SECTION A: (50 MARKS)

Answer **all** *questions in this section.*

1. (a) State what would be observed if a bar magnet is brought close to;

(i) a mixture of iron and sulphur. *(01 mark)*

.....

(ii) iron (II) sulphide. *(01 mark)*

.....

(b) What is the practical application of the action in (a) (i)? *(01 mark)*

.....

.....

(c) State a suitable method by which the following substance can be obtained:

(i) Sugar from its mixture with sand. *(01 mark)*

.....

(ii) Sodium chloride from its mixture with sodium hydrogencarbonate. *(01 mark)*

.....

2. The atomic numbers of elements *X*, *Y* and *Z* are 12, 14 and 17 respectively.

(a) Write the electronic configuration of the ion formed by:

(i) *X*. *(½ mark)*

.....

(ii) *Y*. *(½ mark)*

.....

(b) Element *Z* can react with elements *X* and *Y* to form compounds *Q* and *R* respectively.

(i) Write the formula of the compound that can be formed between *Z* and:

X. *(01 mark)*

.....

Y. *(01 mark)*

.....

(ii) Which **one** of the compounds *Q* and *R* will conduct electricity when in molten state? (*½ mark*)

.....

(iii) Give a reason for your answer in (b) (ii). (*01 mark*)

.....

3. (a) Charcoal was burnt in a charcoal stove as shown in figure **1**.

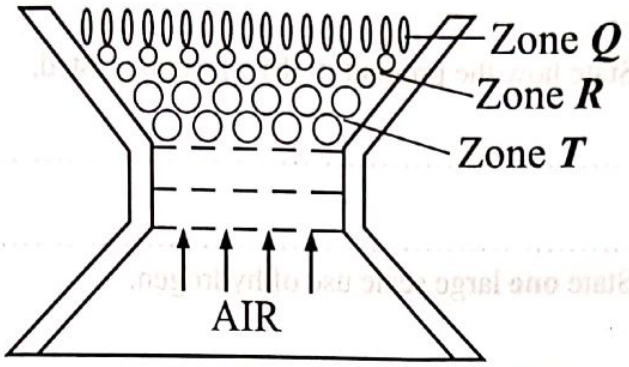

Fig. 1

Name the substance that was produced at zone:

(i) *Q* ..... (*01 mark*)

(ii) *R* ..... (*01 mark*)

(iii) *T* ..... (*01 mark*)

(b) State;

(i) the structural difference between charcoal and graphite.(*01 mark*)

.....

.....

(ii) **one** chemical property in which charcoal resembles graphite. (*01 mark*)

.....

.....

4. (a) (i) State the condition under which hydrochloric acid reacts with magnesium to produce hydrogen. (*½ mark*)

.....

.....

(ii) Write the ionic equation for the reaction in (a) (i). *(1½ marks)*

.....

.....

(b) A dry sample of hydrogen was burnt in air.

(i) Write the equation for the reaction that took place. *(1½ marks)*

.....

.....

(ii) State how the product in (b) (i) can be tested. *(01 mark)*

.....

.....

(iii) State **one** large scale use of hydrogen. *(½ mark)*

.....

5. When a mixture of dilute sodium hydroxide solution and a substance containing a cation *Q* was heated, a gas *X*, which gave dense white fumes with hydrogen chloride was evolved.

(a) Identify;

(i) the cation *Q*. *(½ mark)*

.....

(ii) gas *X*. *(½ mark)*

.....

(b) Write the equation for the reaction leading to the formation of;

(i) *X*. *(1½ marks)*

.....

.....

(ii) the dense white fumes. *(1½ marks)*

.....

.....

(c) X was bubbled through a solution containing zinc ions until there was no further change. State what was observed. *(1½ marks)*

.....

.....

6. 3.4 g of compound Z consists of 1.0 g calcium, 0.8 g sulphur and the rest being oxygen.

(a) (i) Calculate the empirical formula of Z.
(O =16; S =32; Ca= 40) *(02 marks)*

.....

.....

.....

.....

.....

.....

(ii) Deduce the molecular formula of Z.
(Formula mass of Z =136) *(01 mark)*

.....

.....

.....

.....

(b) (i) Name **one** reagent that can be used to identify the anion in an aqueous solution of Z. *(01 mark)*

.....

(ii) Write an ionic equation for the reaction that would take place if aqueous solution of Z was treated with the reagent you have named in (b) (i). *(1½ marks)*

.....

.....

7. Figure 2 shows an electrochemical cell.

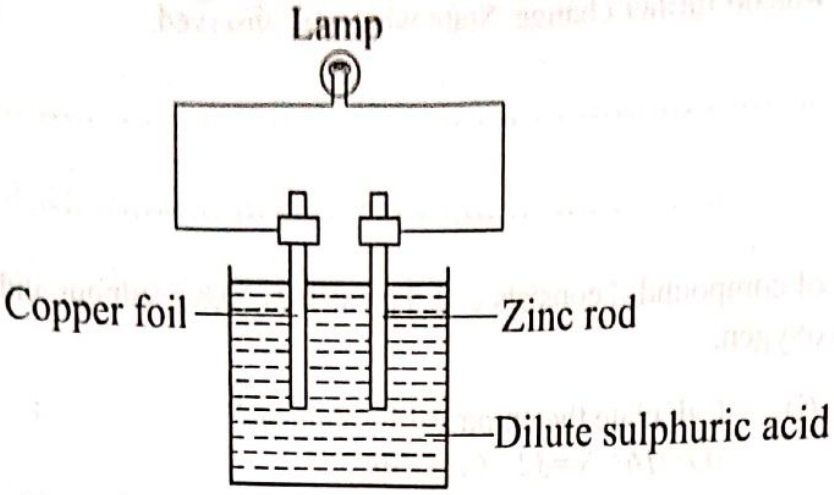

Fig.2

(a) State what is observed at the copper foil. *(½ mark)*

.....

.....

(b) Write the equation(s) for the reaction at the;

(i) cathode. *(01 mark)*

.....

.....

(ii) anode. *(01 mark)*

.....

.....

(c) Write the overall cell reaction equation. *(1½ marks)*

.....

.....

(d) State **one** application of an electrochemical cell. *(½ mark)*

.....

.....

8. (a) (i) State a suitable method of preparing iron(II) sulphate. *(01 mark)*

.....

(ii) Write the equation to show formation of iron(II) sulphate by the method you have stated in (a) (i). *(1½ marks)*

.....

.....

(b) When aqueous ammonia was added to iron(II) sulphate solution, a green precipitate which turned brown on standing was formed.

(i) Write the formula of the substance that appeared as the green precipitate. *(01 mark)*

.....

(ii) Give a reason why the green precipitate turned brown. *(01 mark)*

.....

.....

(iii) Name **one** substance, other than air, that would turn the green precipitate brown. *(½ mark)*

.....

9. (a) Chlorine dissolves in water to form hypochlorous acid.

(i) Write the equation for the reaction leading to the formation of hypochlorous acid. *(1½ marks)*

.....

.....

(ii) State what would be observed if a handkerchief stained with black ink was soaked in hypochlorous acid. *(½ mark)*

.....

.....

(b) Hypochlorous acid solution was exposed to bright sunlight. State what happened. *(1½ marks)*

.....

(c) State what would be observed if chlorine was bubbled into potassium bromide solution then tetrachloromethane added to the resultant mixture. *(1½ marks)*

.....

.....

10. (a) Carbon dioxide is produced by the reaction of calcium carbonate with hydrochloric acid. Write an ionic equation for the reaction. *(1½ marks)*

.....

.....

(b) The sketch graphs in figure **3** show variations in volumes of carbon dioxide evolved with time, when equal masses of calcium carbonate lumps were reacted separately with 50 cm^3 portions of 1.0 M solutions of monobasic acids ***T*** and ***R*** at room temperature.

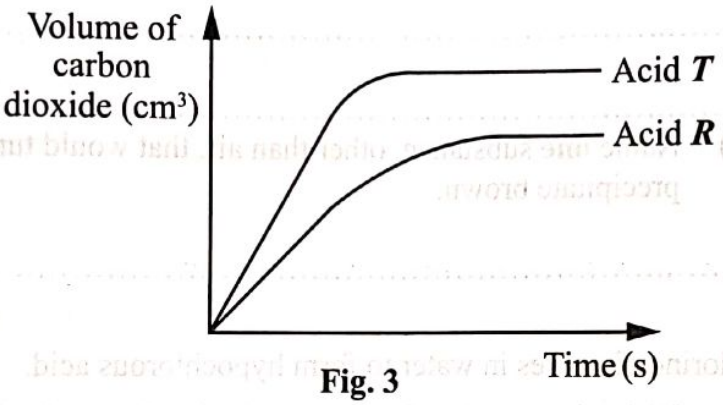

Fig. 3

(i) Which **one** of the acids is a stronger acid? *(½ mark)*

.....

(ii) Give reasons for your answer in (b) (i). *(02 marks)*

.....

.....

.....

.....

(iii) Sketch, on the same axes of figure **3**, the graph that would be obtained when an equal mass of calcium carbonate powder was reacted with 50 cm^3 of a 1.0 M acid ***T*** at room temperature. *(01 mark)*

SECTION B (30 MARKS)

Answer any **two** *questions from this section.*
Additional question(s) answered will **not** *be marked.*

11. Sulphuric acid is manufactured from sulphur dioxide by the contact process.

(a) (i) Name **one** substance from which the sulphur dioxide used in the contact process can be prepared. *(01 mark)*

(ii) Write an equation to show how the substance you have named in (a) (i) is converted into sulphur dioxide. *(1½ marks)*

(iii) With the aid of equation(s), describe how sulphur dioxide is converted into sulphuric acid. *(6½ marks)*

(b) State how concentrated sulphuric acid reacts with the following substances, and in each case, write the equation for the reaction:

(i) Sulphur. *(02 marks)*
(ii) Sucrose ($C_{12}H_{22}O_{11}$). *(02 marks)*

(c) (i) Name **one** fertilizer manufactured from sulphuric acid. *(½ mark)*

(ii) Write an equation to show how the fertilizer you have named in (c) (i) is formed. *(1½ marks)*

12. (a) Describe the reactions of magnesium with;

(i) water. *(2½ marks)*
(ii) oxygen. *(02 marks)*
(iii) chlorine. *(02 marks)*

(b) Aqueous sodium hydrogencarbonate was added to a solution containing magnesium ions, and the mixture heated. Explain what happened;

(i) before the mixture was heated. *(03 marks)*
(ii) after the mixture was heated. *(3½ marks)*

(c) (i) Name **one** reagent that can be used to differentiate magnesium ion from lead(II) ion. *(01 mark)*

(ii) State what would be observed if magnesium ion and lead(II) ion are treated separately with the reagent you have named in (c) (i). *(01 mark)*

13. (a) (i) State **two** substances which when reacted together can form soap. *(01 mark)*

(ii) Briefly describe how a sample of solid soap can be prepared in the laboratory. *(04 marks)*

(b) Describe how soap removes dirt from clothes. *(04 marks)*

(c) Give reasons why detergents do not form scum with hard water. *(01 mark)*

(d) Explain why it is **not** advisable to dispose of detergents in water bodies. *(05 marks)*

14. (a) Methanol undergoes combustion according to the following equation.

$2CH_3OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(l);\ \Delta H = -726\ kJ\ mol^{-1}$.

What is meant by the expression "$\Delta H = -726\ kJ\ mol^{-1}$" ? *(01 mark)*

(b) When 0.87 g of methanol was burnt, the heat evolved raised the temperature of 500 cm^3 of water by 7.0°C.
Calculate the enthalpy of combustion of methanol.
(H = 1; C = 12; O = 16; density of water = 1g cm^{-3}; specific heat capacity of water = 4.2 J $g^{-1}K^{-1}$.) *(3 ½ marks)*

(c) The Standard Enthalpy of Combustion of methanol is −726 kJ mol^{-1} .
Compare the experimental value obtained in (b) with the standard value. Explain your answer. *(3 ½ marks)*

(d) The enthalpy of some straight chain alcohols are shown in the table 1.

Table 1

Alcohol	CH_3OH	C_2H_5OH	C_3H_7OH	C_4H_9OH	$C_5H_{11}OH$	$C_6H_{13}OH$
Formula mass						
Enthalpy of combustion (kJ mol^{-1})	726	1371	2017	2673	3331	3984

(i) Copy the table and fill in the values for the formula masses of the alcohols. *(H = 1; C = 12; O = 16.)* *(1½ marks)*

(ii) Plot a graph of enthalpy of combustion against formula mass. *(04 marks)*

(iii) State how the enthalpies of the straight chain alcohols vary with their formula masses. *(½ mark)*

(iv) Use your graph to determine the enthalpy of a straight chain alcohol of formula mass 116. *(01 mark)*

END