**ORDINARY LEVEL CHEMISTRY PROBLEMS**

**PART 3: HYDROGEN AND WATER**

1. (a) (i) Draw a labelled diagram to show how a sample of dry hydrogen can be prepared. Your diagram should include apparatus and reagents used.
   (ii) Write an equation for the reaction that takes place.
   (b) Calcium, lead, potassium and zinc form part of the metal activity series.
   (i) Arrange the metals in order of reactivity starting with the most reactive metal.
   (ii) Describe how each metal reacts with cold water. Write equations for the reactions that take place.
   (c) Iron reacts with steam according to the equation
   $$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g).$$
   Calculate the mass of iron required to produce 2.24 l of hydrogen at s.t.p.

2. When hydrogen gas was passed over $x$ g of strongly heated copper (II) oxide until there was no further change, 4 g of a solid was formed.
   (a) State what was observed.
   (b) Write equation for the reaction.
   (c) Determine the value of x

3. (a) Write an equation to show how hydrogen gas can be prepared from zinc and dilute sulphuric acid.
   (b) Hydrogen was reacted with copper (II) oxide. State
   (i) The conditions for the reaction.
   (ii) What was observed?

4. A stream of dry hydrogen was passed over 6.85 g of heated lead (II) oxide in a combustion tube. The residue weighted 6.21 g.
   (a) State what was observed in the reaction.
   (b) Write equation for the reaction
   (c) Calculate the moles of the residue

5. (a) A sample of dry hydrogen can be prepared in the laboratory using zinc and dilute sulphuric acid in the presence of a catalyst.
   (i) Draw a diagram to show a set – up of the apparatus that can be used to prepare dry hydrogen in the laboratory. (3 ½ marks)
   (ii) Name the catalyst that can be used in this reaction. (01 mark)
   (iii) Write the equation for the reaction leading to the formation of hydrogen
   (iv) State how hydrogen can be identified. (01 mark)
   (b) Dry hydrogen was passed over heated lead (II) oxide.
   (i) State what was observed. (1 ½ marks)
   (ii) Write equation for the reaction that took place. (1 ½ marks)
   (c) Hydrogen burns in oxygen according to the following equation.
   $$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l) + heat$$
   (i) Name one substance that can be used to identidy the product of the combustion of hydrogen in oxygen. (01 mark)

(ii) State what would be observed if the reagent you have named in (c) (i) was used to identify the product. (01 mark)

(iii) Calculate the volume of hydrogen at s.t.p that would burn in oxygen to produce 5720 J of heat.

(*The molar heat of combustion of hydrogen = - 286 kJ mol$^{-1}$; 1 mole of gas occupies 22.4 dm$^3$ at s.t.p*)

6. (a) (i) Write equation to show how hydrogen can be prepared using zinc and dilute sulphuric acid

(ii) State how hydrogen can be tested in the laboratory

(b) Hydrogen reacts with copper(II) oxide according to the following equation

$$CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$$

(i) State what was observed

(ii) Calculate the volume of hydrogen gas at s.t.p, that would react with copper(II) oxide to form 3.20 g of copper.

($O = 16; Cu = 64;$ *one mole of gas occupies* $22.4\ dm^3$ *at s.t.p.*)

7. (a) Describe how a dry sample of hydrogen can be prepared in the laboratory (diagram is not required)

(b) Hydrogen burns in air to form a liquid L

(i) Identify L

(ii) Name a reagent that can be used to test for L

(iii) State what is observed when the reagent you have named in b(ii) is used to test for L

(c) Write equation to show the reaction of hydrogen with

(i) Chlorine

(ii) Nitrogen

(iii) Lead(II) oxide

(d) Name the property of hydrogen illustrated in the reaction in c(iii)

(e) State the conditions under which hydrogen reacts with copper(II) oxide and write equation for the reaction

(f) Hydrogen reacts with triiron tetraoxide according to the equation

$$Fe_3O_4(s) + 4H_2(g) \rightarrow 3Fe(s) + 4H_2O(l)$$

Calculate the volume of hydrogen measured at room temperature that would be required to produce 3.36 g of iron

(g) State one industrial use of hydrogen

8. (a) Hydrogen is usually prepared by reacting zinc granules with dilute hydrochloric acid. The reaction is usually warmed

(i) State what is observed during the reaction

(ii) Name the substance that can be used to dry hydrogen

(iii) How is dry hydrogen collected? Give a reason for the method of collection

(b) Name the catalyst used in the reaction

(c) Explain why sulphuric acid is not usually used to react with zinc to produce hydrogen

(d) Explain why nitric acid is not used in the preparation of hydrogen

9. (a) Describe the reaction of hydrogen with each of the following.
   (i) Copper(II) oxide
   (ii) Triiron tetraoxide
   (iii) Lead(II) oxide
   (iv) Oxygen
   (Your answers should include conditions and equations for the reactions and any observations made)
   (b) Magnesium was added to dilute sulphuric acid and a colourless gas T was produced.
   (i) State what was observed
   (ii) Write equation for the reaction
   (iii) Identify the gas T
   (iv) State who gas T can be identified in the laboratory
   (c) State three ways in which the reaction can be made to occur faster
   (d) State the uses of hydrogen

10. (a) Draw a diagram for the set-up of apparatus that can be used to prepare a dry sample of hydrogen in the laboratory
   (b) Write the equation leading to the formation of hydrogen in the apparatus you have drawn
   (c) Explain why hydrogen is not usually prepared by reacting
   (i) Calcium and dilute sulphuric acid
   (ii) Lead and dilute sulphuric acid
   (iii) Lead and dilute hydrochloric acid
   (d) Draw a set-up of apparatus that can be used to show the hydrogen can reduce copper(II) oxide.
   (e) State what is observed and write equation for the reaction that takes place during the reduction of copper(II) oxide and hydrogen
   (f) Explain why hydrogen does not reduce zinc oxide yet it reduces lead(II) oxide
   (g) Hydrogen is a light gas, which is less dense than air. State the application of hydrogen as a result of this property.

11. (a). State the conditions under which the following substances react with water. And in each case, state what would be observed and write the equation for the reaction when the substance is reacted with water
   (i). Sodium
   (ii). Calcium
   (iii). Magnesium
   (iv). Iron
   (v). Zinc

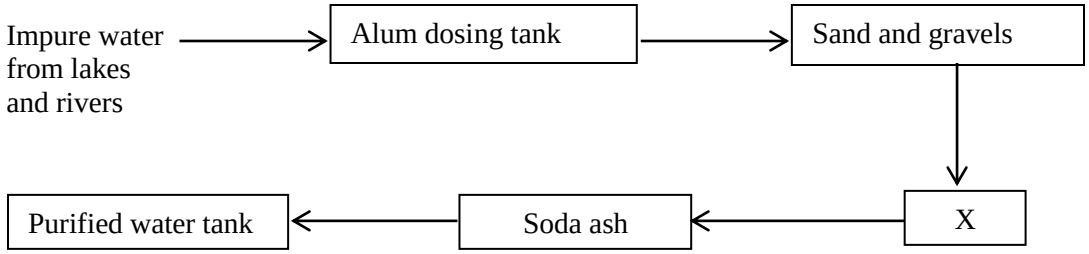
12. (a) (i) What is water pollution?
   (ii) How can you tell that water is polluted? Give two ways
   (b) (i) What is sewage?
   (ii) How does sewage pollute water
   (iii) Describe how urban sewage is treated

(iv) How can sewage be useful to the society

32. (a). State what is meant bythe ter **hard water**
(b). Name **two** cations and **two**anions present in hard water
(c). When a solution of barium nitrate was added to a sample of hard water, followed by dilute nitric acid, a white precipitate was formed that did not dissovle in the acid. Write eqaution for the reactionthat took place.

33. (a). State the difference between **hard water** and **soft water**
(b). Name one substance that causes
(i). Temporary hardness
(ii). Permanent hardness
(c). State one method that can be used to remove
(i). Temporary hardness in water
(ii). Permanent hardness in water

34. (a). What is meant by the term water pollution?
(b) (i) Name two substances that can cause water pollution
(ii) Describe how each of the substances you have named in b(i) above can cause water pollution
(c) The flow diagram below shows the general scheme used in water purification




(i) State the purpose of the alum dosing tank and the sand and gravels
(ii) Identify X and state its purpose
(iii) State the role of soda ash
(iv) Write equations to show the role of soda ashs