PRE-U REVISION NOTES.

THERMAL PHYSICS (I)

TEMPERATURE & HOW TO MEASURE IT
IDEAL GASES. LATENT HEAT OF FUSION & VAPORIZATION. COOLING CURVES

Thermodynamics is the physics of heat, what it is and how it is transported. Heat is the kinetic energy associated with the random motion of a large number of molecules which constitute a gas, liquid or solid. It is a statistical theory i.e. properties such as pressure, temperature and density are averages.

The **Kelvin** Scale of temperature (T) is proportional to the mean kinetic energy of molecules

For a gas:

$$U = \alpha \times \tfrac{1}{2} n R T$$

- U: Internal energy
- α: Degrees of freedom of molecular motion (x, y, z so $\alpha = 3$ for most gases)
- n: # moles of gas
- R: Molar gas constant $8.314\ J mol^{-1} k^{-1}$
- T: 'Absolute' temperature / k

↑ i.e. where we can ignore the effect of intermolecular forces as molecules are moving too fast and density is low i.e. mean free path >> molecular dimensions

1 Mole = N_A Molecules

$N_A = 6.02 \times 10^{23}$ (Avogadro's number)

Celsius scale is based upon the freezing (0°C) and boiling (100°C) points of water at at 1 atmosphere (101,325 Pa)

$$T_C = T - 273$$

Fahrenheit is based upon cold brine (0°F) and the human body temperature (37°C or 100°F)

$$T_F = \frac{9}{5}(T - 273) + 32$$

when $T_C = -40°C$, $T_F = \frac{9}{5}(-40) + 32 = -40$ i.e. $T_C = T_F$

To **measure temperature**, we ideally require a sensor that varies (in a measurable quantity) in a linear fashion between two fixed points of known temperature (eg 0°C and 100°C).