Heat

A transfer of energy (from a warmer to a colder object).

Heat is measured in joules (J)

Temperature

A measure of the average kinetic energy contained in the motion of particles.

Temperature is measured in degrees Celsius (℃) or in Kelvin (K)

Heat *(energy transferred to or from a substance)* is a function of three variables:

The _mass_ of the substance, the _type_ of substance being heated or cooled, and the ___change in temperature___ of the substance.

Heat formula:

$$Q = m\ c\ \Delta T$$

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

Heat (J)

Mass (g)

Specific Heat Capacity $\left(\frac{\mathrm{J}}{\mathrm{g}\ {}^{\circ}\mathrm{C}}\right)$

Change in Temperature (℃)

*('**C**' Takes into account **what** substance is being heated or cooled)*

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

Specific heat capacity (c) is a ____characteristic____ property of a substance that describes how much ____energy____ per unit ____mass____ is needed to raise the ____temperature____ of that substance by ____1 °C____ or by ____1 K____.

Specific Heat Capacity of Water: $c_{water} = 4.19\,\frac{\mathrm{J}}{g\ ℃}$

$$Q = m\ c\ \Delta T$$

Ex I: A 50.0 g sample of water is heated from an initial temperature of 24.0 °C to its boiling point.

How much heat was transferred into the water?

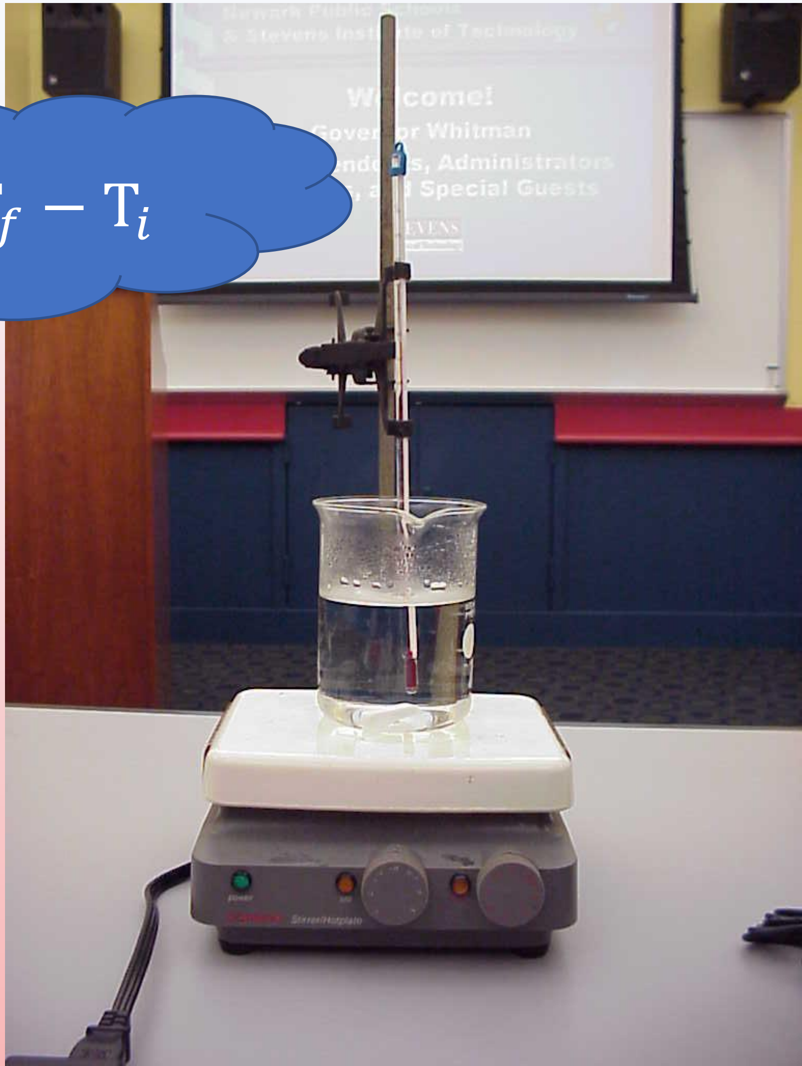
$$Q = m\ c\ \Delta T$$

$$\Delta T = T_f - T_i$$

$$Q = (50.0\ \text{g})\left(4.19\,\frac{\text{J}}{g\ ^\circ\text{C}}\right)(100.0^\circ\text{C} - 24.0^\circ\text{C})$$

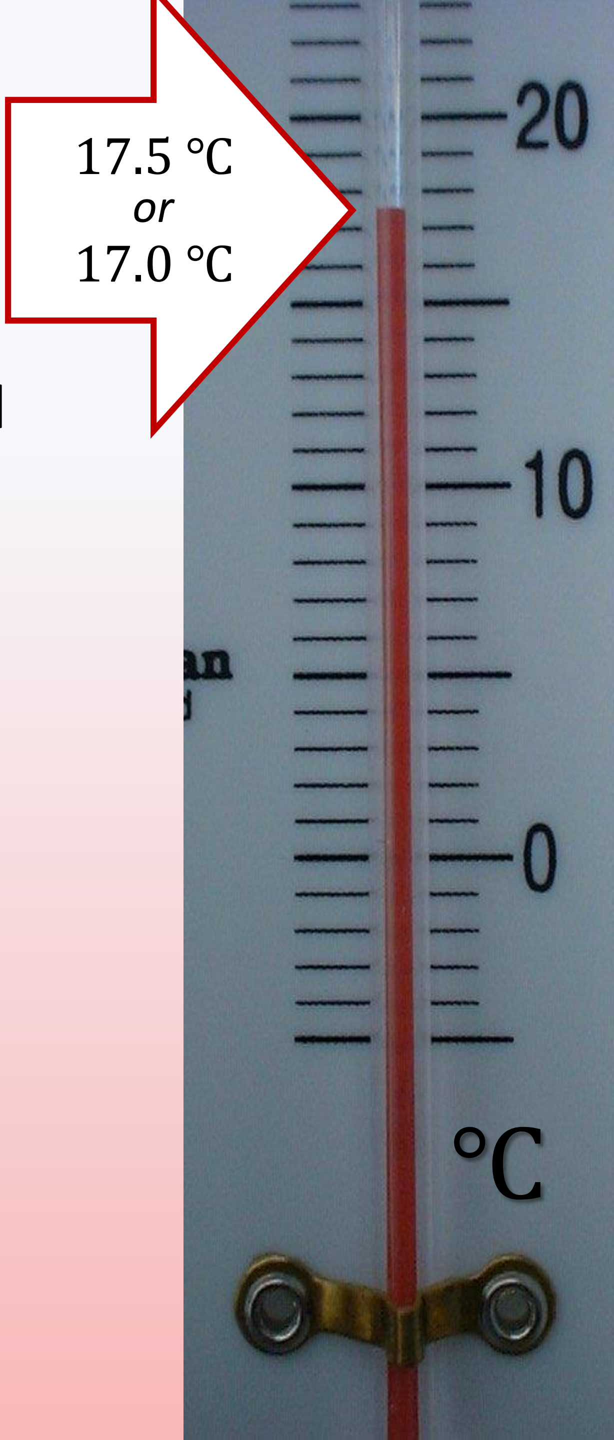
$$Q = (50.0\ \text{g})\left(4.19\,\frac{\text{J}}{g\ ^\circ\text{C}}\right)(76.0^\circ\text{C})$$

$$\boxed{Q = 15900\ \text{J}}$$



$$Q = m\ c\ \Delta T$$

Ex II: A 250 mL sample of water has an initial temperature as shown on the thermometer to the right.
If 56.0 kJ of heat energy is transferred into this water, what will be the final temperature of the water?



$$Q = m\ c\ \Delta T$$

$$56\ 000\ \text{J} = (250.0\ \text{g})\left(4.19\,\frac{\text{J}}{g\ {}^\circ\text{C}}\right)(\text{T}_f - 17.5{}^\circ\text{C})$$

$$53.46\ {}^\circ\text{C} = \text{T}_f - 17.5\ {}^\circ\text{C}$$

$$\boxed{\text{T}_f = 71.0\ {}^\circ\text{C}}$$

$$Q = m\ c\ \Delta T$$

Ex III: A 40.0 mL sample of vegetable oil requires 621 J of heat to increase its temperature by 10.0 ℃. Vegetable oil has a density of 0.93 g/mL. Determine the specific heat capacity of vegetable oil.

We need the mass of the oil:

$$\rho = \frac{m}{V}$$

$$0.93\text{g/mL} = \frac{m}{40.0\text{ mL}}$$

$$m = 37.2\text{ g}$$

$$Q = m\ c\ \Delta T$$

$$621\text{ J} = (37.2\text{ g})\ c\ (10.0\text{ °C})$$

$$c = 1.67\,\frac{\text{J}}{\text{g °C}}$$

Workbook (Transformations and Energy)

Pages ??