Heat Worksheet Solutions

Latent Heat Solutions

Specific Heat Solutions

1. How much water at 50^{o}C is needed just to melt 2.2 kg of ice at 0^{o}C?

- $Q_W = Q_I$
- $m_w c_w \Delta T = m_I L_f$
- m_w*4200 J/kgK*50 K = 2.2 kg * 3.34(10^5) J/kg
- m_w = 3.5 kg

2. How much water at 32^oC is needed just to melt 1.5 kg of ice at -10^oC?

- $Q_W = Q_I$
- $m_w c_w \Delta T = m_I L_f + m_I c_I \Delta T$
- m_w*4200 J/kgK*32K = 1.5 kg * 3.34(10^5) J/kg + 1.5 kg*2100 J/kgK*10K
- m_w = 3.962 kg
- m_w = 4 kg

3. How much steam at 100^oC is needed to melt 5 kg of ice at -15^oC?

- $Q_W = Q_I$
- $m_sL_v + m_sc_w\Delta T = m_IL_f + m_Ic_I\Delta T$
- m_s*22.5(10^5)J/kg + m_s*4200 J/kgK*100K = 5 kg * 3.34(10^5) J/kg + 5 kg*2100 J/kgK*15K
- m_s = 0.68446 kg
- m_s = 0.7 kg

4. A copper cup holds some water at 4°C. The copper cup weighs 140 g while the water weighs 80 g. If 100 g of hot water is added, what will be the final temperature of the water?

- $Q_c + Q_{cw} = Q_{hw}$
- 0.14 g*390 J/kgK*(T_f - 4K) + 0.08 g*4200 J/kgK*(T_f - 4K) = 0.1 g*4200 J/kgK*(90-T_fK)
- 810.6 T_f = 39362.4
- T_f = 48.5596 K
- T_f = 50 K

5a. Explain where the energy is going at each section of the curve from “a” to “e”.

- a. T increases as KE increases, solid phase
- b. PE increases during heat of fusion
- c. T increases as KE increases, liquid phase
- d. PE increases during heat of vaporization
- e. T increases as KE increases, gas phase

5b.

- $Q_f = m_i L_f$
- (~467 kJ - ~133 kJ) = m_i 334kJ/kg
- m_i = ~ 1 kg

5c. Using section “c”, calculate the amount of ice used to produce the graph.

- $\Delta Q = mc\Delta T$
- (~900 kJ - ~467 kJ) = m_i *4200 J/kgK * (100K – 0K)
- m_i = ~ 1 kg

1. What is the specific heat of a substance that absorbs 2500 joules of heat when a sample of 100 g of the substance increases in temperature from 10^oC to 70^oC?

- Q = mcΔT
- 2500 J = 100 g * c * (343 K – 283 K)
- c = 2500 J / (100 g * 60 K)
- c = 0.416667 J/gK
- c = 0.4 J/gK

2. If 200 grams of water is to be heated from 24.0^{o}C to 100.0^{o}C to make a cup of tea, how much heat must be added? The specific heat of water is 4.18 J/g^{o}C.

- $Q = mc\Delta T$
- Q = 200g * 4.18 J/g^{o}C * (100^{o}C – 24^{O}C)
- Q = 63536 J
- Q = 60000 J

3. How many grams of water would require 2200 joules of heat to raise its temperature from 34^oC to 100^oC?

- $Q = mc\Delta T$
- $m = Q/(c\Delta T)$
- $m = 2200\ J / (4.18\ J/g^oC * 66^oC)$
- m = 7.97 g
- m = 8.0 g

4. A block of aluminum weighing 140 g is cooled from 98.4^oC to 62.2^oC with the release of 1080 joules of heat. From this data, calculate the specific heat of aluminum.

- $Q = mc\Delta T$
- $c = Q/ (m\Delta T)$
- c = 1080 J / (140 g * 36.2 K)
- c = 0.213 J/gK
- c = 0.21 J/gK

5. 100.0 mL of 4.0^{o}C water is heated until its temperature is 37^{o}C. If the specific heat of water is 4.18 J/g^{o}C, calculate the amount of heat energy needed to cause this rise in temperature.

- $Q = mc\Delta T$ density of water = 1 g/mL
- Q = 100 g * 4.18 J/g^{o}C * 33^{o}C
- Q = 13794 J
- Q = 14000 J

6. A total of 54.0 joules of heat are absorbed as 58.3 g of lead is heated from 12.0°C to 42.0°C. From these data, what is the specific heat of lead?

- $Q = mc\Delta T$
- $c = Q/(m\Delta T)$
- $c = 54\ J / (58.3\ g * 30\ K)$
- $c = 0.030875\ J/gK$
- $c = 0.0309\ J/gK$

7. The specific heat of wood is 2.03 J/g^{o}C. How much heat is needed to convert 550 g of wood at -15^{o}C to 10^{o}C?

- $Q = mc\Delta T$
- Q = 550 g * 2.03 J/g^{o}C * 25^{o}C
- Q = 27912.5 J
- Q = 28000 J

8. What is the total amount of heat needed to change 2.25 kg of silver at 0.0^{o}C to 200.0^{o}C? The specific heat of silver is 0.129 J/g^{o}C.

- $Q = mc\Delta T$
- Q = 2250 g * 0.129 J/g^{o}C * 200^{o}C
- Q = 58050 J
- Q = 58000 J

9. Granite has a specific heat of 800 J/g^{o}C. What mass of granite is needed to store 150,000 J of heat if the temperature of the granite is to be increased by 15.5^{o}C?

- $Q = mc\Delta T$
- $m = Q/(c\Delta T)$
- m = 150000 J / (800 J/g^{o}C * 15.5^{o}C)
- m = 12.097 g
- m = 10 g

10. A 55 kg block of metal has an original temperature of 15.0°C and 0.45 J/g°C. What will be the final temperature of this metal if 450 J of heat energy are added?

- $Q = mc\Delta T$
- $\Delta T = Q/mc$
- $\Delta T = 450\ J / (55000\ g * 0.45\ J/g^{o}C)$
- $\Delta T = 0.018182^{o}C$
- $T_f = 15.018182^{o}C$
- $T_f = 15^{o}C$

11. Object A specific is 2.45 J/g^{o}C and object B specific heat is 0.82 J/g^{o}C. Which object will heat up faster if they have the same mass and equal amount of heat is applied? Explain why.

- Object B will heat up faster because it will require less heat to heat up 1 g of substance by 1^{o}C, so with the same mass it will require less energy to heat object B the same change in temperature as object A.