SECTION A
ATTEMPT ONLY THREE QUESTIONS IN THIS SECTION.

1. (a). Write **the electronic configuration** of element **Gallium**. (0½ mark)
   (b). Natural Gallium consists of isotopes ^{69}**Ga** and ^{71} **Ga** in atomic ratio
   3:2.The relative isotopic masses of ^{69}**Ga** and ^{71} **Ga** are **68.9** and
   70.9 respectively.
   (i). Calculate the approximate relative atomic mass of Gallium.
   (02 marks)
   (ii). Explain how the mass spectrum can be used to obtain the
   relative atomic mass of Gallium. (09 marks)
   (c). (i). The figure **1.0** below represents a mass spectrometer.
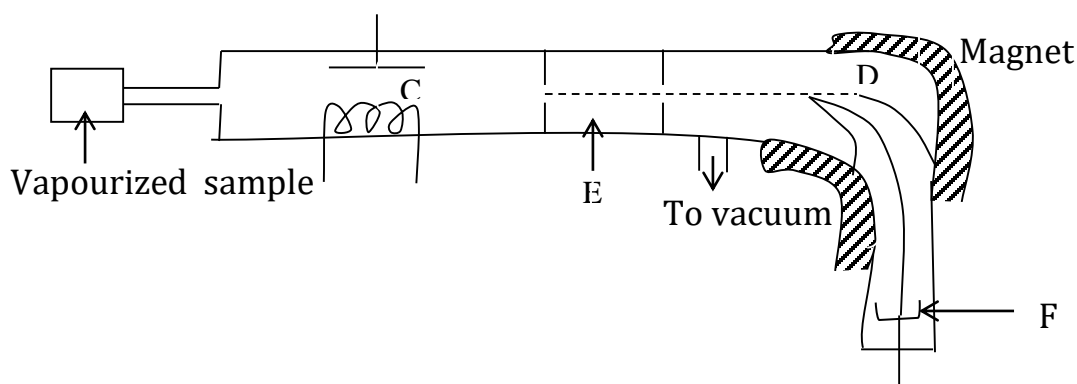
Name and state the functions of the following parts. (04 marks)

C ……………………………………………………………

D ……………………………………………………………

E ……………………………………………………………

F ……………………………………………………………

(ii).Explain why the values of **relative atomic masses** have **no units**.
(01 mark)
(iii).State **two limitations** of using **mass spectrum** for the determination
of relative atomic mass. (02 marks)
(d) Bromine has two isotopes,$^{79}_{35}Br$ and$^{81}_{35}Br$, the mass spectrum shows
peaks m/e of **158,160** and **162**. Write the formula of the ions
corresponding to each peak. (01½ marks)

2. **10.0cm³** of a hydrocarbon **P**, **[CₓHy]** was exploded in **90.0cm³** of oxygen gas. On cooling to room temperature, the residual gases occupied **70.0cm³**.When the residual gases were passed via potassium hydroxide solution, the volume was reduced to **40.0cm³**.
   (a) (i). Write equation for the reaction between **P** and **oxygen gas**.

   (01 mark)
   (ii).Determine the molecular formula of hydrocarbon **P**.   (03 marks)
   (iii).Write the structural formula and name of hydrocarbon P.

   (01 mark)
   (iv).Write a balanced equation for the combustion of hydrocarbon **P** and oxygen gas.   (01½ marks)
   (b)Write equation to show how hydrocarbon **P** can be prepared from a named alcohol.   (03 marks)
   (c) Discuss the following types of reaction
       i.   Nucleophilic substitution reaction   (03 marks)
       ii.   Electrophilic addition reaction   (03 marks)
       iii. Elimination reaction   (03 marks)
   (d)When propene is reacted with bromine gas in presence of tetrachloromethane, 1, 2-dibromopropane is formed but if propene is reacted with bromine gas in presence of sodium chloride solution, 1-bromo-2-chloropropane is formed. Explain the observations.

   (01½ marks)

3. (a). Explain the variation of ionization energy down group (II) elements.

   (02½ marks)
   (b). The table below shows the elements in period 2 of the periodic table.

Elements	$_3$Li	$_4$Be	$_5$B	$_6$C	$_7$N	$_8$O	$_9$F	$_{10}$Ne
1st I.E	520	899	801	1086	1403	1310	1681	2080

    i. Plot a graph of first ionization energy against atomic number.

   (02½ marks)
    ii. Explain the shape of the graph.   (06½ marks)
   (c). (i) Magnesium, Strontium & barium are group (II) elements. Discuss the reaction of the elements with Air.   (04 marks)

(ii)The products of Magnesium & Strontium was reacted with water. State what is observed and write equation for the reaction. State the effect of the gases produced on litmus papers.   (04½ marks)

4. (a). (i). State the difference between ideal and real gas.   (02 marks)
       (ii). State two assumptions of the kinetic theory for ideal gases.
                                                                    (02 marks)
    (b). Explain how liquidifaction of a gas can be affected by:
        i. Temperature.   (02½ marks)
        ii. Pressure.   (02½ marks)
    (c).The curve below shows deviations of some gases from ideal behavior.
        i.   State why Helium shows a small deviation from ideal behavior compared to other gases.   (01½ marks)
        ii.   Compare the deviation of oxygen and carbon dioxide gas from
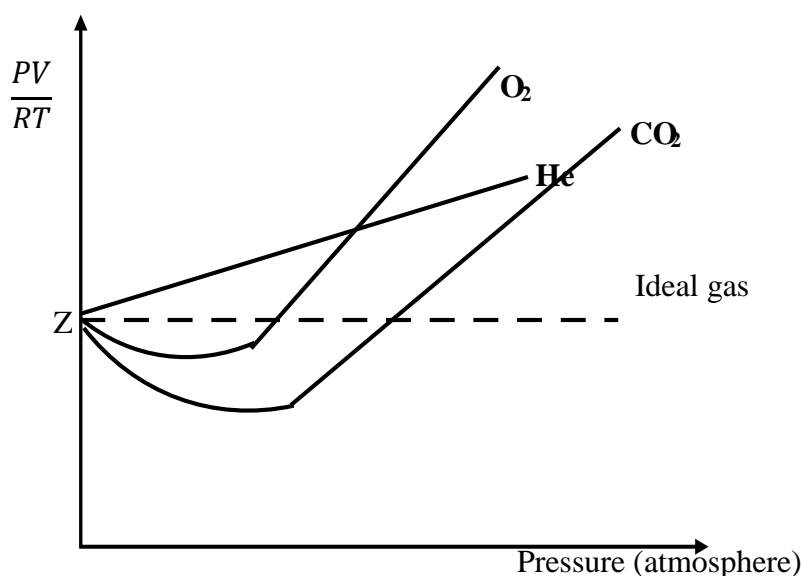
        ideal behavior.   (02½ marks)
        iii. Briefly explain why at point **Z**, oxygen, helium and carbon dioxide have the same pressure with the ideal gas.   (02 marks)
    (d). A gas **Q** contains **30.43%** nitrogen and the rest being oxygen gas. **0.23g** of **Q** occupied **154.11cm³** at **150°C** and **840mmHg**. Determine the:
        i.   Empirical formula of **gas Q**.   (02 marks)
        ii.   Molecular formula of **gas Q**.   (03 marks)
    [**1 mole** of a gas occupies **24dm³** at a temperature of **25°C** and pressure of **760mmHg**]

(e). When a mixture of **Q** and oxygen was bubbled through water, a compound **Y** was formed.
   i. Identify **Y**.
   ii. Write equation for the reaction leading to the formation of **Y**.
   iii. Briefly describe a test(s) that can be carried out to identify **Y**.

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5. When **8.8g** of hydrocarbon, **Z** was burnt in excess air, **14.4g** of steam and **13.44dm³** of carbon dioxide gas were obtained at s.t.p.
   [1 mole of a gas at s.t.p occupies 22.4dm³]
   a) Determine the empirical formula of hydrocarbon, **Z**. (03½ marks)
   b) The vapour density of hydrocarbon, Z is **22**. Write the name of hydrocarbon **Z** after determining the molecular formula. (02½ marks)
   c) (i). Write equation indicating conditions to show how hydrocarbon **Z** can be synthesized from a named alcohol. (03 marks)
      (ii). Indicate the mechanism for the first stage of the reaction.
         (03½ marks)
   d) Name the reagent used to differentiate the following compounds and in each case state what is observed and write the equation of reaction where possible.
      i. $CH_3HC=CH_2$ and $CH_3CH_2CH_3$ (03 marks)
      ii. Ca^{2+} and Mg^{2+} (03 marks)
   e) Explain why dehydration of butan-1-ol and butan-2-ol forms but-2-ene as the major product but not but-1-ene. (01½ marks)

6. (a). Define what is meant by the term distribution constant? (02 marks)
   (b). Describe briefly how partition coefficient of butanoic acid between water and trichloromethane can be determined. (06 marks)
   (c). The distribution coefficient of A between ethoxyethane and water is **90**. An aqueous solution of A with a volume of **500cm³** contains **5.0g**. Calculate what mass of A will be extracted by.
      (i) **100cm³** of ethoxethane. (02 marks)
      (ii) Two successive portions of **50.0cm³** of ethoxyethane. (03 marks)
   (d). State three conditions under which partition coefficient is valid.
         (03 marks)
   (f). The table below shows the partition of ammonia between 0.1M copper (II) sulphate and tetrachloromethane.

Concentration NH_3 in 0.1 M $CuSO_4$	0.86	1.10	1.57	1.80	2.40
Concentration NH_3 in CCl_4	0.02	0.03	0.05	0.06	0.08

(i) Plot a graph of concentration of ammonia in **0.1M** copper (II) sulphate against concentration of ammonia in carbon tetrachloromethane. (02 marks)

(ii)Determine the intercept on y-axis and what information can you get from the intercept? Explain your answer. (02 marks)

7. (a) Explain the term **melting point**. (01 mark)

(b) State the **factors** which **affect the melting point**: (@03 marks)
   i. Metals.
   ii. **Molecular substances**.

(c) Explain the trend in melting points of the elements in **group (II)** and **group (IV)** of the periodic table. (07 marks)

(d) The table below shows melting points of some compounds.

Compounds	Melting point/K
Aluminium oxide	2290
Aluminium chloride	451
Calcium oxide	2850
Calcium chloride	1051

Explain why:
i. The melting point of aluminium chloride is abnormally low compared to that of aluminium oxide. (02 marks)
ii. The melting point of calcium oxide is much higher than that of calcium chloride. (02 marks)

(e) Explain why a solution of aluminium nitrate turns blue litmus paper red. (02 marks)

8. (a) State Raoult's law. (01 mark)

(b) A solution containing **50g** of heptane and **38g** of octane boils at **103°C** and **760mmHg.** The saturated vapour pressure of heptane and octane at **100°C** are **957mmHg** and **378mmHg** respectively. The normal boiling points of heptane and octane are **98°C** and **120°C** respectively.

(i) Sketch a well labelled diagram to show the variation of vapour pressure with composition and another graph to show the variation of boiling point with composition. (04 marks)

(ii) Calculate the composition of the vapour at **103°C**. (03½ marks)

(c) The table below shows the partial vapour pressures for the two component mixtures of propanone and trichloromethane.

Mole fraction of CHCl$_3$	0.0	0.2	0.4	0.6	0.8	1.0
Partial pressure of CHCl$_3$ (mmHg)	0	35	82	142	219	293
Partial pressure of Propanone (mmHg)	347	270	185	102	37	0

(i) Plot a suitable graph to show that this system deviates from Raoult's law. (03 mark)

(ii) Name the type of deviation shown by the system. (0½ mark)

(iii) State the cause of such deviation and characteristics of a system showing this deviation. (03 marks)

(d) Explain the principles of steam distillation. (04 marks)

END