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545/2

S4 CHEMISTRY

Exam 5

PAPER 2

DURATION: 2 HOUR

Instructions:

- Section A consists of 10 structured questions. Attempt all questions in this section. Answers to these questions must be written in the spaces provided **ONLY**.
- Section B consists of 4 semi-structured questions. Attempt **ONLY TWO** questions from this section. Answers to the questions must be written in the answer booklets provided
- In both sections all working must be shown clearly

FOR EXAMINER'S USE ONLY														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL

SECTION A: 50 MARKS)

1. (a) Write the name and formula of one salt that causes permanent hardness of water

(1 mark)

.....
.....

(b) State one physical and one chemical method of removing permanent hardness of water.

Physical method.

(½ mark)

.....

Chemical method

(1 mark)

.....

(c) Write equation for the reaction that takes place during removal of permanent hardness of water by chemical method.

(1 ½ marks)

.....
.....

(d) State one advantage and one disadvantage of hard water.

Advantages

(½ mark)

.....

Disadvantage

(½ marks)

.....

2. (a) During the laboratory preparation of hydrogen at room temperature, zinc metal is reacted with sulphuric acid or hydrochloric acid but not nitric or ethanoic acid

(i) Write an ionic equation for the reaction leading to the formation of hydrogen

(1 ½ marks)

.....
.....

(ii) State the condition for the reaction in (a) (i)

(½ mark)

.....

(iii) State the method of collecting hydrogen

(½ mark)

.....

(iv) Give a reason why laboratory preparation of hydrogen from zinc cannot be done using;

- nitric acid (½ mark)

.....

- Ethanoic acid (½ mark)

.....

(b) Write equation for the reaction that would take place if dry hydrogen is passed over heated copper (II) oxide. (1 ½ marks)

.....

.....

3. (a) When hydrogen chloride was passed through a solution containing a cation X, a white shiny and crystalline precipitate was formed. The precipitate dissolved when the mixture was heated, but recrystallized on cooling the solution.

(i) State the identity of X. (1 mark)

.....

(ii) Write an ionic equation for the reaction that took place between hydrogen chloride and X. (1 ½ mark)

.....

.....

(b) Silver nitrate can react with sodium chloride to form silver chloride according to the following equation:



Calculate the maximum mass of silver chloride that would be formed if excess sodium chloride solution was added to 20.0cm³ of a 0.5M silver nitrate solution

(Ag = 108, Cl = 35.5)

(2 ½ marks)

.....

.....

.....

.....

.....

.....

.....

4. (a) Sulphuric acid can react with ethanol to produce ethene

(i) Write equation for the reaction leading to the formation of ethene (1 mark)

.....
.....

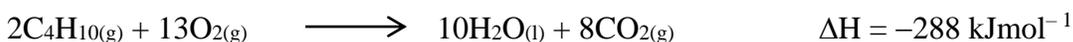
(ii) State the conditions for the reaction in a (i) (1 ½ marks)

.....
.....

(iii) Write equation for the reaction of ethene leading to formation of
1, 2 – dibromoethane. (1 mark)

.....
.....

(b) When butane is burnt in oxygen, the reaction is accompanied by heat change according to the following equation:



(i) Suggest one use of butane. (½ mark)

.....

(ii) Calculate the heat energy change obtained when 5.6dm³ of butane is burnt in oxygen at s.t.p (1 mole of a gas occupies 22.4dm³ at s.t.p) (2 marks)

.....
.....
.....
.....
.....
.....
.....

5. Warm dilute nitric acid was added to a mixture of lead (II) oxide and copper (II) oxide and the solution formed divided into two portions.

(a) To the first portion was added dilute sodium hydroxide drop wise until in excess and filtered.

Identify the cation in the

(i) Filtrate (1 mark)

.....
(ii) Residue (1 mark)

.....
(iii) Write equation for the reaction that led to the formation of the residue
(1 ½ marks)

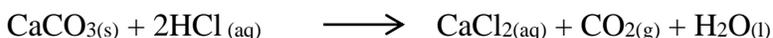
.....
(b) To the second portion was added aqueous ammonia drop wise until in excess. State the colour of the;

(i) Residue (½ mark)

.....
(ii) Filtrate (½ mark)

.....
(c) Write the formula of the cation that was in the filtrate. (1 mark)

.....
6. During laboratory preparation of carbon dioxide, calcium carbonate reacts with dilute hydrochloric acid according to the following equation.



(a) Calculate the maximum volume of carbon dioxide in cm³ that would be produced at room temperature if dilute hydrochloric acid reacted completely with 4.5g of calcium carbonate. (3 marks)

(C = 12, O = 16, Ca = 40, 1 mole of a gas occupies 24.0 dm³ at room temperature)

(b) A quantity of dilute sulphuric acid having the same hydrogen ion concentration as that of the hydrochloric acid in (a) was reacted with 4.5g of the calcium carbonate at room temperature.

(i) State how the maximum volume of carbon dioxide produced would compare with your answer in (a) (1 mark)

.....
.....

(ii) Give a reason for your answer in (b) (i) (1 mark)

.....
.....

7. The atomic numbers of elements Q, R and W are 15, 17 and 19 respectively.

(a) Write the electronic configuration of

(i) Q (½ mark)

.....

(ii) R (½ mark)

.....

(iii) W (½ mark)

.....

(b) R can combine with Q and W to form compounds Y and Z respectively. State the type of bond in

(i) Y (½ mark)

.....

(ii) Z (½ mark)

.....

(c) State one property in which

(i) Y resemble Z (1 mark)

.....

(ii) Y differs from Z (1 mark)

.....

.....

8. (a) Name one allotrope of carbon that is used;

(i) in extraction of iron (½ mark)

.....

(ii) as an electrode (½ mark)

.....

(b) State one property of the allotrope of carbon that you have named in (a) which is the reason for its use;

(i) In extraction of iron (1 mark)

.....

(ii) As an electrode (1 mark)

.....

(c) Carbon – 12 and carbon – 14 are the two common atoms of carbon and carbon – 14 is used extensively in determining ages of old objects,

State

(i) One word, which means the relationship between atoms like carbon – 12 and Carbon – 14 (1 mark)

.....

(ii) The property of carbon – 14 that is applied when it is used in determining the ages of old objects. (1 mark)

.....

9. Both carbon and sulphur can burn in air to form oxides

(a) Name the product of complete combustion of

(i) Sulphur (½ mark)

.....

(ii) Carbon

.....

(b) The products of combustion in (a) were carefully collected into separate boiling tubes and burning magnesium introduced in each. State what was observed in the boiling tube containing the product of combustion of

(i) Sulphur (1 mark)

.....

(ii) Carbon

(1 mark)

.....
(c) Write equation to illustrate your observation in

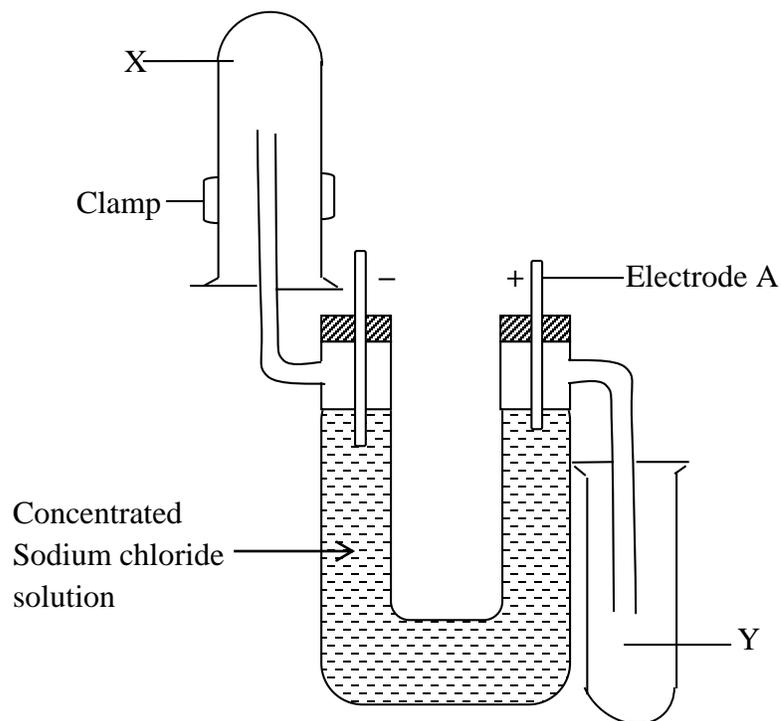
(i) (b) (i)

(1 ½ marks)

.....
(ii) (b) (ii)

(1 ½ marks)

10.



The diagram above is U-tube voltameter for the electrolysis of concentrated sodium chloride solution

(a) Identity

(i) Gas X

(½ mark)

.....
(ii) Gas Y

(½ mark)

(iii) The material electrode A is made of (1 mark)

.....

(b) Give a reason why electrode A should be made of the material you have identified in

(a) (iii) (1 mark)

.....
.....

(c) State why each of the gases X and Y is collected as shown in the diagram (1 mark)

.....
.....

(d) Litmus paper was dropped into the solution near the cathode.

(i) State what was observed. (½ mark)

.....

(ii) Give a reason for your observation in (d) (i) (½ mark)

.....

SECTION B:

Answer any two questions only in this section. Extra questions answered will not be marked.

11. (a) Burning sulphur was lowered into a jar of oxygen.\

(i) State what was observed. (1 mark)

(ii) Write equation for the reaction that took place. (1 mark)

(b) The major product of combustion of sulphur is sulphur dioxide

(i) Name one reagent, which can be used to test for sulphur dioxide. (1 mark)

(ii) State what would be observed if the reagent which you have named in (b) (i) was tested with sulphur dioxide and give a reason for your observation (1 ½ marks)

(c) Under certain temperature and pressure conditions in the presence of a suitable catalyst, sulphur dioxide can be converted into sulphuric acid on a large scale through an industrial process known as the Contact process.

(i) Using equations to illustrate your answer, outline the reactions that lead to conversion of sulphur dioxide to sulphuric acid by the Contact process. (5 ½ marks)

- (ii) Describe the temperature and pressure conditions used during the contact process; and briefly explain their effects on the reaction(s) where they are applied. (4 marks)
- (iii) Name the suitable catalyst in modern day contact process and give a reason for its suitability.

12. (a) (i) Write equation for reaction that takes place when excess carbon dioxide is bubbled through concentrated sodium hydroxide solution (1 ½ marks)
- (ii) Briefly describe how a pure dry sample of the product of the reaction in (a) (i) can be obtained in the laboratory. (2 ½ marks)
- (b) State what would be observed and write equation for the reaction that would take place if
- (i) to the solution of the dry sample in (a) (ii) was added aqueous lead (II) nitrate solution. (2 marks)
- (ii) to some of the dry sample in (a) (ii) was added dilute sulphuric acid (2 marks)
- (d) The Table below shows the variation in volume of carbon dioxide evolved when dilute hydrochloric acid solution was added to several weighed samples of a carbonate with formula, MCO_3 at s.t.p

Mass of MCO_3 (g)	0.025	0.050	0.100	0.150	0.200	0.300	0.40
Volume of CO_2 at s.t.p (cm^3)	4.0	11.0	21.0	33.0	44.5	56.0	56.0

- (i) Plot a graph of volume of carbon dioxide evolved (vertical axis) against mass of the carbonate, MCO_3 used (horizontal axis). (3 marks)
- (ii) Determine the number of moles of the carbonate, MCO_3 that gave maximum volume of carbon dioxide evolved. (2 marks)
- (iii) Calculate the atomic mass of M in the carbonate, MCO_3 (C=12,O=16) (2 marks)
13. Spathic iron is one of the major ores of iron
- (a) Write the chemical name and formula of spathic iron (1 mark)
- (b) During the extraction of iron, spathic iron is first roasted in air before being transferred into the Blast furnace. State the purpose of roasting the ore in air (1 mark)
- (c) Name;
- (i) the major impurity in iron ore (1 mark)
- (ii) two substances, which are fed into the Blast furnace together with roasted iron ore (1 mark)

- (iii) any other substance that is also fed into the furnace, and describe where from the substance is let into the furnace (1 mark)
- (d) Using equations only, outline reactions which take place inside the Blast furnace up to
- (i) Formation of iron (3 ½ marks)
- (ii) Removal of the major impurity in the ore (2 marks)
- (e) State the importance of slag during extraction of iron in the furnace. (1 mark)
- (f) Describe how iron reacts with
- (i) Water (2 marks)
- (ii) Chlorine (2 marks)
14. (a) Draw a labeled diagram for the setup of apparatus that can be used to prepare a dry sample of ammonia in the laboratory (4 marks)
- (b) Explain each of the following and write equation to illustrate your explanation
- (i) Ammonia gives dense white fumes with hydrogen chloride (3 ½ marks)
- (ii) Fused calcium chloride is not a suitable drying agent for ammonia (2 marks)
- (c) Describe the reactions of ammonia with oxygen. (5 ½ marks)

END