Heating, Cooling, Phase Change Study Guide – Answers

Chapter 10:

32. $q = ms\Delta T = (29.2\,g)(0.89\ J/g^\circ C)(41.5^\circ C - 27.2^\circ C) = 371.63\ J = 88.82\ Cal$

34. $\Delta T = \frac{q}{ms} = \frac{100\ J}{(25g)(0.14\ J/g^\circ C)} = 28.57^\circ C$

36. $\frac{0.24\ J}{g^\circ C} \times \frac{0.239\ cal}{1\ J} = 0.057\ cal/g^\circ C$

38. $S = \frac{q}{m\Delta T} = \frac{133\ J}{(5g)(55.1^\circ C - 25.2^\circ C)} = 0.89\ J/g^\circ C$

The substance was Aluminum.

68. $q = ms\Delta T = (145g)(1\ cal/g^\circ C)(75^\circ C - 22.3^\circ C) = 7{,}641.5\ cal$

70. $\Delta T = \frac{q}{ms} = \frac{50\ J}{(10g)(0.45\ J/g^\circ C)} = 11.11^\circ C$

72. $q = ms\Delta T = (2.5\times 10^3 g)(4.184\ J/g^\circ C)(55^\circ C - 18.5^\circ C) = 381.79\ kJ$

74. $q = ms\Delta T = ms(T_f - T_i)$; heat released by 100°C water is transferred to water initially at 50°C

$q_{released} = (50g)(4.184\ J/g^\circ C)(T_f - 100) = -(50g)(4.184\ J/g^\circ C)(T_f - 25) = q_{absorbed}$

$T_f - 100 = 25 - T_f$

$2T_f = 125$

$T_f = 62.5^\circ C$

84. $1\ lb\ body\ fat \times \frac{454\ g}{1\ lb} \times \frac{7.7\times 10^3\ cal}{1\ g\ fat} \times \frac{1\ hr}{400\times 10^3\ cal} = 8.74\ hrs$

Chapter 14:

8. Melting and boiling are examples of physical changes, so no bonds are broken or formed. When a solid melts or a liquid boils, the distance between molecules generally increases, which means that intermolecular forces (LDF, DD, HB) must be overcome.

14. a) The heat of vaporization is so much larger than the heat of fusion because the difference in the spacing between molecules in solids and liquids is much smaller than the difference in the spacing between molecules is ~~the~~ liquids and gases. In other words, the magnitude of intermolecular forces disrupted is much smaller.

b) $q = n\Delta H_{fus} = \left(1\text{ g Na} \times \frac{1\text{ mol Na}}{22.99\text{ g Na}}\right)\left(2.60\ \frac{\text{kJ}}{\text{mol Na}}\right) = 0.11\text{ kJ}$

c) $q = n\Delta H_{vap} = \left(1\text{ g Na} \times \frac{1\text{ mol Na}}{22.99\text{ g Na}}\right)\left(97.0\ \frac{\text{kJ}}{\text{mol Na}}\right) = 4.22\text{ kJ}$

d) The heat released in condensing 1 g of Na at its normal boiling point equals the heat absorbed to evaporate 1 g of Na at its normal boiling point.

$q = 4.22\text{ kJ}$

18. $3.95\ \frac{\text{kJ}}{\text{g Al}} \times \frac{26.98\text{ g Al}}{1\text{ mol Al}} = 106.57\ \text{kJ/mol} = \Delta H_{fus}$

$q = mL = (10\text{g})(3.95\ \text{kJ/g}) = 39.5\text{ kJ}$

$q = n\Delta H = (10\text{ mol})(106.57\ \text{kJ/mol}) = 1{,}065.7\text{ kJ}$

32. A vapor pressure builds up above a liquid because some of the liquid molecules escape from the surface of the liquid into the gas phase. In a closed container, these molecules will strike the sides of the container walls, creating a pressure. The processes giving rise to a vapor pressure are the breaking of intermolecular forces.

67. a) $q = ms\Delta T = \left(1\text{ mol Al} \times \frac{26.98\text{ g Al}}{1\text{ mol Al}}\right)\left(\frac{0.902\text{ J}}{\text{g}^\circ\text{C}}\right)(658^\circ\text{C} - 25^\circ\text{C}) = 15.40\text{ kJ}$

b) $q = mL = \left(1\text{ mol Al} \times \frac{26.98\text{ g Al}}{1\text{ mol Al}}\right)\left(3.95\frac{\text{kJ}}{\text{g}}\right) = 106.57\text{ kJ}$

c) $q = mL = \left(1\text{ mol Al} \times \frac{26.98\text{ g Al}}{1\text{ mol Al}}\right)\left(10.52\frac{\text{kJ}}{\text{g}}\right) = 283.83\text{ kJ}$

80. CH_4 is a non-polar molecule. It has only London Dispersion forces. NH_3, in contrast, is a polar molecule that has both dipole-dipole interactions and hydrogen bonding. The stronger intermolecular forces in NH_3 give it a much higher boiling point.

90. In evaporation, liquid molecules overcome intermolecular forces to escape from the surface of a liquid into the gas phase.

In condensation, gas molecules, attracted by intermolecular forces, join surface liquid molecules to become part of the liquid.

Evaporation requires an input of energy, because it costs energy to overcome the attractive intermolecular forces in the liquid.