545/2

S4 CHEMISTRY

Exam 12 Marking guide

PAPER 2

DURATION: 2 HOUR

SECTION A:

Answer **all** the questions

1. Under suitable conditions, hydrogen peroxide, H_2O_2 can decompose rapidly to produce oxygen
   (a) (i) Write equation for the decomposition of hydrogen peroxide. (1 ½ marks)
   $2H_2O_2\ (aq) \rightarrow 2H_2O(l) + O_2(g)$

   (ii) State two ways in which the decomposition of hydrogen peroxide can be made to occur rapidly. (1 mark)
   Using a catalyst, MnO_2

   Increasing temperature/heating

   (b) Burning magnesium ribbon was lowered into a jar of oxygen
   (i) State what was observed (1 mark)
   Bright white flame and white ash

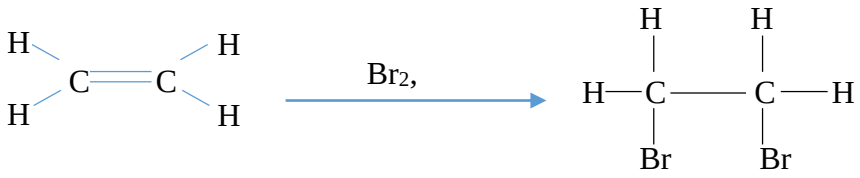
   ii) Write an equation for the reaction that took place. (1 ½ marks)
   $2Mg(s) + O_2\ (g) \rightarrow 2MgO(s)$

2. A colourless gas, G decolorized potassium permanganate (VII) solution
   (a) Name two gases that are likely to be G. (1 mark)
   Ethene or sulphur dioxide

   (b) G also decolorized a solution of bromine in tetrachloromethane, but did not have any effect on acidified potassium dichromate solution.
   (i) Identify G (½ mark)

Ethene

(ii) Write an equation to show the reaction between G and bromine in tetrachloromethane. (1 mark)



(c) G was burnt in air containing plentiful supply of oxygen. Write equation for the reaction that took place.
$C_2H_4\ (g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$

(d) Name two substances that can react to produce G. (1 mark)
chlorine

hydrogen

hydrochloric acid

3. (a) Give one example of a mixture of substances that can be separated by each of the following methods
   (i) Sublimation (1 mark)
   Sodium chloride (NaCl) and ammonium chloride (NH_4Cl)

   (ii) Fractional crystallization (1 mark)
   Potassium nitrate and potassium chloride

   (b) Air is a mixture of mainly two gases
   (i) Name the two gases and give their approximate composition in ordinary air by volume. (2 marks)
   Nitrogen and oxygen

   (ii) State two reasons why air is considered a mixture and not a compound. (1 mark)
   - *its composition is variable*
   - *has no chemical formula*

   (iii) Name the industrial method by which the two major gaseous components of air can be separated. (1 mark)
   Fractional distillation

4. (a) When mixed with a solution containing copper (II) ions, zinc granules react with sulphuric acid at room temperature to produce hydrogen gas.
   (i) State the condition under which sulphuric acid reacts with the zinc granules

(½ mark)

heat

(ii) Suggest the property of sulphuric acid in this reaction (½ mark)
it is an acid

(iii) What is the role of copper (II) ions in the reaction? (½ mark)
catalyst

(iv) Write an ionic equation for the reaction leading to the formation of hydrogen gas (1 ½ marks)

$Zn\ (s) + 2H^+(g) \rightarrow Zn^{2+}(aq) + H_2(g)$

(b) Dry hydrogen gas was passed over a strongly heated copper (II) oxide
(i) State what was observed. (1 ½ marks)
Black powder turn brown

(ii) Write equation for the reaction that took place (1½ marks)
$CuO(s) + H_2(g) \rightarrow Cu\ (s) + H_2O(l)$

5. Write equation only, to show the reaction that takes place when each of the following substances is strongly heated in air. (1 ½ marks @)
(a) copper metal
$2Cu\ (s) + O_2(g) \rightarrow 2CuO(s)$

(b) Potassium nitrate
$2KNO_3\ (s) \rightarrow 2KNO_2(s) + O_2(g)$

(c) Sodium hydrogen carbonate
$2NaHCO_3\ (s) \rightarrow Na_2CO_3(s) + CO_2g) + H_2O(l)$

(d) Zinc nitrate
$2Zn(NO_3)_2(s) \rightarrow 2ZnO(s) + 4NO_2(g) + O_2(g)$

6. 50.0cm^3 of a 2M sodium hydroxide solution was accurately measured into a volumetric flask and water added to make 1 dm^3 of dilute solution. Calculate the volume of the dilute solution that would be required to react completely with 25.0cm^3 of a 0.04M copper (II) sulphate solution [copper (II) sulphate reacts with sodium hydroxide according to the following ionic equation:
$Cu^{2+}(aq) + 2OH^-(aq) \longrightarrow Cu(OH)_2(s)]$ (4 marks)

moles of sodium hydroxide = $\frac{50\ x\ 2}{1000} = 0.1 mole$

moles of copper ions = $\frac{25\ x\ 0.04}{1000} = 0.001 moles$

moles sodium hydroxide that reacted with copper ions = 0.001 x 2 = 0.002moles

Volume that contain 0.002 moles of sodium hydroxide

0.1 moles of sodium hydroxide is contained in 1000cm^3

0.002 moles of sodium hydroxide contained in $\frac{0.002\ x\ 1000}{0.1}$ = 20cm^3

7. (a) State what would be observed if each of the following substances was left exposed in air for sometime.

(i) Sodium carbonate – 10 – water (1 ½ marks)

Crystals turn into a powder

(ii) Fused calcium chloride (1 ½ marks)

Turns into a liquid

(b) State **one** word which describes the property of each of the compounds shown in (i) (a) (i)

efflorescence

(ii) (a) (ii)

deliquescence

(c) State **one** practical application of fused calcium chloride that is as a result of the property that you have stated in (b) (ii) (1 mark)

It is used as drying agent

8. Ammonia can react with lead (II) oxide to produce lead according to the following equation

$3PbO(s) + 2NH_3(g) \longrightarrow 3Pb(s) + N_2(g) + 3H_2O(l)$

(a) State

(i) the condition(s) under which the reaction takes place (1 mark)

heat

(ii) the property of ammonia shown in the reaction (1 mark)

reducing agent

(b) 3.1g of lead was obtained when ammonia reacted with lead (II) oxide. Calculate the maximum volume of ammonia, measured at s.t.p that reacted with lead (II) oxide. (Pb = 207, O = 16, 1 mole of a gas occupies 22.4dm^3 at s.t.p)

(2 marks)

3 x 207 of Pb require 2 x 22.4 dm^3 of ammonia

3.1g of Pb require = $\frac{2 \text{ x } 22.4 \text{ x } 3.1}{3\ x\ 207}$ = 0.224dm^3 of ammonia

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9 (a) A dilute solution of copper (II) chloride was electrolysed between graphite electrodes

(i) State what was observed at the cathode (1 mark)

brown coat

(ii) Give a reason for your observation in (i) (½ mark)
Cu^{2+} are discharged in preference to H^+

(iii) Name the product obtained at the anode (1 mark)
Oxygen

(c) The electrolysis in (a) above was repeated using a concentrated solution of copper (II) chloride.
Write an ionic equation to show the reaction at the anode. (1 ½ marks)
$2Cl^-(aq) + 2e \rightarrow Cl_2(g)$

10. When a mixture of a compound **R** and concentrated sulphuric acid was warmed, a vigorous effervescence took place and a colourless gas W with a choking smell was evolved. W gave dense white fumes with concentrated ammonia solution.

(a) (i) Name W (1 mark)

HCl

(ii)Suggest a possible identity of the anion in **R** (1 mark)

NaCl

(iii) Name **one** reagent which would be used to confirm the identity of the anion which you have suggested in (ii) (½ marks)

Silver nitrate solution forms a white ppt.

(b) Write an ionic equation to show the reaction that can take place between lead (II) nitrate solution and an aqueous solution of **R** (1 ½ marks)

$2Cl^-(aq) + Pb^{2+}(aq) \rightarrow PbCl_2(s)$

SECTION B:

Attempt any **two** questions in this section

11. A compound Q consists of 26.7% carbon and 2.2% hydrogen by mass, the rest being oxygen.

(a) Calculate the empirical formula of Q. (3 ½ marks)

(H = 1, C = 12, O = 16)

Percentage of oxygen =100 – (26.7 + 2.2) = 71.1

Elements	C	H	O
Percentage	26.7	2.2	71.1
Atomic mass	12	1	16
Moles	2.22	2.2	4.44
Mole ratio	1	1	2
Empirical formula	CHO_2		

(b) An aqueous solution of Q turns blue litmus paper pale red.

(i) Suggest how the pH value of a 2M aqueous solution of Q would compare with the pH value of a 2M hydrochloric acid. Give a reason for your suggestion

2M hydrochloric acid has a lower pH because Q is a weak acid

(ii) Predict how Q would react with sodium hydrogen carbonate. (2 marks)

Reacts with effervescence

(iii) Write an ionic equation for the reaction that you have predicted in (ii)

(1 ½ marks)

$2H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$

(c) $20cm^3$ of a solution containing 4.5g of per dm^3 of the solution required exactly $25cm^3$ of a 0.08M sodium hydrogen carbonate solution for complete reaction. (1 mole Q reacts with 2 moles $NaHCO_3$)

Calculate:

(i) the concentration of Q in mol dm^{-3} (3 marks)

Moles of $NaHCO_3$ $= \frac{25 \; x \; 0.08}{1000} = 0.002moles$

moles of Q $= \frac{1}{2} \; x \; 0.002 = 0.001mole$

molarity of solution of Q

$20cm^3$ contain 0.001moles

$1000cm^3$ of solution of Q contain $\frac{0.001 \; x \; 1000}{20} \; 0.05moles$

(ii) the molar mass of Q (1 ½ marks)

0.05moles of Q weigh 4.5g

1 moles of Q weigh $\frac{4.5 \; x \; 1}{0.05} = 90$

(d) Determine the molecular formula of Q (1 ½ marks)

$(CHO_2)n = 90$

$n = 2$

Molecular formula $C_2H_2O_4$

12. (a) With the help of a labelled diagram, briefly describe how a sample of dry chlorine can be prepared in the laboratory, starting from concentrated hydrochloric acid (9 marks)

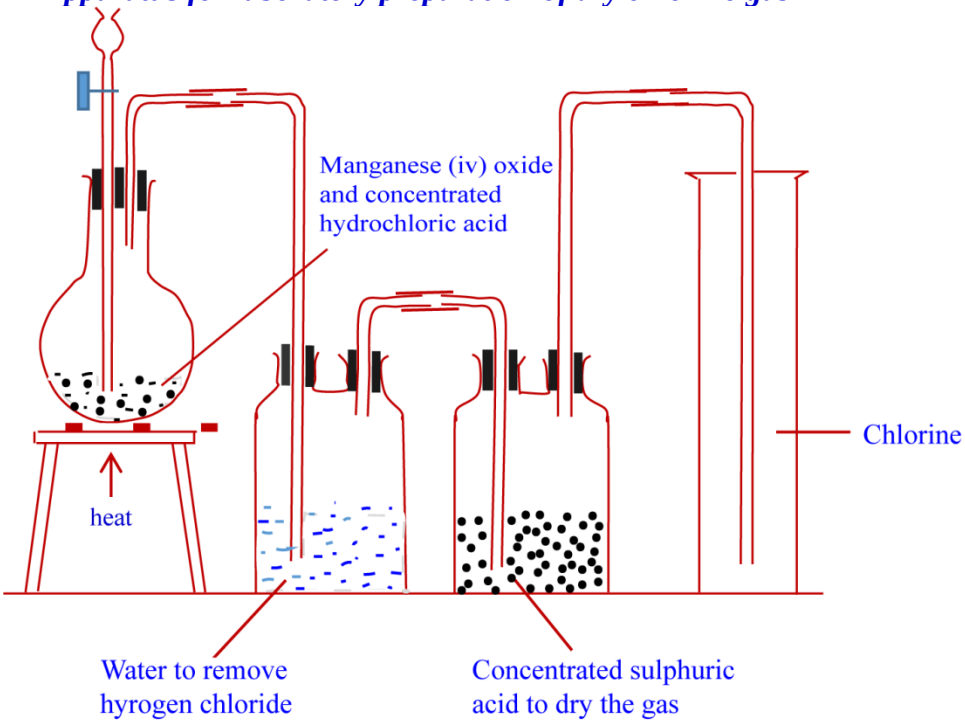
In the laboratory:

Chlorine is obtained by oxidation of concentrated hydrochloric acid with potassium permanganate (VII) or with manganese (iv) Oxide.

$MnO_4^-(aq) + 8HCl(aq) \rightarrow MnCl_2(aq) + 4H_2O(l) + 3Cl_2(g)$

$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2$

Apparatus for laboratory preparation of dry chlorine gas



Note that chlorine is collected by downward delivery or upward displacement of air because it is denser than air

(b) Chlorine was bubbled through a dilute solution of potassium hydroxide

(i) State what was observed

Pale yellow solution is formed

(ii) Write an equation for the reaction that takes place (1 ½ marks)

$2OH^-(aq) + Cl_2(g) \rightarrow Cl^-(aq) + ClO^-(aq) + H_2O(l)$

(c) When exposed to sunlight, chlorine water produces a colourless gas, Name the gas

oxygen

(d) (i) Write an equation for the reaction that can take place between iron and

chlorine.

$2Fe(s) + 3Cl_2(g) \rightarrow 2FeCl_3(s)$

(ii) Give a reason why the reaction in (i) is regarded as oxidation of iron.

+3

(1 mark)

13. (a) (i) Outline an experiment which can be carried out to show that the rate of the reaction between calcium carbonate and dilute hydrochloric acid depends on the surface area of the calcium carbonate. (No equations or diagrams required)

(7 marks)

Experiment

Equal masses of calcium carbonate power and granules are added to separate test tubes containing equal volumes of dilute acid.

Observation

Carbon dioxide is liberated at a faster rate in a test tube where the powder is used.

Conclusion

Increasing surface area increases the rate of reaction

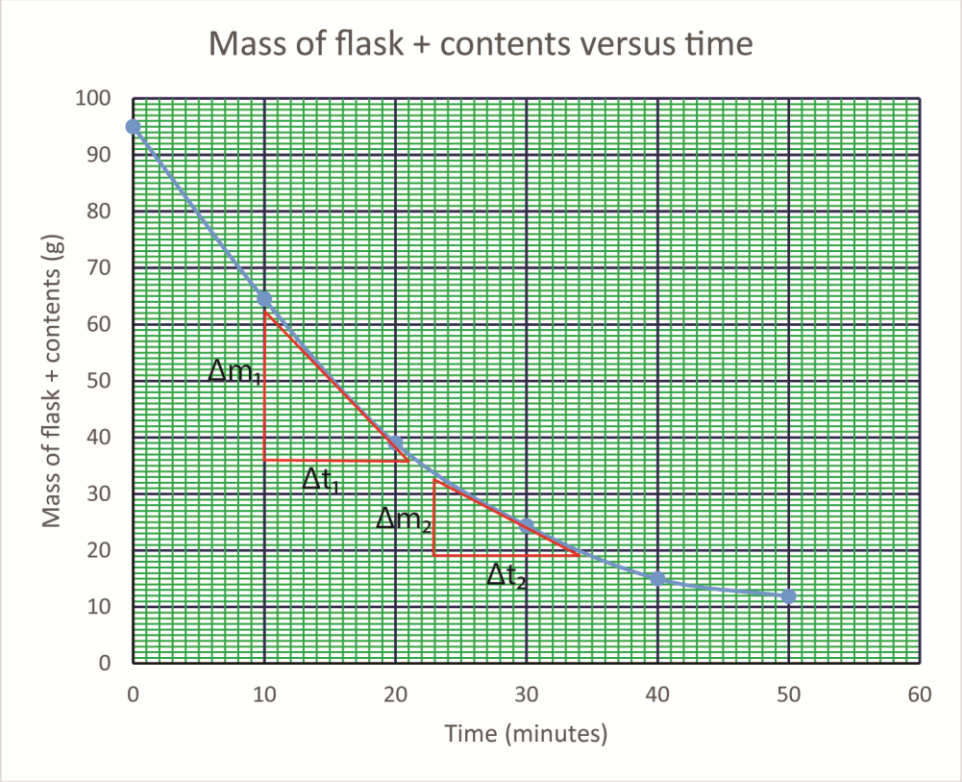
(ii) State two conditions that would affect the rate of the reaction in (i) other than the surface area of the calcium carbonate. (1marks)

- *increasing temperature increases the rate of reaction*
- *increasing the concentration of the acid increases the rate of reaction*

(b) In an experiment to investigate the rate of the reaction of magnesium with dilute sulphuric acid, a flask containing magnesium and sulphuric acid was weighed after every 10 minutes for a total time interval of 50 minutes. The results obtained are shown in the table below.

Time/minutes	0	10	20	30	40	50
Mass of flask + contents/g	95.0	64.5	39.0	24.4	15.0	11.9

(i) Plot the graph of mass of flask + contents against time (4 marks)



(ii) Determine the rates of the reaction after 15.0 and 27.5 minutes respectively and comment on your results (3 marks)

Rate15.0 minute $=\frac{\Delta m_1}{\Delta t_1} = \frac{62-36}{21-10} = \frac{26}{11}$ = 2.36g/minute

Rate27.5minute $=\frac{\Delta m_2}{\Delta t_2} = \frac{32-19}{34-23} = \frac{13}{11}$ = 1.18g/minute

14. Iron (III) oxide (haematite) is one of the common ores of iron from which iron can be extracted in a blast furnace.

(a) Name

(i) one common ore of iron other than iron (III) oxide (1 mark)

Magnetite, Fe_3O_4, and from the siderite, $FeCO_3$

(ii) One major impunity that can be found in the ore you have named in (i) (1 mark)

Silicate, SiO_2

(b) Outline the reactions which occur in the blast furnace during the extraction of iron from iron (III) oxide ore.

$2C\ (s) + O_2\ (g) \rightarrow 2CO\ (g)$

$Fe_2O_3\ (s) + 3CO\ (g) \rightarrow 2Fe\ (s) + 3CO_2\ (g)$

(c) (i) Name the major components of stainless steel (1 mark)

Iron and carbon

(ii) State one use of stainless steel (½ mark)

folks, spoons, sauce pans, tanks

(iii) Give a reason why stainless steel is more used than pure iron (1 mark)
Steel does not rust easily as iron

(d) Most common compounds of iron are either those of iron (II) or iron (III) Write the formula of one compound of
(i) Iron (II) (½ mark)
Iron II sulphate, $FeSO_4$
(ii) Iron (III) (½ mark)
Iron III sulphate, $Fe_2(SO_4)_3$

(e) Name one reagent that could be used to distinguish between iron (II) and iron (III) compounds and in each case state the observations that would be made if the reagent you have named was used. (2 ½ marks)

Reagent	Observation	
	Fe^{2+}	Fe^{3+}
Sodium hydroxide solution	green ppt.	Brown ppt.
Ammonia solution	green ppt.	Brown ppt.
Potassium hexacyanoferrate II	Blue	Deep blue solution
Potassium hexacyanoferrate III	Deep blue solution	blue

END