1 (a) Biogas is a mixture of mainly carbon(IV) oxide and methane.

(i) Give a reason why biogas can be used as a fuel. (1 mark)

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(ii) Other than fractional distillation, describe a method that can be used to determine the percentage of methane in biogas. (3 marks)

.....

.....

(b) A sample of biogas contains 35.2% by mass of methane. A biogas cylinder contains 5.0 kg of the gas.

Calculate the:

(i) number of moles of methane in the cylinder. (Molar mass of methane = 16) (2 marks)

.....

.....

(ii) total volume of carbon(IV) oxide produced by the combustion of methane in the cylinder (Molar gas volume = 24.0 dm^{-3} at room temperature and pressure). (2 marks)

.....

.....

(c) Carbon(IV) oxide, methane, nitrogen(1) oxide and trichlorofluoromethane are green-house gases.

(i) State **one** effect of an increased level of these gases to the environment. (1 mark)

.....

(ii) Give **one** source from which each of the following gases is released to the environment:

I Nitrogen(1) oxide. (1 mark)

.....

II Trichlorofluoromethane. (1 mark)

.....

2 (a) Write an equation to show the effect of heat on the nitrate of:

(i) Potassium (1 mark)

.....

(ii) Silver. (1 mark)

.....

(b) The table below gives information about elements A_1, A_2, A_3, and A_4.

Element	Atomic number	Atomic radius (nm)	Ionic radius (nm)
A_1	3	0.134	0.074
A_2	5	0.090	0.012
A_3	13	0.143	0.050
A_4	17	0.099	0.181

(i) In which period of the periodic table is element A_2? Give a reason. (2 marks)

.....

.....

(ii) Explain why the atomic radius of:

I. A_1 is greater than that of A_2; (2 marks)

.....

.....

II. A_4 is smaller than its ionic radius. (2 marks)

.....

.....

(iii) Select the element which is in the same group as A_3. (1 mark)

.....

(iv) Using dots(.) and crosses (x) to represent outermost electrons, draw a diagram to show the bonding in the compound formed when A_1 reacts with A_4. (1 mark)

.....

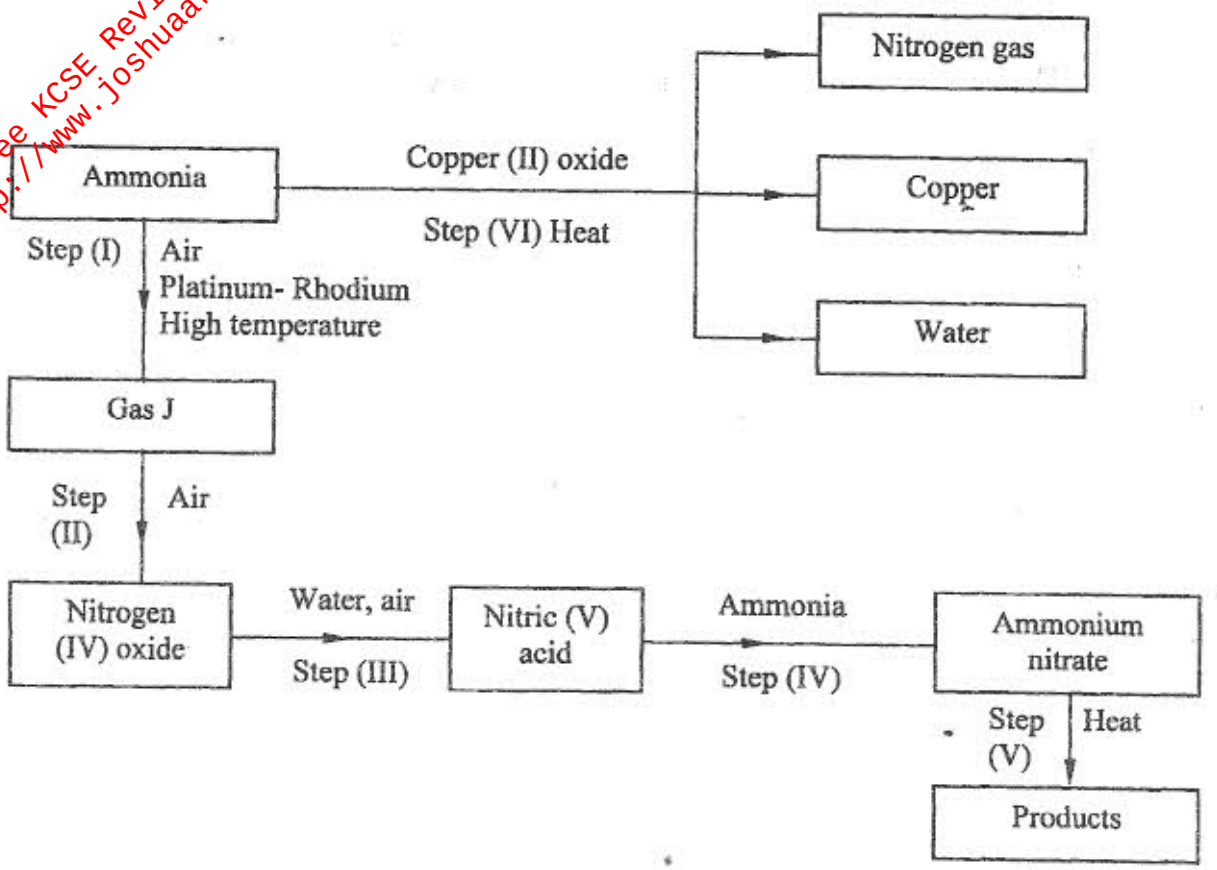
.....

3 (a) Describe the process by which Nitrogen is obtained from air on a large scale. (4 marks)

.....

.....

(b) Study the flow chart below and answer the questions that follow.



(i) Identify gas J. (1 mark)

.....

(ii) Using oxidation numbers, show that ammonia is the reducing agent in step (VI). (2 marks)

.....

.....

(iii) Write the equation for the reaction that occurs in step (V). (1 mark)

.....

(iv) Give **one** use of ammonium nitrate. (1 mark)

.....

(c) The table below shows the observations made when aqueous ammonia was added to cations of elements E, F and G until in excess.

Cation of	Addition of a few drops of aqueous ammonia.	Addition of excess aqueous ammonia.
E	White precipitate	Insoluble
F	No precipitate	No precipitate
G	White precipitate	Dissolves

(i) Select the cation that is likely to be Zn^{2+}. (1 mark)

.....

(ii) Given that the formula of the cation of element E is E^{2+}, write the ionic equation for the reaction between $E^{2+}_{(aq)}$ and aqueous ammonia. (1 mark)

.....

.....

4 (a) (i) State the Le chatelier's principle. (1 mark)

.....

.....

(ii) Carbon(II) oxide gas reacts with steam according to the equation;

$$CO_{(g)} + H_2O_{(g)} \rightleftharpoons H_{2(g)} + CO_{2(g)}$$

What would be the effect of increasing the pressure of the system at equilibrium? Explain. (2 marks)

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.....

.....

(iii) When the reaction in (ii) above was carried out at lower temperature, the yields of hydrogen and carbon (IV) oxide increased.
What is the sign of ΔH for the reaction? Explain. (2 marks)

.....

.....

.....

(b) The table below gives the volumes of oxygen gas produced at different times when hydrogen peroxide decomposed in the presence of a catalyst.

Time (Sec)	0	10	20	30	40	50	60
Volume of oxygen (cm^3)	0	66	98	110	119	120	120

(i) Name the catalyst used for this reaction. (1 mark)

.....

(ii) On the grid provided, draw the graph of volume of oxygen gas produced (vertical axis) against time. (3 marks)

(iii) Using the graph, determine the rate of decomposition of hydrogen peroxide after 24 seconds. (2 marks)

.....

.....

(iv) Give a reason why the total volume of oxygen gas produced after 50 seconds remains constant. (1 mark)

.....

5 (a) Alkanes, alkenes and alkynes can be obtained from crude oil. Draw the structure of the second member of the alkyne homologous series. (1 mark)

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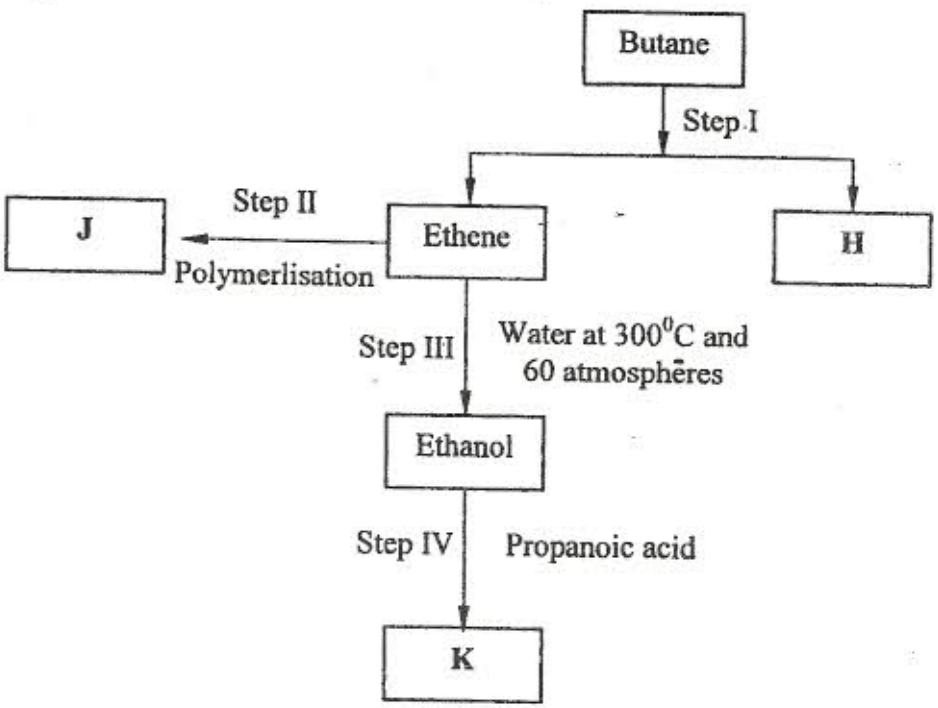
.....

(b) Study the flow chart below and answer the questions that follow.



(i) State the conditions for the reaction in step I to occur. (1 mark)

.....

.....

(ii) Identify substance H. (1 mark)

.....

(iii) Give:

I. one disadvantage of the continued use of substances such as J. (1 mark)

.....

II. the name of the process that takes place in step III. (1 mark)

.....

III. the name and the formula of substance **K**. (2 marks)

Name .....

Formula.....

(iv) The relative molecular mass of **J** is 16,800. Calculate the number of monomers that make up **J**. (2 marks)

.....

.....

(c) The table below gives the formulae of four compounds, **L, M, N** and **P**.

Compound	Formula
L	C_2H_6O
M	C_3H_6
N	$C_3H_6O_2$
P	C_3H_8

Giving a reason in each case, select the letter which represents a compound that:

(i) decolourises bromine in the absence of UV light. (2 marks)

.....

.....

(ii) gives effervescence when reacted with aqueous sodium carbonate. (2 marks)

.....

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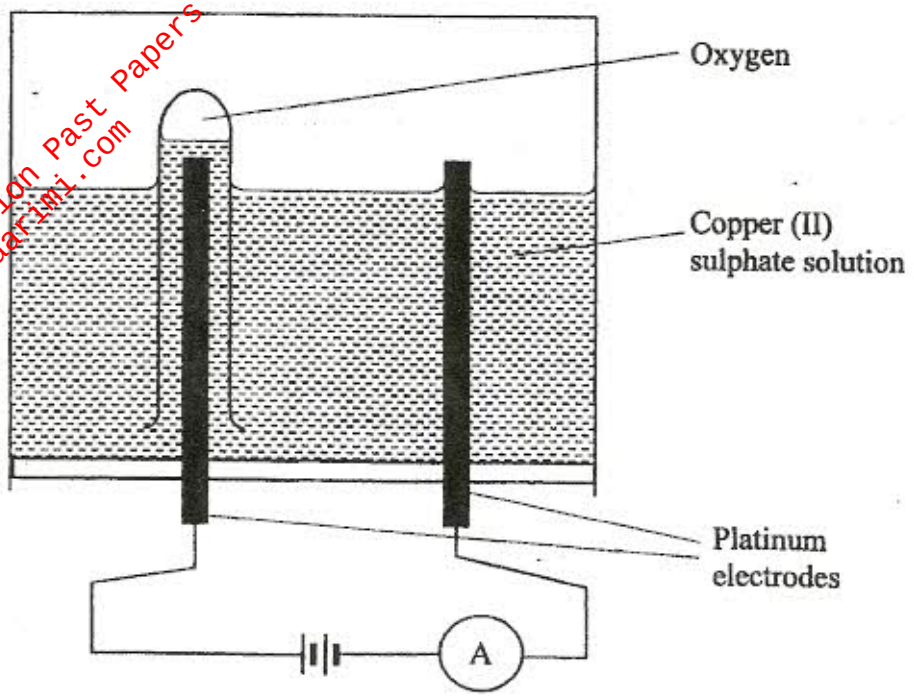
6 The diagram below represents a set up that can be used to electrolyse aqueous copper(II) sulphate.



(a) (i) Describe how oxygen gas is produced during the electrolysis. (2 marks)

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(ii) Explain why copper electrodes are not suitable for this electrolysis. (2 marks)

.....

.....

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(b) Impure copper is purified by an electrolytic process.

(i) Name one ore from which copper is obtained. (1 mark)

.....

(ii) Write the equation for the reaction that occurs at the cathode during the purification of copper. (1 mark)

.....

.....

(iii) In an experiment to electroplate a copper spoon with silver, a current of 0.5A was passed for 18 minutes. Calculate the amount of silver deposited on the spoon. (1F = 96500 coulombs, Ag = 108) (3 marks)

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(iv) Give **two** reasons why some metals are electroplated. (2 marks)

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7 (a) Define the standard enthalpy of formation of a substance. (1 mark)

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.....

.....

(b) Use the thermochemical equations below to answer the questions that follow.

1. $C_2H_{6(g)} + \frac{7}{2}O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$; $\Delta H_1 - 1560 kJmol^{-1}$

2. $C_{(graphite)} + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H_2 = -394 kJmol^{-1}$

3. $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}$, $\Delta H_3 = -286 kJmol^{-1}$

(i) Name **two** types of heat changes represented by ΔH_3. (2 marks)

.....

.....

.....

(ii) Draw an energy level diagram for the reaction represented by equation 1. (3 marks)

(iii) Calculate the standard enthalpy of formation of ethane. (2 marks)

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.....

.....

(iv) When a sample of ethane was burnt, the heat produced raised the temperature of 500g of water by 21.5K,. (Specific heat capacity of water = $4.2Jg^{-1}K^{-}$).

Calculate the:

I. heat change for the reaction. (2 marks)

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.....

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II. mass of ethane that was burnt. (Relative formula mass of ethane = 30.) (2 marks)

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