

Group 2

1. This question is about reactions and uses of the weak acids methanoic acid, HCOOH, and ethanoic acid, CH₃COOH.

A student adds magnesium metal to an aqueous solution of ethanoic acid, CH₃COOH. A redox reaction takes place.

Write the overall equation for this reaction and explain, in terms of oxidation numbers, which element has been oxidised and which element has been reduced.

Equation

Oxidation

Reduction

[3]

2. This question is about some elements in Period 4 of the periodic table.

Calcium reacts with bromine to form calcium bromide, CaBr₂.

- i. Draw a 'dot-and-cross' diagram to show the bonding in CaBr₂.

Show **outer** electrons only.

[2]

4. A student adds a small amount of strontium to water.

When the reaction has finished, the student measures the pH of the final solution.

- i. Write the equation for the reaction of strontium with water.

[1]

- ii. Describe **two** observations which would be different if the student had used calcium in place of strontium.

1

2

[2]

5. A student adds an excess of calcium oxide to water in a test tube.
In a separate test tube, the student adds an excess of strontium oxide to water.

- i. Write the equation for the reaction of calcium oxide with water.

State symbols are **not** required.

[1]

- ii. Suggest the approximate pH of the two solutions formed in the test tubes.

pH with calcium oxide

pH with strontium oxide

[1]

6. Calcium reacts with nitrogen to form calcium nitride, Ca_3N_2 , which is an ionic compound.

i. Construct a 'dot-and-cross' diagram for Ca_3N_2 .

Show outer electrons only and the charges on each ion.

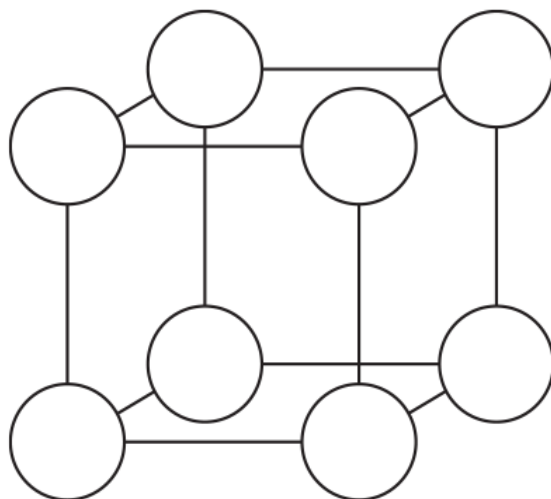
ii. Calcium nitride reacts with water to form a solution containing two alkaline compounds.

Write an equation for this reaction.

[2]

iii. Calcium reacts with oxygen to form a compound which has a giant ionic lattice structure. The diagram shows ions as circles in part of the lattice.

Complete the diagram by showing the symbols of the ions, including charges.



[2]

- iv. Nitrogen forms an oxide with the formula N_2O . A molecule of N_2O is linear and has a nitrogen atom in the centre.

Draw a 'dot-and-cross' diagram for an N_2O molecule.

Show outer electrons only.

[2]

- 7(a). This question is about Group 2 and Group 17 (7).

Barium chloride can be prepared from barium hydroxide in a neutralisation reaction.

Write the equation for this reaction. State symbols are **not** required.

[1]

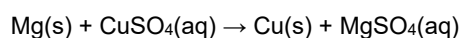
- (b). The reactivity of the Group 2 elements Mg–Ba increases down the group.

Explain why.

[3]

8(a). Magnesium will undergo redox reactions with aqueous salts of less reactive metals.

- i. A student reacts magnesium with aqueous copper(II) sulfate.



Explain, in terms of **numbers** of electron transferred, the redox processes taking place in this reaction.

[2]

- ii. The student also noticed that the magnesium started fizzing.

The student thought the fizzing was due to the magnesium reacting with water in the mixture.

Write the equation for the reaction of magnesium with water.

Include state symbols.

[2]

(b). Compounds of calcium have many uses.

- i. Identify a compound of calcium that could be used to convert a soil pH from 5.8 to 7.5.

[1]

- ii. Calcium phosphide, Ca_3P_2 , is an ionic compound used in rat poison.

Calcium phosphide can be prepared by reacting calcium metal with phosphorus, P_4 .

Write the equation for the reaction of calcium with phosphorus to form calcium phosphide.

[1]

- iii. Draw a 'dot-and-cross' diagram to show the bonding in calcium phosphide, Ca_3P_2 .
Show **outer** electrons only.

[2]

9. The trend in the first and second ionisation energies of Group 2 elements can be linked to the increase in chemical reactivity down the group.

The first and second ionisation energies of calcium and strontium are given in the table.

Element	First ionisation energy / kJmol^{-1}	Second ionisation energy / kJmol^{-1}
Ca	590	1145
Sr	550	1064

- i. Write an equation, including state symbols, to represent the **second** ionisation energy of strontium.

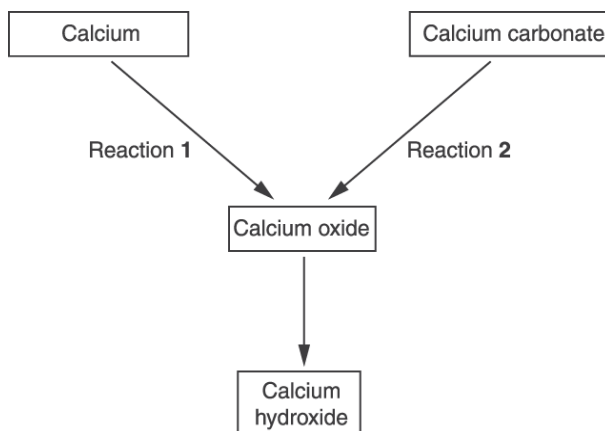
[1]

- ii. Explain why the first ionisation energy of strontium is less than the first ionisation energy of calcium.

[3]

10(a). Calcium is in Group 2 of the Periodic Table.

The diagram shows some reactions of calcium and its compounds.



Reactions **1** and **2** both form calcium oxide.

- i. Write the equation for reaction **1**.

.....
.....
[1]

- ii. What type of reaction is reaction **2**?

.....
.....
[1]

(b). A student prepared some calcium hydroxide by adding a small piece of calcium to a large excess of water.

Describe what the student would observe and write the equation for the reaction.

Observation

.....

Equation

..... [2]

11. A chemist carries out reactions of barium and barium nitride, Ba_3N_2 .

Reaction 1	Barium is reacted with water.
Reaction 2	Barium nitride is reacted with water, forming an alkaline solution and an alkaline gas.
Reaction 3	Barium is reacted with an excess of oxygen at 500°C , forming barium peroxide, BaO_2 .

- i. Write equations for **Reaction 1** and **Reaction 2**.

Ignore state symbols.

Reaction 1:

.....

Reaction 2:

.....

[3]

- ii. Predict the structure and bonding of Ba_3N_2 .

.....
.....

[1]

- iii. BaO_2 formed in **Reaction 3** contains barium and peroxide ions.
The peroxide ion has the structure $[\text{O}-\text{O}]^{2-}$.

Suggest a 'dot-and-cross' diagram for BaO_2 .

Show outer shell electrons only.

[1]

12. This question looks at groups in the periodic table.

Calcium and strontium are Group 2 metals. They both react with water.
A chemist reacts 0.200 g of strontium with 250 cm³ water, leaving a colourless solution containing strontium ions. The volume remains at 250 cm³.

- i. Write an equation for the reaction between strontium and water.

Include state symbols.

[1]

- ii. Calculate the concentration, in mol dm⁻³, of strontium ions in the resulting solution.

concentration of strontium ions =mol dm⁻³ [2]

- iii. A student plans to carry out this experiment using 0.200 g of calcium instead of 0.200 g of strontium.
Predict the difference, if any, between the volume of gas produced by calcium and strontium.
Explain your reasoning and include a calculation in your answer.

[3]

END OF QUESTION PAPER