Temperature:

1) Convert the following temperature readings from ^oF to ^oC:

i) 15 ^oF = -9.4 ^oC

ii) 70.0 ^oF = 21.1 ^oC

iii) 425 ^oF = 218. ^oC

2) Convert the following temperature readings from ^oC to ^oF:

i) 4. ^oC = 39. ^oF

ii) 37.0 ^oC = 98.6 ^oF

iii) −100. ^oC = -148. ^oF

3) Convert the temperatures in (2) to K

i) 4. ^oC = 277. K

ii) 37. ^oC = 310. K

iii) −100. ^oC = 173. K

Heat & Specific Heat Capacity:

1. A metal object of mass = 20.00 g is heated from a temperature of 25.0 ^oC to 200.0 ^oC. During this process, the metal object absorbs 1.34×10^3 J of energy.

(i) What is the specific heat capacity?

Ans. s = 0.383 J/g^oC

(ii) What is the heat energy required to raise the temperature of the metal object in calories?

Ans. s = 320. cal

2) The hot metal object (in problem 1 above) is then placed into a thermally isolated container with 20.00 g of water, initially at 25.0 °C.

(i) What happens to the temperature of the water? The metal object?

Ans. The water warms up, increases temperature.

The metal object cools down, decreases temperature.

(ii) Describe the flow of energy (heat) inside the container.

Ans. Heat energy flows from the metal object into the water.

(iii) What is the final temperature of the water/metal object?

Ans. Both the metal and water reach the same final temperature at thermal equilibrium, and the heat lost by the metal is equal to the heat gained by the water, therefore:

$Q_{Water} = -Q_{Metal}$ or $(s \cdot m \cdot \Delta T)_{Water} = -(s \cdot m \cdot \Delta T)_{Metal}$

Solving for T and inserting all of the numerical values $\rightarrow$ T = 40. °C

3) In a separate experiment, an identical metal object at a temperature of 100.0 °C is placed into a thermally isolated container containing 50.00 kg of a liquid (initial temperature of 20.0 °C) with an unknown specific heat capacity. The final temperature of the mystery liquid/metal object is 23.5 °C.

(i) What is the specific heat capacity of the mystery liquid?

Ans. The heat lost by the metal is equal to the heat gained by the liquid, therefore:

$Q_{liquid} = -Q_{Metal}$ or $(s \cdot m \cdot \Delta T)_{liquid} = -(s \cdot m \cdot \Delta T)_{Metal}$

Solving for s_{liquid} and inserting all of the numerical values $\rightarrow s_{liquid}$ = 3.3 J/g°C

(ii) How much heat (in Joules) would be needed to raise the temperature of the unknown liquid from 25.0 °C to 100.0 °C?

Ans. $Q = s_{liquid} \cdot m_{liquid} \cdot \Delta T_{liquid} = 1.2 \times 10^4$ J

(ii) How much heat (in calories) would be needed to raise the temperature of the unknown liquid from 25.0 °C to 100.0 °C?

Ans. $Q = 2.9 \times 10^3$ cal