PHYSICS Lesson 1-3 Change of State

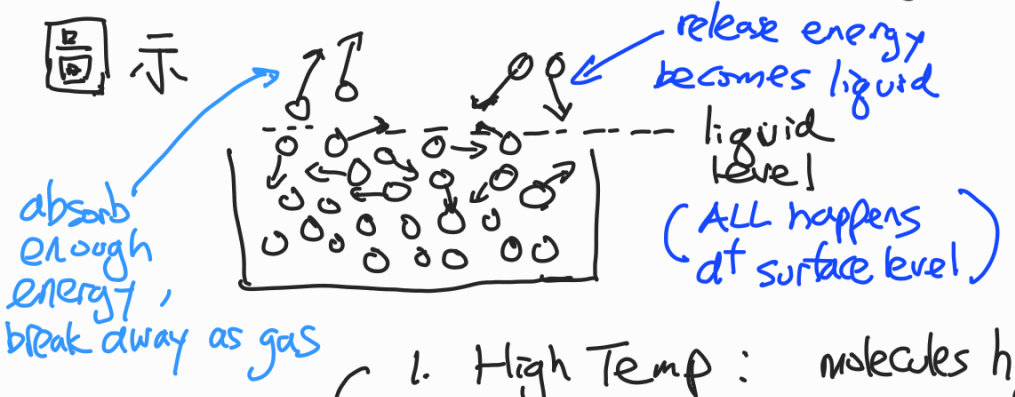
Evaporation and Condensation

matters have 3 states: Solid, Liquid, Gas

Evaporation: change state from liquid to gas, at the surface

Condensation: chage state from gas to liquid

圖示



} escape: liquid to vapour
return: vapour to liquid

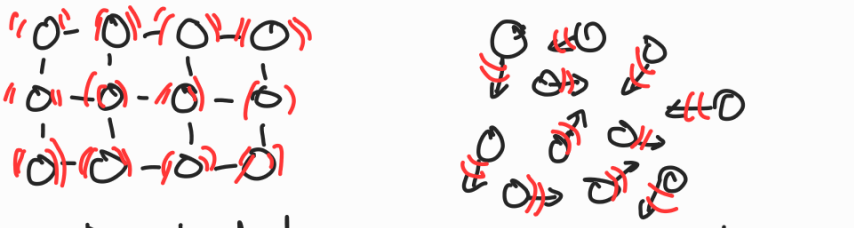
Factors for evaporation
1. High Temp: molecules higher speed, easier to escape
2. Large surface: more molecules spread out on surface
3. Low humidity: reduce the rate of condensation
4. windy: vapour is carried away by wind

Evaporation and Boiling

Evaporation	vs	Boiling
At surface only		throughout liquid
At any temperature		at Boiling Point
No vapour bubbles		Vapour bubbles
gently		Vigourously

Melting and Freezing

FREEZING



SOLID - bonded

LIQUID - break away

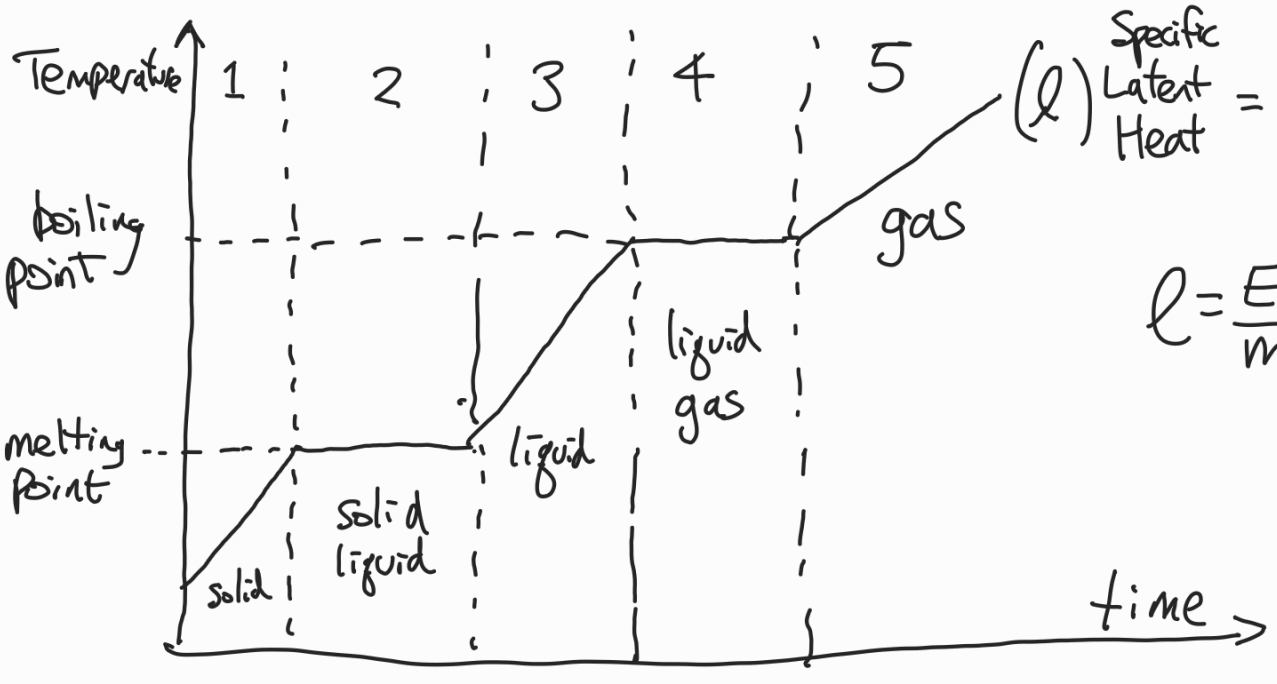
MELTING

LATENT HEAT

Latent Heat is the energy absorbed/released when change state

* During change state molecules arrangement is changed, but the temperature remains unchanged.

Latent Heat = Energy required in change in Molecular P.E. (unit: J)



(ℓ) Specific Latent Heat $= \frac{\text{latent Heat}}{\text{mass}} = \frac{E}{m}$

$\ell = \frac{E}{m}$ unit J/kg

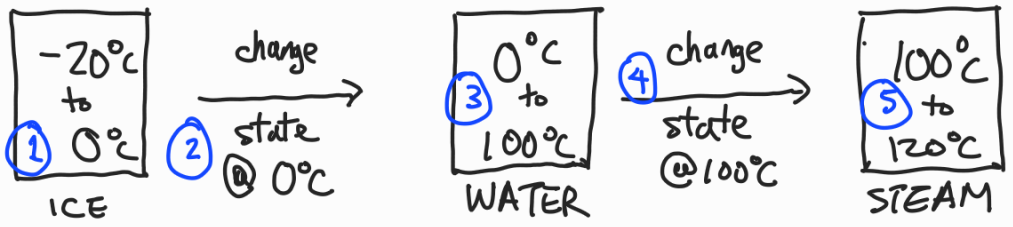
Example: SLH (fusion): $\ell = 334{,}000$ J/kg

For water SLH (vaporization) at 100°C: $\ell = 2260{,}000$ J/kg

Solving a general problem : change 0.5kg -20°C ICE to 120°C STEAM

How much energy is required ?

Total energy required :



1. ICE -20°C to 0°C $E_1 = mC_1\Delta T_1 = 0.5 \times 2.1 \times 20 = 21\ kJ$
2. change state ice → water $E_2 = m l_f = 0.5 \times 334k = 167\ kJ$
3. WATER 0°C to 100°C $E_3 = mC_3\Delta T_3 = 0.5 \times 4.2k \times 100 = 210\ kJ$
4. change state water to steam $E_4 = m l_v = 0.5 \times 2260k = 113\ kJ$
5. STEAM 100°C to 120°C $E_5 = mC_5\Delta T_5 = 0.5 \times 1.9 \times 20k = 19\ kJ$

Add together $E_1 + E_2 + E_3 + E_4 + E_5 = 1517\ kJ$

$= 1.55\ MJ$

Reference Table

SLH of fusion of ice : 334 kJ/kg
SLH of vapourization of water : 2260 kJ/kg
SHC of ice : 2.1 kJ/kg°C
SHC of water 4.2 kJ/kg°C
SHC of water vapour 1.9 kJ/kg°C

~ END OF LESSON 3-1 ~