Specific Heat

1. A 15.75-g piece of iron absorbs 1086.75 joules of heat energy, and its temperature changes from 25°C to 175°C. Calculate the specific heat capacity of iron.

$C = \frac{Q}{m\Delta T}$ $c = \frac{1086.75}{0.01575 \times 150}$ $c = 460\ J\,kg^{-1}\,K^{-1}$

2. How many joules of heat are needed to raise the temperature of 10.0 g of aluminum from 22°C to 55°C, if the specific heat of aluminum is ~~0.90~~ J/g°C? 900 J/kg K

$Q = cm\Delta T$ $Q = 900 \times 0.01 \times 33$ $Q = 297\ J$

3. To what temperature will a 50.0 g piece of glass raise if it absorbs 5275 joules of heat and its specific heat capacity is ~~0.50 J/g°C~~? The initial temperature of the glass is 20.0°C.

~~500~~ 840 J/kg K $Q = cm(T_f - T_o)$ $T_f = \frac{Q}{cm} + T_o$ $T_f = \frac{5275}{840 \times 0.5} + 20 = 32.6°C$

4. Calculate the heat capacity of a piece of wood if 1500.0 g of the wood absorbs 6.75×10^4 joules of heat, and its temperature changes from 32°C to 57°C.

$C = \frac{Q}{m\Delta T}$ $c = \frac{67500}{1.5 \times 25}$ $c = 1800\ J\,kg^{-1}\,K^{-1}$

4180 J/kg K

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

$Q = cm\Delta T$ $Q = 4180 \times 0.1 \times 33$ $Q = 13794\ J$

6. 25.0 g of mercury is heated from 25°C to 155°C, and absorbs 455 joules of heat in the process. Calculate the specific heat capacity of mercury.

$c = \frac{Q}{m\Delta T}$ $c = \frac{455}{0.025 \times 130}$ $c = 140\ J\,kg^{-1}\,K^{-1}$

7. What is the specific heat capacity of silver metal if ~~55~~ 13.00 g of the metal absorbs 47.3 ~~calories~~ Joules of heat and the temperature rises 15.0°C?

$C = \frac{Q}{m\Delta T}$ $c = \frac{47.3}{0.013 \times 15}$ $c = 242\ J\,kg^{-1}\,K^{-1}$

8. If a sample of chloroform is initially at 25°C, what is its final temperature if 150.0 g of chloroform absorbs 1.0 **kilojoules** of heat, and the specific heat of chloroform is ~~0.96 J/g°C~~? 960 J/kg K

$T_f = \frac{Q}{cm} + T_o$ $T_f = \frac{1000}{960 \times 0.15} + 25 = 32°C$

9. How much energy must be absorbed by 20.0 g of water to increase its temperature from 283.0 ~~K~~ to 303.0 ~~K~~? (Cp of H_2O = 4.184 J/g °C)

$Q = cm\Delta T$ $Q = 4184 \times 0.02 \times 20$

$Q = 1674\ J$

10. When 15.0 g of steam drops in temperature from 275.0 °C to 250.0 °C, how much heat energy is released? ~~(Cp of H_2O = 4.184 J/g °C)~~ C of steam 2000 J/kg K

$Q = cm\Delta T \quad Q = 2000 \times 0.015 \times 25 \quad Q = 750$ J

11. How much energy is required to heat 120.0 g of water from 2.0 °C to 24.0 °C? (Cp of H_2O = 4.184 J/g ~~°C~~ kg K)

$Q = cm\Delta T \quad Q = 4184 \times 0.12 \times 22 \quad Q = 11046$ J

12. How much heat (in J) is given out when 85.0 g of lead cools from 200.0 °C to 10.0 °C? (Cp of Pb = 0.129 J/g °C)

$Q = cm\Delta T \quad Q = 129 \times 0.085 \times 190 \quad Q = 2083$ J

13. If it takes 41.72 joules to heat a piece of gold weighing 18.69 g from 10.0 °C to 27.0 °C, what is the specific heat of the gold?

$c = \frac{Q}{M\Delta T} \quad c = \frac{41.72}{0.01869 \times 17} \quad c = 131$ J kg^{-1} K^{-1}

14. A certain mass of water was heated with 41,840 Joules, raising its temperature from 22.0 °C to 28.5 °C. Find the mass of the water, in grams. (Cp of H_2O = 4.184 J/g °C)

$M = \frac{Q}{C\Delta T} \quad m = \frac{41840}{4184 \times 6.5} \quad m = 1.5$ kg

1.538 kg

15. How many joules of heat are needed to change 50.0 grams of ice at -15.0 °C to steam at 120.0 °C? (Cp of H_2O = 4.184 J/g °C) C of steam = 2000 J/kg K C of ice = 2100 J/kg K

L of ice fusion = 3.34×10^5 J/kg L of water boiling = 2.25×10^6 J/kg

$Q = c_{ice} M \times 15 + L_f M + c_w M \times 100 + L_{steam} M + c_{st} M \times 20 \quad Q = 15750 + 16700 + 21000 + 112500 + 2000 = 153775$ J

16. Calculate the number of joules given off when 32.0 grams of steam cools from 110.0 °C to ice at -40.0 °C. (Cp of H_2O = 4.184 J/g °C)

$Q = C_{steam} \times 0.032 \times 10 + L_{steam} \times 0.032 + C_{water} \times 0.032 \times 100 + L_{ice} \times 0.032 + C_{ice} \times 0.032 \times 40$

$Q = 640 + 72000 + 13388.8 + 10688 + 2688 = 99404.8$ J

17. The specific heat of ethanol is 2.46 J/g °C. Find the heat required to raise the temperature of 193 g of ethanol from 19°C to 35°C.

$Q = cm\Delta T \quad Q = 2460 \times 0.193 \times 16$

$Q = 7596.5$ J

18. When a 120 g sample of aluminum (Al) absorbs 9612 J of energy, its temperature increases from 25°C to 115°C. Find the specific heat of aluminum.

$c = \frac{Q}{M\Delta T} \quad c = \frac{9612}{0.12 \times 90}$

$c = 890$ J kg^{-1} K^{-1}