	Marks KU	PS

1. Boron carbide, B_4C, is a covalent network compound.

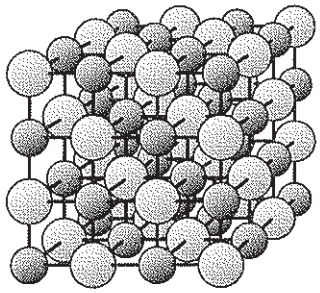
(a) What type of bonding will be the **main** bonding force in this compound? (1)

(b) What does the term **network** refer to in this example? (1)

(c) What does the formula tell you about this structure? (1)

2. Magnesium oxide and barium oxide both have the same pattern in their ionic lattices.

The only difference is that the barium ion is larger than the magnesium ion.



(a) What effect will the larger size of the barium ion have on the strength of the ionic bond? (1)

(b) What effect will this have on the melting point of barium oxide compared with that of magnesium oxide? (1)

3. CH_4 and CF_4 are both molecular compounds in which the molecules have the same tetrahedral shape.

(a) What type of bonding holds the atoms together within the molecules of these two compounds? (1)

(b) Which would you expect to have the higher boiling point and why? (1)

(c) The HCF_3 molecule also has a tetrahedral shape and its boiling point is higher than that of CH_4 or CF_4. Suggest a reason for this. (1)

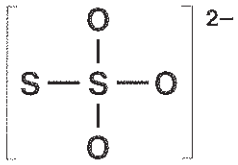
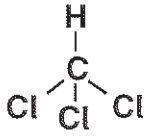
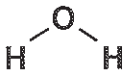
4. The table gives information about three compounds.

Compound	*Melting point*	*Conduction in solid state*	*Conduction in liquid state*
P	2350 °C	O	O
Q	2430 °C	O	✓
R	– 162 °C	O	O

(a) Which would you identify as a **covalent network** compound? (1)

(b) Which would you identify as a **covalent molecular** compound? (1)

TOTALS: (6) (4)

	Marks KU	PS
1. Hydrogen chloride is an example of a molecule containing a polar covalent bond.		
(a) Explain what a polar covalent bond is.	(1)	
(b) Draw a diagram of the HCl molecule to show the direction of the polarity.	(1)	
(c) How do the intermolecular forces in HCl compare in strength with the intermolecular forces in HF and why?	(1)	
2. The thiosulphate ion, $S_2O_3^{2-}$, is an example of a molecular ion. 		
(a) Draw a "dot-and-cross" outer-electron picture for the thiosulphate ion.		(1)
(b) Use your diagram to explain the 2– charge.		(1)
3. Chloroform and water are both polar liquids, but chloroform is not miscible with water.  chloroform  water		
(a) Draw the structure of the chloroform molecule to show the directions of the dipoles on the polar bonds.	(1)	
(b) Explain why the chloroform molecule as a whole is polar.	(1)	
(c) Explain why chloroform is not miscible with water.	(1)	
4. In ice, water molecules are arranged a network of six-sided rings. Draw an example of one ring of six water molecules showing the two types of bonding present. (Clues: First put the symbols for 6 oxygen atoms at the corners of a hexagon. Then add the two hydrogen atoms joined directly to each oxygen, but remember that half of them will point away from the ring you have drawn. Use solid lines for the covalent bonds and dashed lines for the hydrogen bonds.)		(2)
TOTALS:	(6)	(4)

	Marks KU	PS

1. Silicon dioxide and carbon dioxide have similar names and similar formulae. Yet these two compounds are very different in their properties.

SiO_2

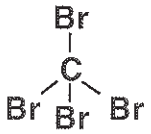
CO_2

Explain in terms of bonding and structure why silicon dioxide is a high melting point solid and carbon dioxide is a gas at room temperature. (2)

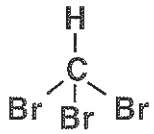
2. Examine the data below about three different compounds.
Predict the main type of bonding and structure present in each compound.

	Compound	*Melting point*	*Conductivity when molten*	PS
(a)	lithium hydride	680 °C	conducts	(1)
(b)	silane	−185 °C	does not conduct	(1)
(c)	quartz	1610 °C	does not conduct	(1)

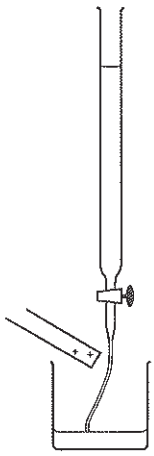
3. A scientist tested two liquids, carbon tetrabromide and tribromomethane, by running them out of burettes. She found only one stream of liquid was deflected by a charged rod.



carbon tetrabromide



tribromomethane



(a) Which of the two liquids was deflected? (1)

(b) Explain in terms of molecular structure why one liquid was deflected and why the other liquid was undeflected. (2)

4. These diagrams show two covalent bonds.

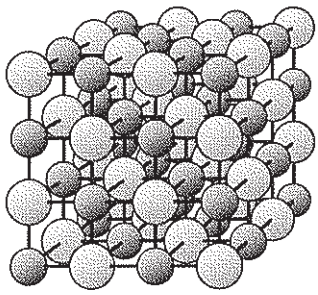
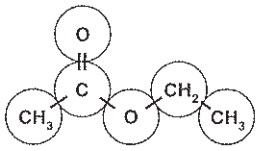
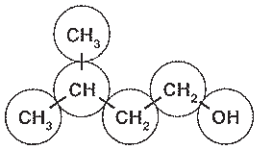
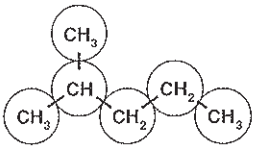
C—Br **N—F**

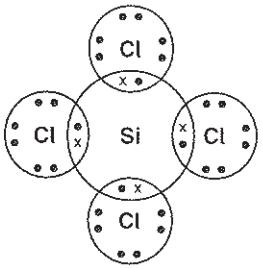
Use electronegativity values from a data booklet to help answer the following.

(a) Copy the diagrams and indicate the direction of polarity in each bond using an arrow on the bond and $\delta+$ and $\delta-$ on the appropriate atoms. (1)

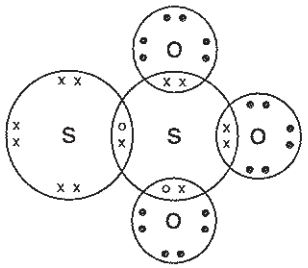
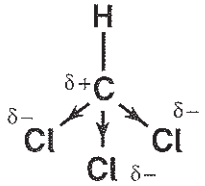
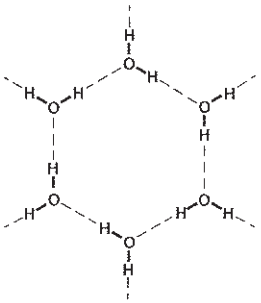
(b) Which of these bonds will be more polar? (1)

TOTALS: (6) (4)

	Marks KU	PS
1. Silicon tetrachloride is a liquid at room temperature.		
(a) Draw a "dot-and-cross" outer-electron picture for this molecule.	(1)	
(b) What type of attraction holds the molecules together in this liquid?	(1)	
2. Barium sulphide has the structure shown in the diagram. 		
(a) What is the main type of bonding in this structure?	(1)	
(b) In terms of its structure, why is the formula of barium sulphide given as BaS?	(1)	
3. In an experiment, three liquids were tested for polarity and viscosity. The diagram shows the molecules in each of these liquids.		
Liquid P 		
Liquid Q 		
Liquid R 		
(a) Which of these liquids contains polar molecules?		(1)
(b) Which of these liquids will contain hydrogen bonding?		(1)
(c) Which of these liquids will be undeflected by a charged rod as it drains from a burette?		(1)
(d) Which of these liquids is likely to drain from the burette most slowly?		(1)
4. Ice is unusually strong for the small size of its molecules.		
(a) What type of bonding holds the molecules together in ice?	(1)	
(b) Explain why ice has a lower density than liquid water.	(1)	
TOTALS:	(6)	(4)

		KU	PS
1. (a)		1	-
(b)	Van der Waals forces	1	-
2. (a)	Ionic	1	-
(b)	Because the ratio of barium ions to sulphide ions is 1 to 1. **OR** For every barium ion there is one sulphide ion.	1	-
3. (a)	**P** (½) and **Q** (½)	-	1
(b)	**Q**	-	1
(c)	**R**	-	1
(d)	**Q**	-	1
4. (a)	Hydrogen bonding	1	-
(b)	Ice has an open network structure that spaces out the water molecules.	1	-
	TOTALS	6	4

		KU	PS
1. (a)	Covalent	1	-
(b)	The covalent bonds extend throughout entire structure.	1	-
(c)	Only that ratio of boron atoms to carbon atoms is 4 to 1. **OR** For every carbon atom there are 4 boron atoms.	1	-
2. (a)	It will be weaker.	1	-
(b)	It will be lower.	1	-
3. (a)	Covalent	1	-
(b)	CF_4 (½) F atoms are larger than H atoms (½)	-	1
(c)	HCF_3 is polar and polar-polar attractions are stronger than van der Waals.	-	1
4. (a)	**P**	-	1
(b)	**R**	-	1
	TOTALS	6	4

		KU	PS
1. (a)	Unequal sharing of electrons between two atoms	1	-
(b)	$H \rightarrow Cl$ ($\delta+$ $\delta-$)	1	-
(c)	Weaker (½) Polar-polar attractions are weaker than hydrogen bonding (½)	1	-
2. (a)	 [Note: Which positions are given dots, crosses, or naughts is quite arbitrary but each atom should end up with a stable octet. The noughts are the 2 extra electrons required to complete the octets.]	-	1
(b)	Two extra electrons are needed to give stable electron arrangements for all five atoms.	-	1
3. (a)		1	-
(b)	The dipoles do not cancel. **OR** The dipoles are not symmetrically opposed. **OR** The molecule has a $\delta+$ side and a $\delta-$ side.	1	-
(c)	It cannot hydrogen bond with water molecules	1	-
4.		-	2
	TOTALS	6	4

		KU	PS
1.	SiO_2 has a covalent network structure (½) and considerable heat energy is required to break the covalent bonds (½) CO_2 has a molecular structure (½) and the van der Waals attractions are insufficient to keep the molecules together (½)	2	-
2. (a)	Ionic bonding (½) network structure (½)	-	1
(b)	Covalent bonding (½) molecular structure (½)	-	1
(c)	Covalent bonding (½) network structure (½)	-	1
3. (a)	Tribromomethane	-	1
(b)	Polar bonds in carbon tetrachloride are symmetrical (½) so the molecule is non-polar (½) whereas dipoles in tribromomethane do not cancel (½) so the molecule as a whole is polar. (½)	2	-
4. (a)	$C \rightarrow Br$ ($\delta+$ $\delta-$) (½) $N \rightarrow F$ ($\delta+$ $\delta-$) (½)	1	-
(b)	N–F	1	-
	TOTALS	6	4