

Q1.The following pairs of compounds can be distinguished by simple test-tube reactions.

For each pair of compounds, give a reagent (or combination of reagents) that, when added separately to each compound, could be used to distinguish between them. State what is observed in each case.

(a) Butan-2-ol and 2-methylpropan-2-ol

Reagent

Observation with butan-2-ol

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Observation with 2-methylpropan-2-ol

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(3)

(b) Propane and propene

Reagent

Observation with propane

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Observation with propene

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(3)

(c) Aqueous silver nitrate and aqueous sodium nitrate

Reagent

Observation with aqueous silver nitrate

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Observation with aqueous sodium nitrate

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(3)

(d) Aqueous magnesium chloride and aqueous barium chloride

Reagent

Observation with aqueous magnesium chloride

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Observation with aqueous barium chloride

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(3)

(Total 12 marks)

Q2. This question is about the elements in Group 2 and their compounds.

(a) Use the Periodic Table to deduce the full electron configuration of calcium.

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(1)

(b) Write an ionic equation, with state symbols, to show the reaction of calcium with an excess of water.

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(1)

(c) State the role of water in the reaction with calcium.

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(1)

- (d) Write an equation to show the process that occurs when the first ionisation energy of calcium is measured.

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(1)

- (e) State and explain the trend in the first ionisation energies of the elements in Group 2 from magnesium to barium.

Trend

Explanation

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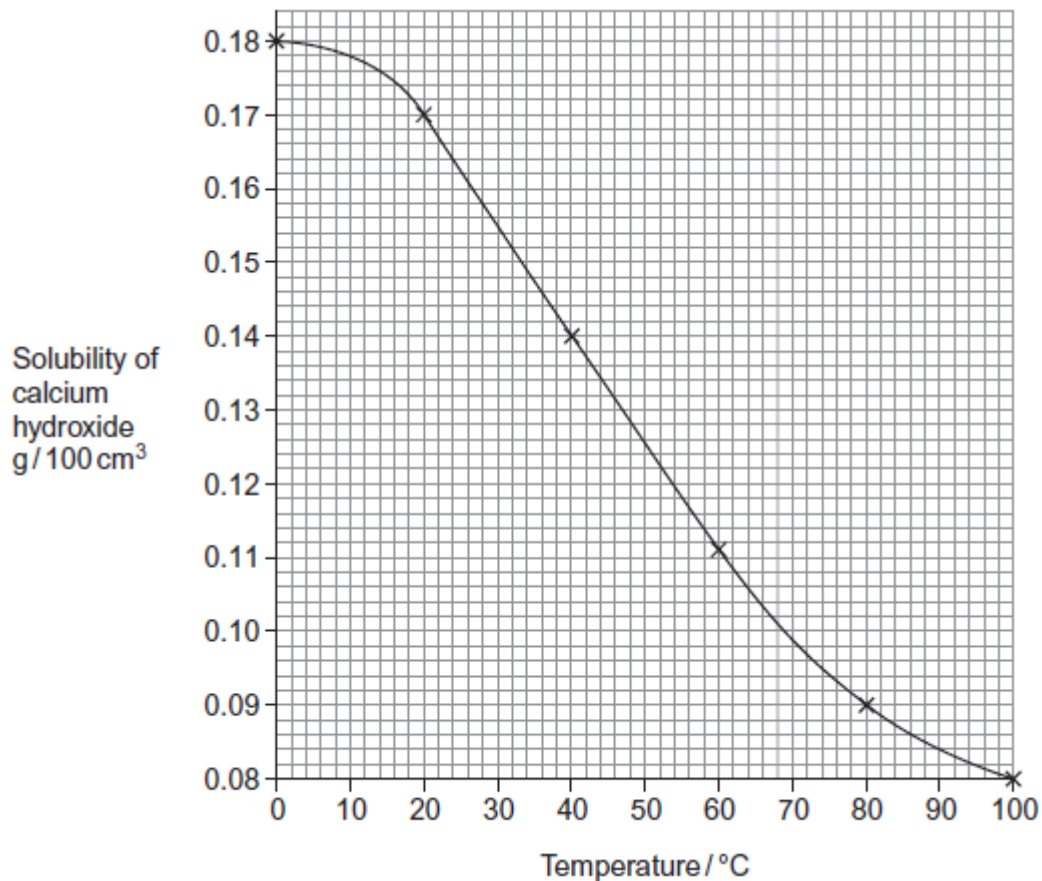
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(3)

(Total 7 marks)

Q3. Calcium hydroxide is slightly soluble in water at room temperature. As the temperature rises, the solubility decreases. When the maximum amount of solid has dissolved at a particular temperature the solution is said to be **saturated**.

In an experiment, the solubility of calcium hydroxide was measured over a range of temperatures. The results are shown in the graph.



- (a) Use data from the graph to calculate the concentration, in mol dm⁻³, of a saturated solution of calcium hydroxide at 30 °C. Give your answer to 3 significant figures.

Show your working.

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(3)

- (b) You are given a sample of saturated calcium hydroxide solution. Outline the practical steps that you would take to determine the solubility of calcium hydroxide in this solution.

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(3)
(Total 6 marks)

Q4. Zinc is similar to Group 2 metals and forms compounds containing Zn^{2+} ions.

Write an equation for the thermal decomposition of zinc carbonate to zinc oxide.

Calculate the percentage atom economy for the formation of zinc oxide from zinc carbonate in this reaction.

Equation

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Percentage atom economy

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(Total 3 marks)

Q5. A laboratory technician discovered four badly-labelled bottles, each containing one pure white solid. Each bottle contained a compound of a different Group 2 metal (magnesium, calcium, strontium and barium).

Some tests were carried out on the solids or, if the compound was soluble, on the aqueous solution. The results are given in the table.

Test	Compound 1	Compound 2	Compound 3	Compound 4
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Added to water	Dissolves	Insoluble	Dissolves	Dissolves
Solution or solid added to HCl(aq)	Solution remains colourless	Gives off carbon dioxide gas and a colourless solution forms	Solution remains colourless	Solution remains colourless and heat released
Solution or solid added to NaOH(aq)	Solution gives a white precipitate	Solid remains insoluble	Solution gives a slight white precipitate	Solution has no visible change
Solution or solid added to H ₂ SO ₄ (aq)	Solution has no visible change	Gives off carbon dioxide gas and a white solid remains	Solution slowly forms a slight white precipitate	Solution forms a white precipitate

(a) One of the bottles has a very faint label that could be read as 'Magnesium Sulfate'.

Use the information in the table to deduce which **one** of the four compounds is magnesium sulfate and explain your answer.

Compound

Explanation

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(3)

(b) The bottle containing **Compound 2** has a 'TOXIC' hazard symbol.

Use the information in the table to identify **Compound 2**.

Explain both observations in the reaction with H₂SO₄(aq).

Identity of **Compound 2**

Explanation

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(3)

(c) Identify the compound that is strontium hydroxide.

Give an equation for the reaction of strontium hydroxide with sulfuric acid.

Compound

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Equation

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(2)

(Total 8 marks)

Q6. The elements in Group 2 from Mg to Ba can be used to show the trends in properties down a group in the Periodic Table.

(a) State the trend in atomic radius for atoms of the elements down Group 2 from Mg to Ba
Give a reason for this trend.

Trend

Reason

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(2)

(b) The Group 2 elements react with water.

(i) State the trend in reactivity with water of the elements down Group 2 from Mg to Ba

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(1)

(ii) Write an equation for the reaction of strontium with water.

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(1)

(c) Give the **formula** of the hydroxide of the element in Group 2 from Mg to Ba that is most soluble in water.

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(1)

(Total 5 marks)