INTERNAL ENERGY:
"SUM OF KE + PE OF ALL PARTICLES IN A SUBSTANCE."
- RAISE TEMP → KE
- CHANGE STATE → PE

CHANGING TEMP:

$$E = m \times SHC \times \Delta T \quad (\Delta\theta)$$

(Q)

SPECIFIC HEAT CAP (c)

* IF SOLID MELTS AND TEMP ↑,

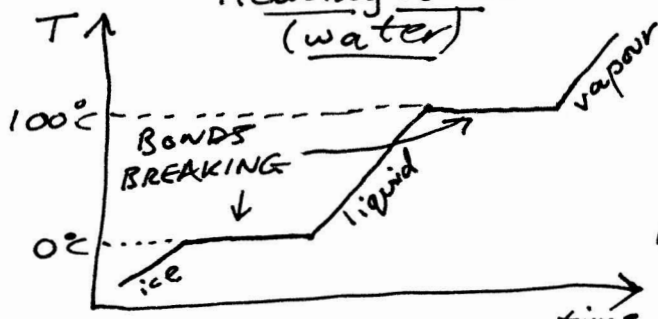
$$E = m((SHC \times \Delta T) + SLH)$$

* IF 2 SUBSTANCES TOUCH, REACH COMMON TEMP e.g.

$$m_1 c_1 (T - T_1) = m_2 c_2 (T_2 - T)$$

* CONDUCTION: HEAT TRANSFERRED THROUGH VIBRATIONS.
* CONVECTION: HOT SUBSTANCE RISES, COLD SUBSTANCE FALLS
* RADIATION: INFRA-RED EM WAVE ABSORBED.

Heating Curve (water)



CHANGING STATE:

$$E = m \times SLH$$

SPECIFIC LATENT HEAT (L) (FUSION/VAPOURISATION)

WHEN CHANGING STATE, ENERGY/HEAT DOES NOT INCREASE KE, ONLY PE BY BREAKING PHYSICAL BONDS (NOT CHEMICAL).

GASES

Boyle's: $P \propto \frac{1}{V}$

Charles's: $V \propto T$

Pressure: $P \propto T$

Gaslaw: $pV = NkT$

$pV = nRT$

Isothermal: T constant
$\therefore p_1V_1 = p_2V_2$ $\Delta U = 0$

Isobaric: P constant $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Isochoric: V constant $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

Adiabatic: $Q = 0 \therefore \Delta U = -W$ $p_1V_1^{\gamma} = p_2V_2^{\gamma}$

Otto Cycle: Petrol

1st law of thermo:

$$Q = \Delta U + W$$

(heat ↑, int E ↑, work done ↑ (expansion))

Kinetic Theory:

Assumptions (THERMR)

R - Random motion
A - Attraction (none)
V - Volume (negligible)
E - Elastic collisions
D - Duration of collisions short.

$$pV = \frac{1}{3} N m c_{rms}^2$$

(c_{rms}^2 = mean square speed, m^2s^{-2})

$$p = \frac{1}{3}\left(\frac{Nm}{V}\right) c^2 = \frac{1}{3}\rho c^2$$

$$pV = \frac{1}{3} N m c_{rms}^2 = NkT$$

$$E_K = \frac{1}{2} m c_{rms}^2 \quad \therefore \boxed{E_K = \frac{3}{2}kT}$$

BROWNIAN MOTION: RANDOM MOTION - PROVED BY SMOKE PUSHED AROUND BY AIR.

Diesel

2nd law:

Heat cannot be converted into work unless it flows from a hot space to a cold one (aka no engine is 100% efficient).

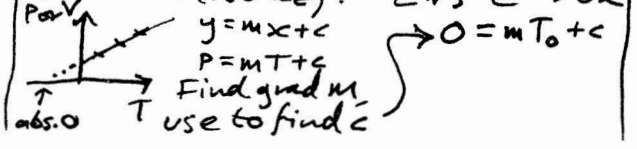
$$\varepsilon = \frac{T_H - T_C}{T_H}$$

HEAT ENGINE

HEAT PUMP COP $= \frac{T_H}{T_H - T_C}$

FRIDGE COP $= \frac{T_C}{T_H - T_C}$

ABS. ZERO (NO KE): $-273°C \rightarrow 0K$



× #cylinders × cycles per sec = INDICATED P.

* THERMAL ε = INDICATED P / INPUT P (fuel)
* MECH ε = BRAKE (OUTPUT) P / INDICATED P
* OVERALL ε = BRAKE P / INPUT P