

1. (a) Complete the following table:

Leave blank

| Element | State at room temperature |
|----------|---------------------------|
| Chlorine | Gas |
| Bromine | |
| Iodine | |

(2)

(b) Describe how you could use solutions of silver nitrate and ammonia to distinguish a solution of sodium iodide from a solution of sodium bromide.

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(4)

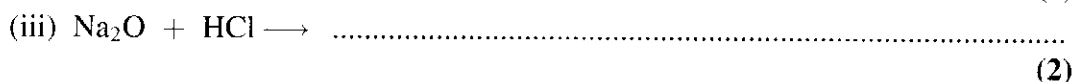
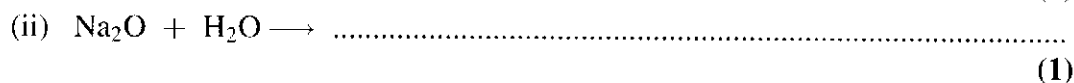
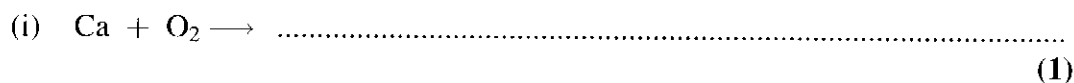
Q1

(Total 6 marks)

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2. (a) Complete and balance the following equations:

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(b) State and explain the trend in thermal stability of the carbonates of the Group 2 elements as the group is descended.

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(3) Q2

(Total 7 marks)

3. (a) Draw the shape of each of the following molecules and mark on the diagram a value for the bond angle in each case.

Leave blank

(i) CH_4

(2)

(ii) NH_3

(2)

(iii) BeCl_2

(2)

(b) Name the strongest type of intermolecular force present in separate samples of each of the following substances:

(i) CH_4

..... (1)

(ii) HF

..... (1)

(c) State and explain which of the substances CH_4 and HF has the higher boiling temperature.

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(2)

Q3

(Total 10 marks)

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4. (a) Complete the following table:

| Particle | Relative charge | Relative mass |
|----------|-----------------|---------------|
| Proton | | 1 |
| Electron | -1 | |
| Neutron | | 1 |

(3)

(b) State the number of each of the above particles present in one molecule of CH₄, showing clearly how you arrive at your answer.

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(3)

(c) Complete the electronic configuration of a chlorine atom.

1s²

(1)

(d) Give the **formula** of the chlorine species composed of 17 protons, 20 neutrons and 16 electrons.

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(2)

(e) Write one equation in each case to represent the change occurring when the following quantities are measured.

(i) The first electron affinity of sulphur.

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(2)

(ii) The first ionisation energy of sulphur.

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(1)

(f) Explain why the first ionisation energy of chlorine is higher than that of sulphur.

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(2)

Q4

(Total 14 marks)

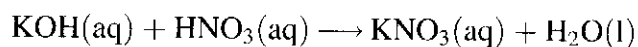
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5. (a) (i) Calculate the number of moles of potassium nitrate, KNO_3 , in 10.1 g of KNO_3 .

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blank*

(1)

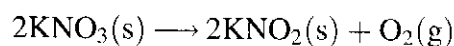
- (ii) Potassium nitrate, KNO_3 , can be prepared from potassium hydroxide solution as shown in the following equation:



Calculate the minimum volume, in cm^3 , of 2.00 mol dm^{-3} KOH required to produce 10.1 g of KNO_3 .

(2)

- (iii) Potassium nitrate decomposes, when heated, to produce oxygen.



Calculate the volume of oxygen gas, in dm^3 , produced when 10.1 g of potassium nitrate decomposes in this way.

(1 mole of gas has a volume of 24 dm^3 under the conditions of the experiment.)

(2)

(b) A compound of potassium and oxygen contains 70.9% potassium.

*Leave
blank*

(i) Calculate the empirical formula of this compound, using the data above and the periodic table.

(3)

(ii) 0.200 moles of this compound has a mass of 22.0 g. Use this information to help you deduce the molecular formula of this compound.

(2)

Q5

(Total 10 marks)

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6. (a) State the structure of, and the type of bonding in, the following substances.
Draw labelled diagrams to illustrate your answers.

*Leave
blank*

(i) **Graphite**

Structure

Bonding

Diagram:

(4)

(ii) **Sodium chloride**

Structure

Bonding

Diagram:

(3)

(b) Explain why **both** graphite and sodium chloride have high melting temperatures.

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(3)

(c) (i) Explain why graphite is able to conduct electricity in the solid state.

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(2)

(ii) Explain why sodium chloride conducts electricity in the liquid state.

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(1)

Q6

(Total 13 marks)

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7. (a) Hydrogen sulphide is produced when concentrated sulphuric acid is added to solid sodium iodide, but sulphur dioxide is produced when concentrated sulphuric acid is added to solid sodium bromide.

Leave blank

- (i) Complete the following table:

| Compound | Formula | Oxidation number of sulphur in compound |
|-------------------|--------------------------------|---|
| Sulphuric acid | H ₂ SO ₄ | |
| Hydrogen sulphide | H ₂ S | |
| Sulphur dioxide | SO ₂ | |

(3)

- (ii) Use your answers to part (a)(i) to suggest which of the ions, iodide or bromide, has the greater reducing power.

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(2)

- (b) (i) Write an ionic half-equation to show the oxidation of chloride ions, Cl⁻, to chlorine, Cl₂.

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(1)

- (ii) Write an ionic half-equation to show the reduction of chlorate(I) ions, OCl⁻, to chloride ions, in acidic conditions.

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(2)

- (iii) Bleach is a solution of chlorate(I) ions and chloride ions. Combine the two ionic half-equations above to produce an equation which shows the effect of adding acid to bleach.

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(1)

Q7

(Total 9 marks)

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8. (a) The hydrated metal ion $[\text{Mg}(\text{H}_2\text{O})_6]^{2+}$ contains covalent bonds and dative covalent bonds.

Leave blank

(i) Name two elements in $[\text{Mg}(\text{H}_2\text{O})_6]^{2+}$ which are joined by a covalent bond.

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(1)

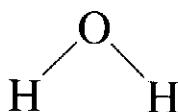
(ii) Name two elements in $[\text{Mg}(\text{H}_2\text{O})_6]^{2+}$ which are joined by a dative covalent bond.

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(1)

(b) (i) On the following diagram of a water molecule draw partial charges on each atom to show the bond polarities:



(1)

(ii) Explain why a water molecule has the partial charges you have drawn.

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(2)

(iii) Explain whether or not a water molecule is polar overall.

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(1)

Q8

(Total 6 marks)

TOTAL FOR PAPER: 75 MARKS

END

