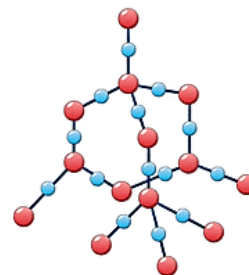


Topic 5 – Covalent Compounds

5.1 Giant Molecular Structure of Compound (7.2)

Quartz (silicon dioxide – SiO₂)

- Compound of 2 elements: silicon + oxygen
→ chemically bonded in fixed composition by mass
- Most common constituent of sand
- Physical properties
 1. Hard (excellent abrasive material)
 2. Resistant to heat (make refractory bricks)



Comparison of characteristics:

Characteristic	Diamond	Quartz
Types of atoms	1 (C)	2 (Si, O)
Bonding of atoms	Strong covalent bonds	Strong covalent bonds
Description	1 carbon atom → 4 carbon atoms in tetrahedral arrangement	1 silicon atom → 4 oxygen atoms 1 oxygen atom → 2 silicon atoms
Chemical formula	C	SiO ₂

Physical properties

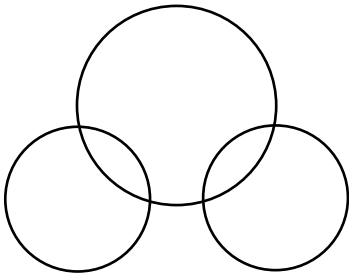
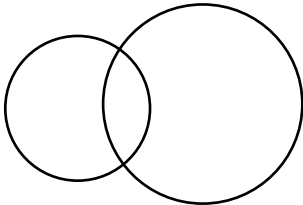
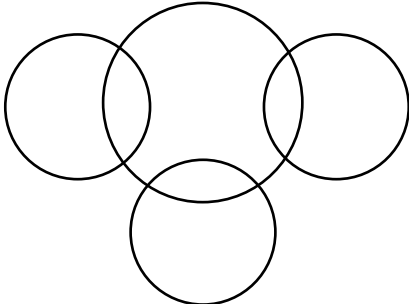
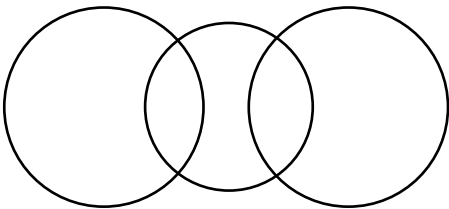
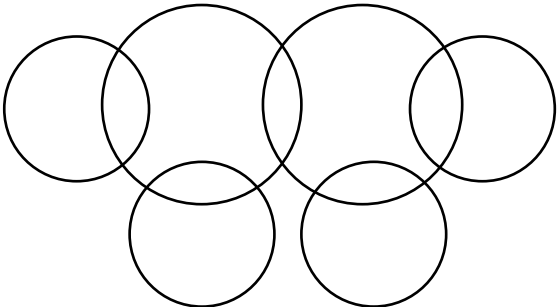
Properties	Quartz
1. Hardness	High
2. Melting & boiling point	High
3. Electrical conductivity	×
4. Solubility in water	×

5.2 Simple Molecular Structure of Compound (7.1, 7.2)

Simple molecular compounds

- Exist as simple molecules
- Examples
 - (a) methane (CH₄)
 - (b) water (H₂O)
 - (c) hydrogen chloride (HCl)
 - (d) ammonia (NH₃)
 - (e) carbon dioxide (CO₂)
 - (f) ethene (C₂H₄)

Compound	Chemical formula	Dot-and-cross diagram	Structural formula
methane	CH ₄		$ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array} $

water	H_2O		$\begin{array}{c} \text{O} \\ / \quad \backslash \\ \text{H} \quad \text{H} \end{array}$
hydrogen chloride	HCl		$\text{H} - \text{Cl}$
ammonia	NH_3		$\begin{array}{c} \text{H} - \text{N} - \text{H} \\ \\ \text{H} \end{array}$
carbon dioxide	CO_2		$\text{O} - \text{C} - \text{O}$
ethene	C_2H_4		$\begin{array}{cc} \text{H} & \text{H} \\ \backslash & / \\ & \text{C} = \text{C} \\ / & \backslash \\ \text{H} & \text{H} \end{array}$

Typical questions

1. Explain, in terms of bonding and structure, why quartz is
(a) a good abrasive material

In quartz's **giant molecular structure**,
silicon & oxygen atoms are held by **strong covalent bonds**.
Large amount of energy is needed to break these bonds.
Hence, quartz is very **hard** and can withstand great forces.

- (b) used in high temperature furnaces to provide insulation

Quartz has **very high melting and boiling points**.
In quartz's **giant molecular structure**,
large amount of energy is needed to
break **strong covalent bonds** between silicon & oxygen atoms.

2. Explain quartz's electrical conductivity.

Quartz **does not conduct** electricity.
There are **no free moving electrons** in the structure for electrical conduction.