

Temperature & Heat

Heat Capacity

- Early scientists thought: heat = invisible fluid called 'caloric'. It flowed from hot → cold.
- Daniel Bernoulli (1700's) – gases = moving particles and heat is the Ek of movement.
- James Joule (1845) showed work → can produce temperature change.

In fact – 4.184 J of Energy raised 1.00 g from 14.5 C → 15.5 C.

We say the 'heat capacity' of water is 4.184 J/g °C

...since 1 g of water is so smallwe ramp this up....

Heat capacity of water is 4200 J/kg°C

...physicists love symbols...so heat capacity of water is C_w

$$C_w = 4200 \text{ J/kg}^\circ\text{C}$$

It takes 4200 Joules of energy to heat 1 kg of water up 1 °C !

Aside: The heat capacity of air is 1000 J/ kg°C. It takes less energy to heat up. So...air

Heats up faster than water. You probably know this from summer swimming!

Thermal Energy

- Kinetic molecular theory of matter – all particles in motion
- (Elastic) potential energy = force of attraction between molecules
- Thermal energy = total Ek and elastic potential energy. It is an internal energy.

Temperature

- Average Ek of the molecules of a substance. Faster they are moving (in a gas), the greater the temperature. Slower they are moving (in a solid), the lower the temperature. **think about how a thermometer works when we discuss heat!).

Heat

- Heat is the energy from warmer → cooler object.
- We know energy transfers when work is done and something needs to move. Heat is energy transfer at a microscopic level! Atoms & molecules.
- Hot chocolate
 - 1) h. choc. molecules hot! Moving fast.
 - 2) h. choc. molecules bump into cup molecules..they move faster!
So cup heats up and h. choc. cools a little. Energy of drink transfer to cup
 - 3) Hands on mug. Now thermal energy of cup transfer to hand. You feel the 'heat'!

Friction and Heat

- Friction opposes motion. Object loses Ek...surfaces gain thermal E. (conservation of E)
- So...any time 2 moving objects in contact causes rise in temperature.

Thermal Energy Transfers

- Conduction – objects in direct contact
- Convection – thermal energy transfer by fluid motion (liquid / gas)
- Radiation – transfer of energy through EMR (vis. Light, Infrared, UV)

Insulation

- Can't stop transfer of thermal energy (unless both same temperature), but can slow
- Thermal insulation – materials or methods that reduce rate of thermal energy transfer
- Steps
 - 1) Seal it well – prevent convection
 - 2) Reflect it back – prevent radiation
 - 3) Put it in a blanket – prevent conduction

