Heat, Temperature, Internal Energy Specific Heat and Calorimetry

Definitions

Heat - energy transferred from one body to another due to a difference in temperature.

Unit of heat - the calorie (cal) - the amount of heat necessary to raise the temperature of 1 gram of water by 1 degree Celsius.

Also kilocalorie - the amount of heat necessary to raise the temperature of 1 kg of water by 1 degree Celsius. This is also called the Calorie (Cal).

Btu (British Thermal Units) - the amount of heat needed to raise the temperature of 1 lb of water by 1 F°.

Thermal energy / Internal energy - the sum of all the energy of all the molecules in an object.

Temperature - refers to the average KE of the molecules in a substance. (2 objects may have the same T, but one has a greater internal energy)

Heat - transfer of energy

Internal energy of ideal gas

$$U = N\overline{KE} = N\left(\frac{1}{2}m\overline{v^2}\right) = \frac{3}{2}NkT = \frac{3}{2}nRT$$

$$= \frac{3}{2}PV$$

Specific Heat

p 421 text - specific heat

c

$Q = mc\Delta T$

heat transferred → Q

c ← specific heat

c measured in

$C_{H_2O} = 1.00\ cal/g C^\circ$ cal/g C°

$= 1.00\ kcal/kg C^\circ$ kcal/kg C°

$= 4186\ J/kg C^\circ$ J/kg C°

Calorimetry - Cons of energy

$$Q_{lost} = Q_{gained}$$

$\rho_{H_2O} = 1.0\ g/mL$

Example

A 50 g ice cube at -5.0°C is placed in a Styrofoam cup, which is a good insulator of heat, full of water (250 mL) at 10.0°C. How much does the water cool as the ice warms to the melting point (not including melting the ice - this involves something called latent heat - another lesson).

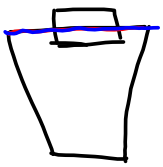
$$Q_{lost\ H_2O} = Q_{gained\ ice}$$

$$= (mc\Delta T)_{H_2O} = (mc\Delta T)_{ice}$$

for equality

since ΔT is neg here and pos here

$C_{ice} = 0.50\ \frac{cal}{g \cdot C^\circ}$



When the ice cube melts the water level

A. overflows
B. stays the same
C. decreases.