
SPOT 4 – ATHLETE 4
SPOT 5 – ATHLETE 5

a) Which of the two steroids is most likely to be more soluble in methanol? Give a reason. (1mk)
b) Identify the athletes that tested positive for the illegal steroids. (2mks)

20 A carbonate was suspected to be an ore of iron. Describe how the presence of iron can be confirmed in the ore. (3mks)

21 Use the reaction scheme below to answer the questions that follow.



a) Draw the structure of alcohol X. (1mk)
b) Name the process Y. (1mk)
c) Write the molecular formula of the 5th member in which propene belongs. (1mk)

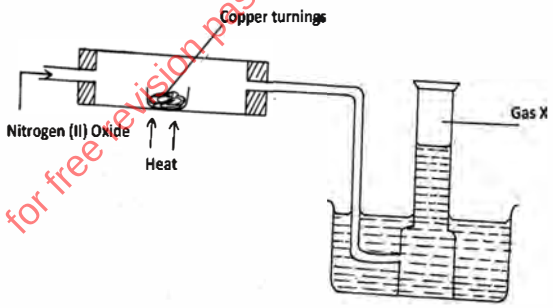
22 Describe how a solid sample of Lead (II) Sulphate would be prepared using the following reagents. Dilute Sulphuric (VI) acid, Nitric (V) acid, solid lead (II) Carbonate (3mks)

23 Give the following electrode potential.

	Eθ v
$A^{+}_{(aq)} + e^{-} \rightarrow A_{(s)}$	+0.76.
$B^{2+}_{(aq)} + 2e^{-} \rightarrow B_{(s)}$	-0.48
$\frac{1}{2} Q_{2\,(g)} + 2e^{-} \rightarrow Q^{2-}_{(aq)}$	+1.62

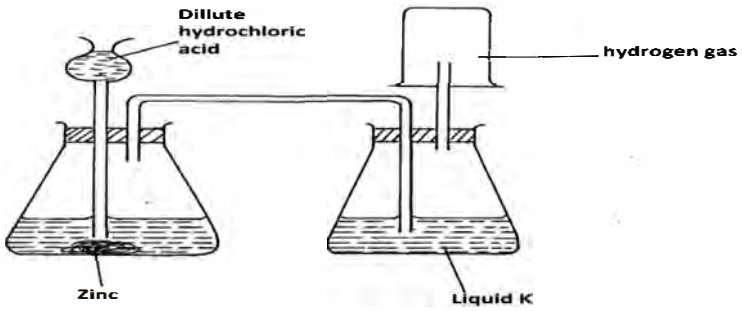
a) Determine the maximum E.M.F. that can be obtained by combining two of the given half cells. (1mk)
b) Write the cell representation for the cell in (a) above. (1mk)
c) What would be the electrode potential of A if B was made standard electrode. (1mk)

24 Study the set up below and answer the questions that follow.



a) Identify gas X. (1mk)
b) State the observation made in the combustion tube. (1mk)
c) Write equation for the reaction in combustion tube

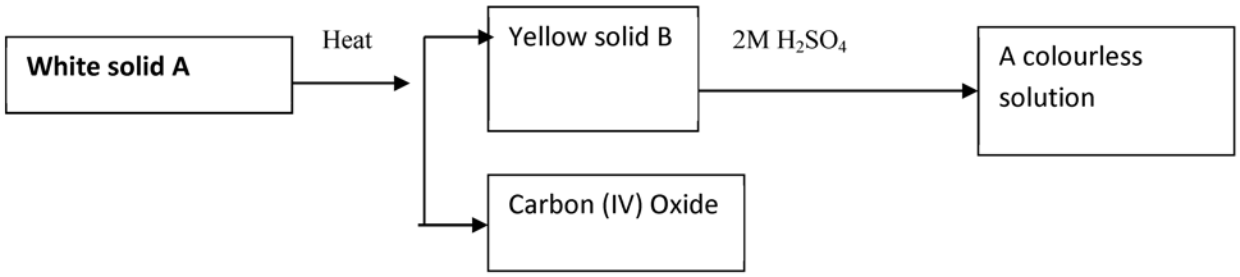
25 The diagram below represents an arrangement for preparing and collecting dry hydrogen. Study it and answer the questions that follow.



a) Write the equation for the reaction that produces hydrogen gas. (1mk)
b) Name the suitable substance that liquid K is likely to be. (1mk)

c) Explain why it is not advisable to use nitric (v) acid as an alternative to hydrochloric acid in the preparation experiment. (1mk)

26 The scheme below represents some reactions starting with a white solid A.



a) Identify the solids; A and B (2 marks)
b) Write an equation for the reaction between B and 2M Sulphuric acid. (1mark)
27 Using dots (.) and (x) show bonding in:
a) The compound formed when nitrogen reacts with fluorine (Atomic number F = 9 , N = 7) (2marks)
b) Sodium oxide (Atomic number Na = 11 , O = 8) (1mark)
28 An aide of potassium has a relative formula mass of 110, if 2.75g of the oxide contains 1.95g of potassium; determine the formula of the oxide. K = 39.0 , O = 16.0) (3marks)
29 Explain what happens when blue litmus paper is dipped in methylbenzene in which hydrogen chloride is bubbled. (2marks)
30 Give reason for use of aluminum in sufurias but not steam boilers. (2marks)

NAKA EVALUATION TEST.
Kenya Certificate of Secondary Education (K.C.S.E)

233/2
CHEMISTRY
PAPER 2
THEORY
TIME: 2 HOURS

1 The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.

V									A
B	F			G	Z	N	E		
W	J		T	L			H	C	
D	K						M		
Y									

a) What name is given to the family of the;
   i) Elements to which E, H and M belong? (1mk)
   ii) Elements to which F,J and K belong? (1mk)

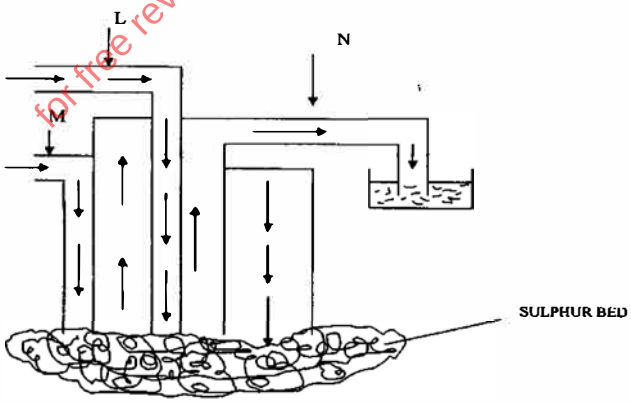
b) Write the chemical formula of the;
   i) Sulphate of T. (1mk)
   ii) Nitrate of J. (1mk)

c) Name the type of bond and structure formed between reactions of:
   i) D and N. (1mk)
      Bond……
      Structure……..
   ii) T and H. (1mk)
      Bond……
      Structure……

d) i) Ionic radius of element E is bigger than its atomic radius. Explain (2mks)
   ii) The Oxide of G has a lower melting point than the Oxide of L.Explain. (1mks)
   iii) Explain in terms of bonding and structure the following observation.
      There is an increase in melting and boiling points from W to T. (2mks)

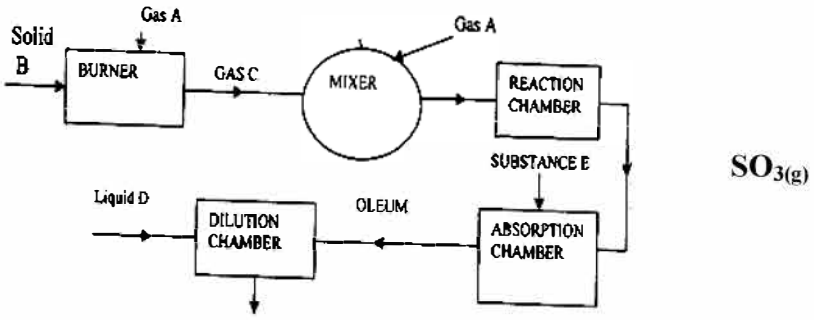
e) Using dot (·) and cross (X) diagram show bonding in ZV^{+}_{4}. (2mks)

2 a) The diagram below represents the extraction of sulphur from its underground deposits by the Frasch process. Study the diagram and answer the questions that follow.



   i) Name the substances that pass through pipes L,M and N. (3mks)
   ii) What is the purpose of the
      i) Superheated water. (1mk)
      ii) Hot compressed air. (1mk)

b) The flow chart below shows how sulphuric acid is produced on a large scale by contact process.



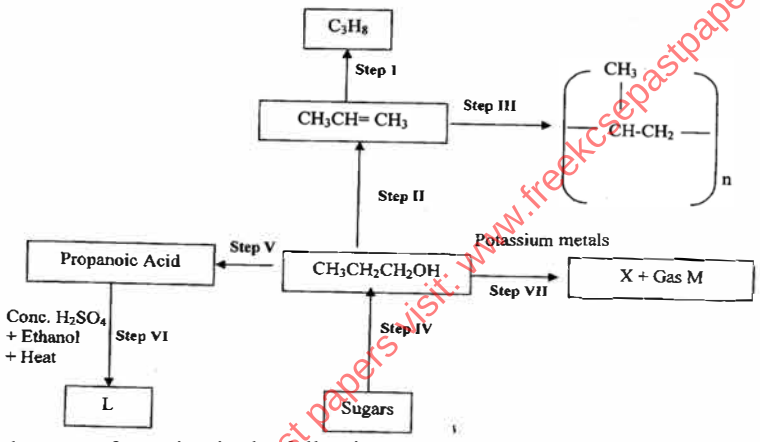
i) Identify:
   i) Gas A…… (1mk)
   ii) Solid B…… (1mk)
   iii) Gas C…… (1mk)
   iv) Substance E…… (1mk)

ii) Name the catalyst used in the reaction chamber. (1mk)

iii) Write a chemical equation for the reaction taking place in the dilution chamber. (1mk)

c) State **one** industrial use of sulphuric acid. (1mk)

3 Study the flow chart below and answer the question that follows:



a) i) Name the type of reaction in the following steps.
   I. Step III (½ mk)
   II Step IV (½ mk)

   ii) Name the important reagent and conditions in.
   Step I Reagent…….. (½ mk)
   Condition…….. (½ mk)
   Step II Reagent…….. (½ mk)
   Condition…… (½ mk)
   Step V Reagent…… (½ mk)
   Condition…… (½ mk)

b) i) Write a balance equation for the reaction taking place in VII(1mk)
   ii) Give the systematic name of substance L. (1mk)

c) Describe chemical tests used to differentiate between C_3H_8 and C_3H_6. (2mks)

d) i) If the relative molecular mass of compound formed in step III is 42,000.Determine the value of n in the compound.(C=12.0 , H=1.0) (2mks)
   ii) State one disadvantage of continued use of items made from the compound formed in stepIII. (1mk)

4 Solubility of potassium and copper II Sulphate were determined at different temperatures. The following data was obtained.

Temperature (^{0}C)		0	20	40	60	80	100
Solubility of 100g of water	**KNO_3**	12	30	75	125	185	250
	$CuSO_4$	15	20	35	45	65	80

i) On the graph paper provided; plot solubility curves for both salts, where solubility (vertical axis) is plotted against temperature. (4mks)

ii) Determine from the graph the solubility of each salt at 50^{0}C (1mk)
   I. KNO_3:
   II. $CuSO_4$ (1mk)

iii) At what temperature was the solubility of both salts equal? (1mk)

iv) Saturated solution of potassium nitrate at 70^{0}C was cooled to 20^{0}C.What mass of the crystals will be deposited? (1mk)

b) i) What is permanent hardness of water? (1mk)

ii) State two chemical substances that can be used to remove permanent hardness. (1mk)

c) Explain why aluminum sulphate solution is acidic. (1mk)

5 a) Use the bond energies given in the table below to calculate the enthalpy change for the reaction. (2mks)

Bond	C – H	C –Br	Br – Br	H - Br	C-C
Bond energy KJ/mol	413	280	193	365	343

$C_2H_{6(g)} + Br_{2(g)} \rightarrow C_2H_5Br_{(g)} + HBr_{(g)}$

b) Hydrogen peroxide decomposes according to the equation below;

$H_2O_{(l)} \rightarrow H_2O_{(l)} + \frac{1}{2} O_{2(g)}$; $\Delta H = -98KJ/mol$.

If 6.8g of hydrogen peroxide contained 75cm3 of solution with water were completely decomposed, determine the rise in temperature due to the reaction.(Specific heat capacity of water $=4.2Jg^{-1}K^{-1}$, density of water = $1g/cm^3$, O = 16 , H = 1). (2mks)

c) On the space provided below sketch the cooling curve that would be obtained when a boiling tube containing water at 80^0C is immersed in a freezing mixture maintained at -10^0C. (3mks)

d) Butane C_4H_{10} cannot be prepared directly from its elements but its standard heat of formation ($\Delta H^{\theta} f$) can be obtained directly. The following heats of combustion are given.

ΔH^{θ} c carbon (s) = -393KJ/mol

ΔH^{θ} c $H_2(g)$ = -286KJ/mol

ΔH^{θ} c C_4H_{10} = -2877KJ/mol

i) Draw an energy circle diagram linking the heat of formation of butane with its heat of combustion and the heat of combustion of its constituents elements. (2mks)

ii) Calculate the heat of formation of butane $\Delta H^{\theta} f(C_4H_{10})$. (2mks)

e) Given that the lattice enthalpy of potassium chloride is +690KJ/mol and hydration enthalpies of K^+ and Cl^- are -322KJ and -364KJ respectively. Calculate the enthalpy of solution of potassium chloride. (2mks)

6 a) Use the standard electrode potentials for elements A,B,C,D and E given below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Standard Electrode Potential				E^{θ} (Volts)
$A^{2+}_{(aq)}$	+	2e	$A_{(s)}$	-2.90
$B2+_{(aq)}$	+	2e	$B_{(s)}$	-2.38
$C^{+}_{(aq)}$	+	e	$\frac{1}{2} C_{2(g)}$	-0.00
$D^{2+}_{(aq)}$	+	2e	$D_{(s)}$	+0.34
$\frac{1}{2} E_{2(g)}$	+	e	$E^{-}_{(aq)}$	+2.87

i) Which element is likely to be hydrogen?Give a reason for your answer. (2mks)

ii) What is E^{θ} value of the strongest reducing agent? (1mk)

iii) In the space provided, draw a labeled diagram of the electrochemical cell that would be obtained when half – cell of element B and D are combined. (3mks)

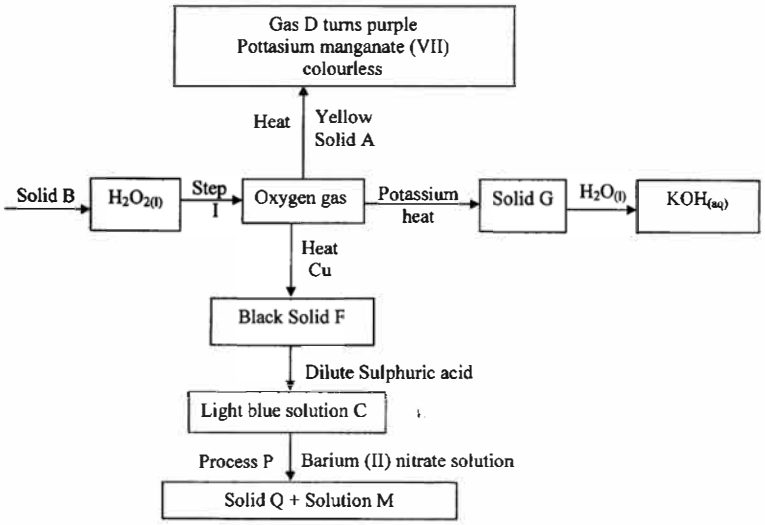
iv) Calculate the E^{θ} volume of the electrochemical cell constructed in (iii) above. (1mk)

b) During the electrolysis of aqueous copper (II) Sulphate using copper electrodes, a current of 0.2A was passed through the cell for 5hrs.

i) Write an ionic equation that took place at the anode. (1mk)

ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process. (Cu = 63.5 , IF = 96500C). (3mks)

7 The flow chart below represents preparation and properties of oxygen gas.Study it and answer the question that follow.



i) Identify the following substances (2mks)
   a. Solid A
   b. Gas D.
   c. Solid Q.
   d. Solution M.

ii) Write a chemical equation for the reaction in step I. (1mk)

iii) Write chemical equation for the formation of the following compound. (3mks)
   a. Solid G.
   b. Gas D.
   c. Light blue solution C.

iv) State the confirmatory test for oxygen gas. (1mk)

v) Write the ionic equation for reaction taking place in process P. (1mk)

vi) State one use of oxygen. (1mk)

NAKA JOINT EVALUATION TEST.
Kenya Certificate of Secondary Education (K.C.S.E)
233/3
CHEMISTRY
PAPER 3
PRACTICALS
2017
TIME: 2 ¼ HOURS

1 You are provided with:
Solution M 0.2M hydrochloric acid,
Solution F containing 15.3g per litre of basic compound $G_2X.H_2O$.
You are required to determine the relative atomic mass of G.

PRECEDURE:
Place solution M in a burette ,pipette 25cm^3 of solution F into a 250cm^3 conical flask. Add two drops of methyl orange indicator and titrate. Record your results in the table below. Repeat the procedure two more times and complete table I.
Table I

a) i)

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution M used (cm^3)			

(4mks)

ii) What is the average volume of solution M.? (1mk)

b) Given that one mole of F reacts with 2moles of M. Calculate the;
i) number of moles the basic compound,G_2X, $10H_2O$ in the volume of solution F used. (2mks)
ii) Concentration of solution F in mole per litre. (2mks)
iii) Relative formula mass of the basic compound, $G_2X.10H_2O$. (1 ½ mks)
iv) relative atomic mass of G (Relative formula Mass of X=60 , atomic mass of H=1.0 , O=16.0). (1 ½ mks)

2 You are provided with:
1 1.899g of solid P, solid P is adiabatic acid H_2X.
2 0.5M Solution of the dibasic acid , H_2X , Solution V.
3 Sodium hydroxide, Solution K.
You are required to determine:

a) i) the molar heat of solid P.
ii) the heat of reaction of one mole of the dibasic acid with sodium hydroxide.
b) Calculate the heat of reaction of solid H_2X with aqueous sodium hydroxide.

PROCEDURE I.
Place 30cm^3 of distilled water into a 100ml beaker. Measure the initial temperature of the water and record it in the table II below. Add all the solid P at once; stir the mixture carefully with the thermometer until all the solid dissolves. Measure the final temperature reached and records it in the table II

Table II

Final temperature (^{o}c)	
Initial temperature (^{o}c)	

a) Determine the change in temperature ΔT_1 (1½mks)
b) Calculate the:
i) heat change when H_2X dissolves in water, (Assuming the heat capacity of the solution is 4.2Jg$^o{}_K{}^{-1}$ and density is 1g/cm^3) (2mks)
ii) number of moles of the acid that were used. (Relative formula mass of H_2X is 126) (1mk)
iii) molar heat of solution ΔH_1 solution of the acid H_2X. (1mk)

PROCEDURE II.
Place 30cm^3 of solution V into a 100cm^3 beaker. Measure the initial temperature and record it in table III below. Measure 30cm^3 of sodium hydroxide, solution K.Add all of the 30cm^3 of t of solution K at once to V in the beaker. Stir the mixture with the thermometer. Measure the final temperature reached and record it in table III.

Table III.

a)

Final temperature (^{o}C)	
Initial temperature (^{o}C)	

(1 ½ mks)

b) Determine the change in temperature, ΔT_2. (½ mk)
c) Determine the:
i) heat change for the reaction (Assume the heat capacity of the solution is 4.2Jg-1$^{-1}{}_k{}^{-1}$ and density is 1g/cm^3 (2mks)
ii) Number of moles of the acid used (H_2X). (1mk)

iii) Heat of reaction , ΔH_2 of one mole of the acid H_2X with sodium hydroxide (1mk)

d) Given that,

ΔH_1 is the heat for reaction $H_2X_{(s)} \xrightarrow{water} 2H^+_{(aq)} + X^{2-}_{(aq)}$

ΔH_2 is the heat for the reaction $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$

Calculate ΔH_3 for the reaction $H_2X_{(s)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + X^{2-}_{(aq)}$ (2mks)

3 You are provided with solid S. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place about one third of solid S in a dry test tube. Heat the solid gently and the strongly. Test any gases produced with blue and red litmus papers.

Observations	Inferences
(2mks)	(1mk)

b) Dissolve the remaining portion of solid S in $8cm^3$ of distilled water.

i) Divide the solution into the first portions, to the first portion, add aqueous sodium hydroxide drop wise until in excess.

Observations	Inferences
(1mk)	(2mks)

ii) To the second portion , add aqueous ammonia dropwise in excess.

Observations	Inferences
(1mk)	(1mk)

iii) To the third portion , add $10cm^3$ of barium chloride solution.

Observations	Inferences
(1mk)	(1mk)

iv) To the forth portion , add about $1cm^3$ of Lead (II) nitrate solution.

Observations	Inferences
(1mk)	(1mk)

v) To the fifth portion, add about 2ml of hydrogen peroxide then about $1cm^3$ of sodium hydroxide solution.

Observations	Inferences
(1mk)	(1mk)

MOSTA JOINT EXAMINATION - 2017
Kenya Certificate to Secondary Education

233/1
CHEMISTRY
Paper 1
2017
Time: 2 hours

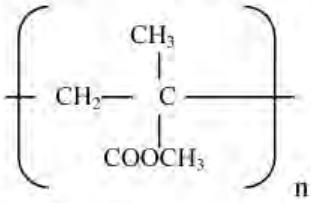
1. Explain the following:
(i) It is always advisable to scoop chemical substances using a clean spatula. **(½ mark)**
(ii) Flammable substances should always be kept away from flames in the laboratory. **(½ mark)**
2. Name one reagent that can be used to distinguish between Al^{3+} and Zn^{2+} ions in solution and state what would be observed if each of the ions is treated with the reagent you have named. **(3 marks)**
3. Manganese sulphide reacts with acids according to the following equation.

$$(s) \quad (aq) \rightleftharpoons (aq) + (l) \quad (aq)$$

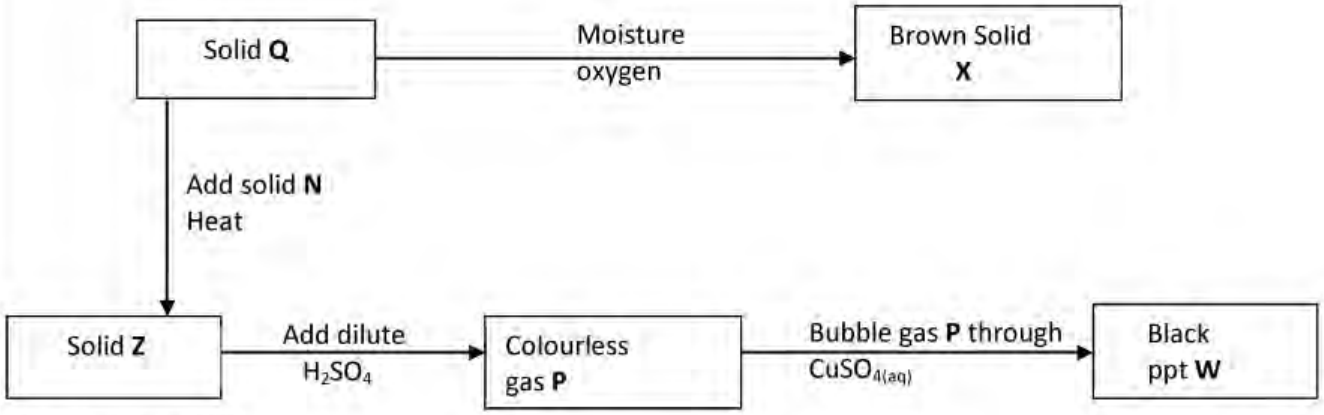
State, giving a reason what would happen to the equilibrium if;
(i) Water is added to the equilibrium mixture. **(1 ½ marks)**
(ii) Hydrogen chloride is bubbled into the equilibrium mixture. **(1 ½ marks)**
4. Use the thermochemical equations below to answer the questions that follow.

$$- \; 2(g) \longrightarrow \quad 2(g) \quad (l)$$
$$(s) \quad 2(g) \longrightarrow \quad 2(g)$$
$$2(g) \quad - \; 2(g) \longrightarrow$$

(i) Draw an energy cycle diagram to show the enthalpy of formation of ethane. **(1 ½ marks)**
(ii) Calculate the enthalpy of formation of ethane. **(1 ½ marks)**
5. State the conditions under which copper reacts with sulphuric acid and give an equation for the reaction. **(2 marks)**
6. When 8.8g of hydrocarbon Z was burnt in excess air, 14.4g of water and 11.95 dm^3 of carbon (IV) oxide were obtained at s.t.p. Determine the empirical formula of Z. **(3 marks)**
7. Perspex is a synthetic polymer of formula



(a) Write the structural formula of the monomer of Perspex. **(1 mark)**
(b) State the type of polymerization involved in the formation of perspex. **(1 mark)**
8. When zinc granules are dropped into two separate solutions of dilute sulphuric (VI) and concentrated sulphuric (VI) acid, effervescence of a colourless gas occurs in each case. Give equations to represent the reactions that take place. **(2 marks)**
9. Study the chart below and answer the questions that follow.



(a) Identity solid **X**. **(1 mark)**
(b) Write an ionic equation for the reaction between P and copper (II) sulphide solution. **(1 mark)**
(c) State the observation made when gas P is bubbled through iron (III) chloride solution. **(1 mark)**
10. Use the nuclear equations below to answer the questions that follow.

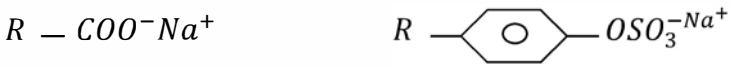
(i) $^{220}_{86}Rn \longrightarrow {}^{220}_{87}Fr + X$

(ii) $^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + Y$

(a) Give the actual names of particles X and Y. **(1 mark)**

(b) Give the name of a radiation whose emission does not change the mass number or the atomic number of a radioisotope. **(1 mark)**

11. The structures below represent two cleaning agents M and P.



M **P**

Which cleaning agent would be most suitable for use with water containing calcium sulphate. Give a reason. **(2 marks)**

12. You are given the following half equations:

$Mg^{2+}_{(aq)} + 2\bar{e} \longrightarrow Mg_{(s)} \quad E^{\vartheta} = -2.37V$

$Zn^{2+}_{(aq)} + 2\bar{e} \longrightarrow Zn_{(s)} \quad E^{\vartheta} = -0.76V$

(i) Obtain an equation of the cell reaction. **(1 mark)**

(ii) Calculate the E^{ϑ} value for the cell. **(1 mark)**

(iii) Give the oxidizing species. **(1 mark)**

13. Using dots (•) and crosses (×) to represent outermost electrons; draw diagrams to show bonding in:

(a) Aluminium chloride. **(1 ½ marks)**

(b) Sulphuric (IV) oxide. **(1 ½ marks)**

14. Use the information in the table below to answer the questions that follow.

Melting point	Element	Atomic number
97.8	R	11
660	S	13
1440	T	14
-40.1	U	17
63.1	V	19

(a) Write the electron arrangement of: **(1 mark)**

(i) ion of S .....

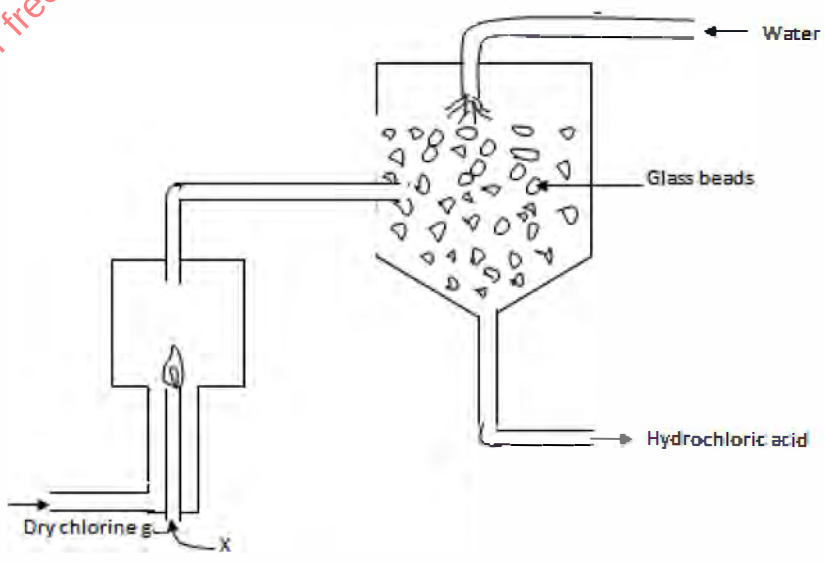
(ii) atom of T .....

(b) Explain why the melting point of T is higher than that of U. **(2 marks)**

15. Complete the table below. **(3 marks)**

Metal	**Aluminium**	**Lead**	**Sodium**
Chief ore	Bauxite		Rock salt
Chemical name			
Method of extraction		reduction	

16. The diagram below represents a set up used for the large scale manufacture of hydrochloric acid.

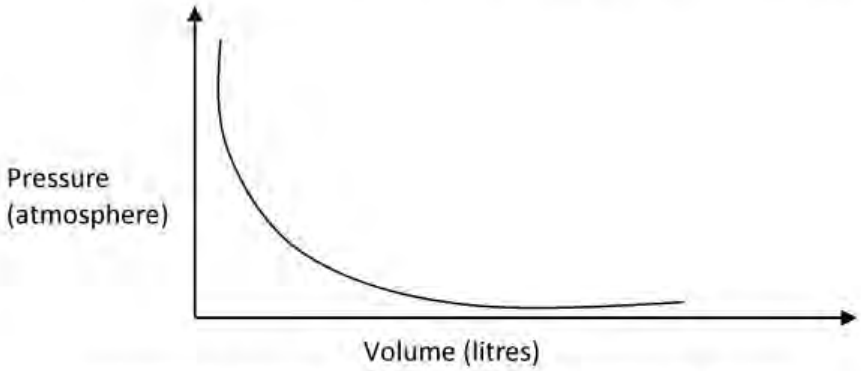


(a) Name substance X. **(1 mark)**

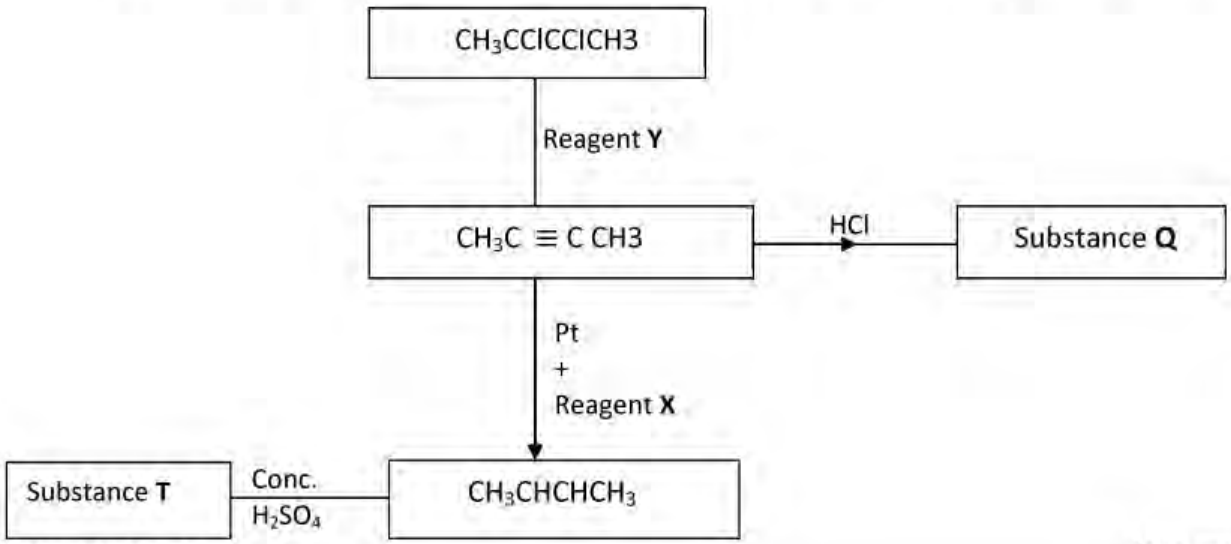
(b) What is the purpose of the glass beads? **(1 mark)**

(c) Give one use of hydrochloric acid. **(1 mark)**

17. Calculate the volume of nitrogen (I) oxide produced when 38.2g of ammonium nitrate is completely decomposed by heating (at s.t.p). (N = 14, H = 1, O = 16) **(3 marks)**
18. Give equations to show the reactions that take place when;
(a) Iron reacts with steam. **(1 mark)**
(b) Give one industrial use of the gas produced in the reactions in (i) and (ii) above. **(1 mark)**
19. (a) When magnesium metal is burnt in air, it reacts with both oxygen and nitrogen gases giving a white ash. Write two equations for the reactions that take place. **(2 marks)**
(b) Give the total number of atoms present in the gas produced when water is added to magnesium nitrate. **(1 mark)**
20. The graph below shows the behavior of a fixed mass of a gas at constant temperature.



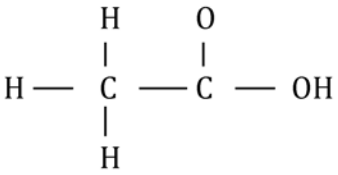
(a) What is the relationship between the volume and the pressure of the gas? **(1 mark)**
(b) 60 cm^3 of oxygen gas diffused through a porous partition in 50 seconds. How long would it take 60cm^3 of sulphur (IV) oxide gas to diffuse through the same partition under the same conditions? (S = 32.), O = 16.0) **(3 marks)**
21. State and explain the observation made when a moist red litmus paper is put in a gas jar of dry chlorine gas. **(2 marks)**
22. (a) When extinguishing a fire caused by burning kerosene, charbon (IV) oxide is preferred to water. Explain. **(2 marks)**
(b) Write the formula of the oxide of carbon which is 'silent killer'. **(1 mark)**
23. Explain why chlorine is a gas while iodine is a solid at room temperature. **(2 marks)**
24. Apart from their location, state any two differences between a proton and an electron **(2 marks)**
25. What term is given to: The amount of energy given out when a neutral atom in gaseous state gains an electron? **(1 mark)**
26. A certain fertilizer is suspected to be containing nitrate ions. Describe how the presence of nitrate ions can be determined in such fertilizer. **(3 marks)**
27. Write balanced chemical equations to show the action of heat on the following nitrates.
(a) Lead (II) nitrate **(1 mark)**
(b) Silver nitrate **(1 mark)**
28. What is an amphoteric oxide? **(1 mark)**
29. Starting with zinc carbonate solid describe how zinc hydroxide can be prepared in the laboratory. **(3 marks)**
30. Below is a scheme of some reactions starting with but-z-yne. Study it and answer the questions that follow.



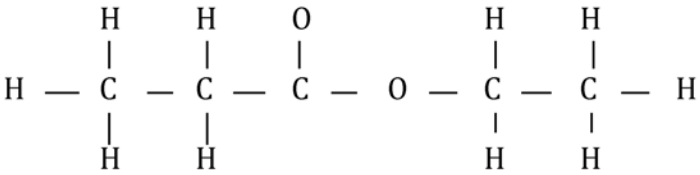
(a) Name Y, X and T **(1 ½ marks)**

(b) Give the name of the following organic compounds. **(½ mark)**

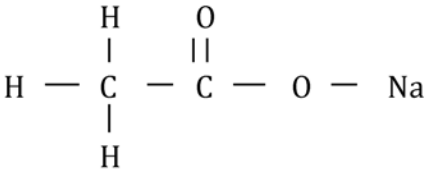
(i)



(ii)



(iii)



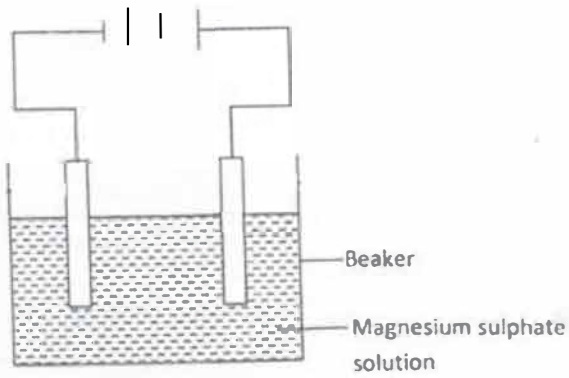
31. The following results were obtained during an experiment to determine the solubility of potassium nitrate in water at 30^0C. Mass of dish = 15.86g, mass of dish + saturated solution at 30^0C = 26.86g, mass of dish + solid KNO_3 after evaporation to dryness = 16.7g. Calculate the mass of saturated solution containing 60.0g of water at 30^0C.

(3 marks)

MOSTA JOINT EVALUATION TEST-2017
Kenya Certificate of Secondary Education (K.C.S.E.)
233/2
CHEMISTRY
PAPER 2
2017
2 HRS

1. (a) Define an electrolyte. **(1mark)**

(b)The set-up below was used to carry out electrolysis of an aqueous solution of magnesium sulphate using carbon electrodes.

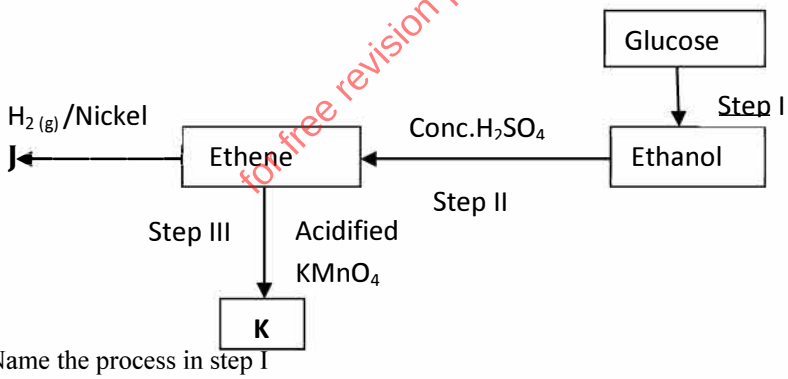


(i) State and explain the observation made at the cathode. **(2 marks)**
(ii) Write down an equation for the reaction that occurs at the anode. **(1mark)**
(iii) What change occurred to the concentration of magnesium sulphate solution during the experiment? Explain. **(3 marks)**
(c) During the electrolysis of dilute copper (II) chloride, the mass of the platinum cathode increased by 3.2g. If a current of 2.5 amperes was passed through the solution for some time, calculate the time taken. (Cu= 64.0; 1 faraday = 96,500 Coulombs) **(3 marks)**

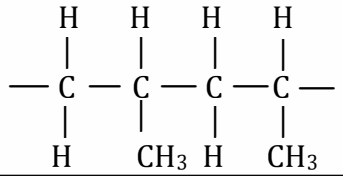
(d) Use the information below to answer the question that follows.

$Al^{3+}(aq) + 3e^- \rightleftharpoons Al(s)$ $E^\theta = -1.66v$
$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$ $E^\theta = -0.44v$

Why is it not advisable to keep a solution of iron (II) nitrate in a container made of aluminium? **(2 marks)**
(e) Other than electroplating, give one application of electrolysis. **(1 mark)**
2. a) Draw the structural formula of . **(3 marks)**
(i) Propan-1-ol
(ii) Pent-2-yne
(iii) 2,3-dimethylbutane
(b) Study the reaction scheme below and answer the questions that follow.



(i) `Name the process in step I **(1 mark)**
(ii) Give the two conditions necessary in step II **(2 marks)**
(iii) State the observation made in step III. **(1 mark)**
(iv) Name compound J. **(1 mark)**
(v) Draw the structural formula of compound K. **(1 mark)**
(c) Water is added drop wise to calcium carbide in a conical flask.
(i) Identify the gas produced. **(1 mark)**
(ii) Write a chemical equation for the reaction that occurs. **(1 mark)**
(d) Part of a polymer is required below.



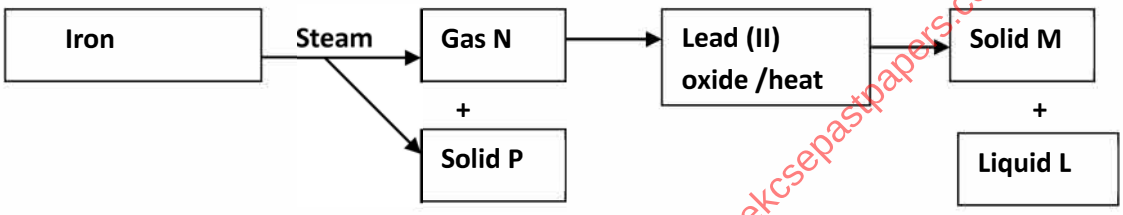
(i) Draw the structural formula of the monomer of this polymer. **(1 mark)**
(ii) State one use of this polymer. **(1 mark)**

3. The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbols of the elements.

Y	R					Q	**X**	
	V		**W**					U

(a) Select an element whose oxide is amphoteric. **(1 mark)**
(b) On the grid indicate with letter J the position of element J which is in period 3 and forms a stable ion J^{2-}. **(1 mark)**
(c) Draw a dot-cross diagram to show bonding in the compound consisting of elements V and X only. **(2 marks)**
(d) Write an equation to show the formation of an ion by R. **(1 mark)**
(e) Which is the least reactive element? Give a reason for your answer. **(2 marks)**
(f) Write an equation for the reaction that occurs when element Y is placed in water. **(1 mark)**
(g) How does the atomic radius of W compare with that of V? Explain. **(2 marks)**
(h) Name the chemical family to which elements R and V belong. **(1 mark)**

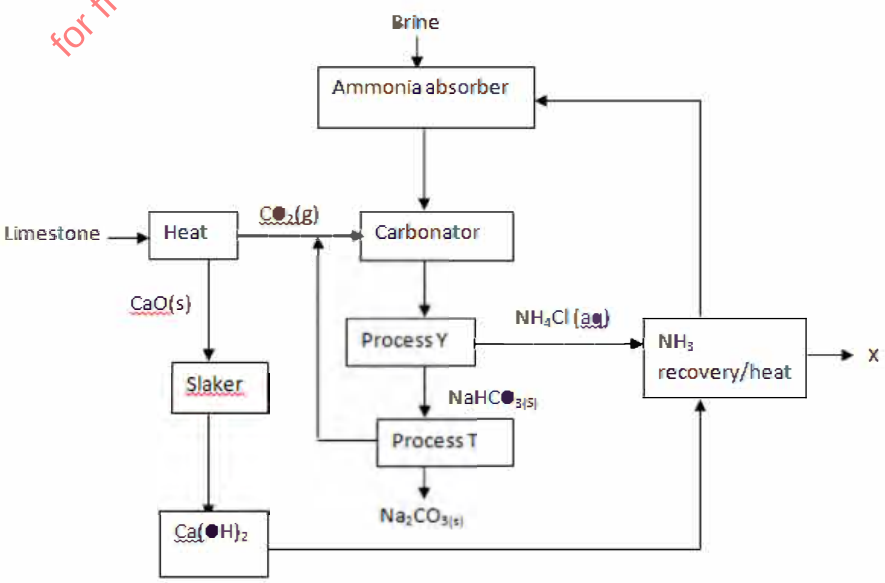
4. a) Use the chart below to answer the questions that follow.



Identify:
Gas **N** **(½ mark)**
Solid **P** **(½ mark)**
Solid M **(½ mark)**
Liquid **L** **(½ mark)**

b) Name the method that can be used to extract oil from castor oil seeds. **(1 mark)**
c) i) In the method named above, state the property of oil that enables the extraction to take place. **(1 mark)**
ii) Describe an experimental procedure that can be used to extract oil from the seeds. **(3 marks)**
d) How is phosphorus stored in the laboratory? Explain your answer. **(1 mark)**
e) i) In the fractional distillation of liquid air some substances must be removed, name two substances removed. **(1 mark)**
ii) Why must the substances named in (i) above be removed? **(1 mark)**
iii) State the processes involved in fractional distillation of liquid air. **(2 marks)**

5. Study the flow chart below showing the Solvay process and use it to answer the questions that follow.



a) Write the equation for the reaction producing substance X. **(1 mark)**
b) Name processes Y and T. **(1 mark)**
c) In the carbonator, two reactions take place. Write the two equations for the reactions. **(2 marks)**
d) Explain why the Solvay process is said to be one of the most efficient industrial process. **(2 marks)**
e) 16.8g of sodium hydrogen carbonate are completely decomposed by heating. Calculate;
i) the mass of the resulting solid produced. **(2 marks)**
ii) the volume in litres of the gas produced at s.t.p **(2 marks)**
(Molar Gas Volume at s.t.p =22400 cm^3, Na=23.0, C=12.0, H= 1.0, O=16.0)
f) Give two industrial uses of sodium carbonate. **(2 marks)**

6. a) An experiment was done using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce 50cm^3 of the gas for every experiment was recorded in the table below.

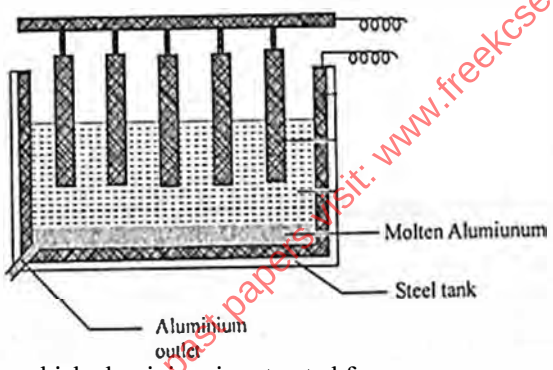
Concentration of HCl in mol/Litre	2.0	1.75	1.50	1.25	1.00	0.75	0.50	0.25
Time in Sec (s)	8.8	10.0	11.7	13.5	17.5	22.7	35.5	70.0
Rate=$^1/_t$ Sec^{-1}								

i) Complete the table above. **(2 marks)**
ii) Plot a graph of rate (^{1}/time) against concentration. **(3 marks)**
iii) Determine from your graph the concentration needed to produce 50cm^3 of hydrogen gas, when time is 15 seconds. **(1 mark)**
b) Apart from concentration, state two other factors that may affect the rate of chemical reaction. **(2 marks)**
c) i) State Le Chatelier's principle. **(1 mark)**
ii) Given the equation below;

$$Br_2\,(aq) + H_2O\,(l) \rightleftharpoons OBr^-\,(aq) + Br^-\,(aq) + H^+\,(aq)$$
(Yellow-orange) (colourless)

State and explain the observation made when dilute hydrochloric acid is added to the bromine water. **(2 marks)**

7. The diagram below shows the electrolysis process in the extraction of aluminium. Study it and answer the questions that follow.



a) i) Name the main ore from which aluminium is extracted from. **(1 mark)**
ii) Explain how the impurities present in the ore are removed. **(3 marks)**
b) Label on the diagram the anode and the cathode. **(1 mark)**
c) The melting point of aluminium oxide is 2015°C but the electrolysis is carried out at temperature of around 800°C.
i) Why is the electrolysis not carried out at 2015°C? **(1 mark)**
ii) How is the temperature lowered to about 800°C? **(1 mark)**
d) Duralumin (an alloy of aluminium) is preferred to pure aluminium in the construction of aeroplane bodies. Give **two** properties that make it suitable for making the aeroplane bodies. **(2 marks)**

MOSTA JOINT EVALUATION EXAMINATION 2017
Kenya Certificate of Secondary Education

233/3
CHEMISTRY
Paper 3
PRACTICAL
2017
Time: 2 ¼ Hours

1. You are provided with;
- 3.6g of solid P which is a hydrated acid with formula $H_2C_2O_4.nH_2O$
- Solution X, a 0.2M sodium hydroxide solution.

You are required to determine:

(i) Solubility of solid P
(ii) The value of n in the formula $H_2C_2O_4.nH_2O$

Procedure I

(i) Fill the burette with distilled water
(ii) Place solid P in the boiling tube.
(iii) Transfer 4cm^3 of distilled water from the burette into the boiling tube containing solid P.
(iv) Heat the mixture while stirring with the thermometer to a temperature of 80°C.
(v) Allow the solution to cool while stirring with a thermometer.
(vi) Record the temperature at which the crystals start to form in the table below
(vii) Add a further 2cm^3 of distilled water from the burette to the mixture

Repeat procedure (iv) and (v) above and record the crystallization temperature. Complete the table below by adding the volumes of distilled water as indicated. **(PRESERVE THE CONTENTS)**

Volume of distilled water	Crystallization temperature	Solubility of solid P in g/100g of water
4		
6		
8		
10		
12		

(4 mks)

On the grid provided, plot a graph of solubility of solid P (y – axis) against crystallization temperature. (3 marks)

From the graph determine;

(i) The solubility of solid P at 60°C (1 mark)
(ii) The temperature at which 40g of P dissolves in 50g of water (1 mark)

Procedure II

(i) Transfer the contents of the boiling tube in procedure I to a clean 250ml volumetric flask.
(ii) Add distilled water to the mark
(iii) Label the resulting solution as Q
(iv) Fill the burette with solution Q.
(v) Pipette 25cm^3 of solution X into a clean conical flask. Add three drops of phenolphthalein indicator
(vi) Titrate Q against X to an accurate end point.

Record your results in table II below.

Table II

	I	II	III
Final burette reading in cm^3			
Initial burette reading in cm^3			
Volume of solution Q used in cm^3			

(4 marks)

Calculate;

a) Average volume of Q used (1 mark)
b) i) Moles of solution X used (1 mark)
ii) Moles of solution Q used (1 mark)
iii) Concentration of solution Q in moles per litre (1 mark)
c) Determine the value of n in the formula $H_2C_2O_4.nH_2O$ (2 marks)

2. You are provided with;
- 1.0M sodium hydroxide solution A
- 1.0M hydrochloric acid solution B
- Exactly 2.0g of solid sodium hydroxide in a corked boiling tube.

You are required to;

- Determine the molar enthalpy of neutralization of solution A
- Determine the molar enthalpy of neutralization of 2.0g solid sodium hydroxide
- Use the results to calculate the molar enthalpy of solution of sodium hydroxide

Procedure I

(i) Measure exactly 25.0cm^3 of solution B using a 50ml measuring cylinder and note its steady temperature T_1°C while still in the measuring cylinder.

(ii) rinse the thermometer

(iii) Transfer 25cm^3 of solution A into a 100ml plastic beaker using a clean 50ml measuring cylinder and note it's steady temperature T_2°C

(iv) Add at once all the solution B to solution A in the plastic beaker
Carefully stir using a thermometer and note the highest temperature T_3°C reached by the mixture

Table III

	Temperature °C
Initial temperature of solution B, T_1	
Initial temperature of solution A, T_2	
Average temperature of solution A and B, $\frac{T_1 + T_2}{2}$	
Highest temperature reached T_3	
Temperature change	

(2mks)

a) Calculate the heat change during the reaction (1 mark)
(Assume that density of solution is 1g/cm^3 and C = 4.2j/g/K)

b) Calculate the number of moles in 25cm^3 of sodium hydroxide solution A (1 mark)

c) Calculate the molar enthalpy of neutralization of aqueous sodium hydroxide (ΔH_{Neut}) (1 mark)

Procedure II

(i) Using a 50 ml measuring cylinder, measure 30.0cm^3 solution B and note its initial steady temperature T_4.

(ii) Quickly add the 30.0cm^3 of solution B into a boiling tube containing 2.0g of solid sodium hydroxide and stir using a thermometer.
Note the highest temperature T_5 reached by the mixture.

Table IV

Initial steady temperature of solution T_4	
Maximum temperature of the mixture T_5	
Temperature change $DT = T_5 - T_4$	

a) Calculate the number of moles in 2.0g of solid sodium hydroxide (Na=23, O=16, H=4) (1 mk)

b) Calculate the molar enthalpy of neutralization of solid sodium hydroxide ΔH_{neut}
(C = 4.2kJ/kg/K) (2 mks)

c) The equation below is part of an energy cycle diagram. Complete and use it to determine the enthalpy of solution of solid sodium hydroxide.
water
NaOH(s) ⟶ NaOH(aq)

3. You are provided with solid Y.
Divide the solid into two portions

a) Transfer the first portion into a clean dry boiling tube
Heat the solid gently and test the gases produced using moist litmus papers

Observation	Inference
1 mk	1 mk

b) Transfer the second portion of solid Y into another clean dry boiling tube. Add about 10cm^3 of distilled water. Shake the mixture and filter into another boiling tube. Divide the filtrate into 5 test tubes.

Observation	Inference
1 mk	1 mk

(i) To the first portion, add about 2cm^3 of sodium carbonate solution

Observation	Inference
½ mk	½ mk

(ii) To the second portion, add 2.0M sodium hydroxide drop wise until in excess.

Observation	Inference
½ mk	½ mk

(iii) To the third portion, add aqueous ammonia solution drop wise until in excess

Observation	Inference
½ mk	1/2mk

(iv) To the fourth portion, add a few drops of barium chloride solution followed by 3 drops of dilute hydrochloric acid.

Observation	Inference
½ mk	½ mk

(v) Heat the tip of a clean spatula over the non luminous flame of the Bunsen burner. Dip the heated end of the spatula into the fifth portion. Remove and heat the end over the flame.

Observation	Inference
½ mk	½ mk

MURANGA SOUTH A
233/1
CHEMISTRY
PAPER 1
FORM 4
JULY 2017
TIME: 2 hours

Kenya Certificate of Secondary Education

1. Element T has an atomic number 19.

a) State the type of bonding that exists in T. (1 mk)

b) In which group and period of the periodic table does element T belong? Give a reason. (2mks)

2 (a) Complete the nuclear equation below by finding the value of M and N (2 mks)

$^{216}_{90}Po \rightarrow {}^{208}_{82}Pb + M \propto + N\beta$

b) 288g of a radioactive substance decayed to 9g in 40 days. Determine the half life of the radioactive substance . (2mks)

3. During a class experiment , chlorine gas was bubbled into a solution of potassium iodide.

a) State the observation made. (1mk)

b) Using an ionic equation, explain why the reaction is redox. (2mks)

$Cl_{2(g)} + 2I^-_{(aq)} \rightarrow 2Cl^-_{(aq)} + I_{2(s)}$

4. Graphite is one of the allotropes of carbon

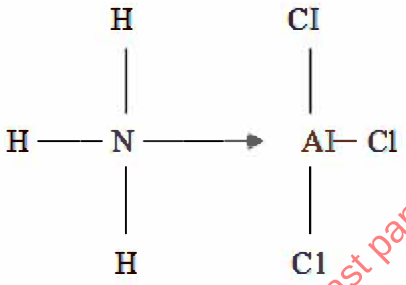
a) Define allotropy. (1mk)

b) Name one other element which exhibits allotropy. (1mk)

5. a) State Gay Lussac's law. (1mk)

b) 10 cm^3 of a gaseous hydrocarbon, C_2H_x required 30cm3 of oxygen for complete combustion. If steam and 20cm^3 of carbon (iv) oxide were produced, what is the value of x. (2mks)

6. The diagram below shows bonding between aluminium chloride and ammonia



a) Name the type of bonds that exists in the molecule. (1mrk)

b) How many electrons are used for bonding the molecule. (1mrk)

6. Use the following information on substances S, T, v and hydrogen to answer the questions that follow.

i) T displaces V from a solution containing V ions.

ii) Hydrogen reacts with heated oxide of S but has no effect on oxide of V.

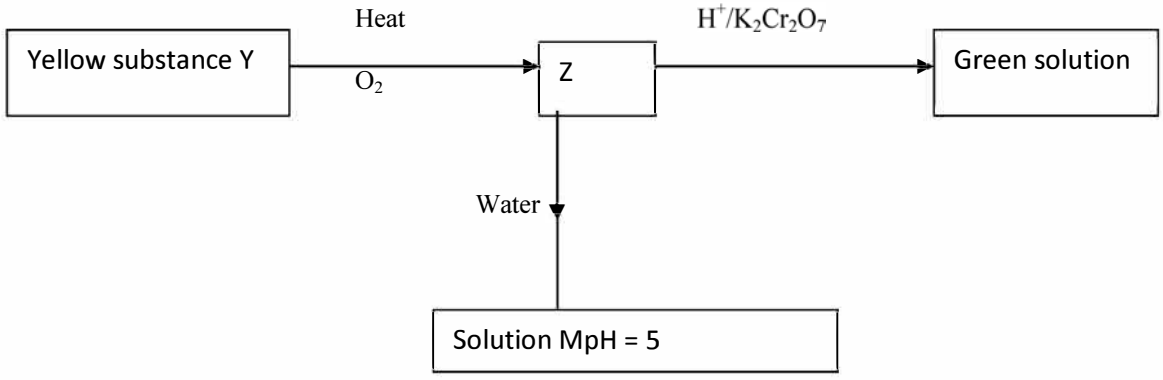
a) Arrange substances S,T,V and hydrogen in the order of increasing reactivity. (2mks)

b) If T and V are divalent metals, write an ionic equation for the reaction in (i) above. (1mk)

7. The empirical formula of A is CH2Br. Given that 0.470 g of A occupies a volume of 56 cm^3 at 546k and 1 atmospheric pressure, determine its molecular formula .(H= 1, C= 12, Br = 80, molar gas volume at s.t.p = 22.4 dm^3).

8. State and explain what would happen if a dry blue litmus paper was dropped in a gas jar of chlorine. (2mks)

9. Study the flow chart below and answer the questions that follow



Identify Z and M (2mks)

10. Draw and name the isomers of pentync . (3mks)
11. $100cm^3$ of a sample of ethane gas diffuses through a porous pot in 100 seconds. What is the molecular mass of the gas Q if $100cm^3$ of the gas diffuses through the same porous pot in 121 seconds under the same conditions?. (C = 12 H= 1) (3mks)
12. Study the table below and answer the questions that follow.

Bond	Bond energy KJ I MOL
C - H	414
CI- CI	244
C – CI	326
H - CI	431

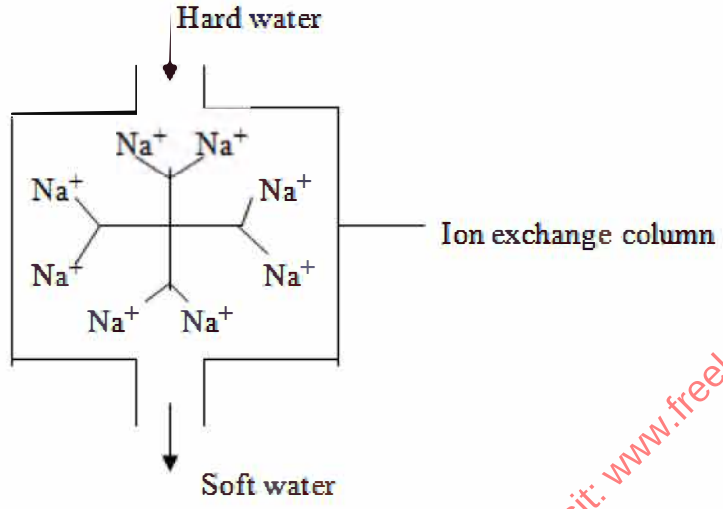
a) Calculate the enthalpy change of the reaction (3mks)

$CH_{4(g)} + 2Cl_{2(g)} \rightarrow CH_2Cl_{2(g)} + 2HCl_{(g)}$

13. Hardness in water is caused by dissolved salts

a) Which cations cause water hardness? (1mk)

b) Explain how the apparatus below soften hard water (2mks).



14. Below are pH values of some solutions

Solution	z	y	x	w
PH	6.5	13.5	2.2.	7.2

a) Which solution is likely to be :

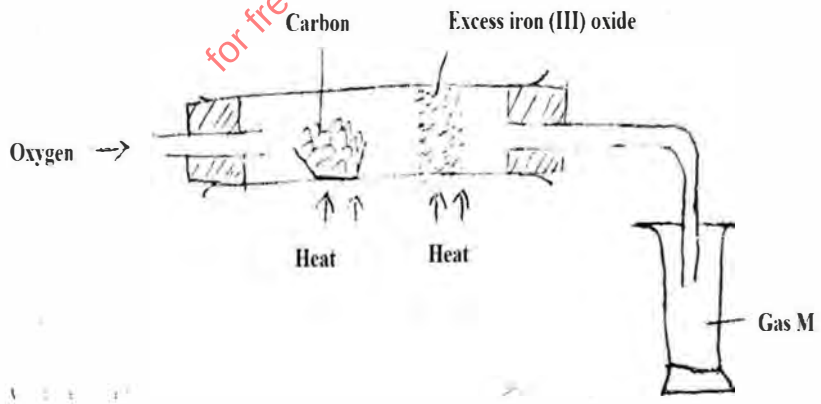
i) Acidic rain (1/2mk)

ii) Potassium hydroxide (1/2mk)

b) A basic substance V reacted with both solutions Y and X . What is the nature of V? (1mk)

c) Identify two substances that show the characteristics in question (ii) above. (1mk)

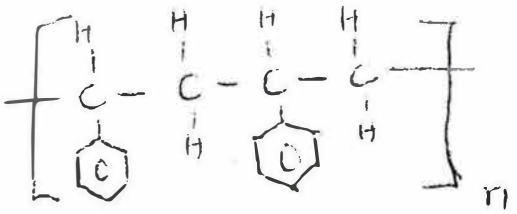
15. The set-up below was used to obtain a sample of iron



a) Identify gas M. (1 mk)

b) Write two equations for the reactions which occur in the combustion tube. (2mks)

16. The formula given below represents a portion of a polymer



a) What is the name of this polymer (1mrk)
b) Draw the structure of the monomer used to manufacture the polymer. (1mrk)
c) Give one use of the polymer given in the real life. (1mrk)

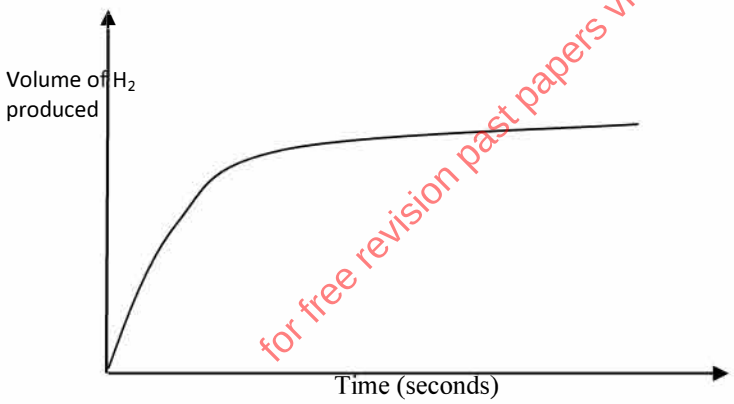
17. Name the process that takes place when
a) Fe^{2+} changes to Fe^{3+} (1mrk)
b) A white sugar changes to black solid when mixed with excess concentrated sulphuric acid. (1mrk)
c) A hydrated salt loses the water of crystallization when exposed to the atmosphere. (1mrk)

18. Study the information in the table below and answer the questions that follow the letters do not represent the actual symbol.

Elements of stable ion	Electron arrangement	Atomic radius(nm)	Ionic radius(nm)
A	2.8.8	0.197	0.099
B	2.8.8	0.99	0.181
C	2.8	0.16	0.065
D	2.8	0.186	0.095
E	2	0.152	0.068
F	2.8	0.072	0.136

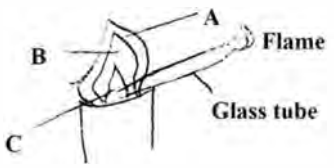
a) Identify the elements that belong to the third period of the periodic table. (1mk
b) Arrange the elements that you have identified in (i) above as they follow each other in the third period.
c) Is element F a metal or non- metal? Explain your answer . (2mks)

19. The graph below shows volume of hydrogen gas collected with against time taken when a magnesium Ribbon was reacted with 2M hydrochloric acid



a) On the same axis sketch the curve obtained when 2cm magnesium ribbon was reacted with 2M ethanoic acid. (1mk)
b) Write an equation for the reaction between ethanoic acid and magnesium.
c) How would powdering of magnesium affect production of hydrogen?. (1mk)

20. A form one student set-up the apparatus as shown below.

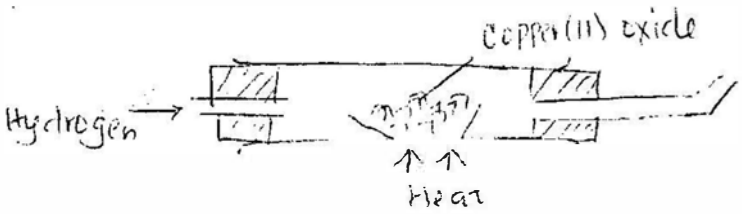


a) Name the flame used in the experiment above. (1mk)
d) There was a flame produced at the end of the glass tube. Explain. (1mk)
c) Name the parts labelled A & B. (1mk)

21. When a burning magnesium ribbon is lowered in a gas jar full of carbon (iv) Oxide , it continues to burn forming a white Ash and black specks on the side of the gas jar.

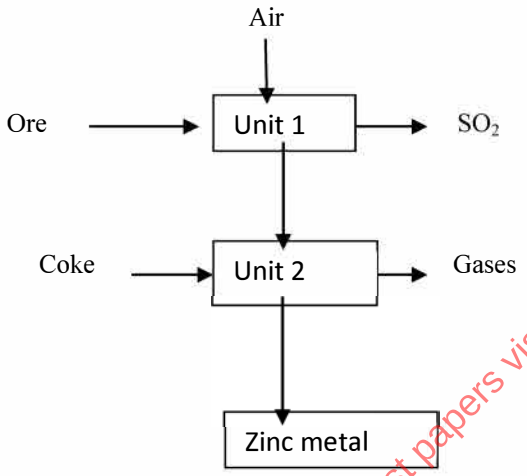
a) Name
   i) White ash (1mk
   ii) Black specks (1mk)
b) Write an equation for the reaction that takes place. (1mark)

22. A form two student set-up the apparatus as shown below to investigate properties of hydrogen gas. Study it and answer the questions that follow.



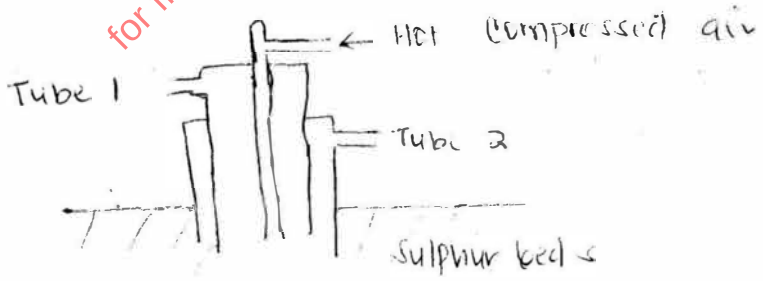
a) Identify the property of hydrogen that was being investigated. (1mk)
b) State the observations that were made in the combustion tube. (1 mk)
c) Other than hydrogen gas, name two other gases that can be used in the above set-up to serve the same purpose as hydrogen. (2mks)

23. The flow chart below shows the processes involved in the industrial extraction of zinc metal



a) Name the ore from which zinc is extracted on the above diagram. (1mk
b) Write the equation for the reaction taking place in unit 1. (1mk)
e) Name two uses of zinc metal. (1mk)

24.The diagram below represents the extraction of sulphur by frasch process



a) Name the substances that pass through
   Tube 1 –
   Tube 2 –
b) What is the name given to the process above? (1mk)
c) What is the purpose of hot compressed air in the process (1mk)

25. a) Give a reason why concentrated sulphuric (IV) acid is not used to dry ammonia gas. (1mk)
    b) Name one suitable drying agent for ammonia gas. (1mk)

26. Explain the following
a) Atomic radius of alkali metals increase down the group. (1mk)

b) Alkaline earth metals are better conductors than alkali metals. (1mk)

c) Halogens have a larger ionic radius than atomic radius. (1mk)

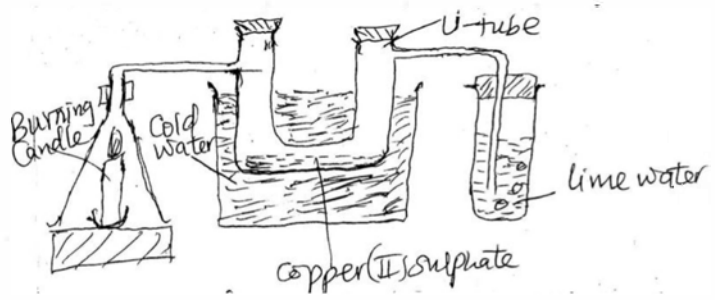
27. a) What are isotopes. (1mk)

b) Element Y (not the actual symbol of the element) has two isotopes with mass number 6 and 7 . If the relative atomic mass of Y is 6.94 , determine the percentage abundance of each isotope (2mks)

28. Explain how you would separate a mixture of nitrogen & oxygen gases given that their boiling points are - 196°c and – 183° c respectively. (2mks)

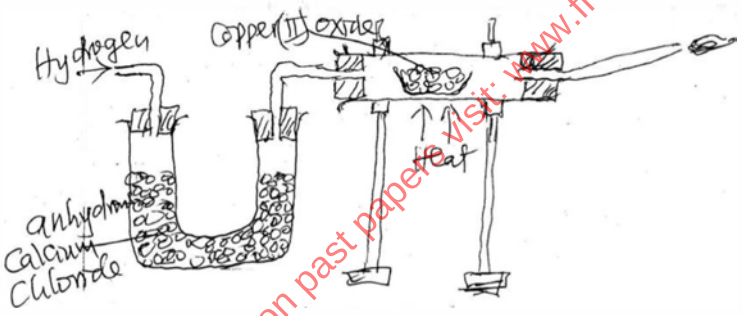
MURANGA SOUTH A
233/2
CHEMISTRY
PAPER 2
FORM 4
JULY 2017
TIME: 2 HOURS
Kenya Certificate of Secondary Education
INSTRUCTIONS:
Answer all the questions in the spaces provided.

1. (a) Below is a diagram of the set-up of apparatus used to investigate the products of combustion of candle wax in an experiment.



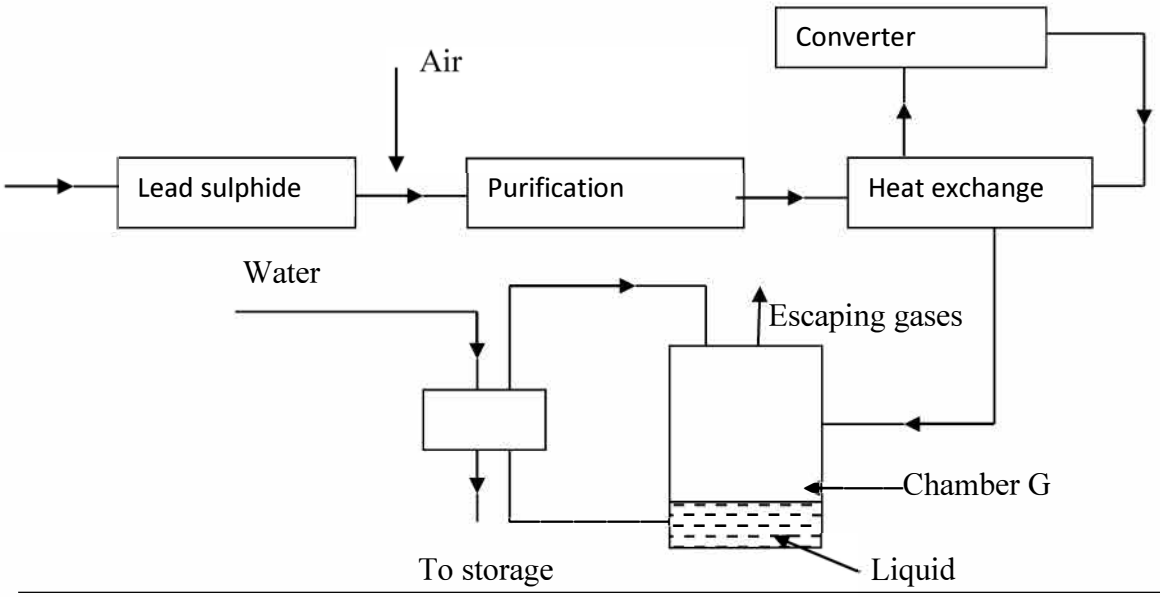
(i) State and explain the observations made in the u-tube. (2mks)
(ii) Name the liquid formed when the candle burns. (1mk)
(iii) What would be observed in the test tube containing lime water? Explain. (2mks)
(iv) What conclusion can be made from this experiment about what composes of a candle wax.
(v) Write an equation for the chemical equation for the combustion of candle wax. (C_xH_y) (1mk)

b) Hydrogen gas was passed over copper (II) oxide in a combustion tube as follows;



(i) What property of hydrogen gas makes this reaction possible? (2mks)
(ii) What would you expect to happen, if magnesium oxide was used instead of copper(II) oxide? (1mk)
(iii) Write an equation for the reaction taking place in the combustion tube.

2. The diagram below shows some processes that takes place during the industril manufacture of sulphuric (VI) acid.



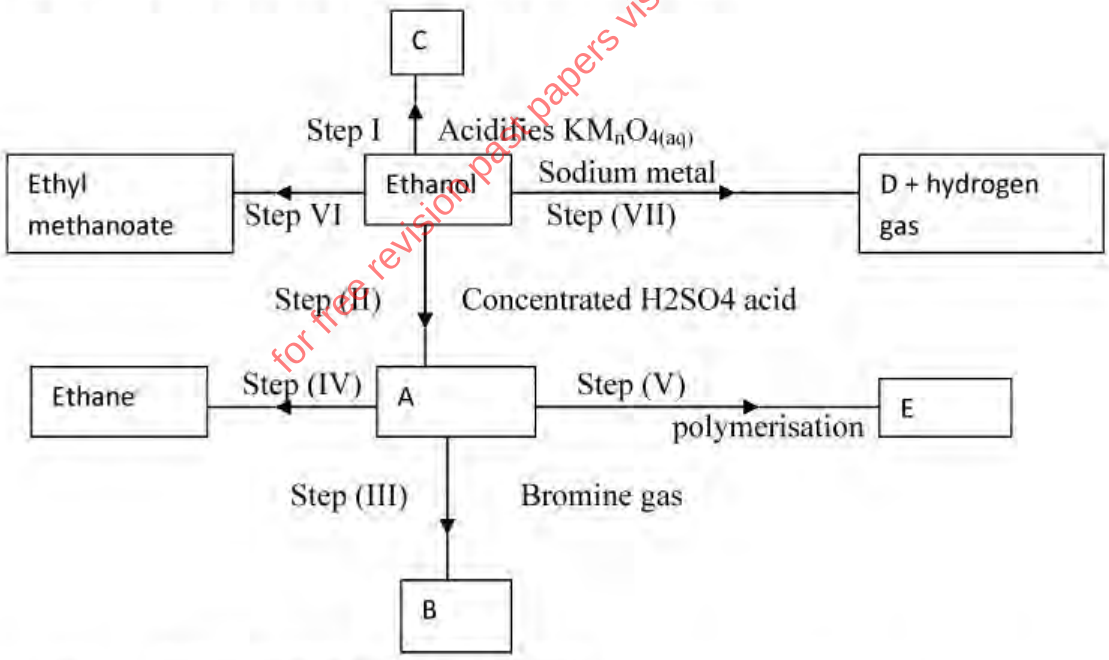
(a) Write the equation for the reaction in which sulphur (IV) oxide gas is produced. (1mk)
ii) Why is it necessary to keep the gases pure and dry (1mk)
iii) Describe the process that takes place in chamber G. (1mk)
iv) Name the gases that escape into the environment. (2mks
v) State and explain the harmful effect on the environment of one of the gases named in (iv) above. (1mk)
vi) Give two reasons why it is necessary to use of pressure of 2-3 atmosphere and not more. (2mks)
vii) Name one fertilizer made from sulphuric acid. (1mk)
vii) Explain what happenes when conc sulphuric is added to crystals of white sugar. (1mk)

3. The grid below is part of the periodic table. Use it to answer the questions that follow; (The letters are not the actual symbols of the elements)

							A		B	C				
D						E	F			G				
										H				

(a) Which is the most reactive non-metallic element shown in the table? Explain. (2mks)
(b) i) Write the formula of the compound formed when element A reacts with element B. (1mk)
ii) Name the type of bond in the compound fomed in b(i) above. (1mk)
(c) i) What is the name given to the group of elements where C,G and H belong? (1mk)
ii) Explain the trend of reactivity down this group. (1mk)
iii) Write an equation for the reaction that occurs when C in gaseous form is passed through a solution containing ions of elemet H. (1mk
(d) D forms two oxides. Write the formula of each of the two oxides.
(e) The melting point of elements F and G are 1410°C and -101°C respectively. In terms of structure and bonding. Explain why there is a large difference in the melting points of F and G. (2mks)
(f) J is an element that belongs to the 3rd period of the periodic table and is a mmember of the alkaline earth elements show the position of J in the grid. (1mk)
(g) Explain teh trend of atomic size across period 3. (1mk)

4. (a) Study the flow chart below and answer the questions that follow;



(I) What observation will be made in step I? (1mk)
(II) Describe a chemical test that can be carried out to show the identity of compound C. (1mk)
(III) Give the names of the following; (2mks)
(a) E _____
(b) Substance D _____
(IV) Give the formula of substance B. (1mk)
(V) Name the type of recation that occurs in; (3mks)
(a) Step II
(b) Step IV

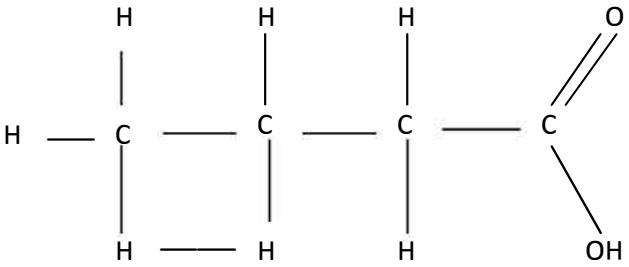
(c) Step VI

(VI) Give the reagent and conditions necessary for step VI. (2mks)

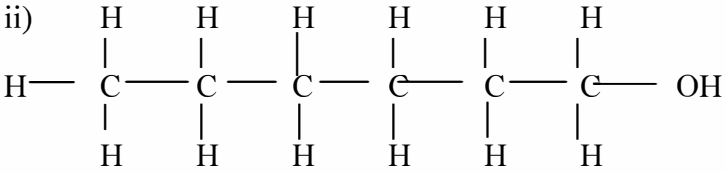
Reagent _____

Conditions _____

b) (i) Name the following structures of an organic compounds. (2mks)

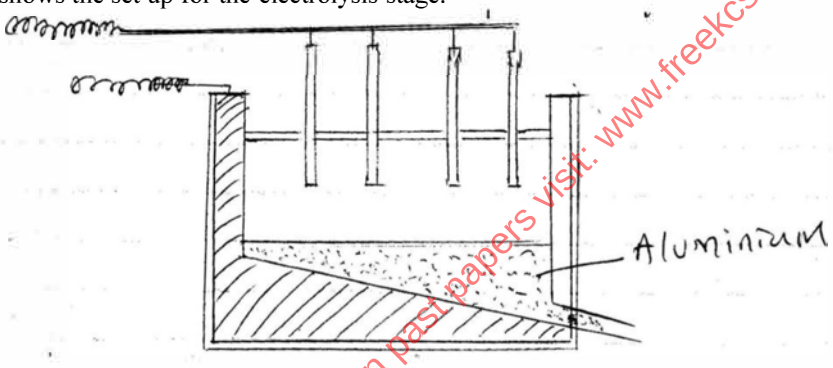


ii)



Draw one of the structures of an isomer of pentene. (1mk)

5. The extraction of aluminium from its ore takes place in two stages, purification stage abd electrolysis stage. The diagram below shows the set up for the electrolysis stage.



(a) (i) Name the ore from which aluminium extracted. (1mk)

ii) Name one impurity which is removed at the purification stage. (1mk)

(b) i) Label on the diagram each of the following; (3mks)

(I) Anode

(II) Cathode

(III) Region containing the electrolyte

ii) The melting point of aluminium oxide is 2054°c but electrolysis is carried out between 800-900°C.

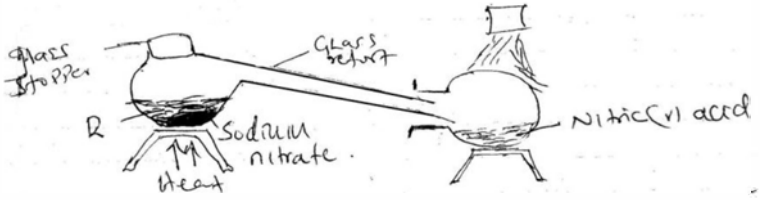
(I) Why is the electrolysis not carried out at 2054°C? (2mks)

(II) What is done to lower the temperature? (1mk)

(III) The aluminium which is produced is tapped off as a liquid. What does this suggest about its melting point. (1mk)

c) A typical electrloysis cell uses current of 40,000 ampheres. Calculate the mass in kilograms of aluminium produced in one hour. (Al = 27, i faraday = 96,500 coulombs) (3mks)

6. In the laboratory, small quantities of nitric (V) acid can be generated using the following set up. Study it and answer the questions that follow;



(a) (i) Give the name of substance R. (1mk)

(ii) Name one other substance that can be used in place of sodium nitrate. (1mk)

(b) Explain the following;

(I) It is not advisable to use a stopper made of rubber in the set up. (1mk)

(II) The reaction between copper metal with 50% nitric (V) acid in an open test tube produces brown fumes. (1mk)

(c) (i) Nitrogen is one of the reactants used in the production of ammonia, name two sources of the other reactant. (2mks)

(ii) A factory uses nitric (V) acid and ammonia gas in the prepartion of a fertiliser if the daily production of the fertilizer is 4800kg. Calculate the mass of ammonia gas used in Kg. (N=14, O=16, H=1) (3mks)

iii) State two other uses of Nitric (V) acid other than production of fertilizers. (2mks)

7. (a) The table below gives reduction potentials obtained when the half cells for each of the metals represented by letters J,K,L,M and N were connected to a copper half cell as the reference electrode.

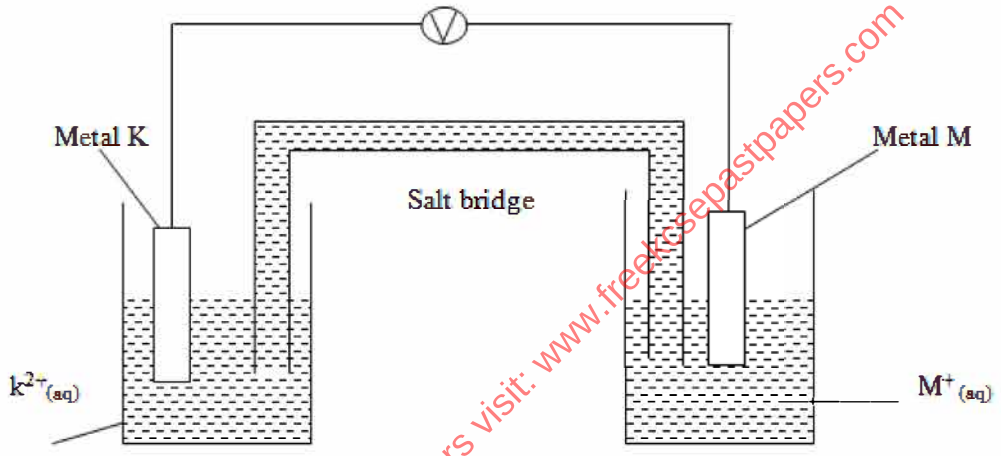
Metal	Reduction potential (volts)
J	-1.10
K	-0.47
L	0.00
M	+0.45
N	+ 1.16

(I) What is metal L likely to be? Give a reason. (2mks)

(II) Which of the metals cannot be displaced from the solution of its salt by any other metal in the table? Give a reason. (2mks)

(III) Calculate the e.m.f of the cell formed by connecting half cells of N and J. (2mks)

b) Metal K and M were connected from a cell as shown in the diagram below;



Write the equation for the half cell reaction that occur at:

Metal (K) electrode. (1mk)

Metal M electrode (1mk)

(a) If the salt bridge is filled with saturated sodium nitrate solution. Explain how it helps to complete the circuit. (2mks)

(b) State one application of electrolysis in industries. (1mk)

MURANG'A SOUTH MULTIILATERAL EXAM

233/3 CHEMISTRY Confidential 2017

Confidential instructions

In addition to the fittings and apparatus found in a chemistry laboratory each candidate should have:

1. Solution B about 150 cm^3
2. About 60 cm^3 of solution A.
3. About 80cm^3 of solution C
4. Burette 50ml
5. Filter funnel
6. 25 cm^3 pipette
7. Clamp and stand
8. White tile
9. 2 CONICAL FLASKS
10. 10ml measuring CYLINDER
11. 6 TEST TUBES
12. Boiling tube
13. Distilled water
14. Thermometer
15. A stop watch
16. About 19 solid L
17. About 1.5g of solid L
18. Metallic spatula
19. About 1g of sodium hydrogen carbonate
20. Water bath
21. Pipette filter

Access to

1. Phenolphthalein indicator
2. Source of heat
3. 2M $Pb(NO_3)_2$ (aq)
4. 2M HNO_3 (aq)
5. 0.5M $Ba(NO_3)2$ (aq)
6. 2M Ammonia solution
7. 2M NaOH
8. Acidified $KMnO_4$ solution
9. 2M HCl (aq)
10. Acidified $K_2CV_2O_7$ solution

NOTES

1. Solution B is 0.05M oxalic acid
2. Solution A is 0.01M potassium manganite (VII) solution.
3. Solution C is 0.1M sodium hydroxide solution .
4. Water bath prepared by placing about 200 cm^3 of water in a 250ml beaker .
5. Solid Q mixture $(NH_4)_2SO_4$ and $AL_2(SO_4)_3$ in the ratio 1: 1
6. Solid L is maleic acid crystal.
7. Acidified $K_2Cr_2O_7$ is prepared by dissolving 25g of solid potassium dichromate(iv) in About 600 cm^3 of 2M H_2SO_4 acid and diluting to one litre of solution.
8. Acidified $KMnO_4$ is made by dissolving 3.169 of the solid $KMnO_4$ in about 500 cm3 of 2M H_2SO_4 acid and and diluting to one litre of solution.

MURANGA SOUTH A
233/3
CHEMISTRY
PAPER 3
FORM 4
JULY 2017
TIME: 2 –

Kenya Certificate of Secondary Education

1. You are provided with potassium manganate (VII)
solution A
solution B, containing 6.3 g' litre of dibasic acid $H_2X.nH_2O$
Solution C_1 containing 4.0g/litre of Sodium hydroxide solution.
You are required to determine :
a) The value of n in $H_2X . nH_2O$
b) How the rate of reaction of solution A with solution B varies with change in temperature.

Procedure 1

Fill the burette with solution B . Pipette $25cm^3$ of solution C into a conical flask and titrate solution B with Solution C using phenolphthalein indicator.
Record your results in table I below and repeat the titration to obtain consistent results:
Table 1.

Burette readings	1	2	3
Final readings (cm^3)			
Initial readings (cm^3)			
Volume of solution B used (cm^3)			

a) Determine the average volume of solution B used . (1mk)
b) Calculate the concentration of solution C in moles per litre.
(Na = 23.0, 16.0, H= 1.0) (1mk)
c) Given that the equation of the reaction taking place and R.F.M of X = 88

$$H_2X_{(aq)} + 2NaOH_{(aq)} \rightarrow Na_2X_{(aq)} + H_2O_{(l)}$$

Calculate
i) The number of moles of the dibasic acid solution B that reacted (2mks)
ii) The number of moles of the dibasic acid solution B in $1000cm^3$ of solution. (1mk)
iii) The R.F.M of the dibasic acid, hydrated. (1mk)
iv) The value of n in the formula of the hydrated acid. (0 =16.0 H = 1.0) (2mks)

Procedure II

i. Using a measuring cylinder, place $10cm^3$ portion of solution A into 5' test tubes placed in a test tube rack.
ii) Clean the measuring cylinder and use it to place 10.0 cm3 of solution B into a boiling tube.
iii) Insert a thermometer in the solution B in the boiling tube and place the boiling tube in the attains a temperature of 40° C.
iv) Remove the boiling tube from the water bath and place it in a test- tube rack and add the first portion of solution A. and at the same time start the stopwatch.
v) Record the time taken for the purple colour and the mixture to decolourise in table II
vi) Repeat the experiment using $10cm^3$ of solution B at 50°, 60° c, 70° c and 80°c. Record the time in the Table. Complete the table by computing 1h/t sec -1.

Table II

Temperature of solution B	40	50	60	70	80
Time of colour to decolourise (seconds) $1/t\ sec^{-1}$					

(5mrks)
a) Plot a graph of 1/t (sec -1) against temperature. (3mks)
b) From the graph , determine the time taken for decolourisation of the mixture, if the temperature of solution B was 65°C (1 mk)
c) How does the rate of reaction of potassium manganite (VII) with oxalic acid vary with temperature. (1mk)

2. You are provided with solid Q . Carry out the tests below and record your observations and inferences. In the spaces provided.
a) Strongly heat a spatula – end full of solid Q in a dry test – tube.

6. i) Place the remaining solid Q in a boiling tube. Add 10cm^3 of distilled water. Divide the solution Into five portions.

Observations ½ mk	Inferences ½ mk

ii) To the first portion, add aqueous lead (II) nitrate solution .

Observations 1 mk	Inferences 1 mk

iii) To the second portion add dilute nitric (V) acid followed by barium nitrate solution .

Observations 1mk	Inferences 1 mk

iv) To the third portion add a few drops of sodium hydroxide until in excess.

Observations 1 mk	Inferences 1 mk

v) To the fourth portion add few drops of aqueous ammonia until in excess'

Observations ½ mk	Inferences ½ mk

vi) To the fifth portion add few drops HCL acid. Warm the content

Observations ½ mk	Inferences ½ mk

3. You are provided with solid L. Carry out the tests and your observations and inferences.
a) Place about one third of solid L on a metallic spatula and burn it using Bunsen burner.

Observations ½ mk	Inferences ½ mk

b) Place the remaining solid L in a test tube . Add about 6cm^3 of distilled water and shake well. Retain the mixture for use in tests (C)

Observations ½ mk	Inferences ½ mk

c.i) To about 2cm^3 of the mixture add a small amount of sodium hydrogen carbonate .

Observations ½ mk	Inferences ½ mk

ii) To about 1cm^3 of the mixture add 1cm^3 of acidified potassium dichromate (VI) and warm

Observations ½ mk	Inferences ½ mk

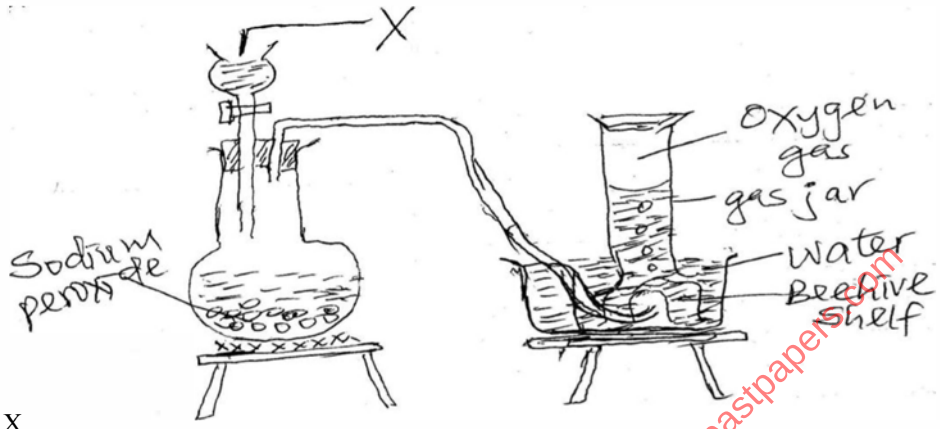
ii) To about 2cm^3 of the mixture add two drops acidified potassium manganite (VII)

Observations ½ mk	Inferences ½ mk

MURANGA SOUTH B
233/1
CHEMISTRY
PAPER 1
JULY 2017 **TIME:**
2 HOURS
Kenya Certificate of Secondary Education

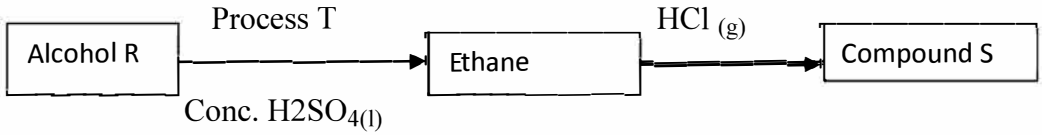
INSTRUCTIONS
ATTEMPT ALL THE QUESTIONS

Q.1The set up below can be used to prepare oxygen gas. Study it and answer the questions that follow.



a) Identify X (1mark)
b) What property of oxygen makes it possible for it to be collected as shown in the above set up. (1mark)
c) State two uses of oxygen. (1karm)

2. Write an equation to show the effect of heat on each of the following:
   a) Silver nitrate (1mk)
   b) An hydrous iron (ii) sulphate (1mk)
   c) Sodium hydrogen carbonate . (1mk)
3. i) What name is given to the process by which alcohol is formed from a carbohydrate.?. (1mk)
   ii) Explain why the solubility of ethane in water is lower than that of ethanol. (2mks)
4. i) Complete the nuclear equation below (1mk)
   $^{131}_{53}I \rightarrow {}^{131}_{54}Xe + \_\_\_\_\_$
   ii) The half –life of $^{131}_{53}I$ is 8 days
   Determine if 50 grammes decayed for 40 days. (1mk)
   iii) Give one agricultural use of radio isotope. (1mk)
5. Charcoal is a fuel that is commonly used for cooking. When it burns it forms two oxides.
   a) Name the two oxides. (2mks)
   b) State one use of any of the two oxides. (1mk)
6. An element X has a relative atomic mass of 88. When a current of 0.5 amperes was passed through a fused chloride of X for 32 minutes, 10 seconds; 0.44g of X was deposited.
   i) Determine the charge of element X (1 Faraday = 96,500c). (2mks)
   ii) Write the formula of hydroxide of X. (1MK)
8. Study the following flow chart and answer the questions that follow:



a) Write the formula of
   i) Alcohol R (1mk
   ii) Compound S (1mk)
b) Name process T (1mk)
8) 60cm^3 of oxygen gas diffuses through a porous plug in 50 seconds. How long will it take 80cm^3 of sulphur (iv) oxide to diffuse through the same plug under the same conditions. (S = 32 O = 16) (3mks)

9. Study the information in the table below and answer the questions that follow.

Salt	Solubility	g/100g water
	At 50° C	At 80°c
G	43	58
Y	82	138

A mixture containing 40g salt G and 120g salt Y in 100g of water at 80° was cooled to 50°.

i) Which salt crystallized out?. Give a reason (2mks)
ii) Calculate the mass of the salt that crystallized out. (1mk)

10 a) State two conditions necessary for rusting to occur. (1mrk)
b) State the two reasons why tin coating is used in food cans. (2mks)

11. A form one student was supplied with a colourless liquid which was suspected to be water.
i) Describe one chemical test that could be carried out to show that the liquid is water. (2mks)
ii) How could it have been shown that one liquid was pure water / (1mk)

12. During extraction of copper, the ore is first concentrated and roasted to produce copper (I) Sulphide.
i) Name the ore from which copper is commonly extracted. (1mik)
ii) Write an equation for the reaction in which copper (I) sulphide is produced by roasting the ore in air . (1mk)
iii) Give one effect that the process in (ii) above could have on the environment. (1mk)
iv) Give one use of copper metals (1mk

13. a) Name two cations that are present in hard water. (1mk)
b) Explain how the ion exchange resin softened had water. (2mrks)

14. Below is a representation of an electrochemical cell.
$Pb_{(s)} / Pb^{2+}_{(aq)} // Ag^{+}_{(aq)} / Ag_{(s)}$
a) What does // represent ? (1mk)
b) Given the following: $E^{\ominus}$ (V)
$Pb^{2+}_{(aq)} + 2e \rightarrow Pb_{(s)}$ - 0.13
$Ag^{+}_{(aq)} + e \rightarrow Ag_{(s)}$ + 0.80
(aq)
Calculate the e.m.f of the electrochemical cell. (2 mks)

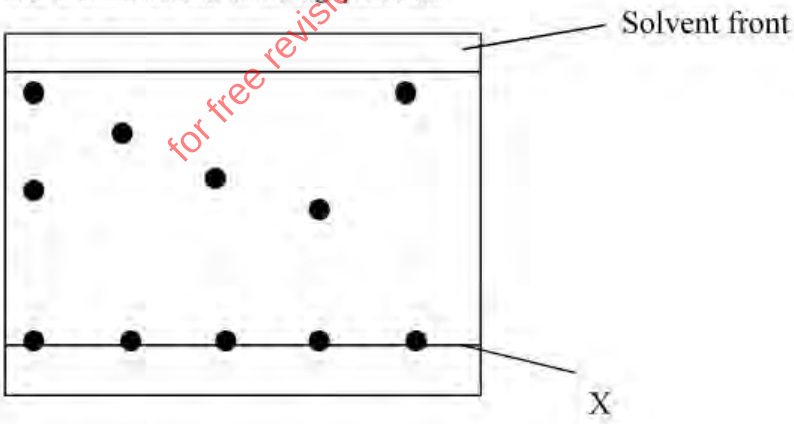
15. Distinguish between ionization energy and electron affinity of an element (1 mk)

16. Calculate the percentage by mass of copper in copper (ii) carbonate salt.
(Cu = 64, C= 12, 0 = 16) (3mks)

17. What name is given to elements which appear in group (II) of the periodic table? (1mk)

18. Explain why the following substances conduct an electric current
a) Magnesium metal (1mk)
b) Molten magnesium chloride (1 mk)

19) The chromatography below was obtained from a contaminated food sample P. Contaminants Q, R, S and T are suspected to be in P. Use it to answer the following questions.



I) Name line labelled X. (1mk)
II) Identify the contaminants in mixture P. (1mk)
III) Which is the most soluble contaminant in P. (1mk)

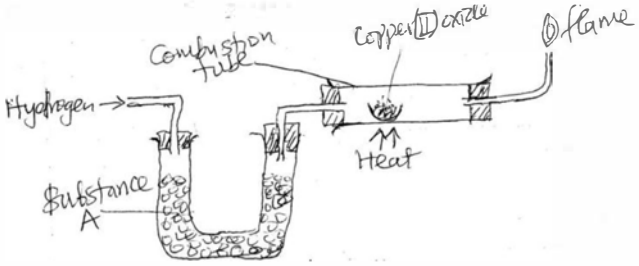
20. a) Diamond and graphite are allotropes of carbon. What is meant by an allotrope? (1 mk)
b) Explain why graphite can be used as a lubricant while diamond cannot. (2mks)

21. Where 15cm^3 of a gaseous hydrocarbon, p, was burnt in 100 cm^3 of oxygen, the resulting gaseous mixture occupied 70cm^3 at room temperature and pressure. When the gaseous mixture was passed through potassium hydroxide solution, its volume decreased to 25cm^3 .
a) What volume of oxygen was used during the reaction?. (1mk)

b) Determine the molecular formular of the hydrocarbon. (2mks)

22. In terms of structure and bonding, explain the following observations:
    a) The melting point of aluminium is higher than that of sodium. (1 ½ mks)
    b) Melting point of chlorine is lower than that of sulphur. (1 ½ mks)

23. The set up below was used to investigate the reaction between dry hydrogen gas and copper (II) oxide.



    i) Name substance A. (1 mk)
    ii) State the observation made in the combustion tube. (1mk)
    iii) Explain the observations made in (ii) above. (1 mk)

24. Hydrogen chloride gas can be prepared by reacting sodium chloride with an acid.
    a) Write an equation for the reaction between sodium chloride and the acid. (1mk)
    b) Give two chemical properties of hydrogen chloride gas (1mk)
    c) State two uses of hydrogen chloride gas. (1mrk)

25. State and explain what would happen if a dry red litmus paper was dropped in a gas jar of dry Chlorine. (2mks)

26. By using aqueous sodium chloride describe how a student can distinguish calcium ions from lead ions. (2mks)

27. Given the following substances: wood ash lemon juice and sodium chloride

a) Name one commercial indicator that can be used to show whether wood, lemon juice and sodium chloride are acidic, basic or neutral. (1mk)

b) Classify the substances in 27(a) above as acids, bases or neutral. (2mks)

Acid	Base	Neutral

28. A solution was made by dissolving 8.2g of calcium nitrate to give 2 litres of solution. Determine the concentration of nitrate ions in moles per litre. (3mks)

MURANGA SOUTH B
233/2
CHEMISTRY
FORM 4
JULY 2017
TIME: 2

INSTRUCTIONS: Answer all the questions in the spaces provided

1. (a) Name the method that can be used to obtain pure iron (III) chloride from a mixture of iron (III) chloride and sodium chloride. (1mk)

b) A student was provided with a mixture of sunflower flour, common salt and red dye. The characteristics of the three substances in the mixture are as shown in the table below;

Substance	Solubility in water	Solubility in ethanol
Sunflower flour	Insoluble	Insoluble
Common salt	Soluble	Insoluble
Solid Red dye	Soluble	Soluble

A form four student wa provided with ethanol, water and any other materials needed. Describe how the student can separate the mixture into three components. (3mks)

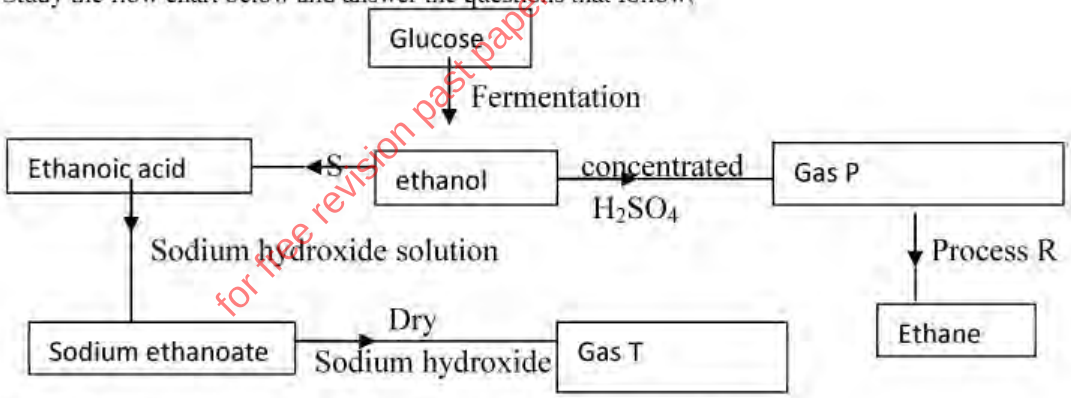
c) The diagram below shows part of a periodic table. The letters do not represent the actual symbols of the elements. Study it and answer the questions that follow;

						H
A				D		
		C		E	F	I
B					G	

(a) Compare the atomic radius of C and F. (2mks)
(b) Explain why the oxidising powere of F is more than that of G. (2mks)
(c) Explain why element D does not react easily. (1mk)
(d) State one use of element I. Explain (2mks)
(e) (i) Write down the formula of the compound formed when F and C react. (1mk)
(ii) What is the nature of the compound formed in e(i) above. (1mk)

2. (a) Draw the structures of the following;
(I) Butan-1, 2-diol (1mk)
(II) Hexanoic acid (1mk)

b) Study the flow chart below and answer the questions that follow;



(I) State the condition necessary for fermentation of glucose to take place. (1mk)
(II) State one reagent that can be used to carry out process S. (1mk)
(III) Identify gases; P,T (2mks)
(IV) Name process R. (1mk)
(V) Give one commercial use of process R. (1mk)

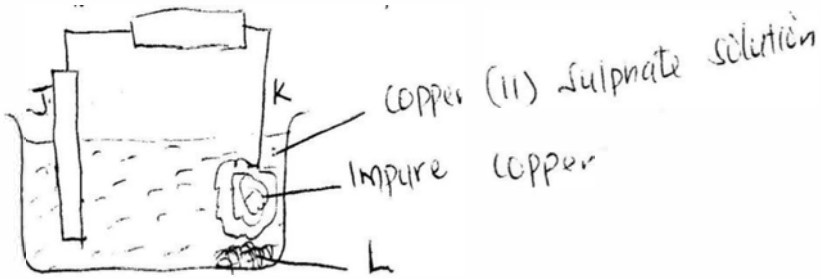
c) When one mole of ethanol is completely burnt in air, 1370KJ of heat energy is released. Given that 1 litres of ethanol is 780g, calculate the amount of heat released when 1 litres of ethanol is completely burnt. (C=12, H=1, O=16) (3mks)

d) State two uses of ethanol other than as an alcoholic drink. (2mks)

3. Study the information given in the table below and answer the questions that follow;

Half reaction	Electrode Potential $E^{\theta}V$
$D^{2+}_{(aq)} + 2e^{-} \rightarrow D(s)$	-13
$E^{-}_{(aq)} + e^{-} \rightarrow E(s)$	+0.80
$F^{3+}_{(aq)} + e^{-} \rightarrow F2+(aq)$	+0.68
$G^{2+}_{(aq)} + 2e^{-} \rightarrow G(s)$	-2.87
$H^{2+}_{(aq)} + 2e^{-} \rightarrow H(s)$	+0.34
$J^{+}_{(aq)} + e^{-} \rightarrow J(s)$	-2.71

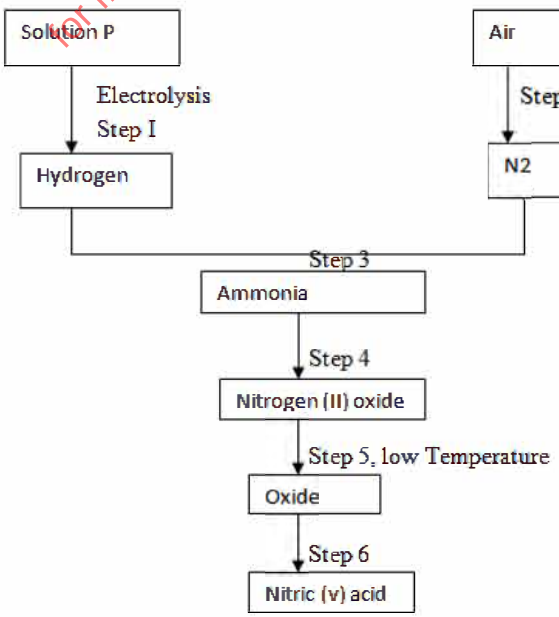
(I) Construct an electrochemical cell that will produce the largest emf. (3mks)
(II) Calculate the emf of the cell constructed in (i) above. (2mks)
(III) Why is it not advisable to store a colution containing J^+ ions in a container made of G? (2mks)
b) Below is a simplified electrolytic cell used for purification of copper. Study it ans answer the questions that follow;



(i) Identify: (1mk)
Anode _____
Cathode _____
(ii) Write down the equation for the recation at the anode. (1mk)
(iii) What name is given to L? (1mk)
(iv) A current of 0.6A was passed through the electrolyte for 3 hours. Determine the amount of copper deposited.
(CU=63.5, Faraday = 96500 Coulombs) (3mks)
(v) State two uses of copper metal. (2mks)

4. a) What is meant by molar enthalpy of combustion? (1mk)
b) State the Hess's law. (1mk)
c) Use the following standard enthalpies of combustion of graphite, hydrogen and enthalpy of ormation of propane.
$\Delta H_C^\theta\ (Graphite) = -393KJMol^{-1}$
$\Delta H_C^\theta\ (H_{2\,(g)}) = -286KJMol^{-1}$
$\Delta H_C^\theta\ (C_2H_{8\,(g)}) = -104KJMol^{-1}$
(i) Write down the equation for the formation of propane. (1mk)
(ii) Draw an energy cycle diagram to show the relationship between the heat of formation of propane with its heat of combustion and the heats of combustion of graphite and hydrogen. (3mks)
(iii) Calculate the standard heat of combustion of propane. (2mks)
d) Other than the enthalpy of combustion, state one facctor whch should be considered when choosing a fuel. (1mk)
e) The molar enthalpies of neutralization for dilute hydrochloric acid and dilute nitric (v) acid are -57.2KJMol^{-1} while that of ethanoic acid is -55.2Kjmol^{-1}. Explain this observation. (2mks)

5. The diagram below shows industrial preparation of ammonia and the process used in manufacture of nitric(v) acid.



(I) Identify solution P. (1mk)

(II) Excess air was used in step 4. What other conditions are necessary in step 4 inorder to produce nitrogen (II) oxide? (1mk)

(III) The eqaution for the reaction in step 5 is

$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_2 \Delta H = -114 Kjmol^{-1}$.

Explain why low temperatures are used in this step. (1mk)

(IV) Draw a diagram to show how nitric (v) acid can be prepared by dissolving nitrogen (iv) oxide in water. (1mk)

(V) The nitric (v) acid produced is only 50% concentrated. Explain how you can increase the concentration of the acid. (1mk)

(VI) State and explain the observations that would be made is a sample of red hot charcoal is heated with Nitric (v) acid. (2mks)

(VII) Describe the process that takes place in step 2. (1mk)

(VIII) Write a chemical equation showing how ammonium nitrate would be produced in the set-up above. (1mk)

(IX) Name the gas produced when ammonium nitrate is heated. (1mk)

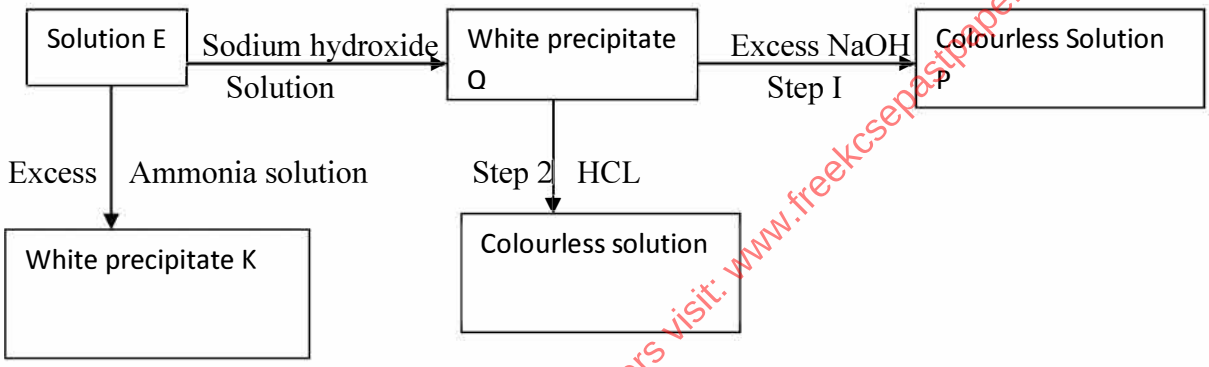
b) In the haber process, nitrogen and hydrogen react according to the following equation at a temperature of 450°C and a pressure of 200 atmospheres.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \Delta H = -92KJ$

(i) Explain how the yield of ammonia would be affected if the pressure was decreased. (2mks)

(ii) Give one use of ammonia. (1mk)

6. Study the flow chart below and answer the questions that follow;



(a) Identify:

(i) Metal ions in solution F. (1mk)

(ii) White precipitate K. (1mk)

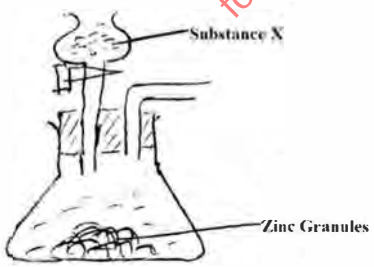
(b) Write down the formula of the ions in solution P. (1mk)

(c) Explain how anions of solution Q could be tested in the laboratory to be sulphate. (2mks)

(d) What is double decomposition? (1mk)

(e) Describe how you would prepare sodium nitrate crystals starting with $200cm^3$ of M nitric(v) acid. (3mks)

7. The set up below was used to prepare and collect dry hydrogen gas.



(a) Complete the diagram to show how dry hydrogen gas is collected. (2mks)

(b) Identify substance X. (1mk)

(c) Explain how hydrogen gas is tested in the lab. (1mk)

(d) State two uses of hydrogen gas. (2mks)

MURANGA SOUTH C
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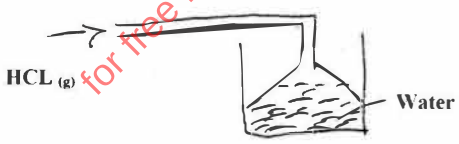
CHEMISTRY
PAPER 1
TIME: 2 HOURS
Kenya Certificate of Secondary Education

1. a) Distinguish between nuclear fission and nuclear fusion. (2mks)
   b) 100g of a radioactive substance were reduced to 12.5g in 15.6 Years .Calculate the half-life of the substance (2mks)
2. a) The electronic arrangement of ion of element Q is 2: 8: 8. If the formula of the ion is Q^{3-} , state the group and period to which Q belongs . (2mks)
   b) Helium , neon and argon belong to group 8 of the periodic table:
   i) The general name of the element. (1mk)
   ii) One use of these elements (1mk)
3. a) Name the products formed when ammonia is burned in air in absence of a catalyst. (1mk)
   b) Write the equation for the above reaction. (1mk)
4. A sample of water did not lather easily with soap solution. A second sample of water was first boiled and soap solution added. This second sample did form lather easily either.
   i) What type of water hardness is present in this water. (1mk)
   ii) What substances are probably present in this water. (2mks)
5. Study the information in the table below and answer the questions that follow.

	Solubility g/100g of water	
$CuSO_4$	At 40°	At 60°
$Pb(N0_3)_2$	28	38
	79	98

   A mixture containing 35g of $CuSO_4$ and 75g of $Pb(NO_3)_2$ in100g of water at 60°c was cooled to 40°C .
   a) Which salt crystallised out. Give a reason (2mks)
   b) Calculate the mass of the salt that crystallized out, (1mrk)
6. a) State any two types of flames that you know (2mks)
   b) Explain how the hotness of Bunsen burner flame can be increased. (1mk)
7. a) Using dots (.) and crosses (x) to represent outermost electron , draw diagrams to show bonding in CO_2 and H_3O^+ (Atomic number H= 1, , C=6 0=8) (3mks)
   b) What type of bond is formed when lithium and fluorine react?. Explain. (2mks)
   (Atomic number Li = 3 and F = 9)
8. a) Name the organic compound formed when CH_3CH_2 CH_2CH_2OH is reacted with concentrated sulphuric (VI) acid at 170°c. (1mk)
   b) In presence of u.v light, ethane gas undergoes substitution reaction with chlorine.
   i) What is meant by the term: substitution reaction. (1mk)
   ii) Give the structural formula and the name of the organic product formed when equal volumes of ethane and chlorine react together. (2mks)
9. Hydrogen Chloride gas was passed into water as shown below.



   a) Explain why the PH of the solution is below 7. (1mk)
   b) What is the use of inverted funnel ? (1mk)
10. The equation below represents a redox reaction-
    $Mg_{(s)} + HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$
    a) Write down the equation for the reduction process. (1mk)
    b) Which substance is oxidized. (1mk)
    c) What is a redox reaction. (1mk
11. Name the process which take place when
    a) Solid carbon (IV) oxide (dry ice) changes directly into gas (1mk)
    b) A red litmus paper turns white when dropped into chlorine water (1mk)
    c) Propene gas molecules are converted into a giant /molecule. (1mk)
12. a) By using only dilute hydrochloric acid, describe how a student would distinguish between barium Sulphite from barium sulphate. (2mks)
    b) State and explain what would happen is a dry litmus paper was dropped in a gas jar of chlorine (1mk)
13. a) Distingush between exothermic and endothermic reaction1
    b) When pure water is heated at1 atmospheric pressure at sea level, the temperature of the water does not rise beyond 100°

C ,even with continued heating. Explain this observation . (2mks)

14. Hydrozine gas burns in oxygen to form nitrogen gas and steam
    a) Write an equation for the reaction. (1mk)
    b) Using the bond energies given below, calculate the enthalpy change for the reaction above

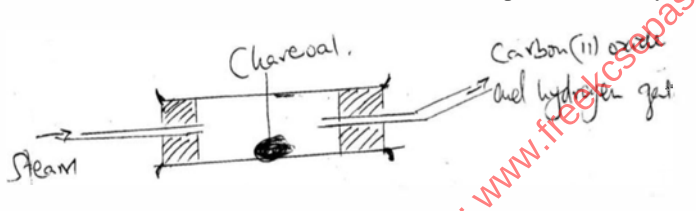
Bond	Bond energy KJ per mole
N = N	944
N - N	163
N - 4	388
0 = 0	496
H - O	462

(2mks)

15. a) Under certain conditions , carbon (IV) Oxide reacts with water to form methanol CH_3OH and oxygen as Shown below $2CO_{2(g)} + 4H_2O \rightleftharpoons 2CH_3OH + 3O_2 \quad H\triangle 1452kJ$
    What would be the effect on the yield of methanol if the temperature of the reaction mixture is increased? Explain. (2 mks)
    b) i) State the Le chatelier's Principles (1mk)
    ii) Carbon (II) Oxide gas reacts with steam according to the equation.
    $CO_{(g)} + H_2O \rightleftharpoons H_{2(q)} + CO_{2(q)}$
    What would be the effect of increasing the pressure of the system at equilibrium?.
    Explain (2mk)

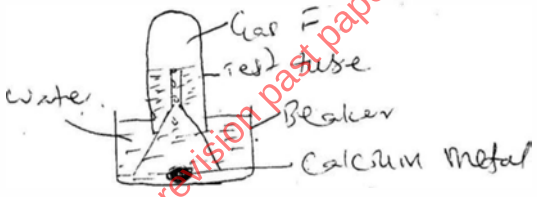
16 a) Explain why burning magnesium continues to burn in a gas jar containing sulphur (IV) Oxide while a burning splint is extinguished. (3mks)
    b) Write an equation for the above reaction. (1mk)

17. When steam was passed over heated charcoal as shown in the diagram below, hydrogen and carbon (II) Oxide were formed.



    b) Name two uses of Carbon (II) oxide gas , which are also uses as hydrogen gas. (2mks)
    c) In terms of structure and bonding, Explain why graphite is used as a lubricant. (2mks)

18. The set up below was used to collect gas F produced by the reaction between water and calcium metal



    i) Name gas F. (1mk)
    ii) At the end of the experiment, the solution in the beaker was found to be a weak base. Explain why. (2mks)
    iii) Give one laboratory use of the solution formed in the beaker. (1mk)
    iv) What is the role of carbon (IV) oxide in fire extinguishing. (1mk)

19. A given volume of Ozone (O3) diffused from a certain apparatus in 96 seconds. Calculate the time taken by an equal volume of carbon (iv) oxide (CO_2) to diffuse under the same conditions.
    (0 =16, C= 12) (3mks)

20. Explain how you would obtain solid sodium carbonate from a mixture of lead carbonate and sodium Carbonate powders. (3mk)

21) $15CM^3$ of ethanoic acid (CH_3COOH) was dissolved in water to make $500cm^3$ of solution . Calculate the Concentration of the solution in moles per litre.
    C = 12 H = 1, 0 = 16 density of exthenoic acid is 1.05g/(cm^3) . (3mks)

22. Starting from solid magnesium oxide, describe how a solid sample of magnesium hydroxide can be Prepared. (3mks)

23. a) What is meant by the term radical. (1mk)

24. The table below contains atoms that formed from various atoms that form common radicals complete the table to show radicals formed from various atoms. (3mks)

Element	N	S	C
H	NH^+_4		
O			

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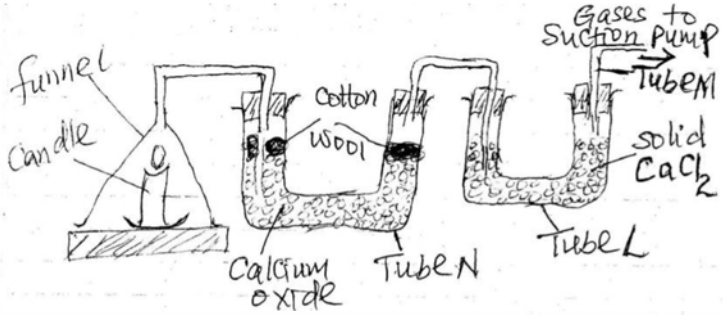
CHEMISTRY
PAPER 2
JULY 2017
TIME: 2 HOURS
Kenya Certificate of Secondary Education

1. a) A candle wax is mainly a compound consisting of two elements. Name the two elements.
   b) The set up below was used to investigate the burning of a candle. Study it and answer the questions that follow;



   i) What would happen to the burning candle if the pump was turned off? (2mks)
   ii) State and explain the changes in mass that are likely to occur in tube N by the end of the experiments. (3mks)
   iii) Name two gases that comes out through tube M. (2mks)
   iv) What is the purpose of calcium chloride in tube L? (1mk)
   v) Name another substance that could be used in the place of calcium oxide in tube N. (1mk)

2. a) The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbols of the elements.

A	D			B		C	
			E		F	G	
H							

   i) Select the most reactive metal. Explain. (2mks)
   ii) Select an element that can form an ion with a charge of 3-. (1mk)
   iii) Select an alkaline earth metal. (1mk)
   iv) Which group I element has the highest first ionization energy? Explain. (2mks)
   v) Element A combine with chlorine to form a chloride of A. state the most likely PH value of a solution of a chloride of A. Explain. (2mks)

b) i) Explain why molten calcium chloride and magnesium chloride conduct electricity while carbon tetrachloride and silicon tetrachloride do not. (2mks)

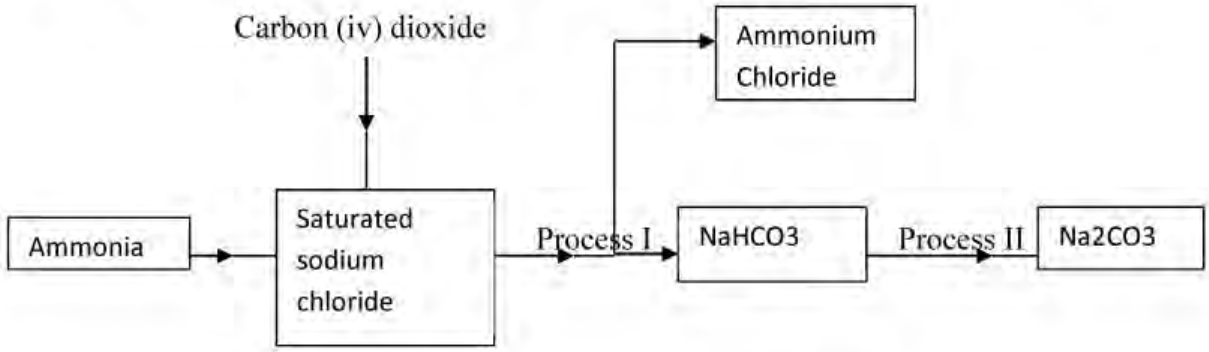
3. a) Distinguish between a neutron and a proton. (1mk)
   b) What is meant by a radioactive substance? (1mk)
   c) Differentiate nuclear fussion and nuclear fission. (2mks)
   d) State two industrial uses of radioactive elements. (2mks)
   e) The two isotopes of hydrogen deuterium $(^{2}_{1}D)$ and tritium $(^{3}_{1}T)$ reacts to form element Y and neutron particles according to the equation below:

$$(^{2}_{1}D) + (^{3}_{1}T) = (^{a}_{b}Y) + (^{1}_{0}n)$$

   (i) What is the atomic; (2mks)
   (I) Mass of Y
   (II) Number of Y
   (ii) What name is given to the type of reaction undergone by the isotopes of hydrogen? (1mk)
   (iii) What is meant by half life of a radioactive substance? (1mk)

f) 288g of a radio active substance decayed to 9 grammes in 40 days. Determine the half life of the radio active substance. (2mks)

4. (a) The schematic diagram shows part of the solvary process used for the manufacture of sodium carbonate.



UNIT I UNIT II

(i) Explain how the sodium chloride required for this process is obtained from sea water. (2mks)

(ii) Two main reactions take place in UNIT I. the first one is the formation of ammonium hydrogen carbonate.

(a) Write an equation for this reaction. (1mk)

(b) Write an equation for the second reaction. (1mk)

(iii) State how the following are carried out;

(a) Process I (1mk)

(b) Process II

(iv) In an experiment to determine the percentage purity of the sample of sodium carbonate produced in the solvary process 2.15g of the sample reacted completely with 46.0cm^3 of 0.5M sulphuric (vi) acid.

(a) Calculate the number of moles of sodium carbonate that reacted. (2mks)

(b) Determine the percentage of sodium carbonate in the sample. (Na = 23, C=12, O=16). (2mks)

(c) Name two industrial uses of sodium carbonate. (2mks)

5. (a) Define the standard enthalpy of formation of a substance. (1mk)

b) Use the thermo chemical equations below to answer the questions that follow:

(I) $C_2H_{6(g)} + 3\frac{1}{2}O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ $\Delta H_1 = -1560KJ/mol$

(II) $C(graphite) + O_{2(g)} \rightarrow Co_{2(g)}$ $\Delta H_2 = -394$ KJ/mol

(III) $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}$ $\Delta H_3 = -286$ KJ/mol

(i) Name two types of changes represented by ΔH_3 (2mks)

(ii) Draw an energy level diagram for the reaction represented by equation (I) (2mks)

(iii) Calculate the standard enthalpy of formation of ethane. (2mks)

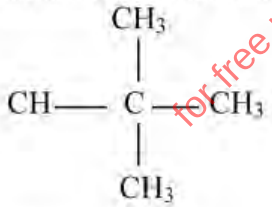
(iv) When a sample of ethane was burnt, the heat produced raised the temperature of 500g of water by 21.5k (Specific heat capacity = 4.2Jg^{-1}K). Calculate;

(I) Heat change for the reaction. (2mks)

(II) Mass of ethane that was burnt. (R.A.M of ethane = 30). (2mks)

6. a) Give the names of the following compounds: (2mks)

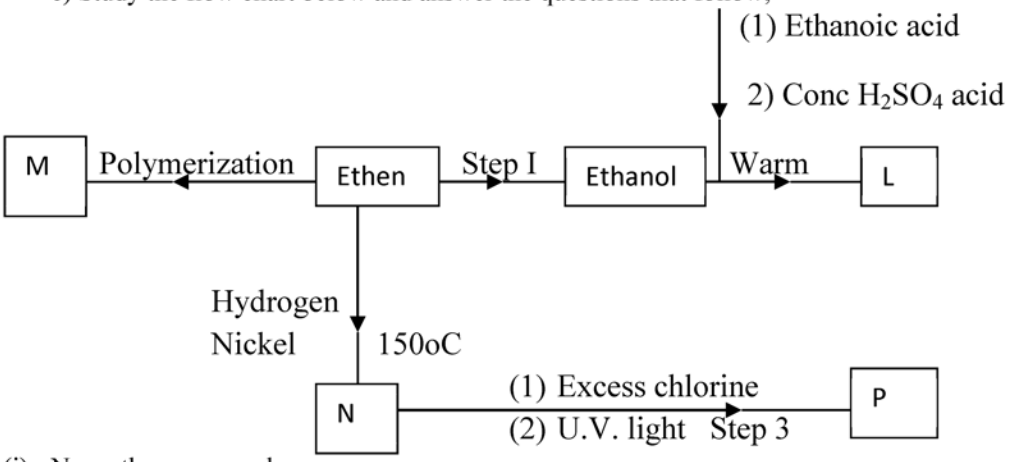
(i)



(ii) $CH_3C \equiv C\,CH_2\,CH_3$

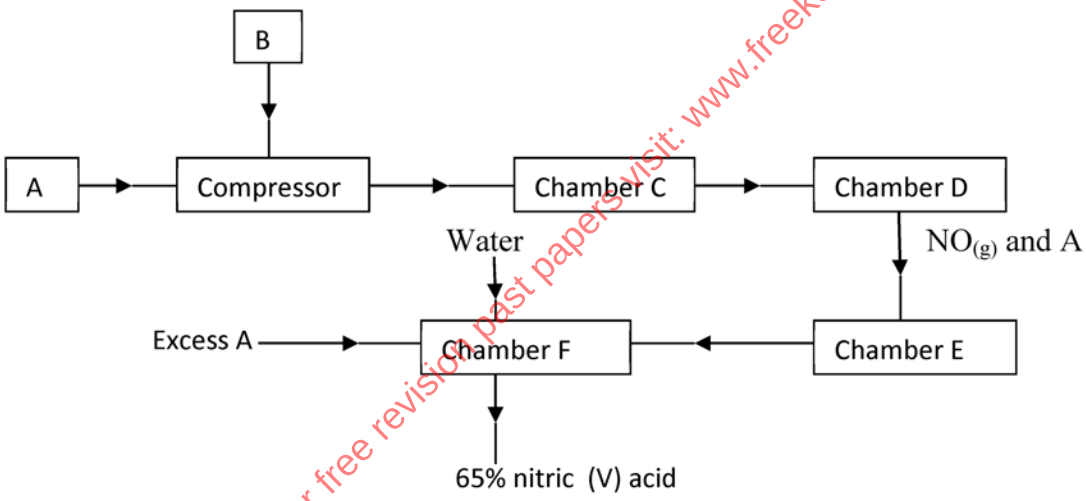
b) Determine a chemical test that can be carried out in order to distinguish between the compounds in (a) above. (2mks)

c) Study the flow chart below and answer the questions that follow;



(i) Name the compounds; (1mk)
(I) L
(II) N
(ii) Draw the structural formula of compound M showing two repeat units. (1mk)
(iii) Give the reagent and the condition used in step I. (1mk)
(iv) State the type of reaction that take place in:
(I) Step 2
(II) Step 3
d) The molecular formula of compound P is $C_2H_2Cl_4$. Draw the structural formula of compound P. (2mks)

7. The flow chart below illustrates the major steps in the manufacture of nitric acid. Study it and answer the questions that follows;



(a) Give reason for purifying the raw materials A and B. (1mk)
(b) Name the substances; A,B (1mk)
(c) Name the parts labeled; D,E,F (3mks)
(d) Write chemical equations for the reactions taking place in;
(I) Chamber D. (1mk)
(II) Chamber F. (1mk)
(e) Name any other condition required in chamber D apart from maintaining temperature at 900°C. (1mk)
(f) that comes out is 65% acid and 35% water. How could the concentration of nitric (v) acid be increased. (1mk)
(g) Give one use of nitric acid. (1mk)
(h) When copper metal is reacted with dilute nitric (v) acid, a brown gas is evolved. Explain. (1mk)