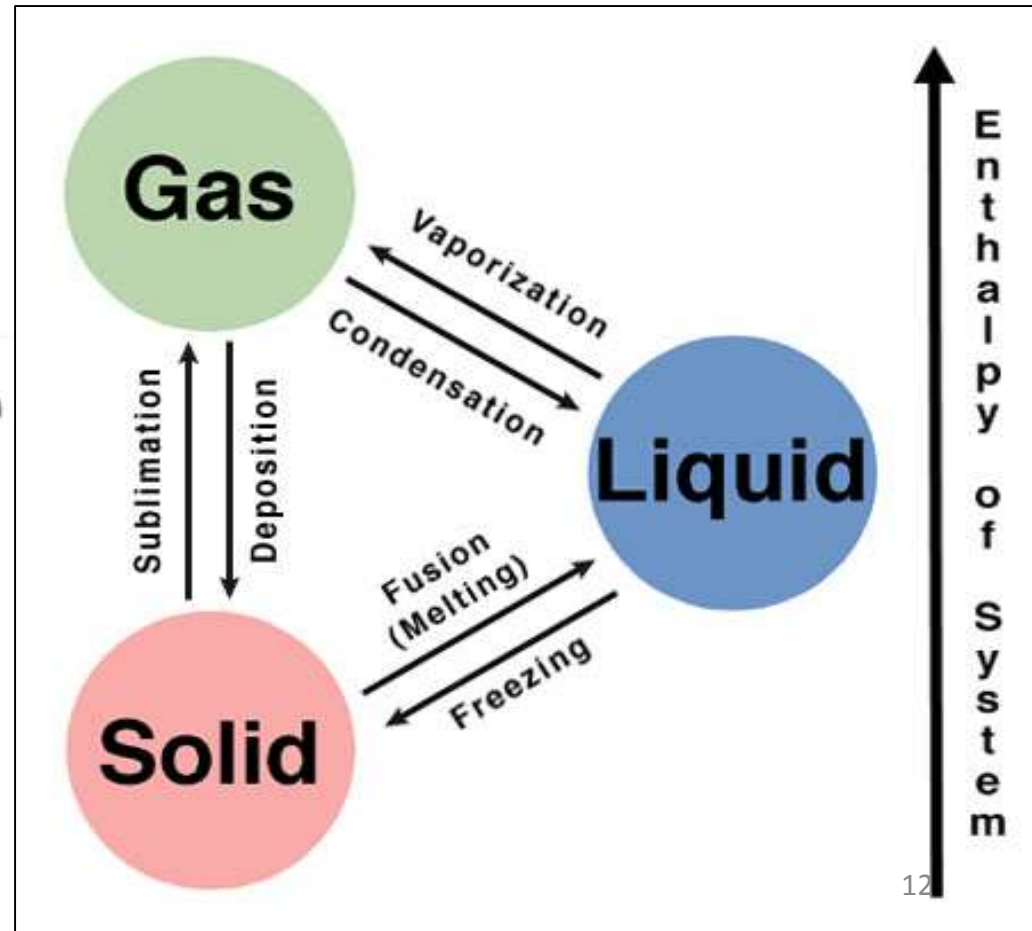
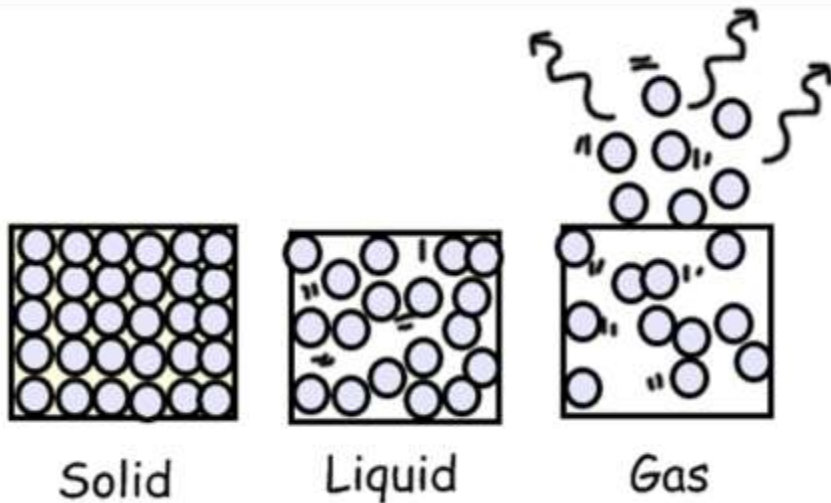


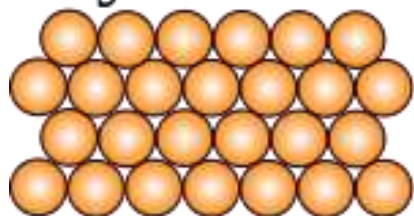
States of matter

- Gases, liquids, and crystalline solids are the three primary states of matter.

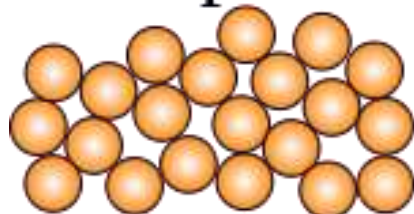


Solids

crystalline




amorphous



Crystalline Solids	Amorphous solids
They have a definite shape and geometrical form.	They do not have a definite geometrical shape.
They have a sharp (definite) melting point.	They melt over a wide range of temperatures.
They are rigid and incompressible.	They too are usually rigid and cannot be compressed to any appreciable extent. However graphite is soft because of its unusual structure.
They give a clean cleavage, i.e, break into pieces with plane surfaces.	They give irregular cleavage.
They have a definite heat of fusion.	They do not have a definite heat of fusion.

Melting point of crystalline solids

- ▶ The temperature at which a liquid passes into the solid state is known as the freezing point. It is also the melting point of a pure crystalline compound.
- ▶ Normal freezing or melting point  (at 1 atm)
- ▶ **heat of fusion:** the heat required to increase the interatomic or intermolecular distances in crystals thus allowing melting.

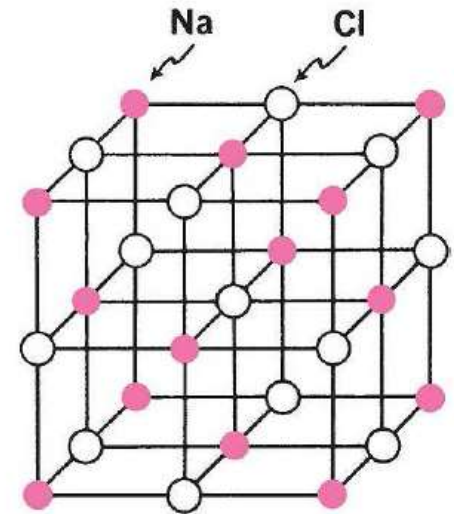
QUIZ

- ▶ How intermolecular forces affect heat of fusion???



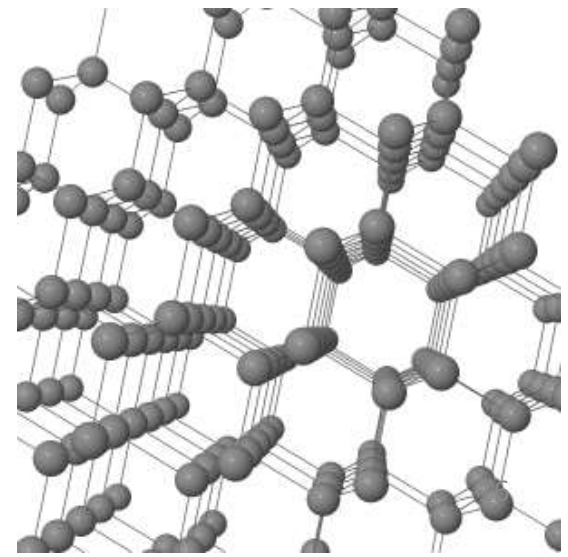
Crystalline solids

- The units that constitute the crystal structure can be atoms, molecules, or ions. The **sodium chloride** crystal, consists of a cubic lattice of sodium ions interpenetrated by a lattice of chloride ions, the binding force of the crystal being the electrostatic attraction of the oppositely charged ions.

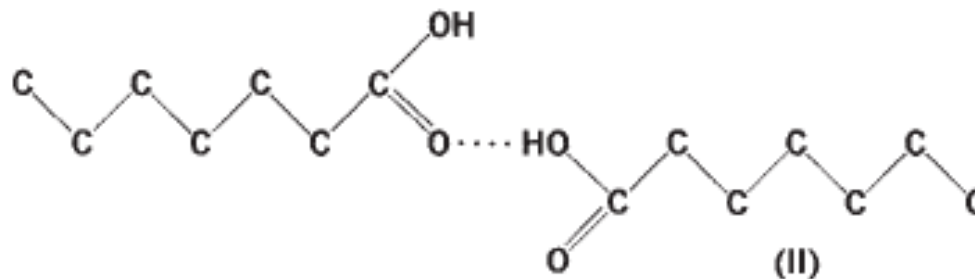
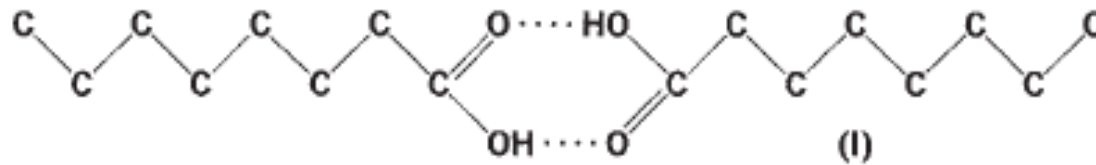


- In **diamond and graphite**, the lattice units consist of atoms held together by covalent bonds.

- In organic compounds, the molecules are held together by **van der Waals forces and hydrogen bonding**, which account for the weak binding and for the low melting points of these crystals.
- **ionic and atomic** crystals in general are hard and brittle and have **high melting points**
- molecular crystals are soft and have relatively low melting points.

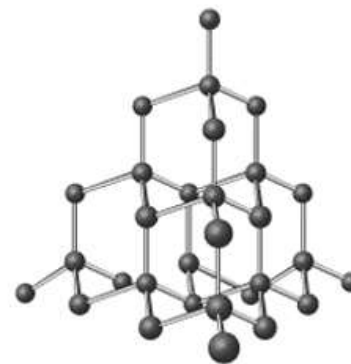


- ▶ Molecular weight, type of intermolecular bonds and molecular configuration, all can affect melting and freezing point of compounds.
- ▶ In the picture below even number chains have higher melting points compared to odd number chains (No, of carbons) **Why???**

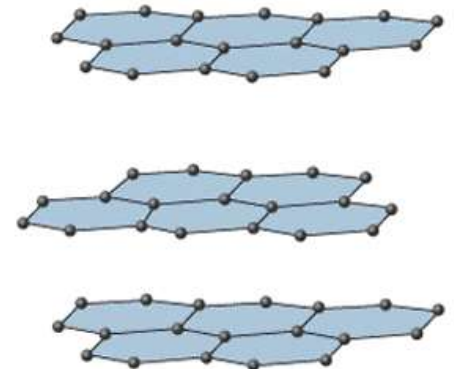


Polymorphism

- When a substance exists in more than one crystalline form, the different forms are designated as polymorphs and the phenomenon as polymorphism.
- Polymorphs have different stabilities and may spontaneously convert from the **metastable** form at a temperature to the **stable** form.
- carbon: diamond in a cubic (tetrahedral lattice arrangement)
- Graphite in sheet of a hexagonal lattice



(a) Diamond



(b) Graphite

- ▶ Depending upon their relative stability, one of the several polymorphic form will be physically more stable than others.
- ▶ **Stable** polymorph represents the lowest energy state, has highest melting point and least aqueous solubility.
- ▶ **Metastable** form represent the higher energy state, have lower melting point and high aqueous solubility .
- ▶ Metastable form **converts** to the stable form due to their higher energy state.
- ▶ Metastable form shows **better bioavailability** and therefore **preferred** in formulations.
- ▶ Only 10% of the pharmaceuticals are present in their metastable form.

Amorphous Solids

- ▶ They differ from crystalline solids in that they tend to flow when subjected to sufficient pressure over a period of time, and they do not have definite melting points.
- ▶ Whether a drug is amorphous or crystalline has been shown to affect its therapeutic activity.
- ▶ the crystalline form of the antibiotic novobiocin acid is poorly absorbed and has no activity, whereas the amorphous form is readily absorbed and therapeutically active.
- ▶ This is due to the difference in the rate of dissolution

