

## Calculations using Q

### Finding variables in Q

1. Determine how much heat is transferred by 1.98 kg of water to heat the water from 14.0°C to 73°C? (C of water is 4,184 j/kg°C)
2. Calculate the amount of heat that must be added to 4.71kg of water to cause it increase in temperature from 9.8°C to 52°C? (C of water is 4,184 j/kg°C)

### Finding final temperature at thermal equilibrium

3. What is the final temperature after 840 Joules is absorbed by 10.0g of water at 25.0°C?
4. Determine the final temperature when 938J of heat are added to 14.1g of water at 40°C.

### Using volume for mass at thermal equilibrium

5. A student is making chamomile tea to soothe her nerves as she studies for a physics test. She does not want the drink's final temperature to be greater than 47°C so she will not burn her tongue. She decides to add .08L of 100°C water to .4L of 25°C water. Will she burn her tongue? What is the teas temperature?
6. A student must mop at his job after school. He must use water that is hotter than 60°C to be sanitary but less than 80°C to not affect the wax. He mixed 30L of 120°C of water with 60L of 19°C. Did he make the correct temperature water? What is the water's temperature?

# Calculations using Q

## Finding variables in Q

4,184 when in 1. Determine how much heat is transferred by 1.98 kg of water to heat the water from 14.0°C to 73°C? (C of water is 4,184 j/kg°C) C

4,186 when in g make sure C in kg and m in kg

$$Q = m C \Delta T$$

$$= (1.98)(4,184)(73-14)$$

$$= (8,284.3)(59)$$

2. Calculate the amount of heat that must be added to 4.71 kg of water to cause it increase in temperature from 9.8°C to 52°C? (C of water is 4,184 j/kg°C)

$$Q = m C \Delta T$$

$$Q = 4.71(4,184)(52-9.8)$$

$$Q = 831,620 J$$

## Finding final temperature at thermal equilibrium

3. What is the final temperature after 840 Joules is absorbed by 10.0g of water at 25.0°C?

$$Q = m C \Delta T$$

$$840 = 10.0(4.186)(T_f - 25)$$

$$840 = 41.86 T_f - 1,046.5$$

$$+1,046.5$$

$$1,886.5 = 41.86 T_f$$

$$T_f = 45$$

*use this to match units of mass*

4. Determine the final temperature when 938J of heat are added to 14.1g of water at 40°C.

$$Q = m C \Delta T$$

$$938 = 14.1(4.186)(T_f - 40)$$

$$938 = 59.02 T_f - 2,360.9$$

$$+2,360.9$$

$$3,298.9 = 59.02 T_f$$

$$T_f = 55.9^\circ C$$

## Using volume for mass at thermal equilibrium

5. A student is making chamomile tea to soothe her nerves as she studies for a physics test. She does not want the drink's final temperature to be greater than 47°C so she will not burn her tongue. She decides to add .08L of 100°C water to .4L of 25°C water. Will she burn her tongue? What is the teas temperature?

100°C T<sub>n</sub> .08L  
25°C T<sub>c</sub> .4L  
not gain E  
lose E out  
gain E in

$$-Q_{out} = Q_{in}$$

$$-m_n c_n \Delta T_n = m_c c_c \Delta T_c$$

$$-V_n (T_f - T_i)_n = V_c (T_f - T_i)_c$$

$$-.08(T_f - 100) = .4(T_f - 25)$$

$$-0.08T_f + 8 = .4T_f - 10$$

$$T_f = T_f = T_f$$

$$-0.08T_f + 8 = .4T_f - 10$$

$$+0.08T_f + 10 = +0.4T_f + 10$$

$$18 = .48 T_f$$

$$\frac{18}{.48} = T_f$$

$$37.5 = T_f$$

D = m/v  
Density of water = 1000  
1 = m/v  
m = m

6. A student must mop at his job after school. He must use water that is hotter than 60°C to be sanitary but less than 80°C to not affect the wax. He mixed 30L of 120°C of water with 60L of 19°C. Did he make the correct temperature water? What is the water's temperature?

$$-Q_{out} = Q_{in}$$

$$-m_n c_n \Delta T_n = m_c c_c \Delta T_c$$

$$-V_n (T_f - T_i)_n = V_c (T_f - T_i)_c$$

$$-30(T_f - 120) = 60(T_f - 19)$$

$$-30T_f + 3600 = 60T_f - 1140$$

$$+30T_f + 1140 = +30T_f + 1140$$

$$4,740 = 90T_f$$

$$\frac{4,740}{90} = T_f$$

$$52.7 = T_f$$

°C