

1) Which requires more energy: a) warming 100.0 mL of water from 20°C (room temperature) to 37°C (body temperature) or b) warming 50.0 mL of ethanol from 20°C to 37°C?

$$a) q = mC\Delta T = 100 \text{ g}(4.184\text{J/g}^\circ\text{C})(37-20^\circ\text{C}) = 7112.8 \text{ J} = \sim 7000 \text{ J}$$

$$b) q = mC\Delta T = 50 \text{ mL}(0.789\text{g/mL})(2.46\text{J/g}^\circ\text{C})(37-20^\circ\text{C}) = 1649 \text{ J} = \sim 2000 \text{ J}$$

a requires more energy

2) An unknown metal requires 561 J to heat a 32.4 g sample of it from 15.5°C to 34.7°C. What metal in Table 6.1 is the unknown?

$$q = mC\Delta T$$

$$561\text{J} = 32.4\text{g}(C)(34.7-15.5^\circ\text{C})$$

$$C = 0.902 \text{ J/g}^\circ\text{C} \text{ Al}$$

3) How much energy (in kilojoules) would be required to raise the temperature of a cube of gold (1ft x 1ft x 1ft) from room temperature (25°C) to its melting point (1064°C) and then melt the gold completely at 1064°C? (the enthalpy of fusion of gold is 12.55 kJ/mole)

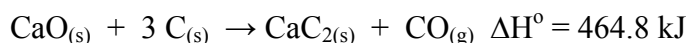
$$1 \text{ ft}^3(12^3\text{in}^3/1\text{ft}^3)(2.54^3\text{cm}^3/1\text{in}^3)(1\text{mL/cm}^3)(19.32\text{g/mL}) = 5.47 \times 10^5 \text{ g}$$

$$\text{Heating } q = mC\Delta T = 5.47 \times 10^5 \text{ g}(0.128\text{J/g}^\circ\text{C})(1064-25^\circ\text{C}) = 7.27 \times 10^7 \text{ J} = 7.27 \times 10^4 \text{ kJ}$$

$$\text{Melting } q = mH_{\text{fus}} = 5.47 \times 10^5 \text{ g} (12.55 \text{ kJ/mol})(1\text{mol}/196.9\text{g}) = 3.49 \times 10^4 \text{ kJ}$$

$$\text{Total} = 7.27 \times 10^4 \text{ J} + 3.49 \times 10^4 \text{ kJ} = 1.076 \times 10^5 \text{ kJ} = 1 \times 10^5 \text{ kJ}$$

4) Given the thermochemical equation



What quantity of energy is transferred when:

a) 10.0 g of CO are formed?

$$10.0 \text{ gCO}(1 \text{ mol CO}/28\text{gCO})(464.8 \text{ kJ/mol}) = 1.66 \times 10^2 \text{ kJ}$$

b) 18.4 moles of CaO are used?  $8.55 \times 10^3 \text{ kJ}$

c) 103.6 g of CaC<sub>2</sub> are made?  $7.515 \times 10^2 \text{ kJ}$

Chapter 6: 34, 36, 46, 52, 56, 70, 74, 76, 86, 92, 95, 102, 115, 126, 140

6.34

$$q_{\text{Cu}} = -q_{\text{H}_2\text{O}}$$

$$mC\Delta T = -mC\Delta T$$

$$192\text{g}(0.385\text{J/g}^\circ\text{C})(T_f-100^\circ\text{C}) = -[750 \text{ g}(4.184\text{J/g}^\circ\text{C})(T_f-4.0^\circ\text{C})]$$

$$T_f = 6.21^\circ\text{C}$$

6.36 a)

$$q = mC\Delta T$$

$$2.38 \text{ J} = 0.310\text{g}(C)(38.7-23.4)$$

$$C = 0.502 \text{ J/g}^\circ\text{C}$$

b)  $0.502 \text{ J/g}^\circ\text{C} (12\text{g}/1 \text{ mol}) = 6.02 \text{ J/mol}^\circ\text{C}$

c) graphite  $0.720 \text{ J/g}^\circ\text{C}$  You would expect the molar heat capacities of graphite and diamond to be the same since they are both materials made of carbon atoms. The molar heat

capacities are different because these two allotropes of carbon contain a different arrangement of carbon atoms creating materials with very different physical properties.

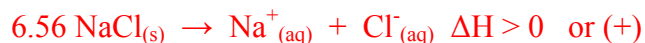
$$6.46 \text{ Melting } q = mH_{\text{fus}} = 240.4\text{g}(333\text{J/g}) = 8.01 \times 10^4 \text{J}$$

$$\text{Heating } q = m\Delta T = 240.4\text{g}(4.184 \text{ J/g}^\circ\text{C})(100-0^\circ\text{C}) = 1.01 \times 10^5 \text{J}$$

$$\text{Evaporation } q = mH_{\text{vap}} = 240.4\text{g} (2260\text{J/g}) = 5.43 \times 10^5 \text{J}$$

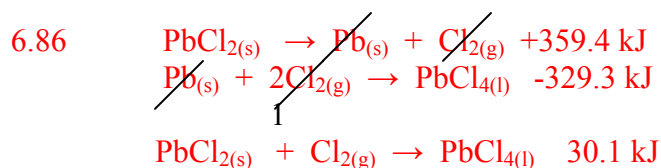
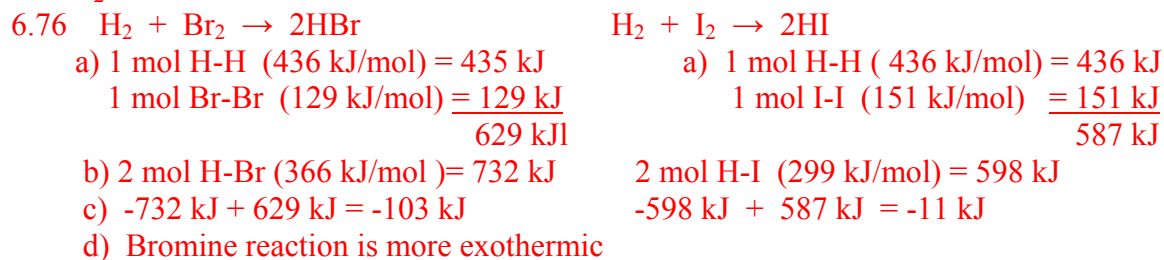
$$\text{Total} = 7.24 \times 10^5 \text{J}$$

6.52 a)  $Y_{(s)}$  b) heat of vaporization; c) fusion is – (exothermic)

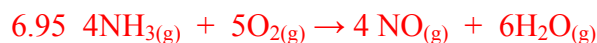


$$6.70 \text{ 10.0g Al}(1\text{molAl}/26.98\text{gAl})(-851.5 \text{ kJ}/2\text{molAl}) = -1.58 \times 10^2 \text{ kJ}$$

6.74  $I_2$



6.92 a) exothermic



$$\Delta H^\circ_{\text{rxn}} = \sum n\Delta H^\circ_{\text{prod}} - \sum n\Delta H^\circ_{\text{reactants}}$$

$$= [(4\text{mol NO}_{(g)})(90.25\text{kJ/mol}) + 6\text{mol H}_2\text{O}_{(g)}(-241.818 \text{ kJ/mol})] + [4 \text{ mol NH}_{3(g)}(-46.11\text{kJ/mol}) + 5\text{mol O}_2(0 \text{ kJ/mol})]$$

$$= -9.06 \times 10^2 \text{ kJ exothermic}$$

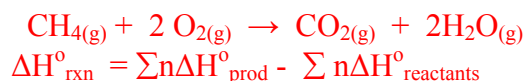
6.102

Moles of air:

$$1800\text{ft}^2(8.0\text{ft})(12^3\text{in}^3/1\text{ft}^3)(2.54^3\text{cm}^3/\text{in}^3)(1\text{mL}/1\text{cm}^3)(1\text{L}/1000\text{mL})(1.22\text{g}/1\text{L})(1\text{mol}/28.9\text{g})$$

$$= 1.72 \times 10^4 \text{mol}$$

$$q = m\Delta T = 1.72 \times 10^4 \text{mol} (29.1 \text{ J/mol}^\circ\text{C})(22.0-15.0^\circ\text{C}) = 3.51 \times 10^6 \text{J}$$



$$= [(1\text{mol CO}_{2(g)})(-393.509\text{kJ/mol}) + 2\text{mol H}_2\text{O}_{(g)} (-241.818\text{kJ/mol})]$$

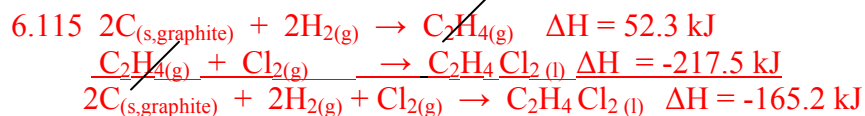
$$- [1\text{mol CH}_{4(g)} (-74.81\text{kJ/mol}) + 2\text{mol O}_2 (0\text{ kJ/mol})]$$

$$= -8.02 \times 10^2 \text{kJ}$$

$$-8.02 \times 10^2 \text{kJ/mol CH}_4 (X \text{ mol CH}_4) = 3.51 \times 10^6 \text{J} (1 \text{ kJ}/1000\text{J})$$

$$X = 4.37 \text{ mol CH}_4 (16 \text{ g CH}_4 / 1 \text{ mol CH}_4)$$

$$= 69.95 \text{ g CH}_4 = 7.0 \times 10^1 \text{g CH}_4$$



6.126 Substance A

6.140 a) exothermic

b) in exp 3 & 4 same heat transferred; all Drano is used up when at least 3Tbs of the Works is added; in exp 4, 1 Tbsp extra of the works was added

c) exp 1 Works

exp 2 Works

exp 3 neither

exp 4 Drano

d) see answer for b

e) Drano<sub>tsp</sub> Works<sub>3Tbsp</sub>