

Chemistry 112
Third Hour Exam

Name: _____
(4 points)

Please show all work for partial credit

1. Normal blood systolic blood pressure is 120 mm of Hg
A. (6 points) Express this pressure in ATM

$$120 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.158 \text{ atm}$$

- B. (6 points) Express this pressure in lbs/in²

$$120 \text{ mmHg} \times \frac{14.7 \text{ psi}}{760 \text{ mmHg}} = 2.32 \text{ psi}$$

2. I have a gas mixture that contains 60 atoms of helium for every 20 atoms of xenon. This gas mixture is at STP.

- A. (6 points) What is the partial pressure of helium in this mixture?

$$\chi_{\text{He}} = \frac{60}{60 + 20} = 0.75 = \frac{P_{\text{He}}}{P_{\text{tot}}}$$

At STP $P_{\text{tot}} = 1 \text{ ATM}$

$$.75 = \frac{X}{1 \text{ ATM}}; X = 0.75 \text{ ATM}$$

- B. (6 points) What is the partial pressure of xenon in this mixture?

$$\chi_{\text{Xe}} = \frac{20}{60 + 20} = 0.25 = \frac{P_{\text{Xe}}}{P_{\text{tot}}}$$

At STP $P_{\text{tot}} = 1 \text{ ATM}$

$$.25 = \frac{X}{1 \text{ ATM}}; X = 0.25 \text{ ATM}$$

3 (12 points) Using the expression below find the temperature at which the rms average velocity of nitrogen gas is only 500 m/second:

$$u_{RMS} = \sqrt{\frac{3RT}{M}}$$

$$u_{RMS} = 500 \text{ m/s} = \sqrt{\frac{3 \times 8.3145 \text{ J/K.mol} \times T}{.028 \text{ kg/mol}}}$$

$$500 * 500 = \frac{3 \times 8.3145 \times T}{.028}$$

$$250,000 \times \left(\frac{.028}{3 \times 8.3145} \right) = T; T = 281 \text{ K}$$

4 (12 points) What is a non-ideal gas, and what are the two reasons that gases act in a non-ideal manner.

A non-ideal gas is one that does not follow the equation $PV=nRT$

There are two reasons why a gas will act in a non-ideal manner, the first is that the volume of the gas molecule is significant when compared to the space the molecule is moving around in, and the second is that sometimes gas molecules interact with each other.

5 A. (6 points) I have an exothermic chemical reaction that will generate 63 kJ of energy. If 40 kJ of this energy is used as work, how much energy is either gained or lost by the system as heat?

Exothermic means $\Delta E = -63 \text{ kJ} = q + w$
 work lost means $w = -40 \text{ kJ}$

$$\text{So } -63 \text{ kJ} = q - 40 \text{ kJ}$$

$$q = -63 + 40 = -23 \text{ kJ}$$

B. (6 points) If this heat is used to change the temperature of 1 kg of water at 35°C, what is the final temperature of the water? (The S.H.C. of water is 4.18 J/°C·g)

$$23 \text{ kJ} = 23,000 \text{ J}; \quad 1 \text{ kg} = 1000 \text{ g};$$

$$23,000 \text{ J} = \Delta T \times 4.18 \text{ J/}^\circ\text{C} \cdot \text{g} \times 1000 \text{ g}$$

$$23,000 / (4.18 \times 1000) = \Delta T = 5.5^\circ\text{C}$$

The heat was lost from the reaction, so the heat would be gained by the water, so the temperature would rise, so $T_f = 35 + 5.5 = 40.5^\circ\text{C}$

6 Definitions (2 points each)

E - Internal Energy $= q + w =$ sum of kinetic and potential energy of all the particles in the system

Endothermic - A reaction that must absorb energy from the surroundings

Intensive property - A property that does not depend on the amount of material in a system

Path function - A property that depends on the path taken between two states

Constant V calorimeter - A 'Bomb' calorimeter, a calorimeter that is designed so its volume cannot change during a reaction. Measures ΔE of a reaction

Enthalpy $H = E + PV$

7. (12 points) The horseshoes you throw in a game are made of iron and weigh 2.5 lbs. If a horseshoe this large was heated to 550° and then dropped in 4 liters of water at 25° C, what is the final temperature of the water (The specific heat capacity of Iron is .45 J/°C·g; the specific heat capacity of water is 4.18 J/°C·g)

Heat lost by horseshoe = heat gained by water

Heat lost by horseshoe

$$\begin{aligned} \text{Mass of horseshoe} &= 2.5 \text{ lbs} \times (1 \text{ kg}/2.2046 \text{ lbs}) \times (1000\text{g}/1\text{kg}) \\ &= 1,134 \text{ g} \end{aligned}$$

$$\text{Heat} = \Delta T \times \text{S.H.C.} \times \text{mass}$$

Since the horseshoe will cool to T_F

$$\begin{aligned} \Delta T &= 550 - T_F \\ &= (550 - T_F) \times 0.45 \times 1,134 \end{aligned}$$

Heat gained by water

$$\Delta T \times \text{S.H.C.} \times \text{mass}$$

Since the water will warm up to T_F

$$\begin{aligned} \Delta T &= T_F - 25 \\ &= (T_F - 25) \times 4.18 \times 4000\text{g} \end{aligned}$$

Complete equation:

$$(550 - T_F) \times 0.45 \times 1,134 = (T_F - 25) \times 4.18 \times 4000\text{g}$$

$$(550 - T_F) \times 510.3 = (T_F - 25) \times 16720$$

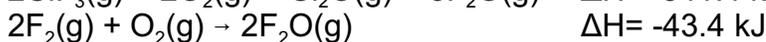
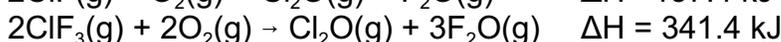
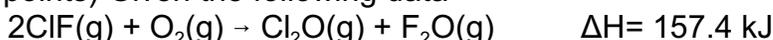
$$280665 - T_F \times 510.3 = 16720 T_F - 418000$$

$$280665 + 418000 = 16720 T_F + 510.3 T_F$$

$$698665 = 17230.3 T_F$$

$$698665/17230.3 = T_F = 40.5^\circ\text{C}$$

8. (12 points) Given the following data

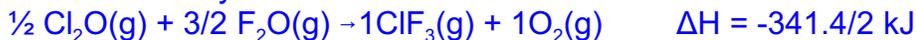


calculate ΔH for the reaction $\text{ClF}(\text{g}) + \text{F}_2(\text{g}) \rightarrow \text{ClF}_3(\text{g})$

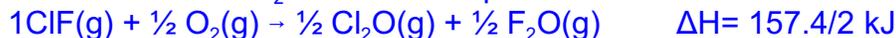
Reverse of equation 2



Divide by 2



Get rid of Cl_2O with $\frac{1}{2}$ of equation 1



Add F_2 with equation $\frac{1}{2}$ of equation 3



Net

