

# AP Physics - Temperature - Specific Heat

Note Title

12/5/2008

## Specific Heat

From chemistry class

$$Q = mc\Delta T$$

$Q$  = Heat flow into or out of substance [Joules]

$m$  = mass of substance [kg]

$\Delta T$  = temperature change [ $^{\circ}\text{C}$ ]

$c$  = specific heat of substance [ $\frac{\text{Joules}}{\text{kg}\cdot^{\circ}\text{C}}$ ]  
(a material property)

$$c = \frac{Q}{m\Delta T}$$

Different substances have different specific heats.

$$c_{\text{water}} = 4186 \frac{\text{J}}{\text{kg}\cdot^{\circ}\text{C}}$$

## Example

What is the final temperature if we mix 20 kg of  $60^{\circ}\text{C}$  water with 10 kg of  $10^{\circ}\text{C}$  water?

Solution: 2 things will happen

1) All water will reach an equilibrium temperature  $T_{f, \text{hot water}} = T_{f, \text{cold water}} = T_f$

2) Heat lost by the hot water will be gained by the cold water:

$$-Q_{\text{lost}} = Q_{\text{gained}}$$

$$-m_{\text{hot}} c_{\text{hot}} (T_f - T_{i, \text{hot}}) = m_{\text{cold}} c_{\text{cold}} (T_f - T_{i, \text{cold}})$$

$$-20 \cdot (T_f - 60) = 10 \cdot (T_f - 10)$$

$$-20 T_f + 1200 = 10 T_f - 100$$

$$1100 = 30 T_f$$

$$T_f = 43^\circ \text{C}$$