1A Exam 3
(end of Ch 4 redox, dilutions;
Chapter 10 gas laws)

NAME: key

10 Q × 5 pts = 50 pts total

Read Carefully. **All work & calculations must be shown**. **All UNITS must be shown!** Relax & Good luck!

1. 1.5L of an 8.5M solution is diluted by adding 350mL of water. Calculate the new concentration of the solution.

$V_1 = 1.5L$
$M_1 = 8.5M$
$V_2 = 0.350L + 1.5L$

$\frac{M_1V_1}{V_2} = \frac{M_2V_2}{V_2}$

$M_2 = \frac{(8.5M)(1.5L)}{(1.5L + 0.350L)} = 6.9M$

2 pts

2. Methane gas, CH_4, combusts into water and carbon dioxide gases.

a. Write a balanced reaction. You should know who your reactants are!

$\overset{-4\,+1}{CH_4} + \overset{0}{2O_2} \rightarrow \overset{+4\,-2}{CO_2} + \overset{+1\,-2}{2H_2O}$

b. Assign oxidation numbers to EACH ATOM.

c. Which atom is the reducing agent? Why?

Red. agent = oxidized = lose e⁻

C −4 → +4

d. Which atom is reduced? Why?

red = gain e⁻

O 0 → −2

3. 3.0 grams of dry ice (solid CO_2) sublimes into a balloon at 25.0°C and 750mmHg. Calculate the volume in mL of CO_2 that occupies the balloon.

$m = 3.0g \times \frac{mol}{44.0g} = 0.0682\ mol$

$T = 25.0°C + 273 = 298K$

$P = 750\ mmHg / 760 = 0.987\ atm$

$V = ?$

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(0.0682mol)(0.08206\frac{atm \cdot L}{mol \cdot K})(298K)}{0.987atm}$

$= 1.69L \rightarrow 1690mL$

4. A gas at 60.0°C and 12L is cooled to 40.0°C. What is the new volume?

$T_1 = 60.0°C + 273 = 333K$

$V_1 = 12L$

$T_2 = 40.0°C + 273 = 313K$

$V_2 = ?$

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

$\frac{V_1 T_2}{T_1} = V_2 \quad \frac{(12L)(313K)}{(333K)} = 11.3L$

5. Calculate the molar mass of a gas if 2.50 g occupies 0.865 L at 690torr and 36°C.

$g/mol = 2.50g / 0.031mol = 80.6\ g/mol$

2pts

$V = 0.865L$

$P = 690\ torr / 760 = 0.908\ atm$

$T = 36°C + 273 = 309K$

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(0.908atm)(0.865L)}{(0.08206\frac{atm \cdot L}{mol \cdot K})(309K)} = 0.031\ mol$

3pts

6. 4.0L of a gas is collected over water 18°C and a pressure of 755mmHg. How many moles of gas is this? (P water @ 18°C = 15.5 torr)

$V = 4.0L$

$T = 18.0°C + 273 = 291K$

$P_{TOTAL} = 755mmHg$

$P_{H_2O} = 15.5torr$

$P_{GAS} = ?\ 755 - 15.5 = 739.5\ mmHg / 760 = 0.973atm$

2pts

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(0.973atm)(4.0L)}{(0.08206\frac{atm \cdot L}{mol \cdot K})(291K)} = 0.163\ mol$

7. A cylinder with a movable piston contains 1.75 moles of helium. How many moles of helium were added to the cylinder if the volume was changed from 2.00 L to 2.70 L?

$n_1 = 1.75\,mol$
$V_1 = 2.00\,L$ 1pt
$V_2 = 2.70\,L$
$n_2 = ?$
mol added = ?

$\frac{n_1}{V_1} = \frac{n_2}{V_2}$

$\frac{n_1 V_2}{V_1} = n_2 = \frac{(1.75\,mol)(2.70\,L)}{2.00\,L} = 2.3625\,mol$ 2pt

mol added = 2.3625 − 1.75 = 0.6125 mol 2pt

8. Calculate the density in g/L of nitrogen monoxide using the molar volume of a gas at STP (22.4 liters/mole).

NO = 30 g/mol
22.4 L/mol

$\frac{g}{L} = \frac{30\,g}{mol} \times \frac{mol}{22.4\,L} = \boxed{1.34\,g/L}$

9. Calculate the amount in moles of methane gas (CH_4) that must be combusted in order to produce 500L of water vapor at 125°C and 760mmHg.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

$\frac{CH_4}{mol\ ?}$

V = 500L
T = 125°C + 273 = 398 K
P = 760 mmHg = 1 atm

$n = \frac{PV}{RT} = \frac{(1\,atm)(500\,L)}{(0.08206)(398\,K)} = 15.3\,mol$ 3pts

2pts
$15.3\,mol\,H_2O \times \frac{1\,mol\,CH_4}{2\,mol\,H_2O} = \boxed{7.65\,mol}$

10. Calculate the velocity of nitrogen gas that is present in the atmosphere on a warm day (35°C).

$N_2 = 28\,g/mol$ 1pt

$V = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3(8.314\,J/mol\cdot K)(308\,K)}{0.028\,kg/mol}}$ 3pts

$= \boxed{524\ \frac{m}{s}}$ 1pt