

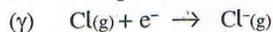
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(iii) Name the type of energy changes that occur in each of the following reactions.



[6 marks]

(d) Potassium, hydrogen gas and potassium hydride exhibit different types of bonds. Copy and complete the following table.

| Substance      | Type of bond | Units which make up the substance |
|----------------|--------------|-----------------------------------|
| K              |              |                                   |
| H <sub>2</sub> |              |                                   |
| KH             |              |                                   |

[6 marks]

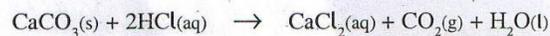
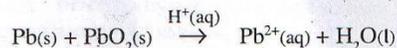
3. (a) (i) What is an *amphoteric oxide*?  
(ii) Write chemical equations to show that aluminium oxide is amphoteric.

[6 marks]

(b) Write a balanced chemical equation for the reaction of dilute hydrochloric acid with **each** of the following substances:  
(i) Zinc metal;  
(ii) Zinc trioxocarbonate (IV).

[4 marks]

(c) Consider the following equations:  
 $Cu^{2+}(aq) + 4NH_3(aq) \rightarrow [Cu(NH_3)_4]^{2+}(aq)$



(i) Which of the equations is  
(α) a redox reaction?  
Give a reason for your answer.  
(β) an acid-base reaction according to Lewis concept?  
Give a reason for your answer.

(ii) In the case of the redox reaction chosen in (c) (i) (α) above, write a balanced half equation for:

(α) oxidation;  
(β) reduction.

(iii) Give a practical application of the redox reaction chosen in (c) (i) (α) above.

[9 marks]

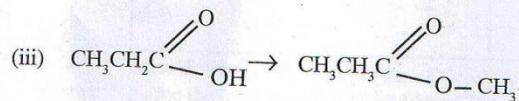
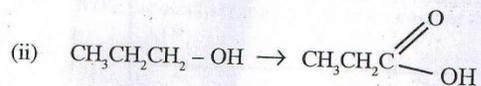
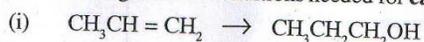
- (d) A solution has a pOH of 4.5. Calculate the:
- pH;
  - number of hydrogen ions present in 300 cm<sup>3</sup> of the solution.  
[N<sub>A</sub> = 6.02 × 10<sup>23</sup> particles mol<sup>-1</sup>]

[6 marks]

4. (a) (i) Explain briefly **each** of the following terms:
- polymer;
  - polymerization.
- (ii) Give **two** examples **each** of the following polymers.
- natural polymer;
  - synthetic polymer.

[8 marks]

- (b) Give the reagents and conditions needed for **each** of the following conversions.



[7 marks]

- (c) An organic compound is known to be unsaturated and monocarboxylic acid. In an experiment, 1.39 g of the compound required 20.0 cm<sup>3</sup> of 0.25 mol dm<sup>-3</sup> NaOH for complete reaction. When 0.417 g of the compound was hydrogenated, 100.8 cm<sup>3</sup> of hydrogen measured at s.t.p was required. Calculate the:

- molar mass of the compound;
- number of C = C bonds in a molecule of the compound.  
[V<sub>m</sub> = 22.4 dm<sup>3</sup>]

[10 marks]

13

## SECTION II

## FOR CANDIDATES IN GHANA ONLY

Answer **one question only** from this section.

5. (a) (i) Define **each** of the following terms:  
 ( $\alpha$ ) rate of reaction;  
 ( $\beta$ ) rate constant;  
 ( $\gamma$ ) rate-determining step.  
 (ii) State **two** factors that determine the rate of a reaction.

[8 marks]

- (b) The following table shows the results obtained for the reaction:



| Experiment | Initial conc. of P (mol dm <sup>-3</sup> ) | Initial conc. of Q (mol dm <sup>-3</sup> ) | Initial rate (mol dm <sup>-3</sup> s <sup>-1</sup> ) |
|------------|--|--|--|
| 1          | 0.01                                       | 0.02                                       | x  |
| 2          | y  | 0.02                                       | 0.0010   |
| 3          | 0.01                                       | z  | 0.0020   |

If the rate = 125 [P][Q]<sup>2</sup>, calculate the

- (i) values of x, y and z;  
 (ii) overall order of the reaction.

[10 marks]

- (c) (i) Arrange the following compounds in order of increasing solubility.  
 MgCl<sub>2</sub>, NaCl, AlCl<sub>3</sub>.  
 Give reasons for your answer.  
 (ii) Explain **briefly** why an aqueous solution of iron (II) tetraoxosulphate (VI) turns brown on standing.

[7 marks]

6. (a) Explain **briefly** why a given mass of sodium hydroxide pellets **cannot** be used to prepare a standard solution.

[3 marks]

- (b) (i) List **two** chemicals used in the laboratory preparation of hydrogen chloride gas.  
 (ii) Write a balanced equation for the laboratory preparation of hydrogen chloride gas.  
 (iii) Mention a chemical that can be used to dry the gas in (b) (i).  
 (iv) Name the method of collection of the gas. Give a reason for your answer.  
 (v) List **two** physical properties of hydrogen chloride gas.

[9 marks]

- (c) (i) State Dalton's law of partial pressures.  
 (ii) A mixture of gases with total pressure of 120 k Nm<sup>-2</sup> consists of 0.175 moles of hydrogen, 0.067 moles of nitrogen and 0.025 moles of oxygen at 25 °C. Calculate the:  
 ( $\alpha$ ) total volume of the gaseous mixture;  
 ( $\beta$ ) partial pressure of hydrogen in the mixture.

$$[R = 8.314 \text{ Jk}^{-1}\text{mol}^{-1}]$$

[9 marks]

- (d) (i) Give **two** reasons why real gases deviate from ideal behaviour.  
 (ii) List the **two** conditions under which a real gas would behave ideally.

[4 marks]

## SECTION III

## FOR CANDIDATES IN NIGERIA, SIERRA LEONE AND THE GAMBIA.

Answer **one** question only from this section.

7. (a) State **one** industrial application of **each** of the following methods of separation:  
 (i) crystallization;  
 (ii) fractional distillation;  
 (iii) filtration.

[3 marks]

- (b) (i) What is a *hydrocarbon*?  
 (ii) State the **major** reaction undergone by alkanes.  
 (iii) Write a chemical equation to illustrate the reaction stated in (b) (ii).  
 (iv) State **two** principal sources of hydrocarbons.

[7 marks]

- (c) (i) Define the term *isomerism*.  
 (ii) Draw the structures of **two** isomers **each** of  $C_4H_8$  and  $C_4H_{10}$ .  
 (iii) ( $\alpha$ ) State the **two** types of bonds formed between the unsaturated carbon atoms in  $C_5H_6$ .  
 ( $\beta$ ) Describe briefly how the bonds stated in (c) (iii) ( $\alpha$ ) are formed.  
 (iv) Consider the following groups of organic compounds: alkanes and alkenes.  
 ( $\alpha$ ) Which of the compounds is more reactive?  
 ( $\beta$ ) Give reasons for your answer in (c) (iv) ( $\alpha$ ).

[12 marks]

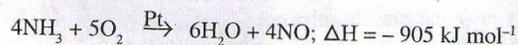
- (d) Name the precipitate formed in **each** case when aqueous solution of the following pairs of compounds are mixed:  
 (i)  $BaCl_2$  and  $ZnSO_4$ ;  
 (ii)  $Na_2CO_3$  and  $Pb(NO_3)_2$ ;  
 (iii)  $MgCl_2$  and  $AgNO_3$ .

[3 marks]

8. (a) (i) Define the term *mole*.  
 (ii) The mass spectrum of carbon shows two peaks at masses 12.00 and 13.00. Calculate the relative atomic mass of carbon given that the relative abundance of the two isotopes are 95% and 5%.

[6 marks]

- (b) (i) Give **two** properties of ammonia.  
 (ii) Name the process by which ammoniacal liquor can be obtained from coal.  
 (iii) List **two** other products of the reaction in (b) (ii).  
 (iv) Sketch and label an energy profile diagram to show the effect of platinum (Pt) on the reaction represented by the following equation:



[11 marks]

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