

Heat Calculations involving water and metals:

When doing a heat calculation that involves dropping a hot metal into cool water, remember: $Q_{in} = Q_{out}$, or in other words, the heat that goes into the water equals the heat that comes out of the hot metal.

Example:

Suppose a piece of iron ($C_p = 0.449 \text{ J/g}^\circ\text{C}$) with a mass of 21.5g at a temperature of 100.0°C is dropped into an insulated container of water. The mass of the water is 132g and its temperature before the iron is 20.0°C. What will be the final temperature of the system?

1. Draw a picture and write down all the information that you know:

Iron – loses heat to the water

$m =$ g
 $C_p =$ J/g°C
 $T_1 =$ °C

Water – gains heat from the iron

$m =$ g
 $C_p =$ J/g°C
 $T_1 =$ °C

Q water = Q metal

$$m_w C_{p_w} \Delta T_w = m_I C_{p_I} \Delta T_I$$

Substitute in and using algebra, solve for the T_f ; remember, ΔT = high temperature – low temperature, the metal starts at a high temperature and goes to a lower one, while the water starts at a lower temperature and ends at a higher one.

Now you try:

1. A piece of aluminum ($C_p = 0.9025 \text{ J/g}^\circ\text{C}$) with mass 3.90g and a temperature of 99.3°C is dropped into 10.0cm^3 of water at 22.6°C . What will be the final temperature of the system? Remember that the density of water is 1.00 g/ml .

2. A piece of cadmium ($C_p = 0.2311 \text{ J/g}^\circ\text{C}$) with a mass 65.6g and a temperature of 100.0°C is dropped into 25.0 cm^3 of water at 23.0°C . What is the final temperature of the system?

3. A piece of an unknown metal with a mass 23.8g is heated to 100.0°C and dropped into 50.0cm^3 of water at 24.0°C . The final temperature of the system is 32.5°C . What is the specific heat of the metal?