CHEM 1100 Practice for Thermodynamics and Gases Dr. Stone

$\Delta E_{system} = q + w$ $PV = nRT$ $R = 0.0821$ (L*atm)/(mole*K) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$P_T = p_1 + p_2 + p_3$ χ = moles A/total moles $\chi_1 P_T = p_1$

$w = -P\Delta V$ K.E. = $\frac{1}{2}$ m *μ_{rms}^2 $\mu_{rms} = \sqrt{\frac{3RT}{M}}$ R = 8.314 J/(mole*K)

$d = \frac{PM}{RT}$ $J = \frac{kg * m^2}{s^2}$ M = molar mass

101J = L x atm 14.7 psi = 1 atm 101325 Pa = 1 atm 760 torr = 1 atm

At constant pressure, $q_p = \Delta H$, ΔH = enthalpy of the reaction

$q_{gained} = - q_{lost}$ $q = m*C_s*\Delta T$ $q = n*C_m*\Delta T$

$\Delta H_{rxn} = \Delta H_{products} - \Delta H_{reactants}$

1. (5 points) What is the change in internal energy (ΔE) when a system is heated with 60 J of energy while it does 15J of work?

2. (5 points) Determine the change in enthalpy for the following reaction from the enthalpies of formation for the reactants and products. (ΔH_f for pure elements is zero.)

   $Cl_2(g) + C_2H_2Cl_2(g) \rightarrow C_2H_2Cl_4(g)$

   $C_2H_2Cl_2$, $\Delta H_f = 4.27$ kJ/mol

   $C_2H_2Cl_4$, $\Delta H_f = -155.6$ kJ/mol

3. (5 points) Use the bond dissociation energies provided in the table to calculate ΔH^o for the reaction:

   $2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(g)$
   H-H O=O H-O-H

Bond Type	H–H	O–H	O=O
kJ/mol	436	460	498

4. (3 points) Which statement A–D about energy units is correct?
a. The SI unit of energy is the kilo Joule (kJ).
b. In terms of SI base units,1 J = 1 kg m^2 s^2.
c. A nutritional calorie (1 Cal) is 4.184 J.
d. A nutritional calorie (1 Cal) is equal to 1,000 cal.
e. Statements A–D all are correct.

5. (3 points) If a chemical reaction causes the temperature of the container to drop, it is a(n) _____ reaction.
a. exothermic b. fast c. spontaneous d. slow e. endothermic

6. (5 points) Use the following information to determine the standard enthalpy change when 1 mol of PbO(*s*) is formed from lead metal and oxygen gas: $Pb(s) + \frac{1}{2}O_2(g) \rightarrow PbO(s)$

$PbO(s) + C(graphite) \rightarrow Pb(s) + CO(g)$ $\Delta H^o = 107$ kJ
$2C(graphite) + O_2(g) \rightarrow 2CO(g)$ $\Delta H^o = -222$ kJ

7. (20 points) Using the following data for water, determine how much energy is need to change 75 g of ice at –18°C to steam at 260°C. Show all of your work to earn any points.

Boiling point	100 °C
Melting point	0°C
Enthalpy of vaporization	2,260 J/g
Enthalpy of fusion	334 J/g
Specific heat capacity (solid)	2.11 J/(g ×°C)
Specific heat capacity (liquid)	4.18 J/(g ×°C)
Specific heat capacity (gas)	2.08 J/(g × °C)

8. (5 points) The total pressure of a gas cylinder that contains both oxygen and nitrogen is 1.8 atm. The mole fraction of oxygen in the cylinder is 0.21 atm, what is the partial pressure of the oxygen gas in the cylinder?

9. (3 points) Which of the following is not important when using the ideal gas law?
   a. The chemical identity of the gas sample.
   b. The temperature of the gas sample.
   c. The amount of gas.
   d. The pressure of the gas sample.
   e. The volume of the container holding the gas sample.
   f. All of these are important

10. (3 points) Which of the following reactions will result in a decrease in total pressure?
   a. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
   b. $2HI(g) \rightarrow H_2(g) + I_2(g)$
   c. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$
   d. $2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$
   e. none of these

11. (3 points) In a mixture of gases, the gas with the smallest mole fraction (X) will have the:
   a. largest number of molecules present.
   b. smallest number of molecules present.
   c. largest molar mass.
   d. highest kinetic energy.
   e. smallest molar mass.

12. (5 points) Propane is the fuel that many people use to grill food. When 152 g of propane (C_3H_8) reacts with excess oxygen in a constant pressure calorimeter, the temperature of the calorimeter increases by 20.3°C. The heat capacity of the calorimeter is 5.46 kJ/°C. Determine the molar enthalpy of combustion of propane.

13. (5 points) A sample of gas at 1.5 atm and 350.0 mL is heated from 10°C to 120°C. If the pressure remains constant, what is the final volume of the gas?

14. (5 points) A balloon is filled with 6.00 L of helium at a pressure of 772 torr. What is the volume of the balloon at an altitude where the pressure in the balloon is 300 torr?

15. (5 points) How many moles of propane are contained in a 2.5 L tank at 1.8 atm and 28°C?

16. (10 points) One of the gas laws is related to breathing. What is the name of the gas law? What is this gas law? Fully describe how this gas law is related to breathing.

17. (10 points) How much ice is needed to chill 30 cans of diet pepsi from 22°C to 4°C. Show your work. The ice is at -10°C. The cans weigh 13 grams and are made of Aluminum. Each can contains 355 mL of diet pepsi. The density of the diet pepsi is 1.0 g/mL. The table contains constants for water (use them for the diet pepsi and for the ice). The specific heat capacity of Aluminum is 24.4 J/mole°C Show all of your work to earn any points.

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