Structure and properties of covalent compounds

1) Classify the following covalent compounds as molecular covalent or giant covalent based on their properties:

Property	Molecular covalent	Giant covalent
High melting and boiling point		
Insoluble in polar and non-polar solvents		
Liquids and gases under standard conditions		
Do not form discrete molecules		
Poor electrical conductors		
Soluble in polar or non-polar solvents		
Form discrete molecules		
Very hard substances		

2) Explain the following properties of covalent compounds.

a) Pentane (C_5H_{12}) is insoluble in water but soluble in hexane (C_6H_{14}).

b) Diamond does not conduct electricity.

c) CO_2 is a gas under standard conditions.

d) SiO_2 has a melting point of 1600^oC

Answers:

1)

Property	Molecular covalent	Giant covalent
High melting and boiling point		✓
Insoluble in polar and non-polar solvents		✓
Liquids and gases under standard conditions	✓	
Do not form discrete molecules		✓
Poor electrical conductors	✓	✓
Soluble in polar or non-polar solvents	✓	
Form discrete molecules	✓	
Very hard substances		✓

2)

a) Pentane and hexane, like all alkanes, are non-polar molecules. Non-polar molecules are soluble in non-polar solvents. Water is a polar molecule, therefore pentane is insoluble in water. The phrase 'like dissolves like' – meaning that non-polar substances will dissolve in non-polar solvents and polar substances will dissolve in polar solvents, is a good way to determine the solubility of covalent compounds.

b) Diamond has a giant covalent structure – the atoms are bonded by covalent bonds therefore it does not have any free moving ions to conduct electricity.

c) **CO_2 has a molecular covalent structure, and is a non-polar molecule. There are weak London dispersion forces between the molecules therefore it is a gas under standard conditions.**

d) **SiO_2 has a giant covalent structure with strong covalent bonds between atoms (the same as diamond), therefore it takes a lot energy to break the bonds between atoms, giving it a high melting point.**