

Exercise :6 C

1. a) Where does Hydrogen occur in free state?
b) How did the name Hydrogen originate?

Solution:

- a) Hydrogen occur in free state n traces in the earth's crust and atmosphere.
b) The name Hyrogen originated from its ability to form water.

2. Hydrogen can be prepared with the help of cold water. Give a reaction of Hydrogen with:
a) a monovalent metal b) divalent metal

Solution:

- a) $2K + 2H_2O \rightarrow 2KOH + H_2$
b) $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

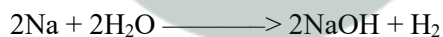
3. Which metal is preferred for collecting Hydrogen from

- a) Cold water
b) Hot water
c) Steam

Write balanced equation for each case.

Solution:

Cold water: Sodium



Hot water: Magnesium



Steam: Aluminium



4. Hydrogen may be prepared in the laboratory by the action of a metal on an acid.

(a) Which of the metals copper, zinc, magnesium or sodium would be the most suitable ?

(b) Which of the acids dilute sulphuric, concentrated sulphuric, dilute nitric and concentrated nitric would you choose ?

Explain why you would not use the acids you reject.

(c) How would you modify your apparatus to collect dry hydrogen ? Which drying agent would you employ for this purpose ?

Solution:

a) Zinc is the most suitable metal to prepare Hydrogen in the laboratory.

b) Dilute sulphuric acid is preferred to prepare Hydrogen in the laboratory because nitric acid in both concentrated and in diluted form is a strong oxidizing agent. This results in the formation of Oxygen which results in the formation of water. Concentrated sulphuric acid is not used because it will produce sulphur dioxide.

c) The gas is collected by the downward displacement of water. Common drying agents such as fused calcium chloride, caustic potash stick and phosphorus pentoxide remove water vapour.

5. Why are the following metals not used in the lab. preparation of hydrogen ?

(a) calcium (b) iron (c) aluminium (d) sodium

Solution:

Answer is (a) calcium because Calcium is expensive.

6. Based on the reactions of water on metals. arrange the following metals in increasing order of reactivity. Iron, sodium magnesium, zinc, calcium.

Solution:

Iron < Zinc < Magnesium < Calcium < Sodium

7. Hydrogen is evolved when dilute HCl reacts with magnesium, but nothing happens in the case of mercury and silver. Explain.

Solution:

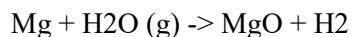
Hydrogen is evolved when dilute HCl reacts with magnesium, but nothing happens in the case of mercury and silver because metals which are more reactive than hydrogen can displace it from HCl.

8. Steam can react with a metal and a nonmetal to liberate a product similar to liberate Hydrogen. Give

necessary conditions
and equations for the same.

Solution:

Metals with low reactivity reacts with steam to liberate Hydrogen gas. For example Magnesium reacts with steam produce Magnesium oxide.



9. Hydrogen is obtained by displacement from

- a) dilute sulphuric acid
- (b) dilute hydrochloric acid

Write equations using zinc and Iron.

Why does not copper show similar behaviour ?

Solution:

- a) $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
- b) $\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$

Hydrogen cannot be prepared from metals which are below it in the activity series of metals such as copper because only metals which are more reactive than hydrogen can displace it from acids.

10. Give reason for the following

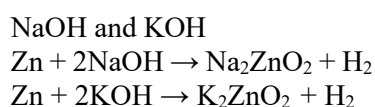
- a) Though lead is above hydrogen in the activity series, it does not react with dilute hydrochloric acid or dilute sulphuric acid.
- (b) Potassium and sodium are not used for reaction with dilute hydrochloric acid or dilute sulphuric acid in laboratory preparation of hydrogen.

Solution:

- a) Lead does not react with hydrochloric acid or dilute sulphuric acid because It forms an insoluble coating of lead sulphate or lead chloride. So, the further reaction is prevented.
- b) Potassium and sodium are not used for reaction with dilute hydrochloric acid or dilute sulphuric acid in laboratory preparation of hydrogen because Potassium and sodium react violently with acid.

11. Name two alkalies that can displace hydrogen. Give balanced equations for the same. Why are the metals you have used considered to have unique nature.

Solution:



Metals such as zinc, lead and aluminium have a unique nature because they react with acids and also with hot

alkalis to form hydrogen
and soluble salt.

12. Complete and balance the following equations.

- a) $\text{Na} + 2\text{H}_2\text{O} \rightarrow \text{-----} + \text{-----}$
b) $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{-----} + \text{-----}$
c) $\text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{-----} + \text{-----}$
d) $\text{Zn} + \text{H}_2\text{O} \rightarrow \text{-----} + \text{-----}$
e) $\text{Fe} + \text{H}_2\text{O} \rightleftharpoons \text{-----} + \text{-----}$
f) $\text{Zn} + 2\text{HCl} \rightarrow \text{-----} + \text{-----}$
g) $\text{Al} + \text{H}_2\text{SO}_4 \rightarrow \text{-----} + \text{-----}$
h) $\text{Fe} + \text{HCl} \rightarrow \text{-----} + \text{-----}$
i) $\text{Zn} + 2\text{NaOH} \rightarrow \text{-----} + \text{-----}$
j) $\text{Al} + 2\text{KOH} + 2\text{H}_2\text{O} \rightarrow \text{-----} + \text{-----}$

Solution:

- a) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$
b) $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$
c) $\text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{H}_2$
d) $\text{Zn} + \text{H}_2\text{O} \rightarrow \text{ZnO} + \text{H}_2$
e) $3\text{Fe} + 4\text{H}_2\text{O} \rightleftharpoons \text{Fe}_3\text{O}_4 + 4\text{H}_2$
f) $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
g) $2\text{Al} + 3\text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{H}_2$
h) $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$
i) $\text{Zn} + 2\text{NaOH} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$
j) $2\text{Al} + 2\text{KOH} + 2\text{H}_2\text{O} \rightarrow 2\text{KAlO}_2 + 3\text{H}_2$

13. If the following are kept in closed vessels at over 400°C what would happen to them ?

- (a) iron filings and steam,
(b) hydrogen and magnetic oxide of iron ?

Solution:

- a) Iron oxide is formed with the evolution of hydrogen gas.
b) Heated magnetic oxide of iron gets reduced by hydrogen.

14. a) A metal in the powdered form reacts very slowly with the boiling water, but it decomposes steam. Name the metal.

- b) Write a balanced equation for the reaction of the named metal with (i) boiling water (ii) steam.

Solution:

- a) Magnesium
b) $\text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{H}_2$
 $\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$

15. What do you observe when hydrogen gas is passed through a soap solution ?

Solution:

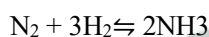
When hydrogen gas is passed through a soap solution soap bubbles filled with hydrogen fly high and burst. This behaviour proves that hydrogen is lighter than air.

16. Under what conditions can hydrogen be made to combine with
(a) nitrogen ? (b) chlorine ? (c) sulphur ? (d) oxygen ?

Name the products in each case and write the equation for each

Solution:

a) Three volumes of hydrogen and one volume of nitrogen react at temperature 450-500°C and pressure 200-900 atm in the presence of finely divided iron catalyst with molybdenum as promoter to give ammonia.

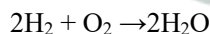


b) Equal volumes of hydrogen and chlorine react slowly in diffused sunlight to form hydrogen chloride.
 $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$

c) Hydrogen gas on passing through molten sulphur reacts to give hydrogen sulphide.



d) Hydrogen burns in the presence of electric spark with a 'pop' sound in oxygen and with a blue flame forming water.



17. When hydrogen is passed over a black solid compound A, the products are 'a colourless liquid' and 'a reddish-brown metal B.'

Substance B is divided into two parts, each placed in separate test tubes.

Dilute HCl is added to one part of substance B and dilute HNO₃ to the other.

- (a) Name the substances A and B. (b) Give two tests for the colourless liquid formed in the experiment.
(c) What happens to substance A when it reacts with hydrogen ? Give reasons for your answer.
(d) Write an equation for the reaction between hydrogen and substance A.
(e) Is there any reaction between substance B and dilute hydrochloric acid ? Give reasons for your answer.

Solution:

a) A = CuO, B = Cu

b) Blue and red litmus paper, when dipped in the colourless liquid, do not change colour. This confirms the liquid formed is neutral and is water.

It changes white anhydrous copper sulphate to blue salt.

c) Black copper oxide (A) on heating with hydrogen reduces copper oxide to reddish-brown copper, and itself gets oxidised to water.

Hydrogen is a strong reducing agent and removes oxygen from less active metals, i.e. it removes oxygen from heated metal oxides when passed over them and itself gets oxidised to water.

d) $\text{CuO} + \text{H}_2 \xrightarrow{\Delta} \text{Cu} + \text{H}_2\text{O}$

e) $\text{Cu} + \text{HCl} \rightarrow \text{No reaction}$

Copper is less reactive than hydrogen and hence cannot displace it from HCl.



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