INORGANIC CHEMISTRY 11

1. Which pair of ions listed below cause hardness in water?

   a) Na^+ and K^+
   b) Na^+ and Mg^{2+}
   c) Na^+ and Ca^{2+}
   d) Mg^{2+} and Ca^{2+}

The next two questions refer to the information below.

A chemist had a 150 mL sample of tapwater from a limestone (beach) area. She found that 50 mL of the water required 15 mL of soap solution to form a lather. After boiling a 50 mL sample of the water, only 3 mL of soap solution was needed to form a lather. The remaining 50 mL sample of water was passed through an ion-exchange resin. Only 0.1 mL of soap solution was needed to form a lather.

2. From the information above, you could conclude that the water found in this area contains

   a) temporary hardness.
   b) permanent hardness.
   c) both temporary and permanent hardness.
   d) a lot of sodium chloride.

3. Which of the following statements BEST explains why boiling of the water sample made it easier to form a lather with soap?

   a) Boiling removes the calcium ions which otherwise bond with the soap molecules, when the hardness is due to the presence of dissolved calcium hydrogen carbonate.
   b) Boiling removes the calcium ions which otherwise bond with the soap molecules, when the hardness is due to the presence of dissolved calcium chloride.
   c) Boiling removes the sodium ions which otherwise bond with the soap molecules, when the hardness is due to the presence of dissolved sodium chloride.
   d) Boiling removes the magnesium ions which otherwise bond with the soap molecules, when the hardness is due to the presence of dissolved magnesium chloride.

4. Which of the following statements is FALSE?

   a) Carbon dioxide can be prepared by adding dilute hydrochloric acid to a carbonate or hydrogen carbonate.
   b) Heating of a carbonate or hydrogen carbonate will produce carbon dioxide.
   c) Carbon dioxide will react with both sodium hydroxide solution and concentrated nitric acid.
   d) Dry ice is solid carbon dioxide and it sublimes at room temperature.

The next two questions refer to the diagram below which shows the apparatus used to prepare oxygen gas in the laboratory.

Refer to page 39 of hard copy for diagram.

5. What is the name of the solution in the tap funnel which decomposes to produce the oxygen gas?

   a) Sodium sulfate.
   b) Potassium nitrate.
   c) Hydrogen peroxide.
   d) Sulfuric acid.

6. By what method is the oxygen gas collected as seen in the diagram above?

   a) Upward displacement of water.
   b) Downward displacement of water.
   c) Upward displacement of air.
   d) Downward displacement of air.

7. Limewater can be used to detect the presence of carbon dioxide gas. What substance is limewater, and what precipitate forms when carbon dioxide gas is passed through it?

a) Sodium hydroxide and sodium carbonate.
b) Sodium chloride and calcium carbonate.
c) Calcium chloride and calcium carbonate.
d) Calcium hydroxide and calcium carbonate.

8. Which one of the following will NOT remove permanent hardness from water?

a) Addition of sodium carbonate (washing soda).
b) Boiling.
c) Distillation.
d) Deionization.

9. A gas was produced in the laboratory which had the following properties:

1. A pale yellow colour.
2. A distinctive, pungent odour.
3. Reacted readily with most metals.
4. Turned moist litmus red, then white.

Which of the gases below has all of these properties?

a) Ammonia.
b) Oxygen.
c) Chlorine.
d) Sulfur dioxide.

10. Which ONE of the following is NOT a property of sulfur dioxide gas?

a) It is colourless.
b) It has a strong, acrid smell.
c) It is soluble in water forming sulfurous acid.
d) It can be collected in the laboratory by the downward displacement of air.

11. Which of the following substances is used to produce ammonia in the laboratory?

a) Ammonium chloride and calcium hydroxide.
b) Ammonium chloride and hydrochloric acid.
c) Calcium carbonate and nitric acid.
d) Copper and nitric acid.

12. Why is helium gas used in preference to hydrogen gas in balloons?

a) Helium gas is non-toxic.
b) The inert nature of Helium makes it much safer to use.
c) The smaller size of the hydrogen molecules allows them to escape too easily from balloons.
d) Helium is lighter than hydrogen.

13. Which of the following is NOT true of graphite.

a) It is an allotrope of carbon.
b) It is soft and slippery.
c) It can be split into sheets due to weak bonding between its layers.
d) It is a non-conductor of electricity.

14. The following list describes four characteristics of a metal:

1. Soft and light coloured.
2. Reacts vigourously with water, liberating hydrogen gas.
3. Reacts explosively with dilute acids.
4. Forms colourless ions.

Which one of the following metals has all these features?

a) Magnesium.
b) Calcium.
c) Sodium.
d) Aluminium.

15. Which one of the metals below has all the following characteristics?

1. Light, silver coloured metal.
2. Does not react readily with water at room temperature.
3. Burns in air with an intense, white light.
4. Burns in carbon dioxide to form a metal oxide and carbon

a) Magnesium.
b) Calcium.
c) Sodium.
d) Aluminium.

16. Which one of the following statements about aluminium metal is FALSE?

a) Aluminium does not react readily with pure water but is rapidly corroded by salt water.

b) Aluminium reacts readily with hydrochloric acid, liberating hydrogen.

c) Aluminium forms the insoluble base $Al(OH)_3$, which can only be dissolved by the addition of an acid.

d) Aluminium ions, Al^{3+}, are colourless and non-toxic.

17. The following statements describe some of the characteristics of a gas.

1. The gas is a component of air and exists as diatomic molecules.
2. The gas is colourless, tasteless and odourless.
3. This gas is non_toxic.
4. The gas does not react with water, acids or alkalis.
5. The gas can be used as one of the reactants in the production of ammonia.

The gas described is

a) hydrogen.

b) oxygen.

c) chlorine.

d) nitrogen.