Honour Chemistry Practice Test: Unit 2 (Part 1): Matter as Solutions and Gases

$$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr} = 101.325 \text{ kPa} \qquad T_K = T_C + 273.15$$

$$\text{STP} = 22.4 \text{ L/mol @ } 0.00°C \text{ \& } 101.325 \text{ kPa (1 atm)} \qquad \text{SATP} = 24.8 \text{ L/mol @ } 25.0°C \text{ \& } 100.\text{ kPa}$$

$$R = 0.0821 \frac{L \bullet atm}{K \bullet mol} \quad \text{or} \quad 8.314 \frac{L \bullet kPa}{K \bullet mol} \qquad D = \frac{m}{V} \qquad n = \frac{m}{M} \qquad C = \frac{n_{solute}}{V_{solution}}$$

$$C_1V_1 = C_2V_2 \qquad PV = nRT \qquad \frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \qquad \frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} \qquad \chi_1 = \frac{n_1}{n_{Total}} = \frac{P_1}{P_{Total}}$$

$$P_{Total} = P_1 + P_2 + P_3 + \ldots \qquad n_{Total} = n_1 + n_2 + n_3 + \ldots$$

Part A: Multiple Choice (1 point each)

1. Which of these compounds is a *strong electrolyte*?

    A. H_2O **B.** O_2 **C.** H_2SO_4 **D.** $C_6H_{12}O_6$ **E.** CH_3COOH

2. Based on the solubility rules, which of these processes will occur if solutions of $CuSO_{4\,(aq)}$ and $BaCl_{2\,(aq)}$ are mixed?

    A. $CuCl_2$ will precipitate; Ba^{2+} and SO_4^{2-} are spectator ions.
    B. $CuSO_4$ will precipitate; Ba^{2+} and Cl^- are spectator ions.
    C. $BaSO_4$ will precipitate; Cu^{2+} and Cl^- are spectator ions.
    D. $BaCl_2$ will precipitate; Cu^{2+} and SO_4^{2-} are spectator ions.
    E. No precipitate will form.

3. Which of these choices is the correct *net ionic equation* for the reaction that occurs when solutions of $Pb(NO_3)_2$ and NH_4Cl are mixed?

    A. $Pb(NO_3)_{2\,(aq)} + 2\,NH_4Cl_{(aq)} \rightarrow NH_4NO_{3\,(aq)} + PbCl_{2\,(s)}$
    B. $Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2\,(s)}$
    C. $Pb^{2+}_{(aq)} + 2\,NO_3^-_{(aq)} + 2\,NH_4^+_{(aq)} + 2\,Cl^-_{(aq)} \rightarrow 2\,NH_4^+_{(aq)} + 2\,NO_3^-_{(aq)} + PbCl_{2\,(s)}$
    D. $NH_4^+_{(aq)} + NO_3^-_{(aq)} \rightarrow 2\,NH_4NO_{3\,(s)}$
    E. No reaction occurs when the solutions are mixed.

4. A 4.691 g sample of $MgCl_2$ is dissolved in enough water to give 750. mL of solution. What is the magnesium ion concentration in this solution?

    A. 3.70×10^{-2} M   **B.** 1.05×10^{-2} M   **C.** 6.57×10^{-2} M
    D. 4.93×10^{-2} M   **E.** 0.131 M

5. Lithium metal dissolves in water to yield hydrogen gas and aqueous lithium hydroxide. What is the final concentration of hydroxide ions when 5.500 g of lithium metal is dropped into 750. mL of water?

    A. 1.06 M   **B.** 0.528 M   **C.** 2.11 M   **D.** 0.792 M   **E.** 0.943 M

6. Which of the following gas molecules have the *highest average kinetic energy* at 25°C?

    A. H_2 **B.** O_2 **C.** N_2 **D.** Cl_2
    E. All the gases have the same average kinetic energy.

7. If 30.0 L of oxygen are cooled from 200ºC to 1°C at constant pressure, what is the new volume of oxygen?

    A. 0.150 L   **B.** 17.4 L   **C.** 23.0 L   **D.** 51.8 L   **E.** 6.00×10^3 L

8. If the pressure of a gas sample is quadrupled and the absolute temperature is doubled, by what factor does the volume of the sample change?

    A. 8   **B.** 2   **C.** ½   **D.** ¼   **E.** ⅛

9. Two moles of chlorine gas at 20.0°C are heated to 350°C while the volume is kept constant. The density of the gas

    A. increases.   **B.** decreases.   **C.** remains the same.
    D. Not enough information is given to correctly answer the question.

10. A mixture of three gases has a total pressure of 1,380 mmHg at 298 K. The mixture is analyzed and is found to contain 1.27 mol CO_2, 3.04 mol CO, and 1.50 mol Ar. What is the partial pressure of Ar?

    A. 0.258 atm   **B.** 301 mmHg   **C.** 356 mmHg
    D. 5,345 mmHg   **E.** 8,020 mmHg

11. What volume of oxygen gas at 320 K and 680 torr will react completely with 2.50 L of NO gas at the same temperature and pressure? $2\ NO_{(g)} + O_{2\,(g)} \rightarrow 2\ NO_{2\,(g)}$

    A. 1.25 L   **B.** 2.50 L   **C.** 3.00 L   **D.** 1.00 L   **E.** 5.00 L

12. Deviations from the ideal gas law are greater at

    A. low temperatures and low pressures.   **B.** low temperatures and high pressures.
    C. high temperatures and high pressures.   **D.** high temperatures and low pressures.

13. Determine the pressure of the gas trapped in the apparatus shown below when the atmospheric pressure is 695 mmHg.

    A. 45 mmHg
    B. 650 mmHg
   **C.** 695 mmHg
    D. 740 mmHg
    E. 760 mmHg
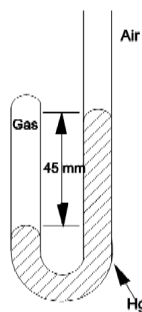
14. 1.000 atm of oxygen gas, placed in a container having a pinhole opening in its side, leaks from the container 2.14 times faster than does 1.000 atm of an unknown gas placed in this same apparatus. Which of the following species could be the unknown gas?

    A. Cl_2 **B.** SF_6 **C.** Kr   **D.** UF_6 **E.** Xe

Part B: Numerical Response   **(1 point each)**

1. A chemistry student needs 500. mL of 0.350 M of K_2CO_3 solution. The mass of solute required for this solution is _____ g

2. It is found that it takes 32.0 mL of a 0.400 mol/L barium hydroxide solution to completely titrate 10.0 mL unknown concentration of hydrochloric acid. Given the *unbalanced* chemical equation below, the concentration of the acid is _____ mol/L

    ____ $HCl_{(aq)}$ + ____ $Ba(OH)_{2\,(aq)} \rightarrow$ ____ $HOH_{(l)}$ + ____ $BaCl_{2\,(aq)}$
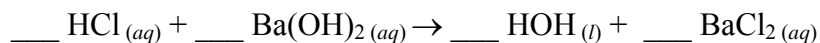
3. A 0.500 mol of gas at 25.0°C has a volume of 300. mL. It is in a cylinder with an expandable in a piston. Suppose the pressure of the gas is kept constant while a worker injects another 0.300 mol of the same gas and raise the temperature to 100.°C. The new volume of the gas in this cylinder is _____ mL.

4. A 353 mL soda bottle consists of 4.83 mol/L of CO_2. At 25°C, the partial pressure of CO_2 in air is 29.18 torr at a concentration 0.0681 mol/L. The pressure of CO_2 in the soda bottle is _____ kPa.

5. An unknown gas has a density 4.25 g/L at STP, its molar mass is _____ g/mol.

Part C: Extended Response

1. Water vapour is produced from the chemical reaction between hydrogen gas and oxygen gas. Suppose 5.00 L of $H_{2 (g)}$ at STP is reacted with 8.50 L of $O_{2 (g)}$ at 15.0°C and 793.0 mmHg. Determine the mass of water vapour produced at SATP. **(3 points)**

Part A: Multiple Choice

1. C 2. C 3. B 4. C 5. A 6. E 7. B 8. C 9. C 10. C
11. A 12. B 13. D 14. B

Part B: Numerical Response

1. __24.2__   2. __2.56__   3. __601__   4. __276__   5. __95.2__

Part C: Extended Response

1. 4.02 g $H_2O_{(g)}$