Calorimetry

- Used to determine the specific heat of a material

unknown metal
- known mass
+ T_i

← Sealed calorimeter

← water of known mass and T_i
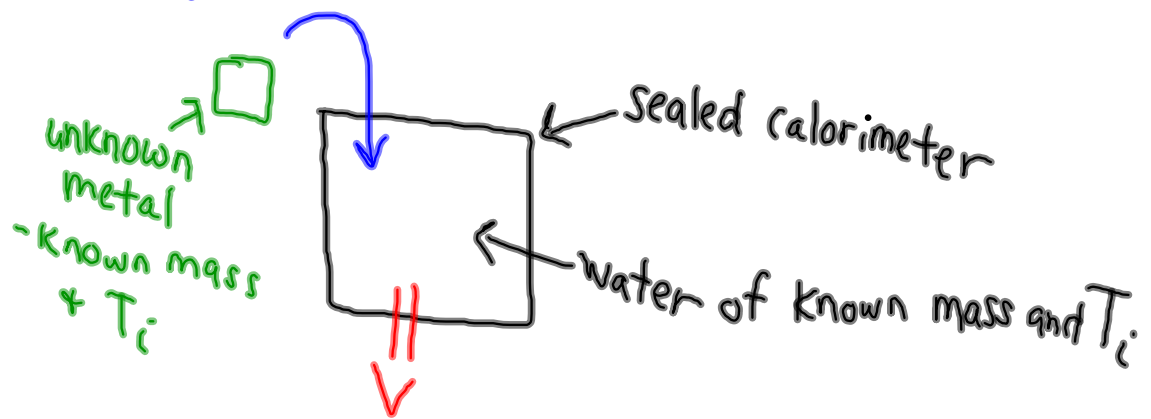
metal and water have same T_f.

Q = Energy

$$Q_w = - Q_m$$

$$Q_w + Q_m = 0$$

$$m_w C_w \Delta T_w + M_m C_m \Delta T_m = 0$$

<u>**Example 4:**</u>

A calorimeter is filled with 200 g of water at 10°C. An unknown material of mass 80 g at 85°C is dropped into the calorimeter. The mixture reaches an equilibrium temperature of 20°C. Find the **specific heat** of the material. The specific heat of water is 4186 J/kg°C.

$$C_m = 1610 \text{ J/kg}°C$$

Challenge Problem #1

A calorimeter is filled with 500g of water at 15 C. A piece of copper metal of mass 200 g and a temperature of 90 C is placed inside the calorimeter. What is the equilibrium temperature?

Specific heat copper = 387 J/kg C
Specific heat water = 4186 J/kg C

$$2093 \left(T_F - 15 \right) = -77.4 \left(T_F - 90 \right)$$

$$2093\, T_F - 31395 = -77.4\, T_F + 6966$$

$$\boxed{T_F = 17.7°C}$$

Challenge Problem #2

A 250 g block of copper at 88 C and a 300 g block of aluminum at 75 C are dropped in a calorimeter with 750 g of water at 5 C. The specific heat capacity of copper is 387 J/kg C, the specific heat capacity of aluminum is 899 J/kg C and the specific heat capacity of water is 4186 J/kg C. Determine the equilibrium temperature reached by the mixture.

$$Q_W + Q_{cu} + Q_{Al} = 0$$

$$Q_W = (-Q_{cu}) + (-Q_{Al})$$

$$(.75)(4186)(T-5) = -[.25(387)(T-88)] + [.3(899)(T-75)]$$

$$3139.5T - 15697.5 = -96.75T + 8514 + 2697 T$$
$$+ 20227$$

$$\boxed{T = 12.7°C}$$

Heininger