Questions

Q1.

This question is about covalent bonds.

State what is meant by the term covalent bond.

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(Total for question = 2 marks)

Q2.

This question is about aluminium chloride.

Aluminium chloride exists as a dimer, Al_2Cl_6, just above its boiling temperature.

(i) Draw a diagram to show how two $AlCl_3$ molecules are joined together in the dimer.

(1)

(ii) State the type of bond that joins the two $AlCl_3$ molecules together.

(1)

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(Total for question = 2 marks)

Q3.

This question is about covalent bonds.

(i) Ammonia and boron trifluoride react to form a compound NH_3BF_3 which contains a dative covalent bond. Each of the molecules, NH_3 and BF_3, has a different feature of its electronic structure that allows this to happen. Use these two different features to explain how a dative covalent bond is formed.

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(ii) During this reaction, the bond angles about the nitrogen atom and the boron atom change.

State the new H—N—H and F—B—F bond angles.

(2)

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(Total for question = 4 marks)

Q4.

State what is meant by the term electronegativity and hence explain the polarity, if any, of the **bonds** in chlorine trifluoride, ClF_3.

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(Total for question = 3 marks)

Q5.

The table shows some information about the structure and bonding in four substances.

Substance	Structure	Bonding	Melting temperature / K
silicon(IV) oxide	giant	covalent	1883
potassium chloride			1043
iron		metallic	1808
iodine		covalent	387

Explain why the melting temperature of silicon(IV) oxide is much higher than that of iodine, even though the bonding in both is covalent.

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(Total for question = 3 marks)

Q6.

Nitrogen forms several hydrides. In addition to ammonia, NH_3, it forms hydrazine, N_2H_4, in which the two nitrogen atoms are covalently bonded together.

(i) Explain what is meant by a covalent bond.

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(ii) Draw a dot-and-cross diagram for hydrazine, showing the outer electrons only.

Use crosses (×) to represent the electrons from nitrogen and dots (•) to represent the electrons from hydrogen.

(1)

(iii) Estimate the H—N—H bond angle in hydrazine.

(1)

Bond angle = ...

(Total for question = 4 marks)

Q7.

This is a question about water.

Explain why both water and carbon dioxide molecules have polar bonds but only water is a polar molecule.

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(Total for question = 4 marks)

Q8.

This question is about atomic structure and the Periodic Table.

The melting temperatures of two elements in Period 3 are given in the table.

Element	silicon	chlorine
Melting temperature / K	1683	172

Explain, in terms of the structure and bonding of each element, the difference between these values.

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(Total for question = 3 marks)

Q9.

This question is about crystalline solids.

Iodine and diamond are crystalline solids at room temperature.

Explain why diamond has a much higher melting temperature than iodine.

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(Total for question = 5 marks)

Q10.

This question is about the thermal stability of Group 1 and Group 2 nitrates and carbonates.

Calcium carbonate is thermally decomposed during the manufacture of cement.

(i) Write an equation, including state symbols, for the thermal decomposition of calcium carbonate.

(1)

(ii) Name all the types of bond present in calcium carbonate.

(1)

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(iii) Give a reason, in terms of the bonding, why a high decomposition temperature is required.

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(Total for question = 3 marks)

Q11.

* Boron and aluminium are in the same group of the Periodic Table. Both form compounds with chlorine and with fluorine.

Aluminium fluoride and aluminium chloride are both crystalline solids at room temperature. Aluminium fluoride sublimes to form a gas at 1291°C (1564 K), whilst aluminium chloride sublimes at 178°C (451 K).

Use the Pauling electronegativity values in the Data Booklet to explain these differences in sublimation temperature.

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(Total for question = 6 marks)