Chemistry Exam Review Questions

SCH3U_2013

The Gas State

1. The term "absolute zero" refers to

   (a) the temperature at which water freezes.
   (b) the temperature at which water freezes at zero atmospheric pressure
   (c) the temperature at which molecular motion is believed to stop.
   (d) the temperature at which molecular kinetic energy equals the potential energy
   (e) -273K

2. When the pressure exerted on 1L of an ideal gas is tripled and the absolute temperature doubled, the volume in litres is:
   (a) 1/6 L (b) 2/3 L (c) 1 L (d) 3/2 L (e) 6 L

3. The volume occupied by 2.50 mol of CO_2 at STP. in litres is
(a) 8.96 L (b) 22.4 L (c) 15.1×10^{23} L (d) 56.0 L

4. Which one of the following quantities is the same for equal volumes of HCl and NH_3 at the same temperature and pressure?
a) Density b) Mass c) Number of molecules d) Velocity

Problems

5. A sample of hydrogen gas has a volume of 54.0 L at 22.0 ^{O}C. What volume will it occupy at a temperature of – 55.0 ^{O}C

6. The pressure on 925 mL of oxygen gas is 120 kPa. What must the pressure be changed to in order to make the volume 0.700 L?

7. A 50.0 L volume of gas is at 42.0 ^{O}C and 87.0 kPa. Calculate the temperature required to change the volume to 35.0 L at a pressure of 96.5 kPa.

8. Calculate the number of moles in:
a. 45.2 L of carbon dioxide gas at STP
b. 125.0 L of helium gas at STP
c. 2.24 L of hydrogen gas at STP

9. Calculate the volume of:
a. 0.25 moles of carbon dioxide gas at STP
b. 1.66 moles of helium gas at STP
c. 5.65 moles of hydrogen gas at STP

10. Nitrogen gas is reacted with fluorine gas to form nitrogen trifluoride gas, $NF_{3\,(g)}$, at the same temperature and the same pressure, according to the following equation:

$$N_{2\,(g)} + 3F_{2\,(g)} \longrightarrow 2\,NF_3$$

What is the maximum volume of nitrogen trifluoride that can be formed from 2.0 mol of nitrogen gas and 3.0 mol of fluorine gas ?

11. 3.60 L of oxygen at STP are converted to 100.0 ^{O}C and 250.0 kPa.
a. Calculate the new volume.
b. How many moles of oxygen are present in the gas sample?
c. How many molecules of oxygen are present in the gas sample?

12. How many moles of oxygen will occupy 95.8 L at a temperature of 45.5°C and a pressure of 43.2 kPa?

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14. The equation for the complete combustion of propane gas, $C_3H_{8(g)}$ is:

$$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(g)}$$

What is the volume, at STP, of carbon dioxide that is formed by the complete combustion of 4.40 g of propane?

15. Magnesium metal reacts with excess hydrochloric acid according to the following equation:

$$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$$

If 1.20 g of magnesium metal is reacted with excess hydrochloric acid, what volume of hydrogen gas is obtained at STP?

16. The overall equation for photosynthesis is:

$$6\,CO_2 + 6\,H_2O \longrightarrow C_6H_{12}O_6 + 6\,O_2$$

What volume of oxygen gas would be produced at STP by the photosynthesis of 180 g of glucose

17. Consider the following reaction:

$$Al_2S_{3(s)} + 6\,HCl_{(aq)} \longrightarrow 2\,AlCl_{3(aq)} + 3\,H_2S_{(g)}$$

a. If 2.56 g of aluminium sulphide is reacted with 25.0 mL of 0.200 mol L^{-1} hydrochloric acid, determine the limiting reactant.

b. Calculate the number of moles of hydrogen sulphide gas that would be obtained.

c. Calculate the volume of hydrogen sulphide gas that would be obtained at 75.0 ^{O}C and 95.2 kPa.

d. If the solution was evaporated to dryness calculate the mass of aluminium chloride solid that would be obtained.

e. In such a reaction at the Colonel By Laboratory a student obtained 1.65 g of solid aluminium chloride, determine the percentage yield.

18. Consider the following reaction:

$$Na_2CO_{3(s)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$$

What mass of sodium carbonate, $Na_2CO_{3(s)}$ must be used to produce 10.36 L of carbon dioxide gas at 24.0 ^{O}C and 103.1 kPa ?

19. If 300.0 g of propane gas and 129.0 g of oxygen gas are mixed and allowed to react as shown below , determine the volume of water vapour formed at 120 ^{O}C and 116 kPa.

$$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(g)}$$

On the surface of a planet called Cyanogen, in the Helios Galaxy, Cyanogen's atmosphere contains a high concentration of a gas unknown on Earth, it contains 46.2 % carbon, 53.8 % nitrogen.

a. Calculate the empirical formula of this unusual gas.

b. On the surface of Cyanogen, where the temperature is 25 ^{O}C and the pressure is 101.32 kPa, 0.476 dm^3 of this gas has a mass of 1.00 g. Calculate the molar mass of the gas.

c. Use the results of your calculations on parts (a) and (b) to determine the molecular formula of the gas.

Solutions, Solubility and Reactions, Acids & Bases

1. Calculate the mass of $Fe(NO_3)_3 \bullet 9H_2O$ required to make 350.0 mL of a 0.0200 mol/L solution.

2. What volume of a 0.240 mol/L copper (I) sulfate solution would contain 8.92 g of copper (I) sulfate (Cu_2SO_4)?

3. Concentrated sulphuric acid has a concentration of 18.0 M. What volume of concentrated sulphuric acid is needed to make 8.00 l of 1.50 mol L^{-1} solution? What volume of water is needed to make this solution?

4. What is the hydronium ion concentration, $[H_3O^{+1}]$, of a hydrobromic acid solution, $HBr_{(aq)}$ with a pH of 0.75 ? What is the $[OH^{-1}]$?

5. Distinguish between a strong and a weak acid.

6. What is the pH of the following solutions:

a. 0.05 M $HNO_{3(aq)}$ b. 0.122 M $H_2SO_{4(aq)}$ c. 0.0150 M $Ba(OH)_{2(aq)}$

7. What volume of 0.520 mol L^{-1} sodium hydroxide is needed to neutralize 50.00 mL of 1.15 mol L^{-1} hydrobromic acid solution, $HBr_{(aq)}$? (Write a balanced equation first!)

8. 100.00 mL of 0.500 mol L^{-1} sulphuric acid is titrated with 24.50 mL of sodium hydroxide. Calculate the concentration of the sodium hydroxide. (Write a balanced equation first!)