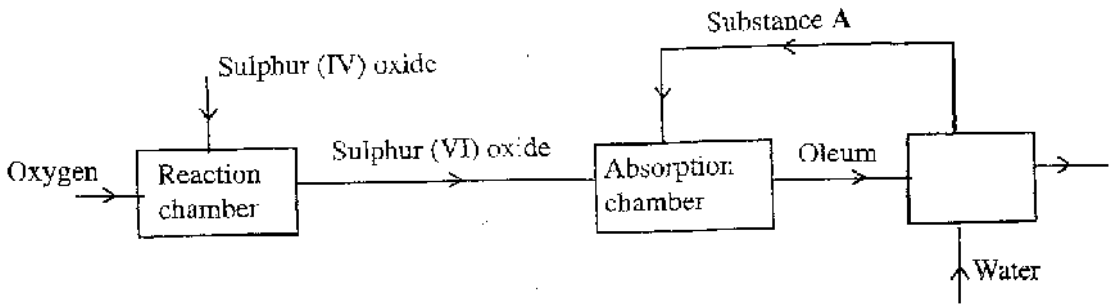
31. What name is given to elements which appear in group (II) of the periodic table?

(1mark)

CHEM. 2011
PAPER 2

1. The flow chart below shows some of the processes involved in large scale production of sulphuric (VI) acid. Use it to answer the questions that follow.



a) Describe how oxygen is obtained from air on a large scale
(3 marks)

(b) (i) Name substance A.

(ii)Write an equation for the process that takes place in the absorption chamber.

(1mark)

(c) Vanadium (V) oxide is a commonly used catalyst in the contact process.

(i) Name another catalyst which can be used for this process.
(1 mark)

(ii) Give two reasons why vanadium (V) oxide is the commonly used catalyst.

(2 marks

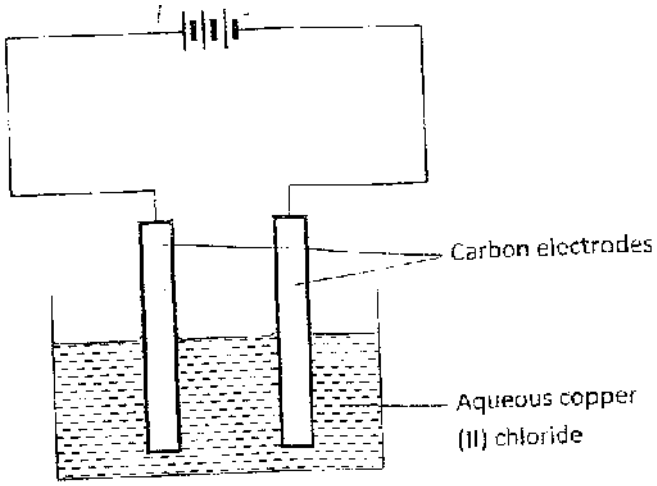
(d) State and explain the observations made when concentrated sulphuric (VI) acid is
added to crystals of copper (II) sulphate in a bearer.
(2 marks)

(e) The reaction of concentrated sulphuric (VI) acid with sodium chloride produces
hydrogen chloride gas. State the property of concentrated sulphuric (VI) acid,illustrated in this reaction.
(1mark)

(f) Name four uses of sulphuric (VI) acid

2. The set-up below was used by a student to investigate the products formed when aqueous copper (II) chloride was electrolysed using

carbon electrodes.



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

(ii) Name and describe a chemical test for the product initially formed at the anode when a highly concentrated solution of copper (II) chloride is electrolysed.

(3 marks)

(iii) How would the mass of the anode change if the carbon anode was replaced with
copper metal? Explain.
(2 marks)

(b) 0.6 g of metal B were deposited when a current of 0.45A was passed through an electrolyte for 72 minutes. Determine the charge on the ion of metal B.
(Relative atomic mass of B = 59, 1 Faraday = 96 500 coulombs) (3 marks)

(c) The electrode potentials for cadmium and zinc are given below:

$Cd^{2+}(aq) + 2e \rightleftharpoons Cd_{(s)}$; $E^{\ominus} = -0.4v$

$Zn^{2+}(aq) + 2e \rightleftharpoons Zn_{(s)}$; $E^{\ominus} = -0.76v$

why it is not advisable to store a solution of cadmium nitrate in a container
made of zinc
(2 marks)

3. (a) Ethanol can be manufactured from ethene and steam as shown in the equation below:

$$C_2H_4(g) + H_2O(g) \rightleftharpoons CH_3CH_2OH(g)$$

Temperature and pressure will affect the position of equilibrium of the above
reaction. Name the other factor that will affect the position of equilibrium of the above reaction. (1 mark)

(b) The data in the table below was recorded when one mole of ethene was reacted
with excess steam. The amount of ethanol in the equilibrium mixture was
recorded under different conditions of temperature and pressure. Use the data to
answer the questions that follow.

Temperature (°C)	Pressure (Atm)	Amount of ethanol at equilibrium (Moles)
300	50	0.40
300	60	0.46
300	70	0.55
250	50	0.42
350	50	0.38

(i)State whether the reaction between ethene and steam is exothermic or endothermic. Explain your answer. (3 marks)

(ii) State and explain **one** advantage and one disadvantage of using extremely high pressure in this reaction.

I Advantage

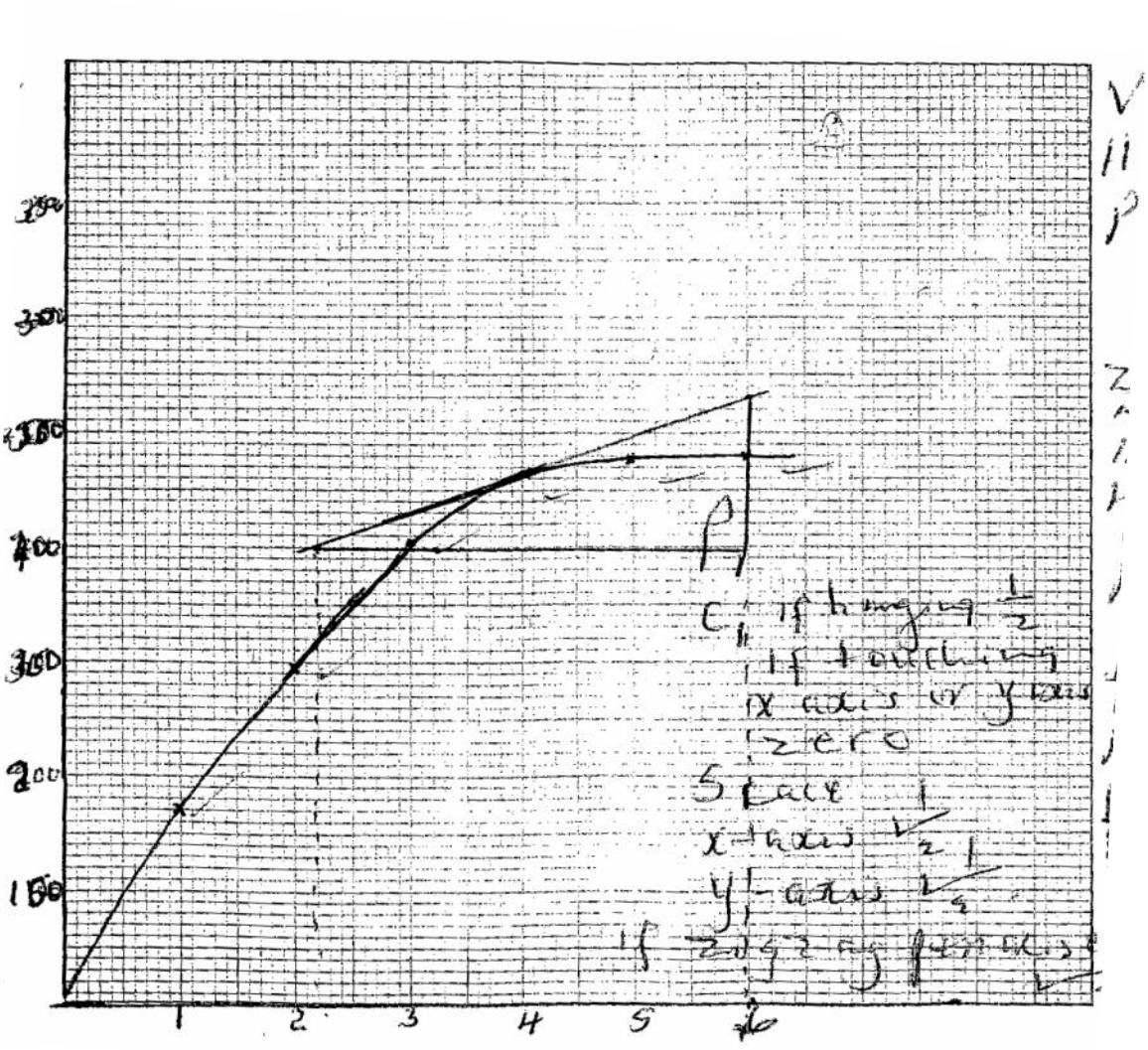
II disadvantage

(c) In an experiment to determine the rate of reaction between calcium carbonate and dilute hydrochloric acid, 2g of calcium carbonate were reacted with excess 2 M hydrochloric acid, The volume of carbon (IV) oxide evolved was recorded at regular intervals of one minute for six minutes. The results are shown in the table below.

Time (minutes)	1	2	3	4	5	6

Volume of carbon (IV) oxide (cm^3)	170	296	405	465	480	480

(i) plot a graph of time in minutes on the horizontal axis against volume of carbon (IV) oxide on the vertical axis.



(ii) determine the rate of reaction at 4 minutes
(2marks)

4 (a) When excess calcium metal was added to 50 cm^3 of 2 M aqueous copper (II) nitrate in a beaker, a brown solid and bubbles of gas were observed.

(i) "Write two equations for the reactions which occurred in the beaker. (2 marks)

(ii) Explain why it is not advisable to use sodium metal for this reaction.

(b) Calculate the mass of calcium metal which reacted with copper (II) nitrate solution. (Relative atomic mass of Ca = 40) (2 mark)

(c) The resulting mixture in (a) above was filtered and sodium hydroxide added to the filtrate dropwise until in excess. What observations were made?

(1mark)

(d) (i) Starting with calcium oxide, describe how a solid sample of calcium carbonate can be prepared.

(ii) Name one use of calcium carbonate

5.(a) Other than their location in the atom, name two other differences between an electron and a proton.

(b) the table below gives the number of electrons ,protons and neutrons in particles

A,B, C , D, E, F and G

particle	Protons	electrons	neutrons
A	6	6	6
B	10	10	12
C	12	10	12
D	6	6	8
E	13	10	14
F	17	17	18
G	8	10	8

(i) Which particle is likely to be a halogen? (1 mark)

(ii) what is the mass number of E

(iii) write the formula of the compound formed when E combines with G (1 mark)

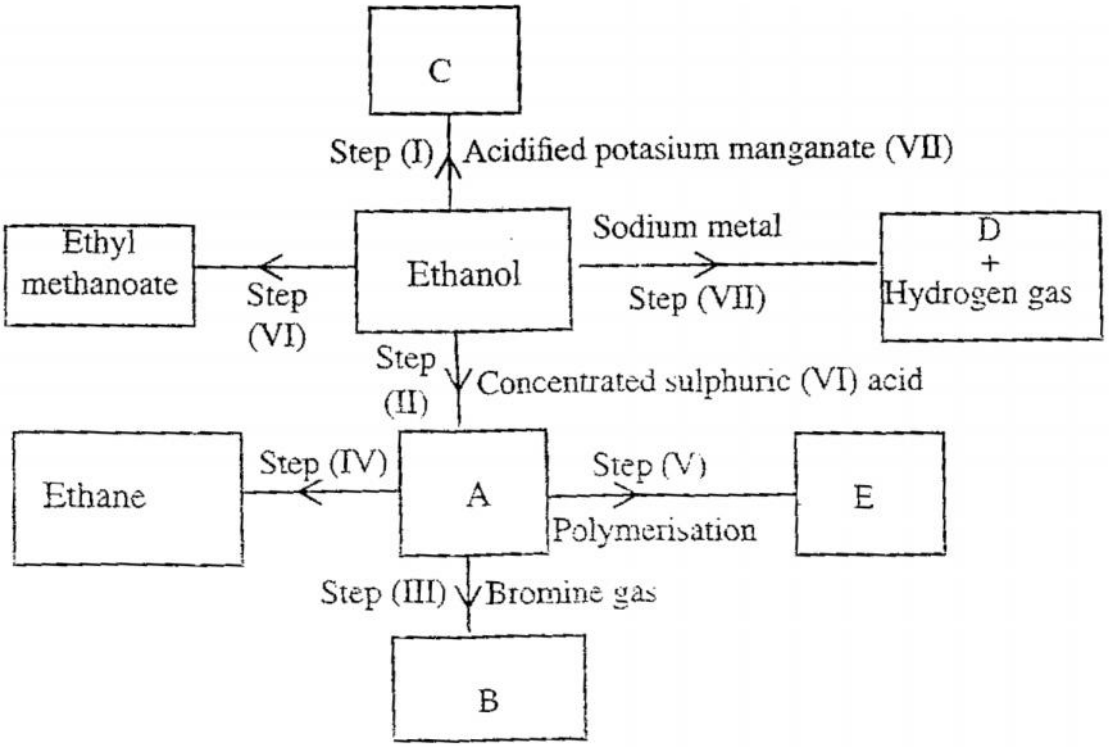
iv) Name the type of bond formed in (iii) above.

(v) How does the radii of C and E compare ? Give reason. (2 marks)

(vi) Draw a dot (.) and cross(x) diagram for the compound formed between

(1 mark)

(vii) Why would particle B not react with particle D ? (1 mark)



(i) I What observation will be made in Step *I* *(1 mark)*

II Describe a chemical test that can be carried out to show the identity of compound C *(2 mark)*

(ii) Give the names of the *following*

I ***E***.....
(2 mark)

II *substance* ***D*** .....
(1 mark)

(iii) Give the formula of substance **B .**

……
….

(iv) Name the type of reaction that occurs in:

I Step (II)

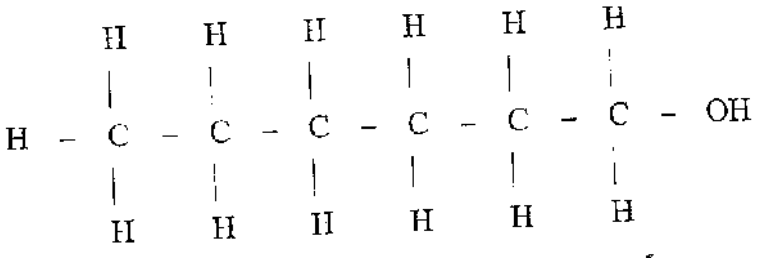
II Step (IV)

(v) Give the reagent and conditions necessary for Step (VI).

Rea2ent:

Conditions

(b) (i) Name the following structure.



(ii) Draw the structure of an isomer of pentene.

7.(a) What is meant by molar heat of combustion? 1 mark)

(b) State the Hess's Law.

c) Use the following standard enthalpies of combustion of graphite, hydrogen and enthalpy of formation of propane.

ΔH_C^{θ} $(Graphite)$ = $-393kJ\ mol^{-1}$

ΔH_C^{θ} $(H_2(g))$ = $-286kJ\ mol^{-1}$

ΔH_f^{θ} $(C_3H_8(g))$ = $-104kJ\ mol^{-1}$

(i) Write the equation for the formation of propane. (1 mark)

(ii) Draw an energy cycle diagram that links the heat of formation of propane with its heat of combustion and the heats of combustion of graphite and hydrogen.

(iii) Calculate the standard heat of combustion of propane. (2 marks)

(d) Other than the enthalpy of combustion, state **one** factor which should be considered
when choosing a fuel. (1 mark)

(e) 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. (2marks

Chemistry paper 3 2011

You are provided with:

- 1.60g of solid **A,** a dibasic acid.
- Solution **B** containing 4.75g per litre of salt **B.**
- Aqueous sodium hydroxide, solution **C**.
- Phenolphthalein indicator.

You are required to prepare a solution of solid **A** and use it to determine the:-

- Concentration of sodium hydroxide, solution **C**
- React salt B with excess sodium hydroxide and then determine the relative molecular mass of salt **B**.

Procedure I

(a) Using a burette, place 25.0cm^3 of solution B in each of two 250ml conical flasks.
Using a pipette and **pipette filler,** add 25 .Ocm^3 of solution C to each of the two conical flasks. (The sodium hydroxide added is in excess). **Label** the conical flasks 1 and 2.

(b) Heat the contents of the first conical flask to boiling and then let the mixture boil for 5 minutes. Allow the mixture to cool.

(c) Repeat procedure (b) with the second conical **flask.**

While the mixtures are cooling, proceed with

procedure II. **Procedure II**

(a) Place **all** of solid A in a 250 ml volumetric flask. Add about 150cm^3 of distilled water, shake well to dissolve the solid and then add water to make up to the mark. Label this as solution A.

(b) Place solution A in a clean burette. Using a pipette and **pipette filler,** place 25.0cm^3 of solution C in a 250ml conical flask. Add 2 drops of phenolphthalein indicator and titrate with solution A. Record your results in Table 1. Repeat the titration two more times and complete the table.

Table 1

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

(4 marks)

Calculate the:-

(i) Average volume of solution A used: ($^1/_2$ marks)

(ii) Concentration in moles per litre of the dibasic acid in solution A; (2 marks)
(Relative molecular mass of **A** is 126).

(iii) Moles of the dibasic acid used; (1 mark)

(iv) moles of sodium hydroxide in 25.0cm^3 of solution C.

(1 mark)

(v) Concentration of sodium hydroxide in moles per litre.
(2 marks)

Procedure III

Add 2 drops of phenolpthalein indicator to the contents of the first conical flask prepared in procedure I and titrate with solution A. Record your results in Table 2. Repeat the procedure with the contents of the second conical flask and complete the table.

Table 2

	1st conical flask	2nd conical flask
Final burette reading		
Initial burette reading		
Volume of solution **A** used (cm^3)		

(3 marks)

Calculate the:-

(i) average volume of solution A used; ($^1/_2$ marks)

(ii) moles of the dibasic acid used;

(1 mark)

(iii) moles of sodium hydroxide that reacted with the dibasic acid. (1 mark)

(iv) moles of sodium hydroxide that reacted with 25.0cm^3 of salt **B** in solution **B;**

(2 marks)

(v) Given that 1 mole of salt **B** reacts with 2 moles of sodium hydroxide, calculate the:

(1 mark)

I. number of moles of salt **B** in 25.0cm^3 of solution **B;**

II. concentration in moles per litre of salt **B** in solution **B**; (1 mark)

III. Relative molecular mass of salt **B**; (2 marks)

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

(i) Place about one half of solid **D** in a test-tube and heat it strongly. Test any gases produced with both red and blue litmus papers.

Observations	**Inferences**
(2 marks)	(1 mark)

(ii) Place the rest of solid **D** in a boiling tube. Add about **10cm^3 of** distilled water. Shake well.

To a 2cm^3 portion of the solution, add about 1cm^3 of hydrogen **peroxide** and shake well. To the resulting mixture, add aqueous sodium hydroxide **dropwise until** in excess.

Observations	**Inferences**
(1 mark)	**(1 mark)**

(b) You are provided with solution **E**. Carry out the following **tests** and write your observations and inferences in the spaces provided.
Divide solution **E** into **two** portions.

(i) To one portion of solution **E** in a test-tube, **add 3 drops** of barium nitrate. **Retain the mixture for use in test (ii) below.**

Observations	**Inferences**
(1 mark)	(2 marks)

(ii) To the mixture obtained in (i) above, add about 5 cm^3 of 2M nitric **(V) acid.**

Observations	**Inferences**
(1 mark)	(1 mark)

(iii) To portion two of solution **E** in a test-tube, add 2 drops of acidified potassium dichromate (VI) and warm the mixture.

Observations	**Inferences**
(1 mark)	(1 mark)

3 You are provided with liquid **F**. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Place five drops of liquid **F** on a clean dry watch glass and ignite it.

Observations	**Inferences**
(1 mark)	(1 mark)

(b) Place about $2cm^3$ of liquid **F** in a clean dry test-tube, add all the sodium hydrogen carbonate provided.

Observations	**Inferences**
(1 mark)	(1 mark)

(c) Place about $2cm^3$ of liquid **F** in a test-tube, add about $1cm^3$ of acidified potassium dichromate (VI) and warm the mixture.

Observations	**Inferences**
(1 mark)	(1 mark)