Heat. Enthalpy and Calorimetry

Sample problem A

$KOH_{(s)} \rightarrow KOH_{(aq)} + 43\ kJ$

a. Warmer (System → surroundings: beaker)
b. exothermic

P.E [R → P] Rxn →

$\Delta H = \frac{43\ kJ}{1\ mol.} = \frac{X}{.25\ mol}$ $\boxed{X = 10.7\ kJ}$

moles $KOH = 14g \times \frac{1\ mol}{56g} = .25\ mol$

Sample Problem D

$3Al + 3NH_4ClO_4 \rightarrow Al_2O_3 + AlCl_3 + 3NO + 6H_2O$

$\Delta H^\circ_{rxn} = \Sigma \Delta H_{products} - \Delta H_{reactants}$

$(Al_2O_3 + AlCl_3 + 3NO + 6H_2O) - (3Al + 3NH_4ClO_4)$

$[(-1676) + (-704) + (3 \cdot 90) + (6 \cdot 242)] - [0 + (3 \cdot -295)]$

$-3562 - (-885)$

$\boxed{\Delta H_{rxn} = -2680\ kJ}$

Exercise 10

$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$

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

$[Al_2O_3 + (2Fe)] - [(2Al) + Fe_2O_3]$

$[(-1676)] - [-826]$

$\Delta H = -1676 - (-826)$

$\Delta H = -850\ kJ/mol$

Sample Problem E

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 2800\,KJ$

$\Delta H_{combustion} = -2800\,KJ$

$\Delta H_{comb} = \Delta prod - \Delta reactants$

$-2800 = [(6 \cdot -393.5) + (6 \cdot -285.8)] - [X + 0]$

$-2800 = -4076 - X$

$1276 = -X$

$X = -1276\,KJ/mol$

$-15^\circ C$ to 0°

$MC\Delta T$

$M = 25g$

$C = 2.03\,J/g^\circ C$

$\Delta T = 0 - (-15) = 15$

$(25)(2.03)(15)$

$761\,J$ +

0° to $0^\circ C$

$m\,H_f$

$M = 25g$

$H_f = 334\,J/g$

$(25)(334)$

$8350\,J$ +

0° to $100^\circ C$

$MC\Delta T$

$M = 25g$

$C = 4.18\,J/g^\circ C$

$\Delta T = 100 - 0 = 100$

$(25)(4.18)(100)$

$10\,450\,J$

100° to 100°

$m\,H_{vap}$

$M = 25g$

$H_{vap} = 2260\,J/g$

$(25)(2260)$

$56,500\,J$ +

100° to 112°

$MC\Delta T$

$M = 25g$

$C = 2.01\,J/g^\circ C$

$\Delta T = 112 - 100 = 12$

$(25)(2.01)(12)$

$603\,J$ = $\boxed{76,664\,J}$

Exercise 5 = $\frac{\Delta H}{\text{mole } BaSO_4}$ $\Delta H = q = \frac{q}{\text{mol } BaSO_4}$

1 mol 1 mol

$Ba(NO_3)_2 + Na_2SO_4 \longrightarrow BaSO_{4(s)} + 2NaNO_{3(aq)}$

1 (aq) 1 (aq) 1 2

mole facts

moles $Ba(NO_3)_2 = M \times L = 1.00 \times 1.00 = 1.00$ mole

moles $Na_2SO_4 = M \times L = 1.00 \times 1.00 = 1.00$ mole

LR

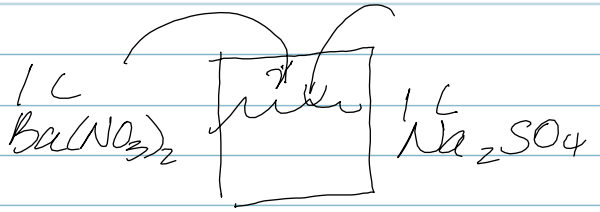
$Ba(NO_3)_2$

$\frac{1 \text{ mol } Ba(NO_3)_2}{1 \text{ mol}} = \frac{x \text{ mol } BaSO_4}{1 \text{ mol}} = \frac{1 \text{ mol}}{BaSO_4}$

Na_2SO_4

$\frac{1 \text{ mol } Na_2SO_4}{1 \text{ mol}} = \frac{x \text{ mol } BaSO_4}{1 \text{ mol}} = \frac{1 \text{ mol}}{BaSO_4}$

$\frac{q =}{1 \text{ mol } BaSO_4}$



$q = m C \Delta T$

m = solution

$C = 4.18 \text{ J/g°C}$

$\Delta T = 28.1 - 25.0 = 3.1°C$

$D_{soln} = \frac{\text{mass solution}}{\text{volume solution}}$

$q = (2000)(4.18)(3.1°C)$

$= \frac{25,916 \text{ J}}{1 \text{ mol } BaSO_4}$

$\frac{1.0 \text{ g}}{\text{ml}} = \frac{x \text{ g}}{2000 \text{ ml}}$

$m = 2000 \text{ g}$

Sample Problem B

$NaOH + HCl \rightarrow NaCl + HOH$

mole NaOH = M x L = 1.0 x .10L = .1 mole
mole HCl = M x L = 1.0 x .10L = .1 mole

$\Delta H = \frac{q}{.1 \text{ mole}}$

$q = mC\Delta T$
m = mass solution
C = 4.18 J/g°C
ΔT = 31.3 - 24.6 = 6.7°C

(200g)(4.18)(6.7)

$= \frac{560.1 \text{ J}}{.1 \text{ mol}}$

$\boxed{-56 \frac{\text{KJ}}{1 \text{ mol}}}$

$\frac{1 \text{g}}{\text{cm}^3} = \frac{1 \text{g}}{\text{ml}}$

$D = \frac{\text{mass solution}}{\text{volume solution}}$

$\frac{1.0 \text{g}}{\text{ml}} = \frac{x \text{g}}{200 \text{ml}}$

g = 200g