Homework #9, Graded Answers

Chem20, Elementary Chemistry

8.29) Consider the unbalanced equation for the reaction of solid lead with silver nitrate.

a.) Balance the equation.
  Pb(s) + **2** $AgNO_3$(aq) → $Pb(NO_3)_2$(aq) + **2** Ag(s)
b.) How many moles of silver nitrate are required to complete react with 9.3 moles of lead?
  9.3 mols Pb × $\frac{\text{2 moles } AgNO_3}{\text{1 mole Pb}}$ = $1\underline{8}.6$ → **19 moles $AgNO_3$**
c.) How many moles of Ag are formed by the complete reaction of 28.4 moles Pb?
  28.4 moles Pb × $\frac{\text{2 moles Ag}}{\text{1 mol Pb}}$ = $56.\underline{8}$ → **56.8 moles Ag**

8.62) Consider the reaction between sulfur trioxide and water. If 61.5 g SO_3 and 11.2 g of H_2O react and 54.9 g H_2SO_4 is collected, calculate the **limiting reactant**, **theoretical yield**, and **percent yield** for the reaction.

SO_3(g) + H_2O(l) → H_2SO_4(aq)

Calculate the molar masses for SO_3, H_2O, and H_2SO_4.
SO_3 = (1)(32.07 g/mol) + (3)(16.00 g/mol) = 80.07 g/mol
H_2O = (2)(1.008 g/mol) + (1)(16.00 g/mol) = 18.016 g/mol
H_2SO_4 = (2)(1.008 g/mol) + (1)(32.07 g/mol) + (4)(16.00 g/mol) = 98.016 g/mol
Convert g SO_3 → g H_2SO_4.
61.5 g SO_3 × $\frac{\text{1 mole } SO_3}{\text{80.07 g } SO_3}$ × $\frac{\text{1 mole } H_2SO_4}{\text{1 mole } SO_3}$ × $\frac{\text{98.016 g } H_2SO_4}{\text{1 mole } H_2SO_4}$ = $75.\underline{2}8$ g H_2SO_4
Convert g H_2O → g H_2SO_4
11.2 g H_2O × $\frac{\text{1 mole } H_2O}{\text{18.016 g } H_2O}$ × $\frac{\text{1 mole } H_2SO_4}{\text{1 mole } H_2O}$ × $\frac{\text{98.106 g } H_2SO_4}{\text{1 mole } H_2SO_4}$ = $60.\underline{9}8$ g H_2SO_4
Since H_2O produces fewer g product
Limiting Reactant: H_2O, Theoretical Yield: 61.0 g H_2SO_4
percent yield = $\frac{\text{54.9 g}}{\text{61.0 g}}$ ×100 = $90.\underline{0}$ → **90.0 % yield**

8.69) Classify each process as exothermic or endothermic, and indicate the sign of ΔH.

a.) Butane gas burning in a lighter → **exothermic, - ΔH** (releases heat)
b.) The reaction that occurs in the chemical cold packs used to ice athletic injuries – **endothermic, + ΔH** (absorbs heat)
c.) The burning of wax in a candle → **exothermic, -ΔH** (releases heat)

8.76) The evaporation of water is endothermic:

H_2O(l) → H_2O(g)   ΔH = + 44.01 kJ/mol

What minimum mass of water (in g) has to evaporate to absorb 175 kJ of heat?
175 kJ × $\frac{\text{1 mole } H_2O}{\text{44.01 kJ}}$ × $\frac{\text{18.016 g } H_2O}{\text{1 mole } H_2O}$ = $71.\underline{6}3$ → **71.6 g H_2O**

8.87) Hydrogen gas can be prepared in the laboratory by a single-displacement reaction in which solid zinc reacts with hydrochloric acid. How much zinc in grams is required to make 14.5 g of hydrogen gas through this reaction?

$Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

$14.5\ g\ H_2 \times \frac{1\ mole\ H_2}{2.016\ g\ H_2} \times \frac{1\ mole\ Zn}{1\ mole\ H_2} \times \frac{65.39\ g\ Zn}{1\ mole\ Zn} = 47\underline{0}.3 \rightarrow \mathbf{4.70 \times 10^2\ g\ Zn}$