

ALLOW multiples. Correct species must be seen
IGNORE state symbols

1

(ii) Fizzes **OR** bubbles **OR** gas produced **OR** effervescing ✓

DO NOT ALLOW 'carbon dioxide gas produced'
DO NOT ALLOW 'hydrogen produced' without 'gas'

Mg dissolves **OR** Mg disappears **OR** a solution is formed ✓

ALLOW 'it for Mg'
IGNORE Mg reacts
IGNORE temperature change
IGNORE steam produced

2

(iii) Quicker **OR** more vigorous **OR** gets hotter

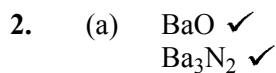
MUST be a comparison of a reaction observation, not just 'more reactive'

ALLOW any comparison of greater rate including more bubbles etc.

DO NOT ALLOW more gas produced

1

[4]



Treat any shown charges as working and ignore.
Treat B for Ba as a slip

2

(b) (i) $\frac{0.11}{137.3}$ ✓

mark is for the working out which MUST lead to the correct answer of 8×10^{-4} up to calculator value

1

(ii) 19.2

OR

calculated answer to (b)(i) $\times 24000$ ✓

ALLOW 19 up to calculator value.

1

(iii) 8.0×10^{-3}

OR

calculated answer to (b)(i) $\times 10$ ✓

ALLOW 8.01×10^{-3} up to calculator value

1

(iv) any pH > 7 but < 15 ✓

ALLOW a correct range of pH.

1

(c) Less barium to react **OR**

some barium has already reacted ✓

ALLOW less volume because contains some BaO or Ba₃N₂

1

(d) reactivity increases (down the group) ✓

atomic radii increase **OR**

there are more shells ✓

there is **more** shielding **OR more** screening ✓

the nuclear attraction decreases **OR**

Increased shielding and distance outweigh the

increased nuclear charge ✓

easier to remove (outer) electrons **OR**

ionisation energy decreases ✓

USE annotations with ticks, crosses, ecf, etc for this part.

***DO NOT ALLOW** more orbitals **OR** more sub-shells*

'More' is essential

***ALLOW** 'more electron repulsion from inner shells'*

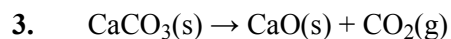
***ALLOW** 'nuclear pull'*

***IGNORE** any reference to 'effective nuclear charge'*

***ALLOW** easier to form positive ion*

5

[12]



equation ✓

state symbols ✓

state symbols are **dependent** on correct formulae of CaCO_3 , CaO and CO_2

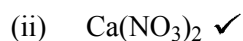
DO NOT ALLOW the 'equation mark' if O_2 is seen on both sides (but note that the 'state symbol mark' may still be accessible)

[2]



IGNORE charges, even if wrong

1



IGNORE charges, even if wrong

1

[2]

5. (i) because Ca has changed from 0 to +2 (**1**)
and H has changed from +1 to 0 (**1**)

2

- (ii) Calcium reacts with water producing
hydrogen/ H_2 /calcium/hydroxide/ $\text{Ca}(\text{OH})_2$ (**1**) (i.e. one product)
 $\text{Ca}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{H}_2(\text{g})$ (**1**) (i.e. full equation)
Equation would subsume both two marks

2

[4]

6. (i) loss (of electrons) ✓

1

- (ii) Ba ✓

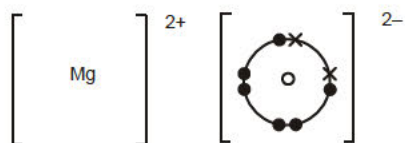
$0 \rightarrow (+)2$ ✓ (accept 2+)

2

[3]

7. (i) Oxidation state goes from 0 in O_2 ✓
 → -2 in MgO ✓ 2

(ii)



or with Mg full shell.

correct dot and cross ✓; correct charges ✓ 2

[4]

8. (i) MgO has reacted with CO_2 ✓ 1

- (ii) Solid dissolves / disappears ✓
 Fizzing / bubbles ✓ 2
 $MgO + 2HCl \rightarrow MgCl_2 + H_2O$ ✓
 $MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$ ✓
 both reactions form magnesium chloride/ $MgCl_2$ ✓ 3

[6]

9. (i) hydrogen / H_2 ✓ 1

- (ii) $Sr + 2H_2O \rightarrow Sr(OH)_2 + H_2$ ✓ 1

- (iii) different numbers of moles/atoms/ different A_r values ✓
 so different number of moles of H_2 / more moles of Ca ✓
(i.e. an attempt to quantify difference) 2

- (iv) 8 – 14 ✓ 1

[5]

10. (i) $\text{Ca}^+(\text{g}) \rightarrow \text{Ca}^{2+}(\text{g}) + \text{e}^-$
Equation with correct charges and 1 electron lost ✓
state symbols ✓
'-' not required on 'e' 2
- (ii) same number of protons or same nuclear charge attracting
less electrons/
electron removed from an ion/
less electron-electron repulsion (**not** less shielding)/
ion is smaller ✓ 1
- (iii) atomic radii of Sr > atomic radii of Ca/
Sr has electrons in shell further from nucleus than Ca/
Sr has electrons in a higher energy level/
Sr has more shells ✓
Therefore less attraction ✓
Sr has **more** shielding than Ca ✓
(*'more' is essential*) 3
- increased nuclear charge is outweighed / despite increased nuclear
charge by at least one of the factors above ✓

[6]

11. $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ ✓
state symbols not required

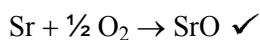
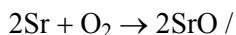
[1]

12. (a) Ca(s) + ...2 ✓ HCl(aq) CaCl₂(aq) + .H₂(g). ✓ 2
(g) not required for H₂
- (b) In Ca, oxidation state = 0 ✓ and 2
In CaCl₂, oxidation state = +2 ✓
Oxidation number increases from Ca to CaCl₂

[4]

13. (i) moles $\text{HCl} = 2.0 \times 50/1000 = 0.10$ ✓ 1
- (ii) moles $\text{Ca} = \frac{1}{2} \times \text{moles HCl} = 0.050$ ✓
 mass $\text{Ca} = 40.1 \times 0.050 = 2.00 \text{ g} / 2.005 \text{ g}$ ✓ 2
 (accept $40 \times 0.050 = 2.0 \text{ g}$)
 (mass Ca of 4.0 g would score 1 mark as 'ecf' as molar ratio has not been identified)
- (iii) Ca has reacted with water ✓
 $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ ✓✓
state symbols not required
- 1st mark for H_2 3
 2nd mark is for the rest of the balanced equation
- [6]
14. (a) RaCl_2 ✓ 1
- (b) Reduction is gain of electrons/decrease in oxidation number
 ✓
 Ra^{2+} gains 2 electrons $\rightarrow \text{Ra}/$
 Oxidation state goes from +2 in $\text{RaCl}_2 \rightarrow 0$ in Ra ✓ 2
- [3]
15. (i) effervescence/bubbles ✓
 Ra disappears/dissolves ✓ 2
- (ii) 8-14 ✓ 1
- [3]
16. CaCO_3 reacts with (or neutralises) HCl ✓
 (or $\text{CaCO}_3 + \text{HCl}$ in an equation)
 $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ ✓
 (correct equation would score both marks)
- [2]

17. Strontium reacts with oxygen/strontium oxide forms/SrO forms ✓



[2]

18. (i) In Sr, oxidation number = 0 ✓
In Sr(OH)₂, oxidation number = (+)2 ✓
OR

Oxidation number increases from Sr → Sr(OH)₂ ✓ by 2 ✓

2

(ii) $0.438/87.6 = 5.00 \times 10^{-3} / 0.00500 \text{ mol} \checkmark$

1

(iii) $0.00500 \times 24.0 = 0.120 \text{ dm}^3 \checkmark$ (accept 120 cm³)

1

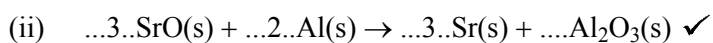
(iv) $0.00500 \times 1000/200 = 0.0250 \text{ mol dm}^{-3} \checkmark$

1

[5]

19. (i) heat ✓

1



1

(iii) Molar mass of SrCO₃ = 87.6 + 12 + 16x3 = 147.6 g mol⁻¹ ✓

Mass SrCO₃ required = $100 \times 147.6/87.6 = 168 \text{ tonnes} \checkmark$

Mass of ore needed = mass SrCO₃ × 100/2

= $168 \times 100/2 = 8400 \text{ tonnes} /$

8425 tonnes (from 168.484931507) ✓

(answer depends on rounding)

5000 tonnes is $50 \times 100 \text{ tonnes}$: worth 1 mark

3

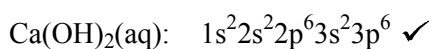
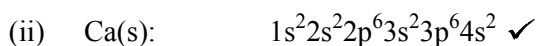
- (iv) 98% waste produced which must be disposing of /made into something worthwhile/CO₂ being removed by something sensible/
any sensible comment ✓

1

[6]

20. (i) Answer is inclusive of 9 – 14 inclusive ✓

1



2

[3]

21. barium atoms are larger ✓
barium atoms have more shielding ✓
this outweighs the increase in nuclear charge ✓
barium electrons are lost more easily
/less energy required
/ionisation energy decreases ✓

[4]