

City College, Chemistry Department
Chemistry 10301, sections T and T2, Prof. T. Lazaridis
Second Midterm exam, Nov. 3, 2005

Name (last name first): _____

I.D. Number: _____

Workshop leader: _____

**Note: There are 7 questions in this exam (check both sides of the sheet).
Fill in your answer in the blank space provided immediately following each
question. 1/2 point will be subtracted every time you report a numerical result
with an incorrect number of significant figures. The last sheet of this exam
contains information that may or may not be needed to answer these questions.**

1. (20) a. (5) What will you obtain by adding MgSO_4 to water?
(Use information provide on your data sheet)

Solution

Heterogeneous Mixture

- b. (5) Will a lead pipe dissolve in a solution of silver nitrate and why ?

Yes, because Pb is higher in the activity series than Ag

- c. (5) How many ml of 2.0 M HCl are required to make 500 ml of 0.50 M HCl ?

$$V_D M_D = V_C M_C \Rightarrow V_C = V_D M_D / M_C =$$

$$500 \text{ ml} * 0.50 \text{ M} / 2.0 \text{ M} = 125 \text{ ml}$$

- d. (5) 50 L of a gas at 5 atm pressure expands at constant temperature until the pressure becomes equal to atmospheric. What will be the volume of the gas after the expansion?

$$PV = \text{constant} \Rightarrow P_i V_i = P_f V_f \Rightarrow V_f = P_i V_i / P_f =$$

$$5 \text{ atm} \times 50 \text{ L} / 1 \text{ atm} = 250 \text{ L}$$

2. (15) How many liters of oxygen, measured at 0 °C and 1.00 atm, are required for the complete combustion of 5.00 g of liquid pentane (C₅H₁₀)?



Molar mass of pentane: 5X12.01 + 10X1.008 = 70.13 g/mol

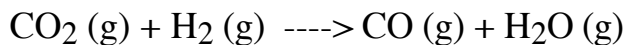
5.00 g / 70.13 (g/mol) = 0.0713 mol of pentane

moles O₂ required: 0.0713 X 15/2 = 0.535

From Ideal Gas law: V = nRT/P = 0.535 mol X 0.082058 (L atm/mol K)

X 273.15 K / 1.00 atm = 12.0 L

3. (10) What is the standard enthalpy of the following reaction at 25 °C:



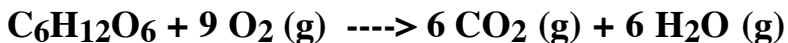
(Hint: use information on your data sheet)

Use enthalpy of formation data:

$$\Delta\text{H}^\circ = \Delta\text{H}_f^\circ (\text{CO}(\text{g})) + \Delta\text{H}_f^\circ (\text{H}_2\text{O}(\text{g})) - \Delta\text{H}_f^\circ (\text{CO}_2(\text{g})) - \Delta\text{H}_f^\circ (\text{H}_2(\text{g})) =$$

$$= -110.5 - 241.8 - (-393.5) - 0 = + 41.2 \text{ kJ/mol}$$

4. (15) The combustion of 1.53 g of glucose, $C_6H_{12}O_6$, raised the temperature of a bomb calorimeter from 22.50 °C to 25.25 °C. The total heat capacity of the calorimeter was 8.65 kJ/°C. Calculate the constant volume heat of combustion per mole of glucose.



Molar mass of glucose: $6 \times 12.01 + 12 \times 1.008 + 6 \times 16.00 = 180.16 \text{ g/mol}$

$1.53 \text{ g} / 180.16 \text{ (g/mol)} = 8.49 \times 10^{-3} \text{ mol of glucose}$

$\Delta T = 25.25 - 22.50 = 2.75 \text{ }^\circ\text{C}$

Heat released = heat capacity $\times \Delta T = 8.65 \text{ kJ/}^\circ\text{C} \times 2.75 \text{ }^\circ\text{C} = 23.8 \text{ kJ}$

(for $8.49 \times 10^{-3} \text{ mol}$)

For 1 mol: $23.8 \text{ kJ} / 8.49 \times 10^{-3} \text{ mol} = 2800 \text{ kJ/mol}$

So, constant volume heat of combustion per mole is -2800 kJ

5. (15) The thermochemical equation for the combustion of CO is:



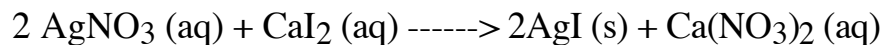
How much heat is generated by burning 50.0 L of CO at 25.00 °C and constant pressure of 1.00 atm?

Find number of moles from IG law: $n = PV/RT = (1.00 \text{ atm} \times 50.0 \text{ L}) /$

$(0.082058 \text{ (L atm/mol K)} \times (25.00 + 273.15 \text{ K})) = 2.04 \text{ moles of CO}$

1 mol of CO gives off 283.0 kJ, \Rightarrow 2.04 moles give off 577 kJ

6. (15) All the silver in a 45.0-mL portion of silver nitrate solution is precipitated as silver iodide by 26.0 mL of a 0.250 M calcium iodide solution:



Calculate the molarity of the silver nitrate solution.

Number of moles of CaI_2 : $26.0 \times 10^{-3} \text{ L} \times 0.250 \text{ mol/L} = 6.50 \times 10^{-3} \text{ mol}$

From stoichiometry, moles of AgNO_3 : $2 \times 6.50 \times 10^{-3} = 13.0 \times 10^{-3} \text{ mol}$

Molarity is : $13.0 \times 10^{-3} \text{ mol} / 45.0 \times 10^{-3} \text{ L} = 0.289 \text{ M}$

7. (10) Give the oxidation number of each element in the following compounds:

a) AlO_2^-

O: -2 Al: +3

b) BrF_3

F: -1 Br: +3

c) HClO_3

O: -2 H:+1 Cl: +5

d) NH_3OH^+

O: -2 H:+1 N: -1