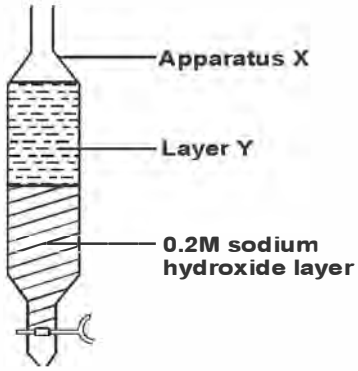
KISII CENTRAL FORM 4 JOINT EVALUATION
233/1
CHEMISTRY
PAPER 1

1. An element in period 4 of the periodic table forms a basic oxide of formula P_2O.
   a) What is the valency of P ? (1 mark)
   b) What name is given to the group of elements in which element P belongs ? (1 mark)
   c) Write down the electronic arrangement of P in the oxide P_2O. (1 mark)
2. a) State Graham's law of diffusion. (1 mark)
   b) The rate of diffusion of sulphur (IV) oxide gas through a porous material is $40cm^3s^{-1}$. Calculate the rate of diffusion of carbon (IV) oxide gas through the same porous material.
   (S= 32.0, O = 16.0, C = 12.0) (2 marks)
3. An aqueous solution of hydrogen chloride gas reacts with manganese (IV) oxide to form chlorine gas while a solution of hydrogen chloride in methylbenzene does not react with manganese (IV) oxide. Explain. (2 marks)
4. A mixture of propane and propanoic acid was shaken with 0.2M sodium hydroxide solution and let to separate as shown in the diagram below.



   a) Name apparatus X. (1 mark)
   b) Name the main component in layer Y. Give a reason for the answer. (2 marks)
5. Chlorine and iodine are elements in the same group in the periodic table. Chlorine gas is yellow while aqueous iodine, $I_{2(aq)}$ is brown.
   a) What observation would be made if chlorine gas is bubbled through aqueous potassium iodide ? Explain using an ionic equation. (2 marks)
   b) Under certain conditions, chlorine and iodine react to give iodine trichloride, $ICl_{3(s)}$. What type of bonding would you expect to exist in iodine trichloride ? Explain. (1 mark)
6. When 0.6g of element J were completely burnt in oxygen and all the heat evolved was used to heat 0.5 litres of water, the temperature of the water changed by 11°C. Calculate the relative atomic mass of element J given that the specific heat capacity of water = $4.2Jk^{-1}g^{-1}$, density of water = $1.0g/cm^3$ and molar heat of combustion of J is $380KJmol^{-1}$. (3 marks)
7. During extraction of iron in the blast furnace, state the uses of the following in the furnace.
   a) Molten slag (1 mark)
   b) Waste gases leaving the furnace. (1 mark)
   c) Limestone (1 mark)
8. Radioactive Poloniun-216 decays as shown below:

$$^{216}_{84}Po \longrightarrow {}^{208}_{82}Pb + m\alpha + n\beta$$

   a) Determine the value of :
      i) m (1 mark)
      ii) n (1 mark)
   b) Distinguish between nuclear fusion and nuclear fission. (1 mark)
9. A reagent bottle containing concentrated hydrochloric acid has a density of $1.18g/cm^3$, molecular mass of 36.5 and is 36% pure.
   a) Determine the molarity of the concentrated acid. (2 marks)
   b) What volume of the concentrated acid would be required to make one litre of 1M dilute acid ? (1 mark)
10. Starting with copper metal describe how copper (II) carbonate can be prepared in the laboratory. (3 marks)
11. When bromine gas reacts with aqueous sodium hydroxide, an equilibrium is established as shown below.

$$\underset{\text{(Brown)}}{Br_{2(aq)}} + 2OH^-_{(aq)} \rightleftharpoons Br^-_{(aq)} + OBr^-_{(aq)} + \underset{\text{(colourless)}}{H_2O_{(l)}}$$

   Explain what would be observed if a few drops of dilute sulphuric (VI) acid were added to the equilibrium mixture. (2 marks)
12. On strong heating sodium nitrate liberates oxygen gas. In the space provided below, draw a labelled diagram of a set up that

could be used for heating sodium nitrate and collecting the oxygen gas liberated. (3 marks)

13. When a hydrated sample of $CaSO_4.nH_2O$ was heated until all water was lost, the following data was recorded.
Mass of crucible = 30.296g
Mass of crucible + hydrated salt = 33.111g
Mass of crucible + anhydrous salt = 32.781g
Determine the value of n in the hydrated salt ($CaSO_4$ = 136,H_2O = 18) (2 marks)

14. Use the cell representation below to answer the questions that follow.
$Cr_{(s)} / Cr^{3+}_{(aq)} // Fe^{2+}_{(aq)} / Fe_{(s)}$

a) Write the equation for the cell reaction. (1 mark)
b) If the e.m.f of the cell is +0.30volts and E^{θ} value for $Fe^{2+}_{(aq)} / Fe_{(s)}$ is -0.44 volts, calculate the E^{θ} for $Cr^{3+}_{(aq)} / Cr_{(s)}$ (2 marks)

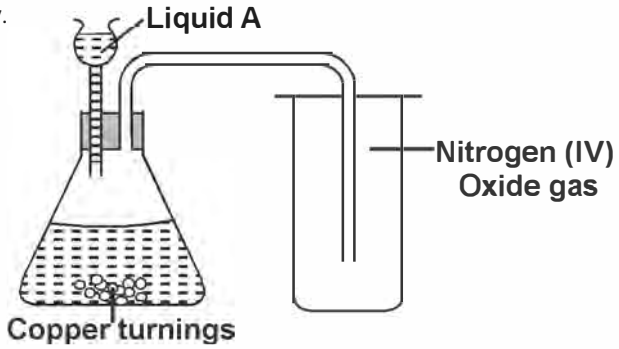
15. When excess carbon (II) oxide gas was passed over heated lead (II) oxide in a combustion tube, lead (II) oxide was reduced.
a) Write an equation for the reaction which took place. (1 mark)
b) What observation was made in the combustion tube when the reaction was complete ? (1 mark)
c) Name another gaseous compound which could be used to reduce lead (II) oxide. (1 mark)

16. The table below shows the pH values of solutions A, B, C and D.

Solution	A	B	C	D
P^H value	2	7	11	14

a) Which solution is likely to be that of calcium hydroxide ? (1 mark)
b) Select the solutions in which a sample of zinc oxide is likely to dissolve. Give a reason for your answer. (2 marks)

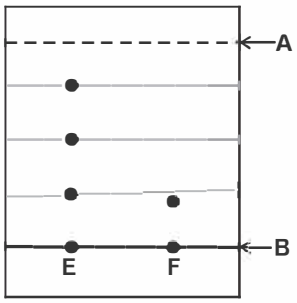
17. The following set up was used to prepare and collect nitrogen (IV) oxide in the laboratory. Study it and answer the questions that follow.



a) Identify liquid A. (1 mark)
b) Write the equation for the reaction that produces nitrogen (IV) oxide gas. (1 mark)
c) Name the method used to collect nitrogen (IV) oxide. (1 mark)

18. a) Draw and name structures of the two positional isomers of butene, C_4H_8. (2 marks)
b) Name the type of reaction that occurs when chlorine gas is mixed with methane gas in sunlight. (1 mark)

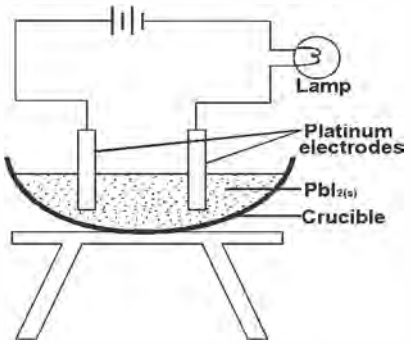
19. The following is chromatogram showing the results obtained after separating two substances E and F.



a) Name lines (1 mark)
b) Name a suitable solvent which can be used in the above process. (1 mark)
c) Which of the two substances is pure ? (1 mark)

20. Explain why there is a general increase in the first ionisation of the elements in period 3 of the periodic table from left to right. (2 marks)

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

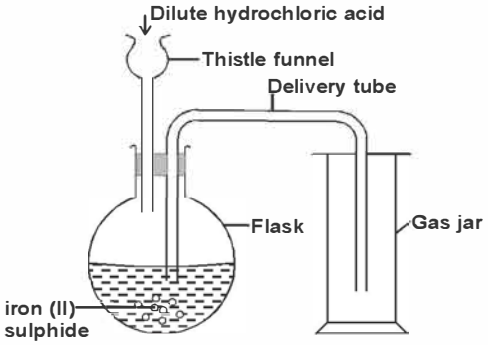


The student noted that the bulb did not light.

a) What had been omitted in the set up ? (1 mark)

b) Explain why the bulb lights when the omission is corrected. (2 marks)

22. Dilute hydrochloric acid and solid iron (II) sulphide were reacted as shown in the set up below.



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a) Name the gas produced in the flask. (1 mark)

b) Give two reasons why no gas was collected in the gas jar. (2 marks)

23. When excess dilute hydrochloric acid was added to sodium sulphite, $960cm^3$ of sulphur (IV) oxide gas was produced. Calculate the mass of sodium sulphite that was used. (Na = 23, S = 32, O = 16, molar gas volume = $24dm^3$) (3 marks)

24. The table below shows the tests carried out on a sample of water and the results obtained.

	Tests	Results
I	Addition of sodium hydroxide solution dropwise until in excess	White precipitate which does not dissolve in excess
II	Addition of excess aqueous ammonia	No white precipitate
III	Addition of lead (II) nitrate then heating the mixture	White precipitate that dissolves on heating

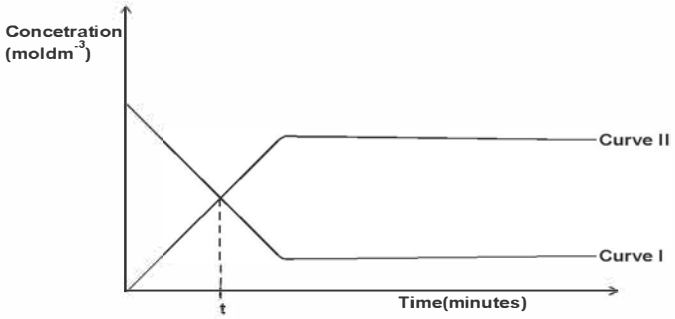
a) Identify the anion present in the water. (1 mark)

b) Write an ionic equation for the reaction in III. (1 mark)

c) What type of hardness is in the sample of water ? (1 mark)

25. The curves below represent the changes in the concentrations of subtstances C and D with time in the reaction

$C_{(g)} \rightleftharpoons D_{(g)}$



a) Which curve represents the change in concentration of substance C. ? Give a reason. (2 marks)

b) What is the significance of time 't' ? (1 mark)

26. An ion of aluminium can be represented as. Draw a diagram to show the distribution of the electrons and the composition of the nucleus of the ion of aluminium. (2 marks)

27. Complete the table by inserting the missing information in the spaces provided. (2 marks)

Name of polymer	Name of monomer	One use of the polymer
i) Polychloroethene	.....	.....
ii)	Propene	.....

28. a) Define the term solubility. (1 mark)
    b) 70g of salt Y were added to 80cm^3 of water at 25°C. After stirring, 10g of crystals of Y were filtered out. Determine the solubility of salt Y at 25°C. (2 marks)
29. The atomic and mass numbers of two elements M and N are and respectively. Describe how one can distinguish between the oxides of the elements above. (2 marks)

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CHEMISTRY
PAPER 2

1.

a) 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 ?

A				E			H	
	C		D		G			K
B				F			J	

i) Select the most reactive non-metal. Give a reason for your answer. (2 marks)
ii) Explain how the melting points of elements C and D compare. (2 marks)
iii) Explain why the atomic radius of K is smaller than that of G. (1 mark)
iv) Element W forms ion W^{2-} and is found in period 3. Indicate the position of W on the grid. (1 mark)
v) Write an equation for the reaction between C and H. (1 mark)

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

Formula of chloride	NaCl	$MgCl_2$	$AlCl_3$	$SiCl_4$	PCl_3
Melting point (°C)	801	714	-	-	-
Formula of oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5
Melting point (°C)	1190	3080	2050	1730	560

i) Using dots (•) and crosses (x) to represent electrons in the outermost energy level, show the bonding in the following compounds.
   I. PCl_3 (1 mark)
   II. $MgCl_2$ (1 mark)
ii) Why is the melting point of $AlCl_3$ not indicated in the table above ? (1 mark)
iii) Explain the large difference in the melting points of MgO and P_2O_5. (2 marks)

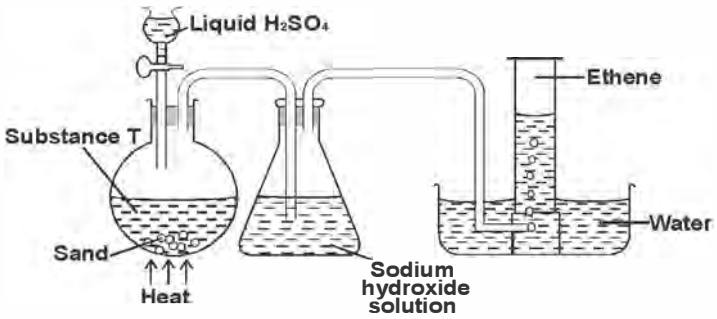
2.

a) Crude oil is a source of many compounds that contain carbon and hydrogen only.
   i) Name the process used to separate the components of crude oil. (1 mark)
   ii) On what two physical properties of the above components does the separation depend ? (2 marks)

b) Under certain conditions hexane can be converted into two products. The formula of one of the products is C_3H_6.
   i) Write the formula of the other product. (1 mark)
   ii) Describe a simple chemical reaction to show the difference between the two products formed in (b) above. (2 marks)

c) Ethyne C_2H_2 is another compound found in crude oil. One mole of ethyne was reacted with one mole of hydrogen chloride gas and a product A_1 was formed. A_1 was then reacted with excess hydrogen gas to form A_2.
   i) Give the IUPAC name of product A1. (1 mark)
   ii) Draw the structure of A_2. (1 mark)

d) The set up below was used to prepare and collect ethene gas. Study it and answer the questions that follow.

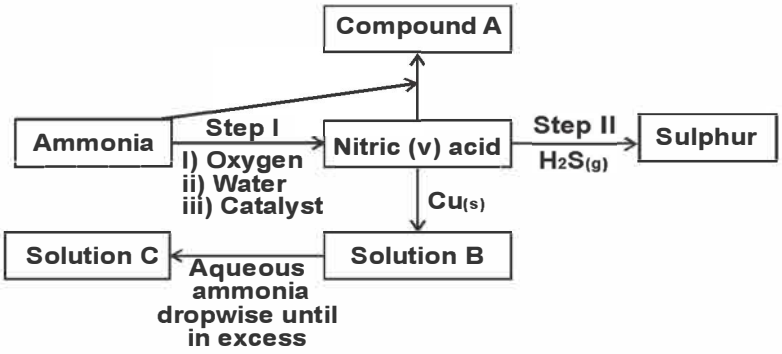


i) Identify substance T. (1 mark)
ii) What type of reaction is taking place in the round bottomed flask ? (1 mark)
iii) Give one property of ethene that allows it to be collected as shown in the set up. (1 mark)
iv) Name two gaseous impurities removed by the sodium hydroxide solution. (1 mark)

3.

a) Nitrogen and hydrogen are the raw materials used in the manufacture of ammonia. Name two sources of hydrogen used in this process. (1 mark)

b) The chart below shows some reactions starting with ammonia. Study it answer the questions that follow.



i) Name the catalyst used in step I. (1 mark)
ii) Write down the equation for the reaction that requires the catalyst in step I. (1 mark)
iii) What observation are made in step III ? (1 mark)
iv) Write down the formula of the complex ion present in solution C. (1 mark)
v) What property of concentrated nitric (V) acid is shown by the reaction in step II ? (1 mark)
vi) State one use of compound A. (1 mark)

c) 1.8 litres of ammonia gas was bubbled through excess dilute nitric (V) acid at room temperature and pressure. Determine the mass of the product formed. (Molar gas volume = 24.0dm^3, N = 14, O = 16, H = 1) (3 marks)

4.

a) Use the standard electrode potentials for elements J, K, L, M and N given below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

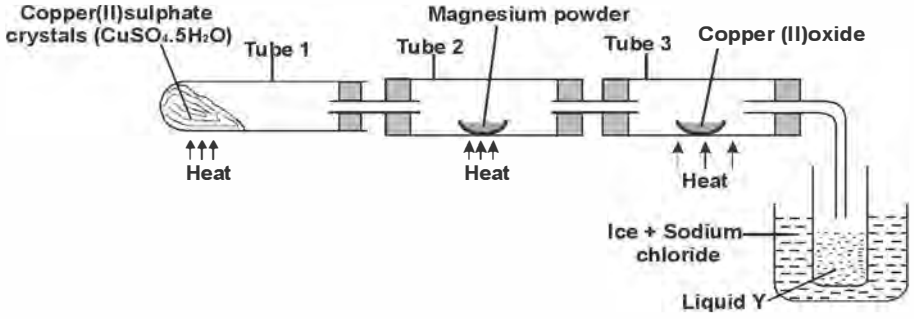
	E^θ volts
$J^{2+}_{(aq)} + 2e^- \rightleftharpoons J_{(s)}$	-2.90
$K^{2+}_{(aq)} + 2e^- \rightleftharpoons K_{(s)}$	-2.38
$L^{+}_{(aq)} + e^- \rightleftharpoons \frac{1}{2}L_{2(g)}$	0.00
$M^{2+}_{(aq)} + 2e^- \rightleftharpoons M_{(s)}$	+0.34
$\frac{1}{2}N_{2(g)} + e^- \rightleftharpoons N^{-1}_{(aq)}$	+2.87

i) Which element is likely to be hydrogen ? Give a reason for your answer. (2 marks)
ii) What is the E^θ value of the strongest oxidising agent. (1 mark)
iii) In the space provided, draw a labelled diagram of the electrochemical cell that would be obtained when half-cells of elements K and M are combined. (3 marks)
iv) Calculate the E^θ value of the electrochemical cell constructed in (iii) above. (1 mark)

b) During the electrolysis of aqueous copper (II) sulphate using copper electrodes, a current of 0.5A was passed through the cell for 2 hours.
i) Write an ionic equation for the reaction that took place at the anode. (1 mark)
ii) Determine the change in mass of the anode which occured as a result of the electrolysis process. (Cu = 64.0, 1Faraday = 96500 coulombs) (3 marks)

c) State the main reason for electroplating metallic items. (1 mark)

5. The diagram below shows the apparatus for the preparation of gas P and investigation on its properties. Study it and answer the questions that follow.



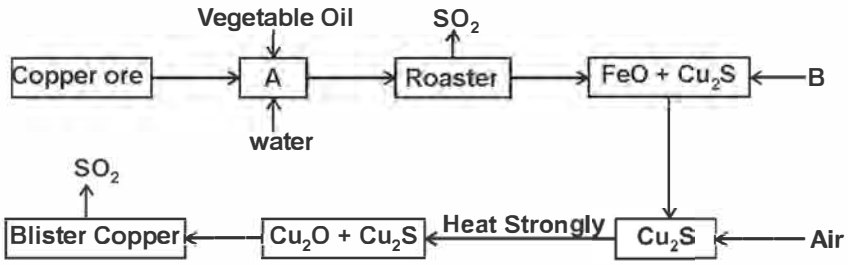
a) i) Name gas P. (1 mark)
ii) Suggest the property of gas P under investigation. (1 mark)
iii) Write chemical equations for the reactions in the :
I. tube 1 (1 mark)
II. tube 2 (1 mark)

b) State and explain the observations made in :
i) tube 1 (2 marks)
ii) tube 3 (2 marks)

c) i) What is the use of copper (II) sulphate crystals in the experiment ? (1 mark)
ii) State the role of sodium chloride in the ice (freezing mixture). (1 mark)
iii) Describe how the purity of liquid Y can be confirmed. (1 mark)

d) Explain why helium is preferred in filling of aeroplane tyres to gas P. (1 mark)6.

Study the flow chart below on extraction of copper and answer the questions that follow.



a) Name the chief copper ore used for the extraction of copper. (1 mark)
b) The amount of copper in the copper ore is very small. State the method used to concentrate the ore in chamber A. (1 mark)
c) Identify substance B and state its function. (2 marks)
d) Write an equation for the reaction that takes place in the roaster. (1 mark)
e) The blister copper obtained is impure. With the aid of a diagram, describe how it can be purified. (2 marks)
f) Give two side effects that this process would have on the environment. (2 marks)
g) Bronze is an alloy of copper and another metal.
i) Give the chemical symbol of the other metal. (1 mark)
ii) State one use of bronze. (1 mark)

7.
a) State Hess's law. (1 mark)
b) Use the following thermochemical equations to determine the heat of formation of butane, C_4H_{10}. (3 marks)

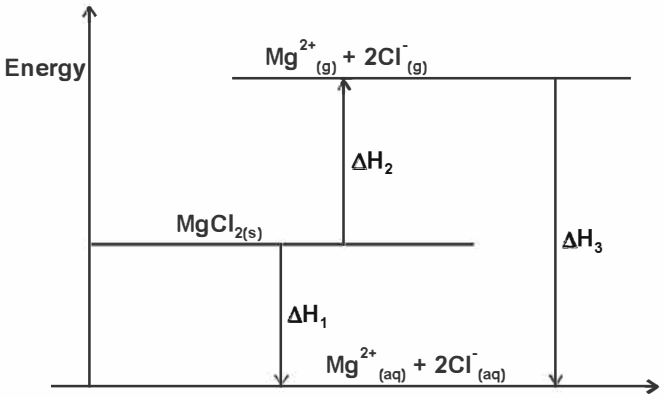
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -393 kJmol^{-1}$

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

$C_4H_{10(g)} + {}^{13}/_2O_{2(g)} \rightarrow 4CO_{2(g)} + 5H_2O_{(g)}$ $\Delta H = -2877 kJmol^{-1}$

c) Explain how the hydration energies of fluoride (F^{-1}) and chloride (Cl^{-1}) ions compare. (2 marks)

d) The diagram below shows an energy level diagram for the dissolution of magnesium chloride. Study it and answer the questions that follow.



i) Which of the energy changes ΔH_1, ΔH_2 and ΔH_3 represent an exothermic process ? Explain. (2 marks)
ii) What is the relationship between ΔH_1, ΔH_2 and ΔH_3 ? (1 mark)
iii) i) Define heating value of a fuel. (1 mark)
ii) Give one reason why wood and charcoal are chosen for domestic heating. (1 mark)

KISII CENTRAL FORM 4 JOINT EVALUATION
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CHEMISTRY
PAPER 3

1. You are provided with :
- 0.5M sodium hydroxide solution labelled solution N
- accurately weighed 6.3g of a dibasic acid, $H_2A.xH_2O$ labelled solid M
- acidified potassium manganate VII labelled solution P
- phenolphthalein indicator

Required :

i) To standardize solution M using solution N so as to obtain concentration of solution M in moles per litre and value of X in one mole of the dibasic acid, solid M.
ii) To determine the rate of reaction between solution M and solution P at different temperatures.

Procedure I

Put all solid M into a 200ml clean beaker. Add 100cm^3 of distilled water and stir until all the solid M dissolves.
Transfer the resulting solution into a 250ml volumetric flask. Add more water to the mark. Shake to homogeneous. Label the solution as solution M.
Fill the burette with solution N.
Using a pipette filler and pipette place 25cm^3 of solution M into a 250ml conical flask. Add 2-3 drops of phenolphthalein indicator.
Titre solution N with solution M till end point. Record your results in table 1. Repeat to complete I with consistent readings.
(Retain solution M for procedure II and question 3)

Experiment No.	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution N used			

(4 marks)

a) Calculate the average volume of solution N. (show your work) (1 mark)
b) Calculate moles of dibasic acid in 25cm^3 of solution M. (1½ marks)
c) Calculate moles of dibasic acid in 250cm^3 of solution M. (1 mark)
d) Calculate the molar mass of solid M. (1½ marks)
e) Calculate the value of X in one mole of solid M. (H = 1, A = 88) (2 marks)

Procedure II

- Using a measuring cylinder, measure 10cm^3 of solution P into a 100ml glass beaker.
Wash the cylinder and use it to measure 10cm^3 of solution M into a boiling tube. Use a test tube holder and heat the contents of the boiling tube to a temperature of 50°C.
Pour the contents of the boiling tube to contents of the beaker and immediately start the stopwatch. Stir the contents of the beaker gently with a thermometer continuously until the purple colour turns to colourless and record time taken in seconds for the mixture to decolourise in table II.

Wash the apparatus and repeat the procedure for the stated temperature of M at 60°C, 70°C and 90°C to complete table II.
Computer $^{1}/_{t}$ to complete the table.

Table II

Temp. of solution M °C	50	60	70	90
Time taken for decolourisation, t (sec)				
$^{1}/_{t}$ sec^{-1}				

a) i) Draw a graph of $^{1}/_{t}$ sec^{-1} (vertical axis) against temperature of solution M. (3 marks)
ii) From your graph determine time taken for decolourisation to occur if temperature of solution M is 80°C. (2 marks)

2. You are provided with solid K. Carry out the following tests on it and record your observations and inferences.

a) Put a sample of solid K into a boiling tube. Add 15cm^3 of distilled water. Shake well.

b) Divide mixture in (a) onto four portions of 2cm^3 each in separate test tubes for tests that follow.
i) To first portion add ammonia solution dropwise till in excess. (3marks)
ii) To second portion add 2cm^3 of dilute sulphuric (VI) acid. (3marks)
iii) To third portion add sodium hydroxide dropwise till in excess. (3marks)
iv) To fourth portion add 3 drops of lead nitrate solution and boil the mixture. (3marks)

3. Divide solution M prepared in question 1 into four portions of 2cm^3 each into separate test tubes for tests i - iv.
i) To first portion add sodium hydrogen carbonate provided. (3marks)
ii) To the second portion add 3 drops of acidified potassium chromate VI. (3marks)
iii) To the third portion add 3 drops of bromine water. (3marks)
iv) To fourth portion add 1cm^3 of ethanol followed by 2 drops of conc. sulphuric VI acid. Warm the mixture and leave to cool. (3marks)