Read 10.4

H.w Due today

office hours 11:30-12:30 today

Next H.w available

D2L updated

Evaluations available

Make up Exam

Next Wed 7 p.m here

covering exams 1-3

Review

Temperature

Celcius	$-273\,^{\circ}C$
Fahrenheit	$-459\,^{\circ}F$
Kelvin	absolute 0 = 0K

Heat: transfer of energy into or out of a system due to a difference in temperature.

$$Q = mc\Delta t$$

- Q: quantity of heat
- m: mass
- c: specific heat capacity
- Δt: temperature change

$Q > 0$ t increases
heat flows into system

$Q < 0$ t decreases
heat flows out of system

Problem: How much heat does it take to make a cup of coffee? Assume that for your 12 oz. cup of coffee the water starts at 20 °C and reaches near boiling at 95 °C.

$m = 12\ oz$

$\Delta T = T_f - T_i = 95^\circ C - 20^\circ C = 75^\circ C \qquad \Delta T = 75\ K$

water $\quad c = 1\ cal/g^\circ C = 4186\ J/kg \cdot K$

$$m = \left(12\ oz \times \frac{29.6\ ml}{oz} \times \frac{1\ l}{1000\ ml} \times \frac{1\ kg}{l}\right) = 0.355\ kg$$

$$Q = mc\Delta T$$

$$= (0.355\ kg)(4186\ J/kg \cdot K)(75\ K) = \underline{111{,}452\ J}$$

Interactive Question

(A)

Two objects of different temperatures are brought together. Eventually the objects reach thermal equilibrium. Which of the following statements is true once they have reached thermal equilibrium?

A) They are at the same temperature.
B) The absolute value of the temperature change of each object was the same.
C) Both objects have the same specific heat.
D) More than one of the above is true.

Interactive Question

(13)

Given that the same amount of heat will affect the following objects in the following ways. Which object has the greatest specific heat capacity?

A) Raises the temperature of 3 g of substance 1 by 10 K
B) Raises the temperature of 4 g of substance 2 by 4 K
C) Raises the temperature of 6 g of substance 3 by 15 K
D) Raises the temperature of 8 g of substance 4 by 6 K
E) Raises the temperature of 10 g of substance 5 by 10 K

Interactive Question

C

An amount of heat is added to ice, raising its temperature from -10 C to -5 C. A larger amount of heat is added to the same mass of liquid water, raising its temperature from15 C to 20 C. From these results, we conclude that

A) overcoming the latent heat of fusion of ice requires an input of energy
B) the latent heat of fusion of ice delivers some energy to the system
C) the specific heat of ice is less than that of water
D) the specific heat of ice is greater than that of water

Problem: You take a 110 gram ice cube out of the freezer and it has a temperature of –18 °C? How much heat, in calories, does it take to completely melt the ice?

$m = 110\,g$ $\quad \Delta t = T_f - T_i \quad T_f = 0^\circ C$

$\Delta t = 0^\circ - (-18^\circ C) = 18^\circ C$

ice $c = 0.5\ cal/g^\circ C$

melting $\quad Q = mL_f \quad L_f = 80\ cal/g$

1st bring ice from $-18^\circ C \rightarrow 0^\circ C$

$Q = mc\Delta t = (110\,g)(0.5\ cal/g^\circ C)(18^\circ C) = 990\ cal$

then melt ice

$Q = mL_f = (110\,g)(80\ cal/g) = 8800\ cal$

Total Heat

$990\ cal + 8800\ cal = 9790\ cal$

Interactive Question

(3)

Which is more likely to cause more damage to skin, a burn caused by water at 100 °C or a burn caused by steam at 100 °C?

A) The burn caused by water.
B) The burn caused by steam.
C) There is no difference.