EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed
104 Minutes

Score /87

Percentage %

CHEMISTRY

OCR AS & A LEVEL

Mark Scheme

Module 3: Periodic table and energy

1. (i) $2Mg + O_2 \rightarrow 2MgO$ ✓

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]

2. (a) BaO ✓
Ba_3N_2 ✓

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)** × 24000 ✓

ALLOW *19 up to calculator value.*

1

(iii) 8.0×10^{-3}
OR
calculated answer to **(b)(i)** × 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 Ba_3N_2*

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]

3. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
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]

4. (i) $Ca(OH)_2$ ✓

***IGNORE** charges, even if wrong*

1

(ii) $Ca(NO_3)_2$ ✓

***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/$Ca(OH)_2$ **(1)** (i.e. one product)
$Ca(s) + H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$ **(1)** (i.e. full equation)
Equation would subsume both two marks 2

[4]

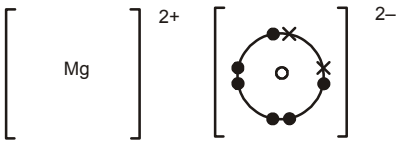
6. (i) loss (of electrons) ✓ 1

(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) $Ca^{+}(g) \rightarrow Ca^{2+}(g) + e^{-}$
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. $CaCO_3 \rightarrow CaO + CO_2$ ✓
state symbols not required

[1]

12. (a) ……Ca(s) + …..2 ✓ HC*l*(aq) …….$CaCl_2$(aq) + .H_2(g). ✓ 2

(g) not required for H_2

(b) In Ca, oxidation state = 0 ✓ and 2
In $CaCl_2$, oxidation state = +2 ✓
Oxidation number increases from Ca to $CaCl_2$

[4]

13. (i) moles HC*l* = 2.0 × 50/1000 = 0.10 ✓ 1

(ii) moles Ca = ½ × moles HC*l* = 0.050 ✓
mass Ca = 40.1 × 0.050 = 2.00 g / 2.005 g ✓ 2
(accept 40 × 0.050 = 2.0 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 ✓
$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ ✓✓
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 → Ra/
Oxidation state goes from +2 in $RaCl_2$ → 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) HC*l* ✓
(or $CaCO_3$ + HC*l* in an equation)

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ ✓
(correct equation would score both marks)

[2]

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

forms ✓

$2Sr + O_2 \rightarrow 2SrO$ /

$Sr + ½ O_2 \rightarrow SrO$ ✓

[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 mol ✓ 1

(iii) $0.00500 \times 24.0 = 0.120\ dm^3$ ✓ (accept 120 cm^3) 1

(iv) $0.00500 \times 1000/200 = 0.0250\ mol\ dm^{-3}$ ✓ 1

[5]

19. (i) heat ✓ 1

(ii) ...3..SrO(s) + ...2..Al(s) → ...3..Sr(s) + ...Al_2O_3(s) ✓ 1

(iii) Molar mass of $SrCO_3$ = 87.6 + 12 + 16x3 = 147.6 g mol^{-1} ✓

Mass $SrCO_3$ required = 100 × 147.6/87.6 = 168 tonnes ✓

Mass of ore needed = mass $SrCO_3$ × 100/2
= 168 × 100/2 = 8400 tonnes /
8425 tonnes (*from 168.484931507*) ✓
(answer depends on rounding)
5000 tonnes is 50 × 100 tonnes: worth 1 mark 3

(iv) 98% waste produced which must be disposing of /made into something worthwhile/CO_2 being removed by something sensible/
any sensible comment ✓ 1

[6]

20. (i) Answer is inclusive of 9 – 14 inclusive ✓ 1

(ii) Ca(s): $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ ✓

$Ca(OH)_2$(aq): $1s^2 2s^2 2p^6 3s^2 3p^6$ ✓ 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]