

City College, Chemistry Department
Chemistry 10301, sections T and T2, Prof. T. Lazaridis
Second Midterm exam, Nov. 2, 2006

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.

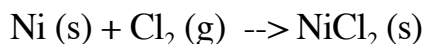
1. (20) a. (6) Predict whether each the following compounds is soluble in water:

K_3PO_4	Soluble	Not Soluble
$BaSO_4$	Soluble	Not Soluble
$NaClO_4$	Soluble	Not Soluble

b. (4) What is the molarity of a solution that contains 0.0345 mol NH_4Cl in 400 mL of solution?

$$0.0345 \text{ mol} / 400 \times 10^{-3} \text{ L} = 0.0863 \text{ M}$$

c. (5) Which element is oxidized and which is reduced in the following reaction?

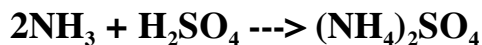


Ni goes from O.N. 0 to +2 so it is oxidized.
Cl goes from O.N. 0 to -1, so it is reduced.

d. (5) If the partial pressure of ozone (O_3) in the stratosphere is 3.0×10^{-3} atm and the temperature is 250 K, how many ozone molecules are in a liter? ($N_{av} = 6.022 \times 10^{23}$)

$$PV = nRT \Rightarrow n = PV/RT = 3.0 \times 10^{-3} \text{ atm} \times 1 \text{ L} / \\ 0.082 \text{ (L atm / mol K)} \times 250 \text{ K} = 1.5 \times 10^{-4} \text{ mol} \\ \times N_{av} = 9.0 \times 10^{19} \text{ molecules}$$

2. (15) Ammonium sulfate, a fertilizer, can be prepared by the reaction of ammonia (NH₃) with sulfuric acid (H₂SO₄). Write a balanced equation for the reaction and calculate the volume of ammonia gas needed at 20.0 °C and 25.0 atm to react with 150 Kg of H₂SO₄.



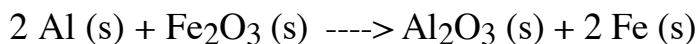
Molar mass of H₂SO₄: 2X1.008+ 32.06+ 2X16.00 = 98.08 g/mol

Convert to mol: 150 000 g / 98.08 g/mol = 1530 mol H₂SO₄

This requires 2X1530 = 3060 mol ammonia.

PV = nRT => V= 3060 mol X 0.082058 L atm / (mol K) X (20.0 +273.15 K) / 25.0 atm = 2940 L

3. (10) Using your datasheet, find the standard enthalpy of the thermite reaction:

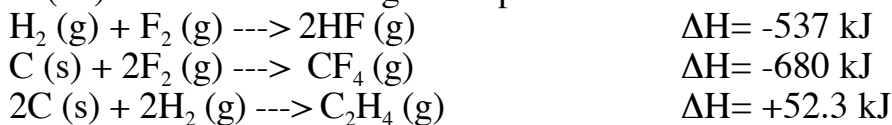


Is it exothermic or endothermic?

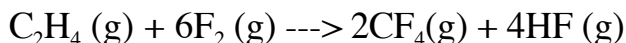
$$\Delta H = -1676 - (-824.2) = -852 \text{ kJ / mol}$$

Exothermic

4. (15) From the following enthalpies of reaction:



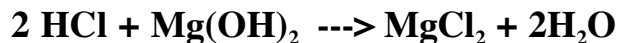
calculate the ΔH for the reaction:



Invert the third equation, multiply the first and second equation by 2, and add them up to get the desired equation.

$$\Delta\text{H} = -52.3 + 2(-537) + 2(-680) = -2486 \text{ kJ}$$

5. (10) What volume of 0.128 M HCl is required to neutralize 2.87 g of $\text{Mg}(\text{OH})_2$?



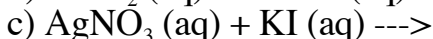
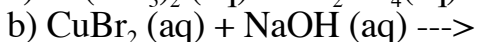
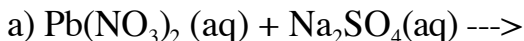
$$\text{Molar mass of } \text{Mg}(\text{OH})_2 : 24.31 + 2 \times 16.00 + 2 \times 1.008 = 58.33 \text{ g/mol}$$

$$\text{Convert to moles: } 2.87 \text{ g} / 58.33 \text{ g/mol} = 0.0492 \text{ mol}$$

$$\text{This requires } 2 \times 0.0492 = 0.0984 \text{ mol HCl}$$

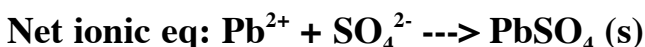
$$\text{Volume} = 0.0984 \text{ mol} / 0.128 \text{ (mol/L)} = 0.769 \text{ L}$$

6. (15) Write balanced net ionic equations for the reactions that occur in each of the following cases. Identify the spectator ions in each reaction:



Check the solubility rules to see what precipitate will form in each case.

a) Pb^{2+} combined with SO_4^{2-} produces an insoluble salt:



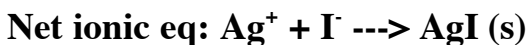
Spectators: NO_3^- , Na^+

b) Cu^{2+} combined with OH^- produces an insoluble salt:



Spectators: Br^- , Na^+

c) Ag^+ combined with I^- produces an insoluble salt:



Spectators: NO_3^- , K^+

7. (15) When a 4.25 g sample of solid ammonium nitrate dissolves in 60.0 g of water in a coffee-cup calorimeter, the temperature drops from 22.0 °C to 16.9 °C. Calculate the ΔH for the following reaction:



(assume that the specific heat of the solution is the same as that of pure water and use your datasheet)

Specific heat of water: 4.180 J/g °C

**Amount of heat absorbed: $(60.0 + 4.25 \text{ g}) \times 4.180 \text{ J/g } ^\circ\text{C} \times (22.0 - 16.9 \text{ } ^\circ\text{C})$
= 1370 J**

**Molar mass of Amm. Nitrate: $2 \times 14.01 + 4 \times 1.008 + 3 \times 16.00 = 80.05 \text{ g/mol}$
 $4.25 \text{ g} / 80.05 \text{ g/mol} = 0.0531 \text{ mol}$**

So, heat per mol of Amm. Nitrate is $1370 \text{ J} / 0.0531 \text{ mol} = 25800 \text{ J}$

$\Delta H = + 25.8 \text{ kJ}$