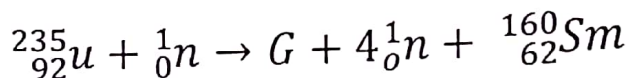## PART A (46 MARKS)
Attempt all questions in this section

1. (a) Balance the equation for the nuclear reaction below and identify the element G (1 mark)

$$^{235}_{92}U + ^{1}_{0}n \rightarrow G + 4^{1}_{0}n + ^{160}_{62}Sm$$

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(b) State the conditions and write the equation for the reaction leading to the formation of the chloride of G. (2½ marks)

Conditions;

Equation;

(c) G was reacted with hot concentrated potassium hydroxide solution. State what is observed and write equation for the reaction that takes place. (2½ marks)

2. $20cm^3$ of a gaseous hydrocarbon R was ignited with $205cm^3$ of oxygen in excess. On cooling to room temperature the volume of the residual gas was found to be $185cm^3$. When the residual gas was treated with concentrated potassium hydroxide solution there was a volume contraction to $125cm^3$.

(a) Write equation for the ignition of R. (1½ marks)

(b) (i) Calculate the molecular formula of R. (2½ marks)

(ii) R reacts with tollen's reagent to form a white precipitate.
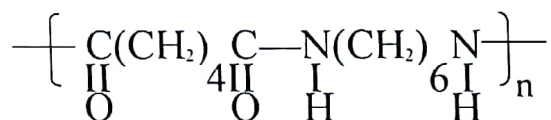Identify R (½ mark)

(c) Write equation(s) for synthesis of R from magnesium.   (1½ marks)

3. State what would be observed and write equation(s) for the reaction(s) that would take place when;
(a) Hydrogen sulphide gas was passed through concentrated nitric acid. (2 ½ marks)

(b) Sodium carbonate solution was added to aqueous aluminium(III) sulphate solution.   (2½ marks)

4. Nylon 6,6 is a synthetic copolymer which has the structure below.

$$\left[\begin{array}{c} \underset{O}{\overset{\parallel}{C}}(CH_2)_4\underset{O}{\overset{\parallel}{C}}-\underset{H}{\overset{\mid}{N}}(CH_2)_6\underset{H}{\overset{\mid}{N}} \end{array} \right]_n$$

(a) (i) Write the structures and give the names of the monomers used to manufacture nylon 6,6.   (2 marks)

(i) Name the type of reaction leading to the formation of Nylon 6,6 (1 mark)

(b) Write equation for the reaction leading to the formation of Nylon 6,6. (1 mark)

(c) State   (½ mark)
  (i)   One use of Nylon 6,6
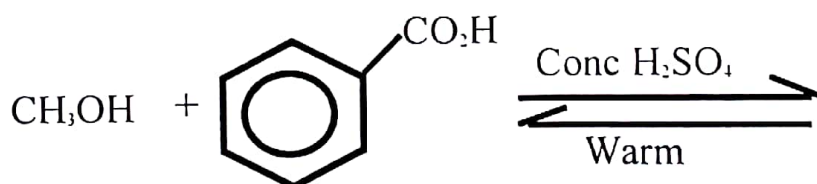
  (ii)   One advantage of using nylon 6,6   (½ mark)

5. Complete the following equation and write the mechanism for the reaction.
                                                                                        (4½ marks)

$$CH_3OH \ + \ \underset{\text{(benzene ring with } CO_2H \text{)}}{\bigcirc} \ \underset{\text{Warm}}{\overset{\text{Conc } H_2SO_4}{\rightleftharpoons}}$$

6. (a) Distinguish between a transition element and a d-block element.   (2 marks)

(b) The atomic number of Zinc is 30.
  (i)   Write the electronic configuration of Zinc.   (½ mark)

(ii) Give two reasons why zinc is considered to be a d-block element and not a transition element. (2 marks)

(c) A few drops of potassium hexacyanofemate (II) solution were added to Zinc(II) sulphate solution.

(i) State what is observed. (½ mark)

(ii) Write equation for the reaction that takes place. (1½ mark)

7. (a) State Hess's law (1 mark)

(b) The enthalpies for some reactions at 298K are given below. $\nabla H (KJmol^{-1})$

(i) $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$ -283.0

(ii) $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ -285.8

(iii) $CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$ -715.0

Use the above thermochemical data to calculate the enthalpy change for the reaction.

$CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(l)}$ (3 marks)
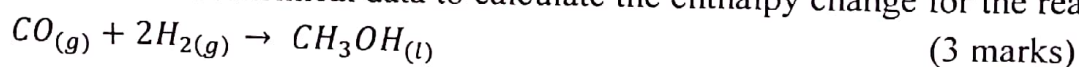
8. The acid dissociation constants for halogen acids at 298K are shown in the table 1.

Formula of acid	HF	HCl	HBr	HI
Ka (moldm^{-3})	6.3 x 10^{-4}	1.3 x 10^{6}	1.0 x 10^{9}	3.2 x 10^{9}

(a) State the trend in the acid dissociation constants of the acids.   (1 mark)

(b) Use the above data to deduce and explain the trend in acid strength of halogen acids.   (4 marks)

9. (a) Define the term steam distillation.   (1 mark)

(b) When the mixture of nitrobenzene and water was steam distilled at 98.2°C and 731 mm Hg, the distillate obtained contained nitrobenzene and water in the mass ratio 0.188. Calculate the molar mass of nitrobenzene.
(The vapour pressure of water at 98.2°C is 711.5 mm Hg)   (2 ½ marks)

(c) Name one method that can be used to separate the distillate into pure components.   (½ marks)
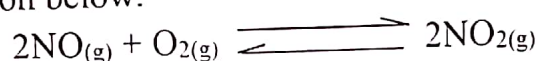
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SECTION B (54 MARKS)

Answer any six questions from this section.

Any additional question(s) answered will not be marked.

10. (a) Write equation for conversion of nitrogen dioxide to nitric acid.   (1½ marks)

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(b) Nitrogen monoxide combines with oxygen to form nitrogen according to the equation below.

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$$

(i)   Write the expression for the equilibrium constant, Kc for the reaction.

(1 mark)

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(ii)   6 moles of nitrogen monoxide and 3 moles of oxygen were put into a vessel which was heated to 300ºC. When equilibrium was established the vessel was found to contain 1 mole of oxygen.
Calculate Kc value at this temperature.   (3½ marks)

(iii)   When the temperature was raised to 400ºC the mixture in (ii) was found to contain 25% of the initial nitrogen monoxide. Calculate Kc at this temperature.   (2 marks)

(c) Using your results in b(ii) and b(iii) deduce whether the reaction is endothenuic or exothermic and explain your answer. (1 mark)

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11. Explain the following observations.
    (a) A solution of sodium thiosulphate becomes cloudy when left expected to air.
    (3 marks)

    (b) Sodium chloride melts at 800°C where as aluminium chloride sublimes at 180°C
    (3 marks)

    (c) Zinc sulphide is sparingly soluble in water but readily soluble in dilute hydrochloric acids.
    (3 marks)

12. Write equation(s) to show how the following compounds can be synthesized.

(a) Propanone from propene   (3 marks)

(b) Methylcylohexane from benzene.   (3 marks)

(c) Methylbenzoate from methylbenzene   (3 marks)

13. (a) (i) Write the electric configuration of iron.   (½ mark)

(ii)   State the common oxidation states of iron in its compounds.   (1 mark)

(b) Describe the reactions of Iron with sulphuric acid. (5½ marks)

c) Dilute nitric acid was added to freshly prepared iron(II) sulphate solution
   (i)   State what is observed. (½ mark)

   (ii)   Write equation for the reaction that takes place. (1½ marks)

14. On analysis an organic compound J was found to contain 79.3% carbon, 5.66% hydrogen and the rest was oxygen.
(a) Calculate the empirical formula of J. (2 marks)

(b) 0.636g of J lowered the freezing point of 120g benzene by 0.25°C. Calculate the molecular formula of J. (K_f=5.0°C per 1000g of benzene) (3 marks)

(b) On further analysis J burns with a luminous flame forms a yellow precipitate with Brady's reagent but has no effect on ammoniacal silver nitrate solution on boiling.

(i) Identify J　　　　　　　　　　　　　　　　　　　　(1 mark)

(ii)　Write the mechanical for the reaction between J and aqueous potassium hydrogen sulphite.　　　　　　　　　(3 marks)

13. The freezing points of molten mixtures of bismuth and cadmium and % of cadmium in the mixture are given in the table 2 below.

% cd	0	20	40	60	80	90
Temperature (°C)	270	205	145	225	280	300

(a) Use the above data to plot a graph of temperature against the percentage composition of cadmium in the mixture.
(clearly label the phases in the graph).　　　　　　　　(4 marks)

(b) Use the graph you have drawn to determine; (½ mark)
    (i)   Eutectic temperature of mixture

    (ii)   The composition of the eutectic mixture. (½ mark)

    (iii)   The freezing point of pure cadmium. (½ mark)

(c) Describe what happens when a mixture containing 30% bismuth at $350^{\circ}C$ is cooled to $100^{\circ}C$. (3 marks)

(d) State one application of eutectic mixture. (½ mark)

16. (a) State two differences and one similarity between a galvanic cell and a voltaic cell
    (i)   Differences; (2 marks)

    (ii)   Similarity. (1 mark)

(b) Standard electrode potentials for some half cell reactions are given below.

$$Cd^{2+}_{(aq)} + 2e^- \longrightarrow Cd_{(s)} \qquad +0.403\,V$$
$$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)} \qquad +0.799\,V$$

Write equation(s) for the reaction(s) that place at the positive and negative electrode(s) of the cell formed when the half cells are combined.

(i)   Positive electrode: (1 mark)

(ii)   Negative electrode   (1 mark)

(c) Write the overall equation for the cell reaction   (1½ marks)

(d) (i) Calculate the cell voltage.   (1½ marks)

(iii)   State whether the cell reaction is feasible or not. Give a reason for your answer.   (1 mark)

17. a) During the extraction of Copper from Copper pyrites as the ore, the ore is first concentrated and then roasted in a blast furnace.

(i)   Write the formula of copper pyrites.   (½ marks)

(ii)   Name the method used to concentrate the ore.   (½ marks)

(b) Describe how the ore is concentrated by the method named in a(ii) (2½ marks)

(c) Write equations for the reactions that take place in the blast furnace leading to the formation of copper. (4 marks)

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(c) Write equation for the reaction between copper and moderately concentrated nitric(V) acid. (1½ marks)