Name: _____ date: _____ period: _____

ch. 15 & 16 solution & thermo test 80 points honors chemistry

In problems involving any calculation, show your work in an organized manner, include any relevant conversion factor(s) and equation (or formula) and units in your answer.

1. Describe how prepare a 175 mL aqueous solution of 375 mM calcium nitrate using ___. [10 points]

$Ca(NO_3)_2$

a. Solid calcium nitrate and water

i) $n = [\ ]V = 375\ \frac{mmol}{10^3\ mL}\ 175\ mL\ \frac{mol}{10^3\ mmol}\ \frac{164\ g}{mol}$ (1 sf) (3 sf)

$= 10.8\ g$

ii) (1 sf) mix 10.8 g $Ca(NO_3)_2$ & enough H_2O to make 175 mL soln

b. 525 mM calcium nitrate

1 p-t

1 i) $[dil]V_{dil} = [conc]V_{conc}$

2 $375\ mM\ (175\ mL) = 525\ mM\ V$

$V = \frac{375\ mM\ (175\ mL)}{525\ mM} = 125\ mL$

1 ii) mix 125 mL 525 mM soln & enough H_2O to ... or 50 mL H_2O

2. 25 mL of H_3PO_4 neutralizes 1.0 grams of magnesium hydroxide in a 75 mL solution. What is the concentration of H_3PO_4 ? [10 points]

$Mg(OH)_2$

3 p-t $3[A]V_A = 2[B]V_B$

3 $3[A]\ 25\ mL = 2\ n_B$

3 $[A] = \frac{2\ n_B}{3(25\ mL)} = \frac{2\left(1\ g\ \frac{1\ mol}{58\ g}\right)}{3(25\ mL)}\ \frac{10^3\ mL}{L}$

1 $= 0.46\ M$

3. Solve: 5.0 grams $Ca(NO_3)2$ + 10.0 grams of $Na_3(PO_4)$ → ___ grams of precipitate. [15 points]

i) $3Ca(NO_3)_2 + 2Na_3PO_4 \rightarrow 6NaNO_3 + Ca_3(PO_4)_2$

ii) $5\text{ g } Ca(NO_3)_2 \cdot \frac{1\text{ mol } Ca(NO_3)_2}{164\text{ g } Ca(NO_3)_2} \cdot \frac{2\text{ mol } Na_3PO_4}{3\text{ mol } Ca(NO_3)_2} \cdot \frac{164\text{ g}}{1\text{ mol}} = 3.3\text{ g } Na_3PO_4$ needed

∴ $Ca(NO_3)_2$ is limiting

iii) $5\text{ g } Ca(NO_3)_2 \cdot \frac{\text{mol } Ca(NO_3)_2}{164\text{ g } Ca(NO_3)_2} \cdot \frac{1\text{ mol } Ca_3(PO_4)_2}{3\text{ mol } Ca(NO_3)_2} \cdot \frac{310\text{ g}}{\text{mol}}$

5 pts

$= 3.15\text{ g}$

4. What is the "final" temperature of mixing 25 mL water at 22 °C and 75 mL water at 88 °C? [10 points]

2 pts

2 $q_{hot} = -q_{cold}$

2 $m_{hot} c \Delta T_{hot} = -m_{cold} c \Delta T_{cold}$

2 $m_{hot} c (T_f - T_{i,hot}) = -m_{cold} c (T_f - T_{i,cold})$

2 $75 (T_f - 88) = -25 (T_f - 22)$

$75 T_f - 6600 = -25 T_f + 550$

$T_f = \frac{7150}{100} = 71.5\text{ °C}$

5. What is the ΔH_{Rx} of the complete combustion of 5.0 grams of ethane (C_2H_6); assume all chemicals in the reaction are gases. [15 points]

i) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

ii) $\Delta H = [4\Delta H_f CO_2 + 6\Delta H_f(H_2O)] - [2\Delta H_f C_2H_6 + 7\Delta H_f(O_2)]$

$= [4(-393) + 6(-242)] - [2(-85) + 0]$

$= -1572 - 1452 + 170$

$= -2854\text{ kJ}$

5 pts

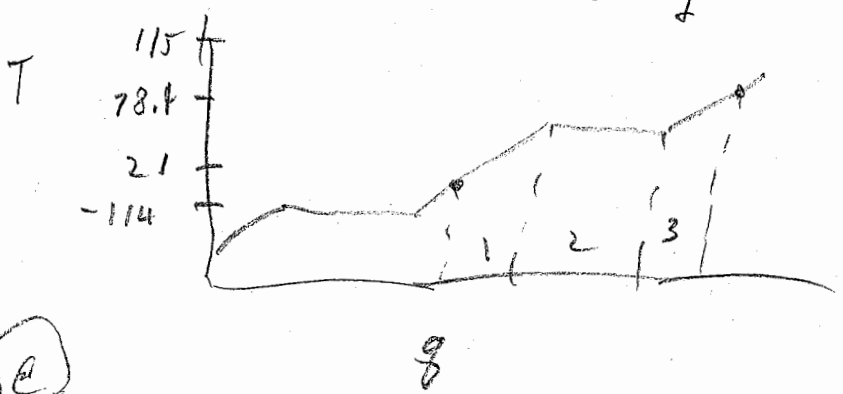
iii) $\frac{-2854\text{ kJ}}{2\text{ mol } C_2H_6} \cdot 5\text{ g } C_2H_6 \cdot \frac{1\text{ mol } C_2H_6}{30\text{ g } C_2H_6}$

$= -238\text{ kJ}$

6. For ethanol, C_2H_5OH,

Specific heat	Melting point = - 114 C	Δ H (fusion) = 4.97 kJ / mol
Solid = 111 J / (mol K)	Boiling point = 78.4 °C	Δ H (vaporization) = 42.3 kJ / mo
Liquid = 2.43 J / (g K)		
Gas = 1.70 J / (g K)		

How much heat would be needed to change 10.0 g ethanol at 21.0 °C to 115 °C ? [20 points]



4 pts @

$q_1 = m c_l \Delta T = 10 g \left(\frac{2.43 J}{g \cdot ^\circ C}\right)(78.4 - 21)^\circ C = 1395 J$

$q_2 = \Delta H_{vap} \cdot m = \frac{42.3 kJ}{mol} \; 10 g \; \frac{1 mol}{46 g} = 9.196 k$

$q_3 = m c_g \Delta T = 10 g \left(\frac{1.7 J}{g \cdot ^\circ C}\right)(115 - 78.4)^\circ C = 622$

$q = \sum_{i=1}^{3} q_i = (1.395 + 9.196 + 0.622) kJ$

$= 11.2 kJ$

7 pts @
w/o heating curve