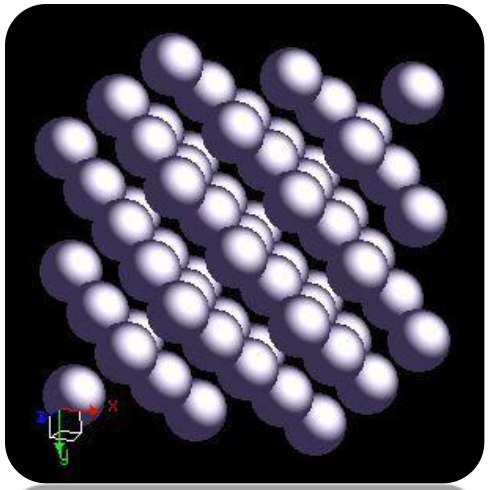
Crystalline & Non-crystalline solids

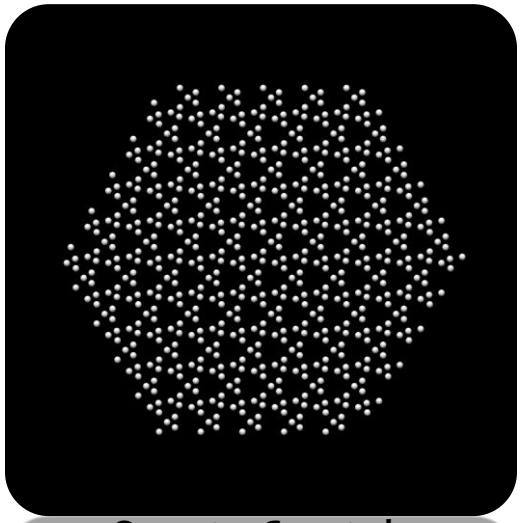
By Kai Song & Rina

Crystalline Solids

* **Crystal:** A collection of atoms or molecules in which each atom is placed precisely in a definite pattern with respect to its neighbors. The pattern is repeated throughout the crystal.



Germanium Crystals



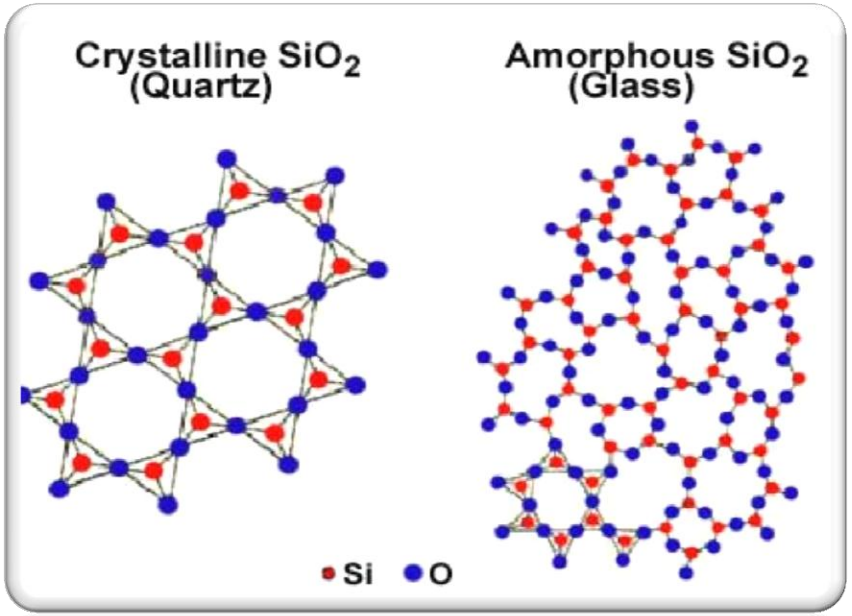
Quartz Crystals

* Crystalline structures crystal-like materials such as salt and sugar, diamond and also metals
* The structure adopted by a crystal depends on factors such as the kind of bonds, the size and the shape of the particles involved.
* Purity of a crystal- Pure crystalline solids melt and freeze sharply. This can be easily explained by noting the similar types of bonding between the atoms, throughout crystal lattice. The bonds break at the same temperature.

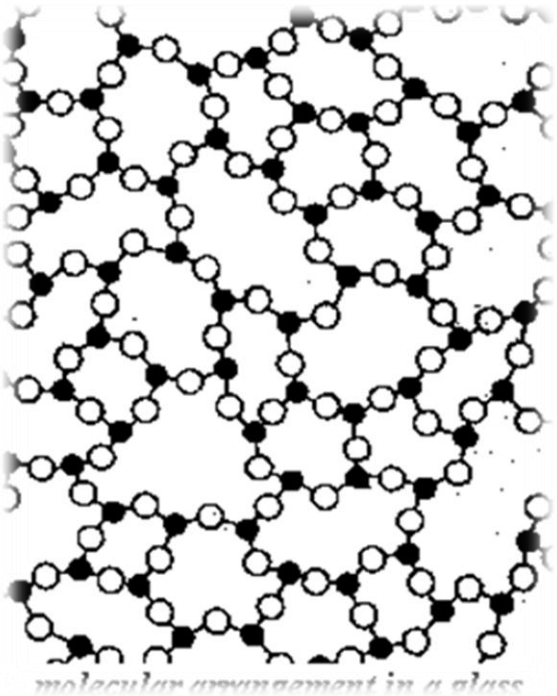
Non – crystalline solids

(A) AMORPHOUS SOLID

* Solids in which their particles are assembled in a more disordered way and only show order for short distances.
* No fixed melting or freezing point. Melts and freezes over a temperature range.
* Examples : glass , ceramics and wax.



- Eg- Glass as an amorphous
- Many types of glass, which are supercooled liquids, are non-crystalline or amorphous in nature.
- Molecules are locked in place but are not arranged in precise pattern. The silicate molecules can be thought of being the positions of the liquid at a particular instant, with no mobility.
- Non-crystalline solid such as glass are usually hard and brittle and do not have high melting point and boiling point.

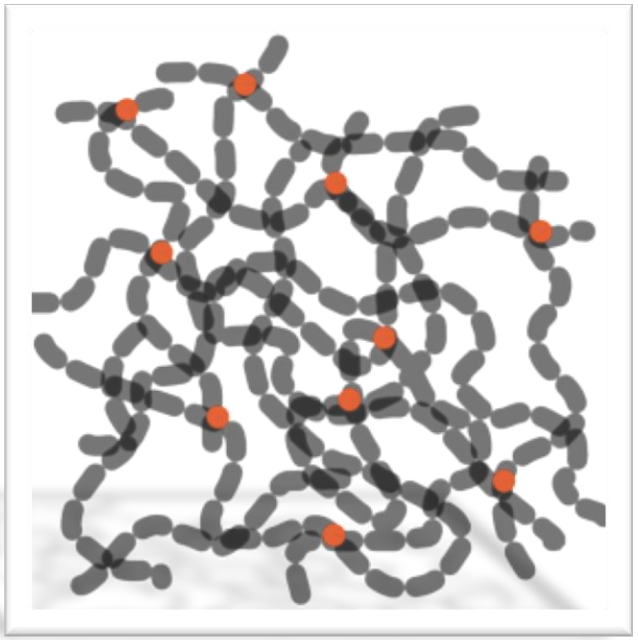


(B) **Polymers**

* Substances which have giant molecules, each containing something like 1000 to 10000 atoms, and are usually carbon (organic) compound.

(i) Natural polymers

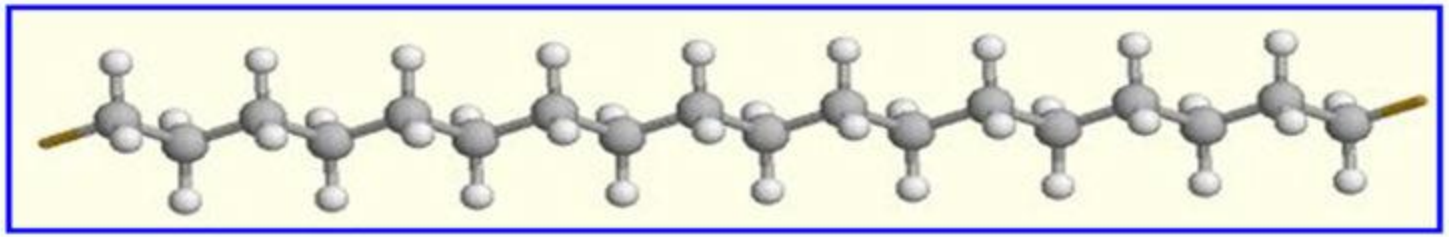
- Each molecule of natural polymer is found to consist of a large number of repeating units called monomers, which are arranged in a long, flexible chain.
- Examples include cellulose, rubber, wool, silks, resins and proteins.



Rubber is a natural polymer consisting repeating units of monomers

(ii) Man-made polymers

- These artificial polymers are made by a chemical reaction called polymerization.
- They are large molecules made by joining large number of small molecules.
- Examples include plastics such as poythene, polystyrene, nylon, perspex and raw and synthetic rubbers.
- For example, by heating ethylene molecules to 100 – 300 degrees celcius under high pressure, long chains of polyethylene polymers are formed.
- Artificial polymers are known for their toughness.



Past Year Questions

November 2004

21 Which two substances are normally both crystalline?

A copper and diamond

B copper and glass

C diamond and glass

D diamond and rubber

November 2005

19 When white sugar granules are heated, they melt. When the melt is cooled quickly, a brittle solid form of toffee is produced.

How does the structure of the sugar change?

A amorphous to polymeric

B crystalline to amorphous

C crystalline to polymeric

D polymeric to amorphous

5 **(a)** Distinguish between the structure of a metal and of a polymer.

metal: .....

.....

.....

polymer: .....

.....

..... [4]

(b) Latex is a natural form of rubber. It is a polymeric material.

(i) Describe the properties of a sample of latex.

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..... [2]

(ii) The process of heating latex with a small amount of sulphur creates cross-links between molecules. Natural latex has very few cross-links between its molecules.

Suggest how this process changes the properties of latex.

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..... [2]

5	**(a)**		metal: crystalline / lattice / atoms in regular pattern	B1	
			(atoms in regular) pattern that repeats itself (within crystal)	B1	[2]
			polymer: long chains of atoms / molecules	B1	
			chain consists of 'units' that repeat themselves	B1	[2]
	(b)	**(i)**	e.g. latex is soft / not strong / flows / ductile	B1	
			elastic limit easily exceeded	B1	[2]
			(*allow any two sensible comments, 1 each*)		
		(ii)	more solid / does not flow / stronger / higher ultimate tensile stress		
			more brittle		
			elastic limit much higher		
			increased toughness		
			(*any two, 1 each*)	B2	[2]

Any Questions