

Q1. Diamond and graphite are both forms of carbon.
Diamond is able to scratch almost all other substances, whereas graphite may be used as a lubricant. Diamond and graphite both have high melting points.

Explain each of these properties of diamond and graphite in terms of structure and bonding. Give **one** other difference in the properties of diamond and graphite.

(Total 9 marks)

Q2. Which one of the following does **not** contain any delocalised electrons?

- A** poly(propene)
- B** benzene
- C** graphite
- D** sodium

(Total 1 mark)

Q3. (a) (i) Describe the bonding in a metal.

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(ii) Explain why magnesium has a higher melting point than sodium.

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(4)

(b) Why do diamond and graphite both have high melting points?

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(3)

(c) Why is graphite a good conductor of electricity?

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(1)

(d) Why is graphite soft?

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(2)

(Total 10 marks)

Q4. The table below shows some values of melting points and some heat energies needed for melting.

Substance	I ₂	NaCl	HF	HCl	HI
Melting point/K	387	1074	190	158	222
Heat energy for melting /kJ mol ⁻¹	7.9	28.9	3.9	2.0	2.9

(a) Name **three** types of intermolecular force.

Force 1

Force 2

Force 3

(3)

(b) (i) Describe the bonding in a crystal of iodine.

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(ii) Name the crystal type which describes an iodine crystal.

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(iii) Explain why heat energy is required to melt an iodine crystal.

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(4)

(c) In terms of the intermolecular forces involved, suggest why

(i) hydrogen fluoride requires more heat energy for melting than does hydrogen chloride,

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(ii) hydrogen iodide requires more heat energy for melting than does hydrogen chloride.

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(5)

(d) (i) Explain why the heat energy required to melt sodium chloride is large.

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(ii) The heat energy needed to vaporise one mole of sodium chloride (171 kJ mol^{-1}) is much greater than the heat energy required to melt one mole of sodium chloride. Explain why this is so.

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(3)

(e) In terms of its structure and bonding, suggest why graphite has a very high melting point.

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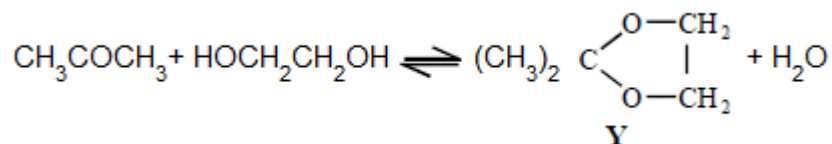
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(Total 17 marks)

Q5. Iodine and diamond are both crystalline solids at room temperature. Identify one similarity in the bonding, and one difference in the structures, of these two solids. Explain why these two solids have very different melting points.

(Total 6 marks)

Q6. This question is about the reaction between propanone and an excess of ethane-1,2-diol, the equation for which is given below.



In a typical procedure, a mixture of 1.00 g of propanone, 5.00 g of ethane-1,2-diol and 0.100 g of benzenesulphonic acid, $\text{C}_6\text{H}_5\text{SO}_3\text{H}$, is heated under reflux in an inert solvent. Benzenesulphonic acid is a strong acid.

Which one of the following statements is **not** true?

- A** Ethane-1,2-diol and water can form hydrogen bonds.
- B** Ethane-1,2-diol is soluble in water.
- C** Propane has a higher boiling point than ethane-1,2-diol.
- D** **Y** and water are polar molecules.

(Total 1 mark)

Q7. (a) Name the strongest type of intermolecular force between hydrogen fluoride molecules and draw a diagram to illustrate how two molecules of HF are attracted to each other.

In your diagram show all lone pairs of electrons and any partial charges. Explain the origin of these charges.

Suggest why this strong intermolecular force is not present between HI molecules.

(7)

(b) Crystals of sodium chloride and of diamond both have giant structures. Their melting points are 1074 K and 3827 K, respectively. State the type of structure present in each case and explain why the melting point of diamond is so high.

(4)

(Total 11 marks)

