

SENIOR FOUR

- 1a) Write ionic equations for the reaction between
- Zinc sulphate and sodium carbonate.
 - Dilute sulphuric acid and barium nitrate solution.
 - Dilute hydrochloric acid and potassium hydrogen carbonate solution.
 - Chlorine and iron (II) chloride solution.
2. When magnesium sulphate solution was added to a solution of a sodium salt, X, no apparent change took place in the cold; but on heating the resultant mixture, a white precipitate appeared.
- Identify X.
 - Write ionic equation for the reaction that took place; if any, when
 - Magnesium sulphate solution was added to cold solution of X.
 - the resultant mixture in b(i) was heated.
 - State;
 - One** practical application of the procedures describe in b(i) and (ii).
 - the industrial application of the reaction in b(ii)
- 3(a) The atomic number of elements W, X and Y are 6, 12, 17 respectively
- Write the electronic configurations of W, X and Y.
 - Using the outermost shell electrons only, draw a diagram to show how **W** and **Y** form a compound.
 - State the type of bond between
 - X** and **Y**
 - W** and **Y**
 - Identify the element that exists as a diatomic molecule.
3. A hydrated salt Q, consists of 20.2% iron, 11.5% sulphur, 23% oxygen and 45.3% water of crystallization.
- Calculate the empirical formula of Q. (Fe=56, S=32, O=16, H=1)
 - Deduce the molecular formula of Q. (relative formula mass of Q = 278)
 - Write equation for the reaction between a solution of Q and chlorine
4. a) Hydrated sodium sulphide $\text{Na}_2\text{S} \cdot n\text{H}_2\text{O}$ contains 67.7% by mass of water. Determine its formula.
- (Na = 23, S = 32, O = 16, H = 1)
- b) A certain solid oxide **MO**₃ contains 60% of oxygen. Calculate the atomic mass of M. [O=16]
5. On heating 12.5g of hydrated copper (II) sulphate, $\text{CuSO}_4 \cdot n\text{H}_2\text{O}$, 8.0g of anhydrous copper (II) sulphate remained. Determine the formula of the hydrated salt. [Cu = 64, O = 16, S = 16, H = 1]

6. 20cm^3 of 0.15M sodium hydroxide solution was neutralized by 20cm^3 of a solution containing 7.35g per litre of an acid having formula H_2X .

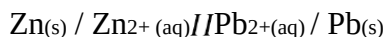
- (a) Write equation for the reaction.
- (b) Calculate;
 - (i) the molarity of the acid solution.
 - (ii) the molecular mass of the acid

7. When excess hydrogen was passed over 1.660g of a strongly heated oxide of a metal **Z**, 1.18g of solid residue remained.

- a) Calculate the formula of the oxide of **Z**. ($\text{O}=16$, $\text{Z}=59$).
- b) Write the equation for the reaction of reduction of **Z** by hydrogen.
- c) 4.0 g of an alloy of copper and zinc when reacted with excess hydrochloric acid gave 840 cm^3 of hydrogen gas measured at s.t.p [$\text{Zn}=65$]
 - a) Name the alloy
 - b) Write the equation for the reaction that took place.
 - c) Calculate the mass of copper in the alloy. (d) State one use of the alloy in (a) above.

8. a) What is the significance of electroplating?
- b) State three conditions necessary for electroplating.
 - c) Draw a diagram to show how an iron spoon can be electroplated with silver metal
 - d) Write an equation that leads to electroplating of the iron spoon.
 - e) Apart from silver, state three other metals that are commonly used for electroplating.

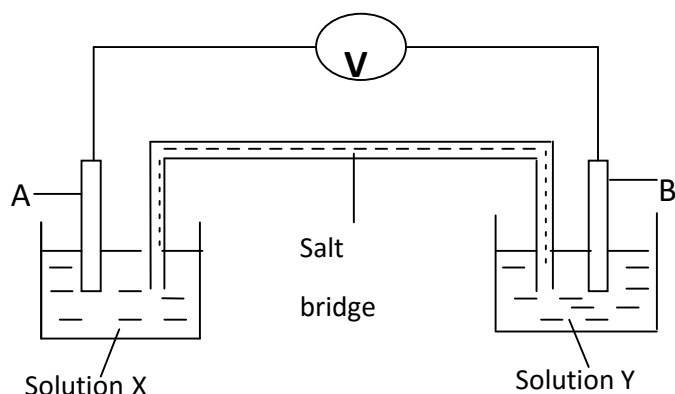
9. The cell convention for an electrochemical cell is shown below;



- (a) Name two substances that could be used as electrolytes.
- (b) State which one of the electrodes is the cathode. (c) Write the equation for the reaction at
 - (i) Cathode
 - (ii) Anode

- (d) Write the equation for the overall cell reaction
- (e) Explain why sodium sulphate is not appropriate for use in the salt bridge in the above electrochemical cell.

10. The diagram below shows an electrochemical cell that was made to compare the reactivities of iron and copper.



- a) Name the metal strip
 - (i) A
 - (ii) B
- b) Identify the possible chemical solutions
 - (i) X
 - (ii) Y
- c) State the function of the salt bridge.
- d) Write the overall cell reaction equation

11(a) Chlorine gas was bubbled through aqueous solutions of

- (i) dilute sodium hydroxide
- (ii) Potassium iodide

State what was observed in each case and write the equation for the reaction.

- (b) Explain using equations why the resulting solution in b(i) has a bleaching action.
- (c) Write an equation to show that chlorine reacts differently with hot concentrated sodium hydroxide.
- (d) A test tube filled with chlorine water was inverted into a beaker containing water and left exposed to sunlight for some time.
 - (i) State what was observed
 - (ii) Using equation(s), explain your observation(s) in d(i) above

e) Blue litmus paper was placed into chlorine water. State what was observed

12 (a) A pure dry sample of hydrogen chloride was prepared in the laboratory by adding concentrated sulphuric acid onto a crystalline solid, **Q**, in a flask and then warming the mixture. The gas evolved was passed through a liquid, **Z**, before it was collected; i) Identify **Q**

ii) Name **one** suitable piece of apparatus by means of which concentrated sulphuric acid was added onto **Q**. iii) Name **Z**, and state its role.

iv) Give a reason why **Z** was preferred for its role, which you have stated in (iii)

v) State the method by which hydrogen chloride was collected; and give a reason. vi) Write equation for the reaction, which led to the formation of hydrogen chloride.

b) State;

i) What an aqueous hydrogen chloride is called.

ii) A suitable procedure for preparing a sample of aqueous hydrogen chloride in the laboratory.

c) **Two** equal masses of magnesium powder were added separately to solutions of hydrogen chloride in water and methylbenzene, respectively. State what was observed in each case; and give a reason for each observation that you have stated.

d) Dry hydrogen chloride was bubbled into silver nitrate solution that was acidified with nitric acid. Write ionic equation for the reaction that took place.

13 a) Red hot platinum was suspended in a flask containing ammonia and oxygen gas allowed to pass through the flask.

(i) State what was observed

(ii) Write equations of reaction in (a) above.

(iii) State the role of red hot platinum wire in this experiment.

(b) During a laboratory preparation of ammonia, ammonium chloride was treated with a

Powdery solid **R**. Write;

i) the name of **R**.

ii) equation for the reaction that led to the formation of ammonia, and state the condition(s) for the reaction.

(c) Concentrated sulphuric acid, fused calcium chloride and calcium oxide are compounds commonly used as drying agents in the laboratory.

i) State which one of the compounds is used as a drying agent for ammonia.

ii) Explain why the other two compounds are **not** suitable for drying ammonia.

d) Write an ionic equation to show the reaction that would take place if;

- i) A few bubbles of ammonia were passed into copper(II) sulphate solution.
- ii) A lot more bubbles of ammonia were passed into the resultant mixture in (d).
- e) State what was observed in (d) above.
- f) State one application of precipitation reactions of aqueous ammonia.

14. a) What is meant by rate of a chemical reaction?

b) State how the following factors affect the rate of a chemical reaction:

- (i) Temperature
- (ii) Concentration

c) The table below shows the time taken for the reaction of a certain substance **W** to go to completion when different concentrations of **W** were used.

Concentration of W mol dm ⁻³	0.1	0.3	0.4	0.6	0.8
Time, t, for completion of reaction	120	40	30	20	10
Reciprocal of time $\frac{1}{t}$ (s ⁻¹)					

- (i) Complete the table by filling in the values of $\frac{1}{t}$ for each time.
- (ii) Plot a graph of $\frac{1}{t}$ against concentration of **W**.
- (iii) Deduce from the graph how the rate of reaction varies with concentration of **W**.

d) From the graph, determine the time taken for completion of reaction when the concentration of **W** is increased to 0.9 mol dm⁻³.

15. When 40cm³ of 2M nitric acid was mixed with 40cm³ of 2M sodium hydroxide solution at an initial temperature of 25.8°C, the temperature of the solution rose to T°C. Calculate the value of T.

Note: = specific Heat capacity of water is 4.2Jg⁻¹C⁻¹

density of solution is 1gcm⁻³

= Enthalpy of neutralization of nitric acid by sodium hydroxide is 56.5KJmol⁻¹

16(a) (i) Define the term enthalpy of combustion.

- (ii) When 448cm³ of ethane measured at standard temperature and pressure is completely burnt in oxygen the heat produced raises the temperature of 100g of water by 12°C. (Specific heat capacity of water = 4.2Jg⁻¹ °C, 1 mole of a gas occupies 22.4l at s.t.p) Calculate the heat of combustion of ethane.

- (b) The enthalpy of combustion of carbon is -390KJmol^{-1} .
- (i) Write the equation for the complete combustion of carbon.
- (ii) 40g of charcoal cost 2,000/=. Calculate the cost of charcoal required to produce 16250KJ of heat. (C = 12)

State three factors considered when choosing a source of fuel

17 (a) Name one reagent that can be used to distinguish between each of the following pairs of ions. In each case state what would be observed if the reagent is separately reacted with each member of a pair.

- (i) Cl^- and I^- ions
- (ii) Al^{3+} and Zn^{2+} ions
- (iii) Pb^{2+} and Mg^{2+} ions
- (iv) SO_3^{2-} and SO_4^{2-} ions
- (v) Ca^{2+} and Mg^{2+} ions
- (vi) CO_3^{2-} and HCO_3^- ions

(b) State what is observed when the silver chloride precipitate is added to;

- (i) Excess ammonia solution
- (ii) Dilute nitric acid

18 (a) Name a reagent that can be used to confirm the presence of the following ions in solution. In each case, state what would be observed when the reagent is used.

- (i) NH_4^+ (iii) Cl^- (ii) I^- (iv) SO_4^{2-}

19(a) Dilute ammonia solution was added drop-wise until in excess to a solution containing aluminium ions. Write an ionic equation for the reaction that took place.

(b) To the mixture in (a) was added excess dilute sodium hydroxide solution and the resultant solution shaken well.

- (i) State what was observed
- (ii) Write the formula of the ionic species in the resultant mixture.

20. Name one metal ion that would behave in a similar way as aluminum ion

- (a) What is meant by water pollution?
- (b) Name any four substances that cause water pollution and explain how the substances pollute the water.
- (c) Describe the process of treatment of polluted water.
- (d) Suggest any two ways of controlling water pollution.

