AP Chemistry Chapter 6 Answers - Kotz

6.9 $q = (168 \text{ g})(0.385 \text{ J/g·K})(298.8 \text{ K} – 261.0 \text{ K}) = 2440 \text{ J}$

6.13 $q_{metal} + q_{water} = 0$

$[(45.5 \text{ g})(0.385 \text{ J/g·K})(T_f – 373.0 \text{ K})] + [(152 \text{ g})(4.184 \text{ J/g·K})(T_f – 291.7 \text{ K})] = 0$

$T_f = 294 \text{ K } (21 \text{ ºC})$

6.15 $q_{cool\ water} + q_{warm\ water} = 0$

$[(156 \text{ g})(4.184 \text{ J/g·K})(T_f – 295 \text{ K})] + [(85.2 \text{ g})(4.184 \text{ J/g·K})(T_f – 368 \text{ K})] = 0$

$T_f = 321 \text{ K } (48 \text{ ºC})$

6.23 $1.00 \text{ mL} \cdot \frac{1 \text{ cm}^3}{1 \text{ mL}} \cdot \frac{13.6 \text{ g}}{1 \text{ cm}^3} = 13.6 \text{ g Hg}$

q_{total} = energy to cool liquid + energy to change phase from liquid to solid

$q_{cool\ liquid} = (13.6 \text{ g})(0.140 \text{ J/g·K})(234.4 \text{ K} – 296.2 \text{ K}) = –118 \text{ J}$

$q_{phase\ change} = –(13.6 \text{ g})(11.4 \text{ J/g}) = –155 \text{ J}$

$q_{total} = –118 \text{ J} + (–155 \text{ J}) = –273 \text{ J}$ (273 J released to the surroundings)

6.29 $1.00 \times 10^3 \text{ mL} \cdot \frac{0.69 \text{ g}}{1 \text{ mL}} \cdot \frac{1 \text{ mol } C_8H_{18}}{114.2 \text{ g}} \cdot \frac{10{,}922 \text{ kJ}}{2 \text{ mol } C_8H_{18}} = 3.3 \times 10^4 \text{ kJ}$ heat evolved

6.33 $q_{metal} + q_{water} = 0$

$[(20.8 \text{ g})(C_{Ti})(297.5 \text{ K} – 372.7 \text{ K})] + [(75 \text{ g})(4.184 \text{ J/g·K})(297.5 \text{ K} – 294.9 \text{ K})] = 0$

$C_{Ti} = 0.52 \text{ J/g·K}$

6.37 $q = q_{water} + q_{calorimeter}$

$q = [(815 \text{ g})(4.184 \text{ J/g·K})(299.87 \text{ K} – 294.40 \text{ K})] + [(923 \text{ J/K})(299.87 \text{ K} – 294.40 \text{ K})]$

$q = 2.37 \times 10^4 \text{ J}$

$2.56 \text{ g } S_8 \cdot \frac{1 \text{ mol } S_8}{256.5 \text{ g}} \cdot \frac{8 \text{ mol } SO_2}{1 \text{ mol } S_8} = 0.0798 \text{ mol } SO_2$

$\frac{2.37 \times 10^4 \text{ J}}{0.0798 \text{ mol } SO_2} \cdot \frac{1 \text{ kJ}}{10^3 \text{ J}} = 297 \text{ kJ/mol } SO_2$

6.41 $q_{Ag} + q_{ice} = 0$

$[(50.0 \text{ g})(C_{Ag})(273.2 \text{ K} – 373.0 \text{ K})] + [(3.54 \text{ g})(333 \text{ J/g})] = 0$

$C_{Ag} = 0.236 \text{ J/g·K}$

6.45 $^1/_2\ N_2(g) + {}^3/_2\ H_2(g) \rightarrow NH_3(g)$ $\Delta H^o = (-91.8\text{ kJ})/2$

$NH_3(g) + {}^5/_4\ O_2(g) \rightarrow NO(g) + {}^3/_2\ H_2O(g)$ $\Delta H^o = (-906.2\text{ kJ})/4$

$^3/_2\ H_2O(g) \rightarrow {}^3/_2\ H_2(g) + {}^3/_4\ O_2(g)$ $\Delta H^o = -(-241.8\text{ kJ}) \times {}^3/_2$

$^1/_2\ N_2(g) + {}^1/_2\ O_2(g) \rightarrow NO(g)$ $\Delta H^o = 90.3\text{ kJ}$

6.47 $C(s) + {}^1/_2\ O_2(g) + 2\ H_2(g) \rightarrow CH_3OH(\ell)$ $\Delta H_f^o = -238.4\text{ kJ}$

6.51 (a) $1.0\text{ g P} \cdot \frac{1\text{ mol P}}{31.0\text{ g}} \cdot \frac{1\text{ mol } P_4O_{10}}{4\text{ mol P}} \cdot \frac{-2984.0\text{ kJ}}{1\text{ mol } P_4O_{10}} = -24\text{ kJ}$

(b) $0.20\text{ mol NO} \cdot \frac{-90.29\text{ kJ}}{1\text{ mol NO}} = -18\text{ kJ}$

(c) $2.40\text{ g NaCl} \cdot \frac{1\text{ mol NaCl}}{58.44\text{ g}} \cdot \frac{-411.12\text{ kJ}}{1\text{ mol NaCl}} = -16.9\text{ kJ}$

(d) $250\text{ g Fe} \cdot \frac{1\text{ mol Fe}}{55.8\text{ g}} \cdot \frac{1\text{ mol } Fe_2O_3}{2\text{ mol Fe}} \cdot \frac{-824.2\text{ kJ}}{1\text{ mol } Fe_2O_3} = -1800\text{ kJ}$

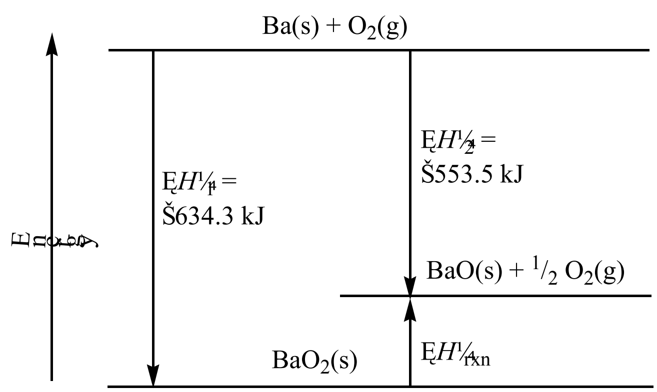
6.55 (a) $\Delta H_f^o[O_2(g)] = 0\text{ kJ/mol}$

$\Delta H^o_{rxn} = \Delta H_f^o[BaO(s)] - \Delta H_f^o[BaO_2(s)]$

$\Delta H^o_{rxn} = 1\text{ mol }(-553.5\text{ kJ/mol}) - 1\text{ mol }(-634.3\text{ kJ/mol})$

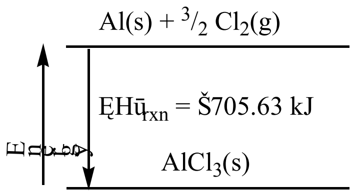
$\Delta H^o_{rxn} = 80.8\text{ kJ}$ The reaction is endothermic

(b)



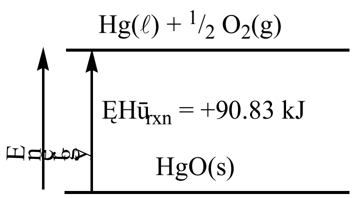
6.59 (a) $Al(s) + {}^{3}/_{2}\, Cl_2(g) \rightarrow AlCl_3(s)$ product-favored

$\Delta H^{o}_{rxn} = \Delta H_f^{o}[AlCl_3(s)] = -705.63$ kJ/mol



(b) $HgO(s) \rightarrow Hg(\ell) + {}^{1}/_{2}\, O_2(g)$ reactant-favored

$\Delta H^{o}_{rxn} = -\Delta H_f^{o}[HgO(s)] = 90.83$ kJ/mol



6.64 (a), (c), and (d) are state functions

6.66 Standard state is the most stable form of a substance in the physical state that exists at a pressure of 1 bar and at a specified temperature. H_2O (liquid), NaCl (solid), Hg (liquid), CH_4 (gas)

6.71 $q_{water} = (50.0\text{ g})(4.184\text{ J/g·K})(-40\text{ K}) = -8400\text{ J}$

$q_{ethanol} = (100.\text{ g})(2.46\text{ J/g·K})(-40\text{ K}) = -9800\text{ J}$ Ethanol gives up more heat

6.77 Assume the density of the tea is 1.00 g/mL and specific heat capacity is 4.184 J/g·K

$q_{tea} + q_{melt\ ice} + q_{warm\ ice} = 0$

$[(5.00 \times 10^2\text{ g})(4.184\text{ J/g·K})(T_f - 293.2\text{ K})] + [(90.\text{ g})(333\text{ J/g})] + [(90.\text{ g})(4.184\text{ J/g·K})(T_f - 273.2\text{ K})] = 0$

$T_f = 278$ K (4.8 ºC)

6.79 $q_{solution} = (250.\text{ g} + 125\text{ g})(4.2\text{ J/g·K})(296.05\text{ K} - 294.30\text{ K})$

$q_{solution} = 2.8 \times 10^3$ J

$q_{rxn} = -q_{solution} = -2.8 \times 10^3$ J

Reactants are present in equimolar amounts

$$0.250\text{ L} \cdot \frac{0.16\text{ mol AgNO}_3}{1\text{ L}} \cdot \frac{1\text{ mol AgCl}}{1\text{ mol AgNO}_3} = 0.040\text{ mol AgCl}$$

$$\frac{-2.8 \times 10^3\text{ J}}{0.040\text{ mol AgCl}} \cdot \frac{1\text{ kJ}}{10^3\text{ J}} = -69\text{ kJ/mol AgCl}$$

6.81 $q = q_{water} + q_{calorimeter}$

q = [(415 g)(4.184 J/g·K)(293.87 K – 292.05 K)] + [(155 J/K)(293.87 K – 292.05 K)]

$q = 3.44 \times 10^3$ J

$$7.647 \text{ g } NH_4NO_3 \cdot \frac{1 \text{ mol } NH_4NO_3}{80.043 \text{ g}} = 0.09554 \text{ mol } NH_4NO_3$$

$$\frac{3.44 \times 10^3 \text{ J}}{0.09554 \text{ mol}} \cdot \frac{1 \text{ kJ}}{10^3 \text{ J}} = 36.0 \text{ kJ/mol } NH_4NO_3 \text{ evolved}$$