

Group 2, the alkaline earth metals – AS Chemistry P1

1. No.2

0 2

This question is about the elements in Group 2.

0 2 . 1

Explain why the third ionisation energy of beryllium is much higher than the second ionisation energy of beryllium.

[3 marks]

The third electron is removed from the first $0s$ orbital rather than $2s$ orbital. The $1s$ electrons are closer to the nucleus with less shielding from other electrons. This means there is a much stronger electrostatic attraction between the nucleus and the electron, so more energy is required to remove it.

0 2 . 2

Magnesium reacts slowly with cold water but rapidly with steam.

Compare these reactions, in terms of the products formed.

You should identify one similarity in, and one difference between, these reactions.

[2 marks]

Similarity Both reactions produce hydrogen gas and magnesium compound that is basic.

Difference With cold water, magnesium forms magnesium hydroxide while steam forms magnesium oxide.

0 2 . 3

The reaction of calcium with water is a redox reaction.

Explain, in terms of oxidation states, why this reaction involves both oxidation and reduction.

[2 marks]

Calcium's oxidation state changes from 0 to $+2$ calcium is therefore oxidised while hydrogen's oxidation state changes from $+1$ to 0 it is reduced. Both oxidation and reduction take place simultaneously in this reaction.

2. No.4

0 4

A student is provided with separate unlabelled samples of four different solutions for analysis.

The four solutions are known to be ammonium nitrate, potassium sulfate, sodium carbonate and magnesium nitrate, but the student does not know which sample is which.

Outline a series of test-tube reactions that the student can use to identify each of these solutions.

Include:

- the expected observations
- ionic equations for any reactions.

[6 marks]

Test 1 : Add sodium hydroxide and warm gently.
Purpose is to identify ammonium nitrate.

Observation - A pungent smell of ammonia gas

Damp red litmus paper held at the mouth of the test tube turns blue.

The sample contains NH_4^+ ions $\rightarrow \text{NH}_4\text{NO}_3$.

Ionic equation.



Test Two : Add sodium hydroxide to a fresh test sample.

Expected observation. A white precipitate forms

$\text{Mg}(\text{OH})_2$ insoluble in excess NaOH .

The test sample contains Mg^{2+} ions $\rightarrow$ Therefore magnesium nitrate



Test 3: Add dilute nitric acid.

Expected observation: Effervescence due to a gas evolved. If the gas is bubbled through limewater, it turns cloudy confirming CO_2 .

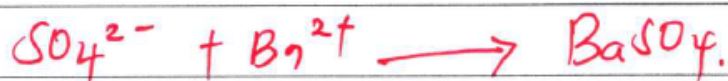
The sample contains CO_3^{2-} ion so the test sample is sodium carbonate.



Test 4: Add acidified barium chloride

Expected observation: white precipitate forms of barium sulfate.

The sample contains SO_4^{2-} ions $\rightarrow \text{K}_2\text{SO}_4$.



3. No.13

Which species is **never** formed during the reactions of chlorine with water?

[1 mark]

A Chloride ions

☐

B Chlorate(I) ions

☐

C Hydrogen

☒

D Oxygen

☐


Disproportionation.



Photodissociation.



4. No.14

Which statement is correct?

[1 mark]

- A Calcium oxide is used to remove sulfur dioxide from flue gases. ☒
- B Calcium has a smaller radius ~~larger~~ atomic radius than barium. ☐ *- below calcium.*
- C Magnesium has a higher ~~lower~~ electronegativity than barium. ☐
- D Magnesium is used to oxidise titanium(IV) chloride in the extraction of titanium. ☐ *magnesium is a reducing agent it reduces titanium*

5. No.15

Which element has the lowest melting point?

In group 1 mpt decreases down the group. [1 mark]

- A Na ☐ *- has high mpt than K.*
- B Mg ☐ *- higher mpt due to strong metallic bond.*
- C K ☒ *- Below Na so low.*
- D Ca ☐ *- higher mpt due to strong metallic bond.*

6. No.16

1 6

Which row correctly shows general trends in properties across Period 3?

[1 mark]

✓ Atomic radius decreases across the period due to increasing nuclear charge pulling electrons closer.

*1st I.E
Increases
again due
to increasing
nuclear
charge*

	Atomic radius	First ionisation energy
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

and decreasing atomic radius making it harder to remove an electron.

- ☒
- ☐
- ☐
- ☐