CHM 151 Quiz 5a 25 Pts Spring 2009 Name: Key

SHOW ALL WORK TO RECEIVE CREDIT

$PV = nRT$ $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $P_1V_1T_2 = P_2V_2T_1$ $R = \frac{0.0821 L \cdot atm}{mol \cdot K} = \frac{62.4 L \cdot torr}{mol \cdot K}$

1. (4 Pts) A balloon containing 3.0 L of CO_2 at 22 °C and a pressure of 725 torr is placed in a freezer at -7 °C. Assume the pressure does not change and calculate the new volume of the balloon.

~~$P_1 = 725$ torr $P_2 =$ SAME~~

$V_1 = 3.0\,L$ $V_2 = ?$

$T_1 = 295\,K$ $T_2 = 267\,K$

$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$

$V_2 = \frac{(3.0\,L)(267\,K)}{295\,K} = 2.7\,L$

2. (5 Pts) Determine the temperature in K of 95.0 g of N_2 gas if the volume of the container is 8.00 L and the pressure is 850 mmHg.

$PV = nRT$

$P = 850$ mm Hg

$V = 8.00\,L$

$n = \frac{95.0\,g}{28.02\,g/mol} = 3.39\,mol$

$R = 62.4 \frac{L \cdot torr}{mol \cdot K}$

$T = \frac{PV}{nR} = \frac{(850\,torr)(8.00\,L)}{(62.4\,L \cdot torr/mol \cdot K)(3.39\,mol)}$

$T = 32.1\,K$

3. (6 Pts) Complete the following reactions, then write the total ionic and the net ionic equations for each.

a. $HClO_4(aq) + NaOH(aq) \rightarrow H_2O(l) + NaClO_4(aq)$ strong acid + Strong Base

total ionic eq.: $H^+ + ClO_4^- + Na^+ + OH^- \rightarrow H_2O(l) + Na^+ + ClO_4^-$

net ionic eq.: $H^+ + OH^- \rightarrow H_2O(l)$

b. $KOH(aq) + HF(aq) \rightarrow H_2O(l) + KF(aq)$

Strong Base weak acid

total ionic eq.: $K^+ + OH^- + HF(aq) \rightarrow H_2O(l) + K^+ + F^-$

net ionic eq.: $OH^- + HF(aq) \rightarrow H_2O + F^-$

4. (5 Pts) Determine the density of O_2 gas at 25 °C and 725 mmHg. (Atomic mass of O is 16.00).

Density = g/mL or g/L (for gases)

$P = 725$ mm Hg

$V = ?$

$n =$ assume 1 mol O_2 (32.0 g)

$R = 62.4 \frac{L \cdot torr}{mol \cdot K}$

$T = 298\,K$

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(1\,mol)(62.4\,L \cdot torr/mol \cdot K)(298\,K)}{(725\,torr)} = 25.65\,L$

$D = \frac{32.00\,g}{25.65\,L} = 1.25\,g/L$

5. (5 Pts) A 0.540 g sample of air at 25 °C and a pressure of 710 mmHg, occupies a volume of 500 mL. Determine the average molar mass of the air.

molar mass = g/mol

$P = 710$ mm Hg

$V = 500\,mL = 0.500\,L$

$n = ?$

$R = 62.4 \frac{L \cdot torr}{mol \cdot K}$

$T = 298\,K$

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(710\,torr)(0.500\,L)}{(62.4\,L \cdot torr/mol \cdot K)(298\,K)} = 0.0191\,mol$

$\text{molar mass} = \frac{0.540\,g}{0.0191\,mol} = 28.3\,g/mol$

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Atomic masses: H 1.008; C 12.01; N 14.007; O 16.00; Na 22.99; K 39.10; S 32.07; Cl 35.45; Ba 137.33

1. (5 Pts) Calculate the mass of sodium sulfate needed to prepare 500 mL of 0.150 M Na_2SO_4 solution.

$$500\ \text{mL} \left| \frac{0.150\ \text{mol}\ Na_2SO_4}{1000\ \text{mL}} \right| \frac{142.05\ \text{g}}{\text{mol}} = 10.65\ \text{g}\ Na_2SO_4$$

10.7 g

2. (5 Pts) A 0.110 M solution of Na_2SO_4 has been prepared. How many mL of this solution and how many mL of water are need to prepare 500 mL of 0.050 M Na_2SO_4 solution?

$M_1V_1 = M_2V_2$

$(0.110\text{M})(V_1) = (0.050\text{M})(500\ \text{mL})$

$V_1 = 227\ \text{mL}\ Na_2SO_4$ and $273\ \text{mL}\ H_2O$

3. (6 Pts) Given the reaction: $Ba(OH)_2(aq) + 2HNO_3(aq) \rightarrow 2H_2O(l) + BaCl_2(aq)$ B
How many grams of $Ba(OH)_2$ would be needed to neutralize 50.0 mL of 0.250 M HNO_3?

$Ba(OH)_2 + 2HNO_3 \rightarrow 2H_2O + Ba(NO_3)_2$

?g 50.0 mL, 0.250 mol/L

$$50.0\ \text{mL}\ HNO_3 \left| \frac{0.250\ \text{mol}\ HNO_3}{1000\ \text{mL}\ HNO_3} \right| \frac{1\ \text{mol}\ Ba(OH)_2}{2\ \text{mol}\ HNO_3} \left| \frac{171.346\ \text{g}}{\text{mol}} \right| = 1.07\ \text{g}\ Ba(OH)_2$$

25.00 mL of

4. (6 Pts) A titration was performed to standardize a solution of barium hydroxide. It took 23.50 mL of 0.110 M nitric acid solution to completely neutralize the barium hydroxide solution. Determine the molarity of the barium hydroxide solution.

$Ba(OH)_2(aq) + 2HNO_3(aq) \rightarrow 2H_2O(l) + BaCl_2(aq)$ $Ba(NO_3)_2$

25.00 mL, ? mol/L $Ba(OH)_2$ | 23.50 mL, 0.110 mol/L HNO_3

$$25.00\times10^{-3}\ \text{L}\ Ba(OH)_2 \left| \frac{23.50\ \text{mL}\ HNO_3}{\text{☺}} \right| \frac{0.110\ \text{mol}\ HNO_3}{1000\ \text{mL}\ HNO_3} \left| \frac{1\ \text{mol}\ Ba(OH)_2}{2\ \text{mol}\ HNO_3} \right| = 0.0517\ \frac{\text{mol}\ Ba(OH)_2}{\text{L}\ Ba(OH)_2}$$

5. (3 Pts) Complete and balance the following reaction:

$3\ Ca(OH)_2(aq) + 2\ H_3PO_4(aq) \rightarrow 6\ H_2O(l) + Ca_3(PO_4)_2$

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