Fusion (melting)

$s \rightarrow l$; ΔH_{fus}, endothermic ($\Delta H = +ve$) — positive

- have to break <u>some</u> IMF

(s) $\xrightarrow[\text{some IMF}]{\text{break}}$ (l) $\xrightarrow[\text{remain. IMF}]{\text{break all}}$ (g)
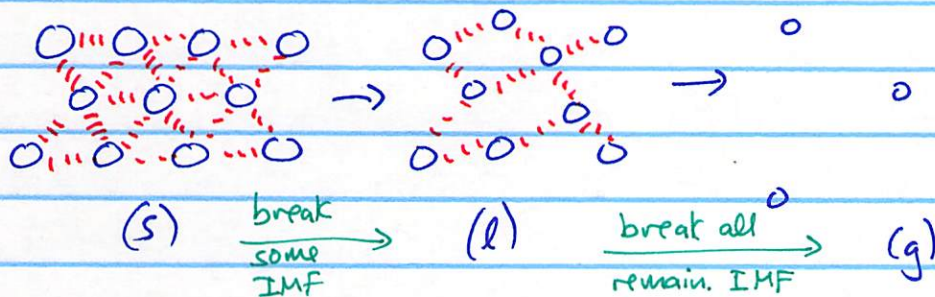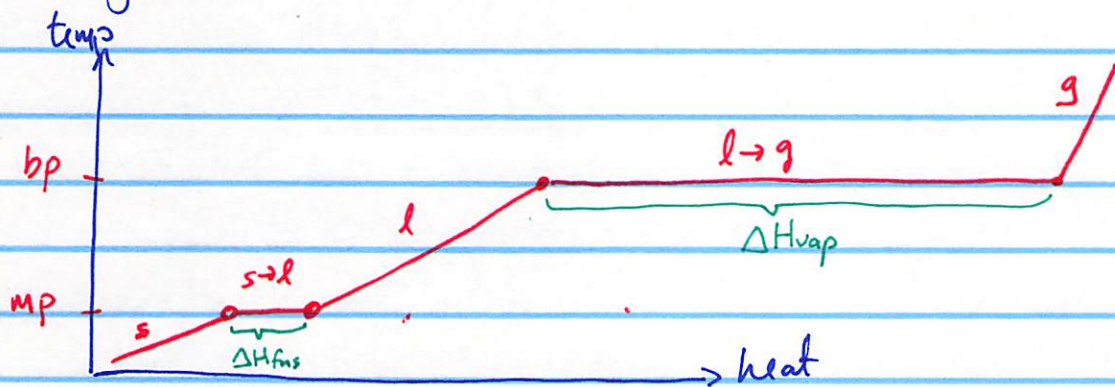
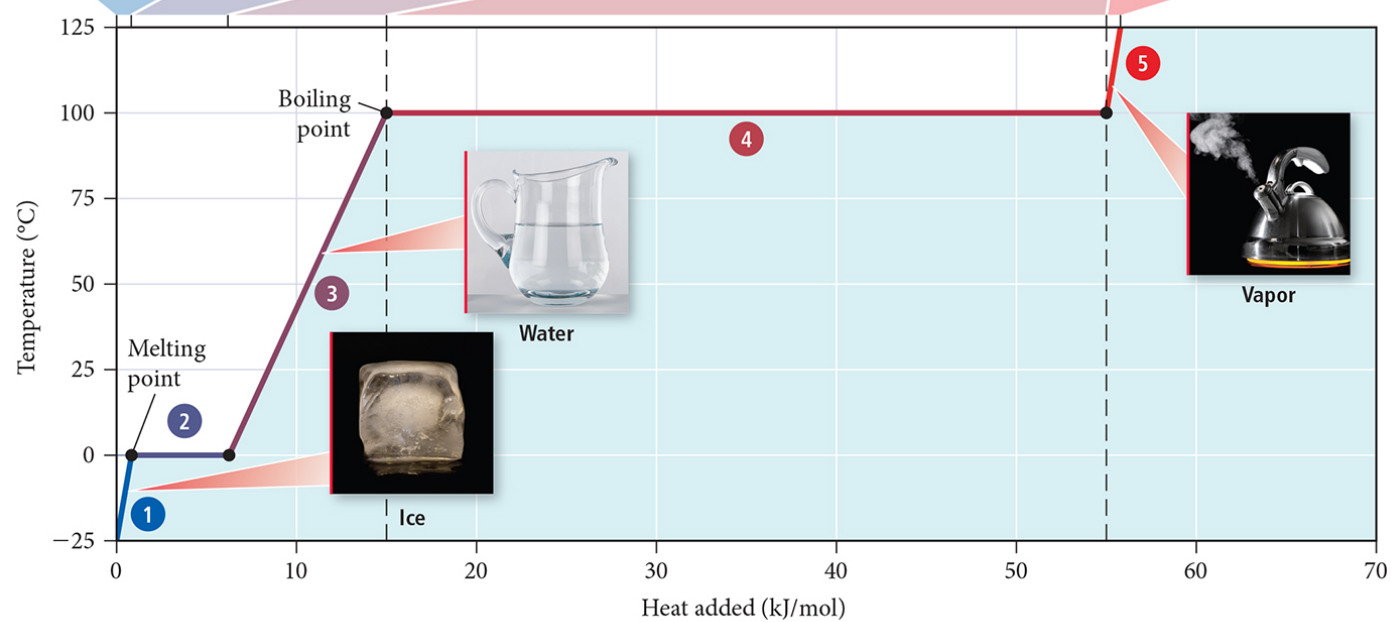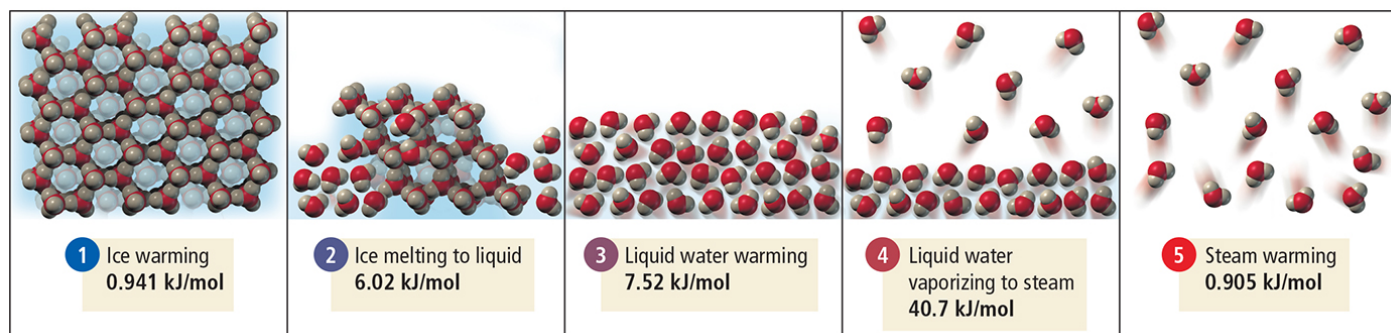in general: $\Delta H_{fus} < \Delta H_{vap}$

H_2O: $\Delta H_{fus} = +6.01 \text{ KJ/mol}$

$\Delta H_{vap} = +40.7 \text{ KJ/mol}$

1/25/2019

Heating curve:

1 Ice warming 0.941 kJ/mol	**2** Ice melting to liquid 6.02 kJ/mol	**3** Liquid water warming 7.52 kJ/mol	**4** Liquid water vaporizing to steam 40.7 kJ/mol	**5** Steam warming 0.905 kJ/mol

Boiling point

Melting point

4

3

5

2

1

Water

Ice

Vapor

Temperature (°C)

Heat added (kJ/mol)

Sublimation

$(s) \longrightarrow (g)$; ΔH_{sub} (have to break _all_ IMF)

$$\Delta H_{sub} > \Delta H_{fus}, \Delta H_{vap}$$

ex: $H_2O(s) \longrightarrow H_2O(g)$; $\Delta H_{sub} = +46.7 \text{ kJ/mol}$
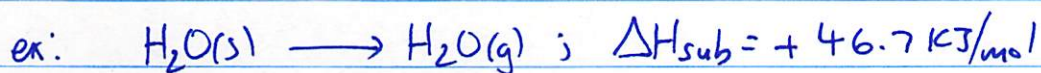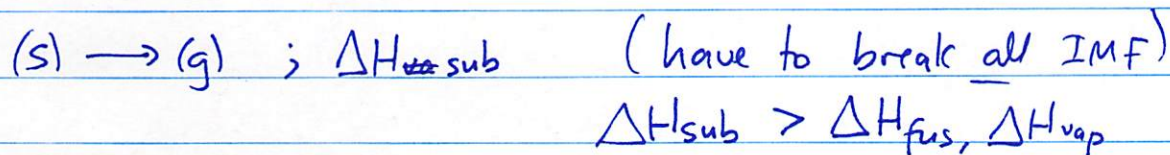
recall: H is a state fxn!

$$\overset{\Delta H_{sub}}{(s) \longrightarrow (g)}$$

$\Delta H_{fus} \searrow \quad \nearrow \Delta H_{vap}$

(ℓ)
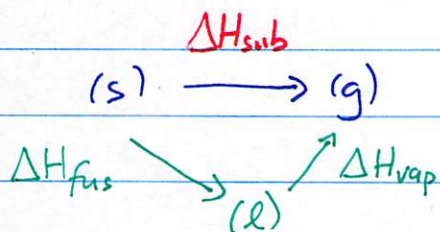
$$\Delta H_{sub} = \Delta H_{fus} + \Delta H_{vap}$$
$$= 6.01 \frac{kJ}{mol} + 40.7 \text{ kJ/mol}$$
$$= +46.7 \text{ kJ/mol}$$

Phase Diagram

- Map of most stable phase of a substance (P, T)

ex: H_2O

@ high P, lower mp

$s \rightleftharpoons l$

unusual $-ve$ slope (H_2O)
because: $d_{SOLID} < d_{LIQ}$

MP

LIQUID

SOLID

CRITICAL POINT

SUPER CRITICAL FLUID

760 mmHg

MP

bp

P_3
4.6 mmHg

BP

$l \rightleftharpoons g$

triple point

s, l, g @ eq^m

T_3, P_3

$s \rightleftharpoons g$

GAS

$\rightarrow T$

0°C
(nmp)

100°C
(nbp)

$T_3 = 0.01°C$
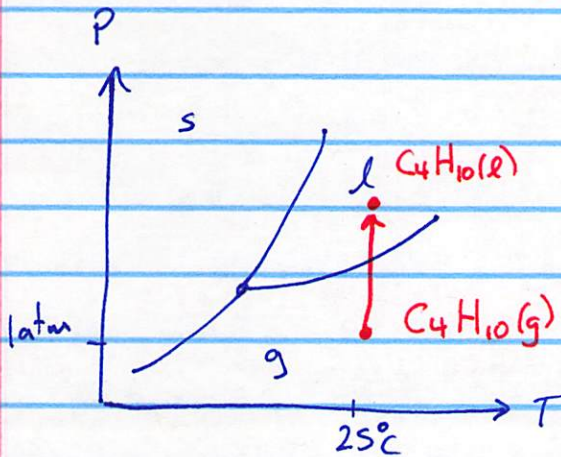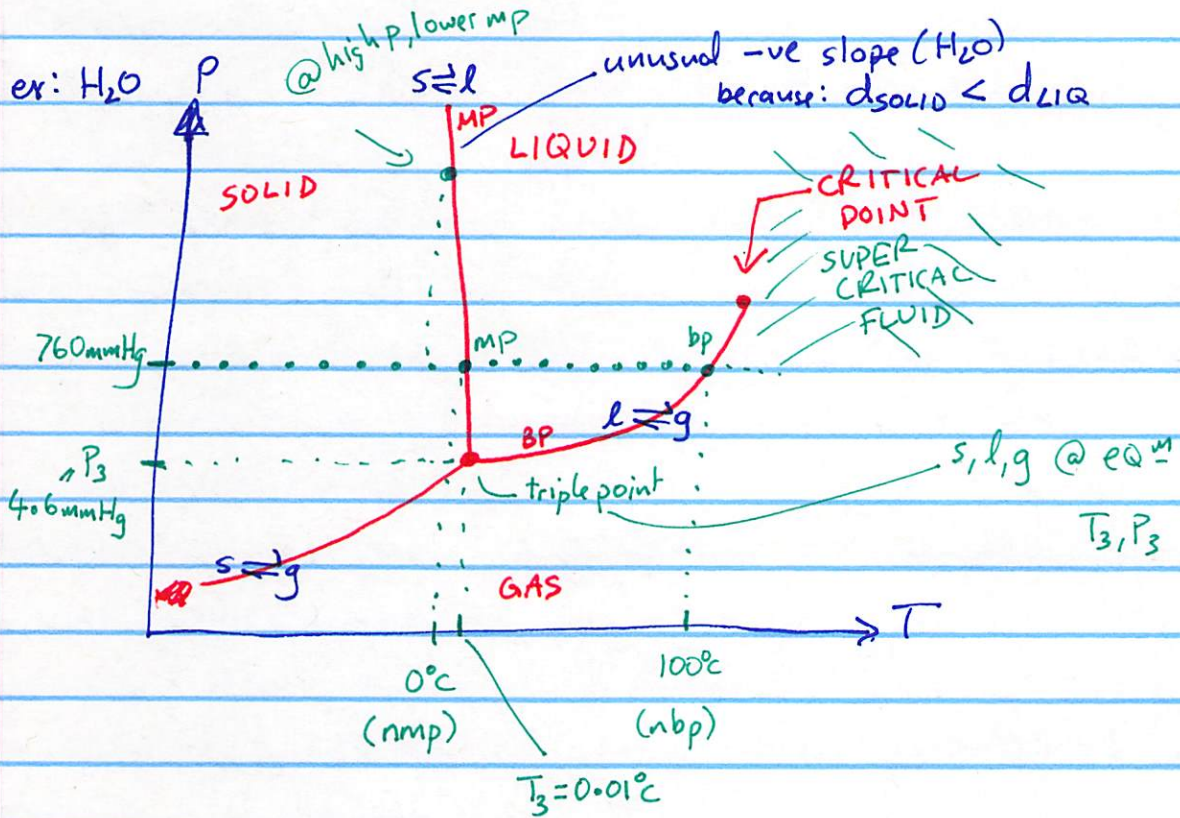
Butane: C_4H_{10} (lighters)

P

s

l $C_4H_{10}(l)$

$C_4H_{10}(g)$

- liquify gases using P !

1 atm

g

$\rightarrow T$

25°C

Phase Diagram for Water