(10) 1.) Balance the following redox equations:

a.) \( \text{CH}_3\text{OH} + \text{Cr}_2\text{O}_7^{-2} \rightarrow \text{CH}_2\text{O} + \text{Cr}^{+3} \) (acidic)

b.) \( \text{Al} + \text{MnO}_4^{-} \rightarrow \text{MnO}_2 + \text{Al(OH)}_4^{-} \) (basic)

(12) 2.) The concentration of a nitric acid solution is being determined by titrating the nitric acid against sodium carbonate. In a particular experiment 0.3548 g of Na\(_2\)CO\(_3\) was titrated against 22.48 ml of HNO\(_3\). Find the concentration of HNO\(_3\). The molecular wt. of Na\(_2\)CO\(_3\) = 105.81. The unbalanced equation for the reaction is \( \text{Na}_2\text{CO}_3 + \text{HNO}_3 \rightarrow \text{NaNO}_3 + \text{H}_2\text{O} + \text{CO}_2 \).

(12) 3.) 1.50 liters of argon gas (atomic wt. = 39.95) has a pressure of 740 torr at a temperature of 25.0 \(^\circ\)C. Find the mass of the argon gas.

(12) 4.) A 2.00 liter flask is originally filled with 1.25 g of N\(_2\) gas. Subsequently 0.50 g of
H₂ was added to the same flask. Find the pressure in the flask if the temperature equals 25 °C. Atomic wts. : N = 14.01, H = 1.01

(12) 5.) At 25 °C and 25.0 atm of pressure 3.00 liters of nitrogen is reacted with 4.70 liters of hydrogen gas at the same temperature and pressure. Find the volume of ammonia gas that will be obtained at the same temperature and pressure if the yield was 25.0 %. The unbalanced equation for the reaction is \(\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3\)

(12) 6.) 0.252 g of Mg is added to 120.0 ml of HCl solution in a coffee cup calorimeter where HCl was present in excess. It was found that the temperature of the solution in the cup went from 23.2 to 33.3 °C. Find the value of \(\Delta H\) for the following balanced equation: \(\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\) Assume that the specific heat of the solution in the cup is the same as that of water which is 4.184 J/mol K, that the density of the solution is the same as that of water which is 1.00 g/cm³, and that the coffee cup itself has a heat capacity = 35.0 J/deg. The atomic weight of Mg = 24.31.
7.) Calculate $\Delta H$ for the following reaction

$$\text{CaO} (s) + \text{CO}_2 (g) \rightarrow \text{CaCO}_3 (s)$$

From the values of $\Delta H$ of the following

$$\text{Ca} (s) + \text{CO}_2 (g) + \frac{1}{2} \text{O}_2 (g) \rightarrow \text{CaCO}_3 (s) \quad \Delta H = -812.8 \text{ kJ}$$

$$2 \text{ Ca} (s) + \text{O}_2 (g) \rightarrow 2 \text{ CaO} (s) \quad \Delta H = -1269.8 \text{ kJ}$$

8.) Find the value of $\Delta H^0$ of the reaction from the following standard enthalpies of formation:

$$\text{N}_2\text{O}_4 (g) + 4 \text{H}_2 (g) \rightarrow \text{N}_2 (g) + 4 \text{H}_2\text{O} (g)$$

$\Delta H^0$/kJ/mol $\quad$ 11.1 $\quad$ -241.8

9.) Fill the missing statement to the following:

a.) Ideal behavior of a gas is observed most closely at ________________________________

b.) The heat of a reaction under the condition of constant volume equals _________ of the reaction.

c.) According to Graham’s law, the rate of diffusion of a gas depends inversely on the ________________________________