1. (a) State Raoult's law of lowering of vapour pressure (1mark)

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(b) When 12.19g of a non-volatile solute, P was dissolved in 200g of water, the vapour pressure of the solution was lowered by 1.72mmHg at certain temperature

(i) Determine the relative molecular mass of P.(vapour pressure of pure water at the same temperature is 92.52mmHg) (3marks)

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(ii) State assumptions you have made in (b)(i) (2marks)

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2. Complete the following equations and in each case name the main organic product.

(a) CH_3CHCH_3 (Br) $\xrightarrow[\text{Dry ether}]{\text{Na}}$ ..... *(1½ marks)*

Name of product.....

(b) $CH_3CH{=}CH_2 + HBr \xrightarrow{\text{ROOR}}$ ..... *(1½ marks)*

Name of product.....

(c) $(CH3)_3CBr \xrightarrow[\text{heat}]{CH_3CH_2OH/KOH}$ .....*(1½ marks)*

Name of product.....

+

3. (a) Define the term "standard enthalpy of formation'' (1mark)

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(b)(i) Draw a Born-Haber cycle for the formation of ethyne (2marks)

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(ii)The enthalpies of combustion of carbon, hydrogen and ethyne are -393.5, -285.8 and -1310kJmol^{-1} respectively. Calculate the heat of formation of ethyne. (2marks)

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4. Carbon monoxide and steam react according to the equation

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

(a) Write the expression for the equilibrium constant, K_c. *(1 mark)*

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(b) Equimolar quantities of carbon monoxide and steam were made to react in1 litre vessel and when equilibrium was attained, the vessel was found tocontain 16.7% carbon dioxide. Calculate the

(i) amount of carbon monoxide, steam, carbon dioxide and hydrogen at equilibrium in moles per litre. *(02½ marks)*

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(ii) equilibrium constant, K_c, for the reaction *(1 mark)*

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(c) State what would happen to the position of equilibrium when sodium hydroxide solution is added to the equilibrium mixture. Give a reason for your answer. *(1 mark)*

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5. Both boron and silicon exhibit diagonal relationship.

(a) State :

(i) what is meant by the term diagonal relationship (1mark)

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(ii) **four** properties in which silicon and boron show similarities (3marks)

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(b) Name **two** other pairs of elements that show diagonal relationship (1mark)

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6. Write equation for the reaction between sodium hydroxide solution and

(a) silicon(iv) oxide

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(b) beryllium oxide

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(c) Phosphorous(V) oxide

7. Draw the structures and name the shapes of the followingspecies. *(6 marks)*

species	structure	Name
(a) $HClO_4$		
(b) $POCl_3$		
(c) $SnCl_2$		
(d) ClO_3^-		

8. Complete the following reaction equations and write the accepted mechanisms.

(a) $(CH_3)_3CBr \xrightarrow{H_2O}$ ……..

(2 marks)

Mechanism

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.....

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(b) $CH_3CH = CHCH_3$ $\xrightarrow{Br_2/H_2O}$ ……..

(3 marks)

Mechanism

.....

.....

9. Write equation for the reaction between water and the hydride of

(a) sodium (1½*marks)*

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(b) silicon (1½*marks)*

.....

(c) sulphur (1½*marks)*

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10. 30 cm^3 of a gaseous hydrocarbon **Q** was exploded with 200 cm^3 of oxygen which was in excess. The gaseous product occupied a volume of 155 cm^3, which was decreased by 120 cm^3 on treatment with concentrated potassium hydroxide solution.

(a) Calculate the molecular formula of **Q** *(3½ marks)*

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(b) **Q** forms a red precipitate on treatment with a solution of copper(I) chloride in aqueous ammonia
Write

(i) the structural formula and IUPAC name of **Q** *(1½ marks)*

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(ii) equation for the reaction between **Q** and copper(i) chloride *(1 mark)*

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(iii) equations to show how **Q** can be obtained from an alcohol (3mark)

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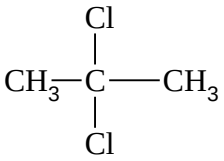
11. Write equations to show how the following conversions can be carried out. In each case indicate the reagent and conditions for the reaction.

(a)  from 2-chloropropane *(2½ marks)*

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(b) CaC_2 to ethanol *(03 marks)*

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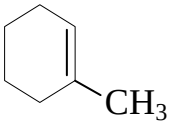
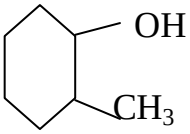
(d)  to 

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12. 20 cm^3 of solution K containing chlorine was diluted to 250 cm^3 with distilled water. 25 $cm^3$of the dilute solution was pippeted. 10 cm^3 of potassium iodide solution was added followed by 10 cm^3 of ethanoic acid. This mixture was titrated with 0.05 M sodium thiosulphate solution using starch indicator. 24.5 cm^3 were required for complete reaction.

(a) Write equations of reactions that took place. *(3 marks)*

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(b) Calculate the

(i) number of moles of iodine that would be liberated by 25 cm^3 of the dilute solution of K. *(2marks)*

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(ii) mass of chlorine in the original solution. *(2marks)*

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(iii) percentage of chlorine in K. *(2marks)*

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13. The data in the table below was obtained for the reaction

$3A \longrightarrow$ Products

Time (hours)	1.3	2.0	4.0	5.3
$\log_{10}[A]$	-0.24	-0.33	-0.57	-0.74

(a) Plot a graph of $\log_{10}[A]$ against time (3marks)

(b) From the graph, determine the

(i) initial concentration of A (1mark)

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(ii) order of the reaction (1½ marks)

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(c) Calculate the rate constant and hence half life of the reaction (3½ marks)

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14. (a) A chloride of aluminium X, contains 20% aluminium and 80% chlorine.

(i) Calculate the empirical formula of X. (2marks)

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(ii) Determine the molecular formula of X (1½*marks)*
(The vapour density of X is 133.5)

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(iii) Write the structural formula of X (1mark)

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(b) (i) State how aluminum chloride can be prepared (1mark)

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(ii) State the type of bond and structure in the aluminum chloride

Type of bond (*½mark)*

.....

Structure (*½mark)*

.....

(c) Sodium carbonate solution was added to aqueous solution of aluminum chloride. State what observed and write equation for the reaction that takes place

Observation (1mark)

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Equation (1½*marks)*

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15. The table below shows the atomic radius and the electron affinity of some elements in group(VII) of the Periodic Table.

Element	F	Cl	Br	I
Atomic radius (nm)	1.36	1.81	1.95	2.16
First electron affinity($KJmol^{-1}$	-328	-349	-325	-295

(a) Explain

(i) how atomic radius of the elements varies down the group (3marks)

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(ii) the trend in the first electron affinity of the elements (3marks)

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(b) write equation for the reaction between chlorine and

(i) hot concentrated sodium hydroxide solution (1½*marks)*

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(ii) potassium bromide solution (1½*marks)*

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16. (a) (i) Define the term lattice energy (1½*marks)*

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(ii) The standard enthalpy of formation of sodium oxide from its constituent elements is -416 kJ mol^{-1}. Write an equation for this process. *(1½ marks)*

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(c) The energy changes that take place during the formation of sodium oxide are shown in the table below

Process	ΔH^{θ} / kJ mol^{-1}
Na(s) $\xrightarrow{A}$ Na(g)	+109
$Na_{(g)} \xrightarrow{B} Na^{+}_{(g)} + e^{-}$	+494
$O_{2(g)} \xrightarrow{C} 2O_{(g)}$	+496
$O_{(g)} + e^{-} \xrightarrow{D} O^{-}_{(g)}$	-142
$O^{-}_{(g)} + e^{-} \xrightarrow{E} O^{2-}_{(g)}$	+844

(i) Name the energy changes for the processes (2½*marks)*

A .....

B.....

C.....

D.....

E.....

(ii) Calculate the standard enthalpy of formation of sodium oxide (3½*marks)*

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17. A compound, **W**, on combustion gave 0.629g of carbon dioxide and 0.257g of water.

(a) Determine the empirical formula of **W** (2½marks)

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(b) When 0.1g of W was vapourised, it occupied a volume of 53.3cm^3 at s.t.p

(i) Calculate the molecular mass of **W**. (1½marks)

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(ii) Determine the molecular formula of **W** (1mark)

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(iii) Write the structural formula of **W** (½mark)

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(c) Write equation to show how **W** can be converted into pent-2-yne (3½marks)

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