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# SOLIDIFICATION & DISPERSION STRENGTHENING

when solubility of a material is exceeded by adding too much of an alloying element, a second phase forms and a two phase alloy is produced. The boundary between the two phases is a surface at which atomic arrangement is not perfect. The boundary interferes with slip of dislocations and strengthens the material. This is called dispersion strengthening.

## Phase Diagrams Containing Three Phase Reactions of Pure Substances

A phase in a material is a region that differs in its microstructure and/or composition from another region. Phase diagrams are graphical representations of what phases are present in a material system at various temperatures, pressures, and compositions. Most phase diagrams are constructed by using equilibrium conditions.

Equilibrium phase diagrams are determined

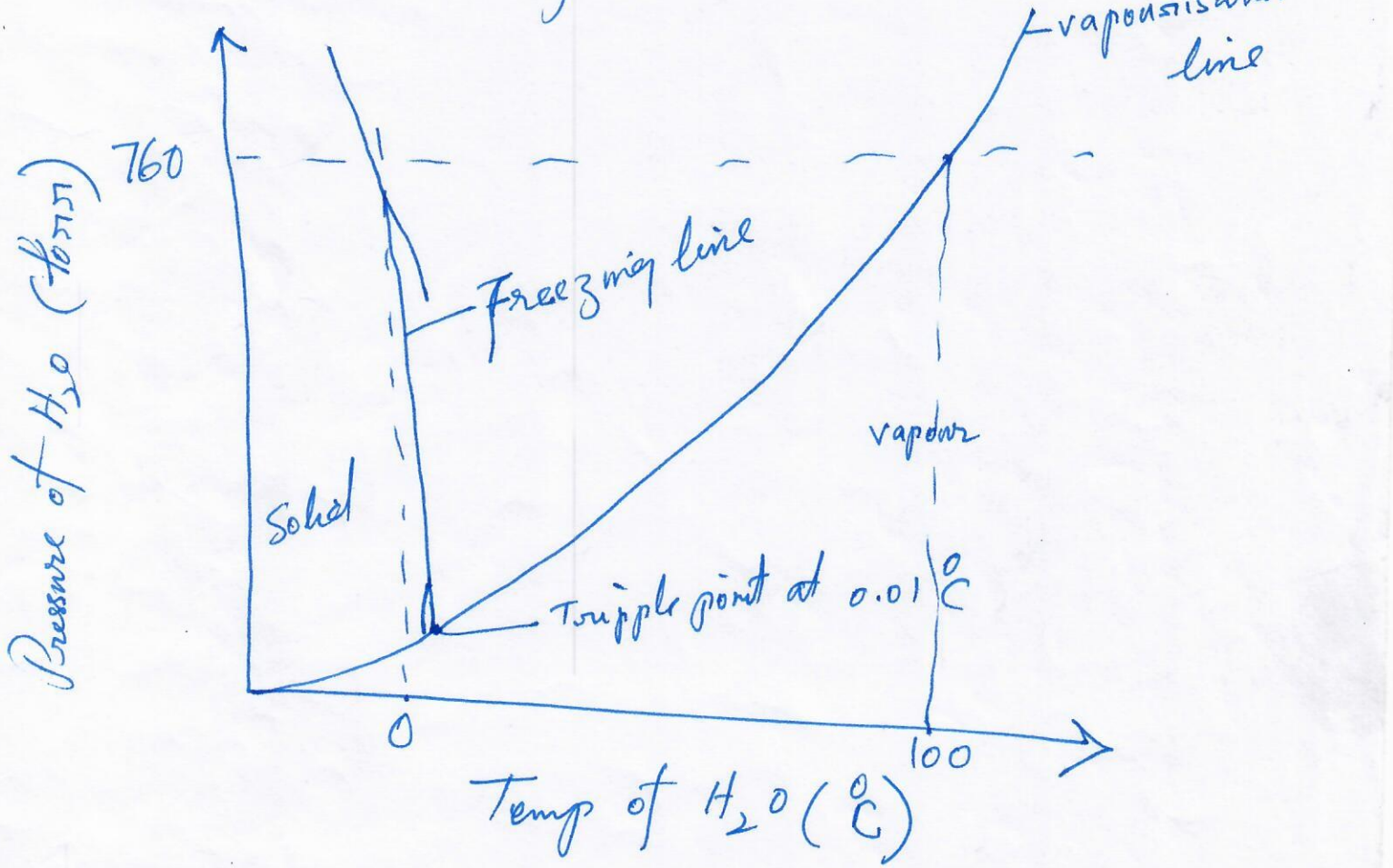
thermal

# Equilibrium

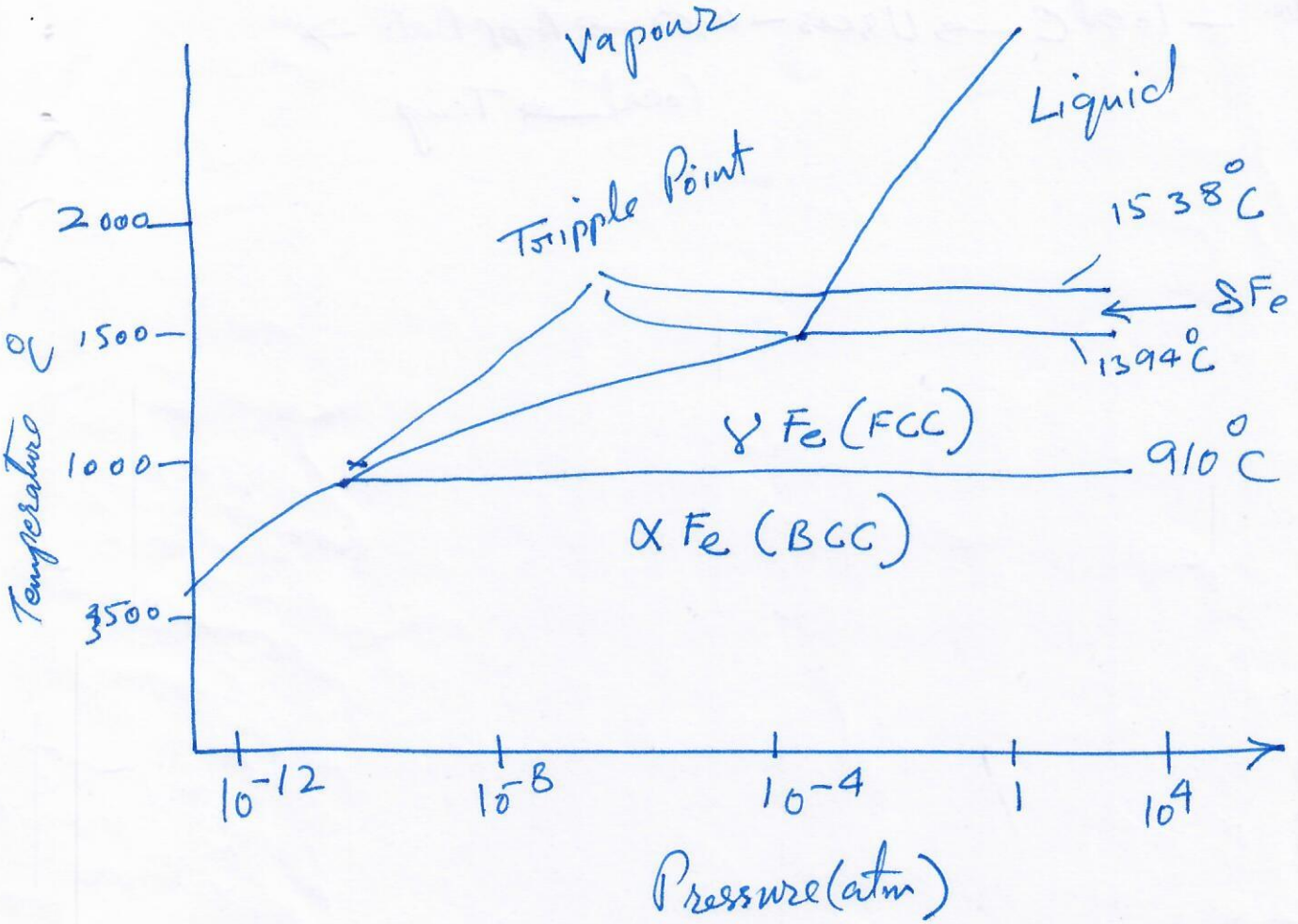
what water and ice exist in a glass, the two phases are separated by a phase boundary and are in equilibrium with each other.

definite chemical composition

## Phase Diagrams of Pure Substances




Approximate PT ~~diagram~~ equilibrium phase diagram of pure water.




Approximate PT equilibrium phase diagram for pure iron.

In the pressure-temperature (PT) phase diagram of water there exists a tripple point at low pressure (4.579 torr) and low temperature (0.0098°C) where solid, liquid and vapour phases of water coexist. Liquid and vapor phases exist along the vapourisation line and liquid-solid phases

Pressure–temperature equilibrium phase diagrams also can be constructed for other pure substances. The equilibrium P-T phase diagram for pure iron is given.

One major difference with this phase diagram is that there are three separate and distinct solid phases:

Alpha ($\alpha$) Fe ← FCC
Gamma ($\gamma$) Fe ← FCC
Delta ($\delta$) Fe ← BCC

Alpha ($\alpha$) and Delta ($\delta$) iron have BCC crystal structures
Gamma ($\gamma$) has FCC structure

The phase boundaries in the solid state have the same properties as the liquid and solid phase boundaries. For example
Under equilibrium conditions, alpha and

and 1 atm pressure.

Above 910°C only single phase gamma(γ) exists. and below 910°C only single phase alpha exists.

There are also three tripple points (in the iron PT diagram where three different phases coexist:

(1) liquid, vapor and δFe (solid)

(2) ~~δFe~~ vapor, δFe (solid) and γFe (solid)

(3) vapor, γFe (solid) and αFe (solid)

## GIBBS PHASE RULE

$$P + F = C + 2$$

P → Number of phases that coexist in a chosen system

C → Number of components in the system

F → Degrees of freedom

no. of elements

C → It is an element, compound or solution in a system

F → degrees of freedom
in the number of variables (pressure, temperature and composition) that change independently without changing phases in equilibrium in chosen system.