OCR A-Level Chemistry A

Group 2 and the halogens mark scheme · goes with “Group 2 and the halogens” · whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/

Mark schemes

Group 2 and the halogens · 9 questions

Q1 · June 2022 · AS Paper 1 (Breadth in chemistry) · Q24 · [9 marks]

OCR MARK SCHEME

24(a)(i)

Oxidation and reduction of the same element ✓

‘Atom’ is insufficient for element

[1 mark]

EXAMINER GUIDANCE

ALLOW ‘chlorine’ OR ‘Cl’ for same element

***IGNORE** ‘species’ for ‘element’*

24(a)(ii)

Equation

$Cl_2 + 2NaOH \rightarrow NaClO + NaCl + H_2O$ ✓

Redox:

Cl is oxidised from 0 (in Cl_2) to +1 in NaClO ✓

Cl is reduced from 0 (in Cl_2) to –1 in NaCl/HCl ✓

***IGNORE** oxidation numbers shown in equation*

(treat as rough working)

BUT

If no oxidation numbers in explanation, look at equation for oxidation numbers

[3 marks]

DO NOT ALLOW

$Cl_2 + NaOH \rightarrow NaClO + HCl$

***ALLOW ECF** from HCl in equation*

ALLOW 1 out of 2 redox marks if NaClO AND NaCl omitted, i.e.

Cl is oxidised from 0 to +1

AND

Cl is reduced from 0 to –1

ALLOW 1 out of 2 redox marks if oxidation number changes are BOTH correct

...BUT reduction/oxidation is incorrectly assigned, i.e.

Cl is reduced from 0 (in Cl_2) to +1 in NaClO

Cl is oxidised from 0 (in Cl_2) to –1 in NaCl/HCl

General:

ALLOW number before sign in ox no,

i.e. 1+ for +1

1– for –1

***IGNORE** ionic charges, e.g. Cl^{1+}*

***IGNORE** ‘1’ (signs required)*

IGNORE *references to electron loss/gain*

(even if wrong)

24(b)

Identification of halide

Add (aqueous) silver nitrate OR $AgNO_3$

OR Ag^+/silver ions ✓

Observations – mark independently

Any 2 precipitate colours from

Chloride/Cl^- gives white precipitate

Bromide/Br^- gives cream precipitate

Iodide/I^- gives yellow precipitate ✓

Precipitate/solid seen at least once

Equation for at least one halide

e.g. $Ag^+ + Cl^- \rightarrow AgCl$

ALLOW $Ag^+ + X^- \rightarrow AgX$ ✓

IGNORE *state symbols (ppt already assessed)*

Identification of B and C

B: NaBr OR sodium bromide ✓

C: $CaCl_2$ OR calcium chloride ✓

[5 marks]

IGNORE *addition of HNO_3 but HCl CONs $AgNO_3$*

IGNORE *references to solubility in NH_3 (dil or conc), even if incorrect*

ALLOW chlorine for chloride, etc

ALLOW equation with Br^- OR I^-

e.g. $Ag^+ + Br^- \rightarrow AgBr$

ALLOW full/partial equations,

e.g. $AgNO_3 + Cl^- \rightarrow AgCl + NO_3^-$

ALLOW explanation for identification: i.e.

B (Group 1):

Subtract molar/atomic mass of halide/Br from number in range 100–115/molar mass of B ✓

C (Group 2):

Subtract 2 × molar/atomic mass of halide/Cl from number in range 100–115/molar mass of C ✓

ALLOW displacement by addition of halogen ✓

2 correct colours in water or organic solvent ✓

Equation, e.g. $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ ✓

Q2 · June 2022 · Paper 1 (Periodic table, elements and physical chemistry) · Q21 · [14 marks]

OCR MARK SCHEME

EXAMINER GUIDANCE

21(a)(i)

Ca fizzes faster

AND

Ca dissolves/disappears more quickly ✓

[1 mark]

CARE Both needed for 1 mark.

ORA

ALLOW AW

IGNORE *finishes first*

IGNORE *more bubbles (need idea of rate)*

IGNORE *exothermic*

21(a)(ii)

Oxidation $Mg \rightarrow Mg^{2+} + 2e^-$ ✓

Reduction $2H^+ + 2e^- \rightarrow H_2$

OR $H^+ + e^- \rightarrow \frac{1}{2}H_2$ ✓

[2 marks]

In half equations,

ALLOW *the use of e for* e^-

ALLOW *Mg -* $2e^- \rightarrow Mg^{2+}$

IGNORE *state symbols even is wrong BUT half equations MUST only have species that change.*

For charges on half equations,

ALLOW Mg^{+2} *for* Mg^{2+}

OR H^{+1} for H^+

If BOTH half equations are correct but shown with oxidation and reduction the wrong way around, award 1 mark from the 2 marks for half equations

21(b)(i)

FIRST CHECK THE ANSWER ON ANSWER LINE

If answer = 2.53(g) award 5 marks

$[H^+] = 10^{-13.12}$ **OR** $7.58..... \times 10^{-14}$ (mol dm^{-3}) ✓

$[OH^-] = \dfrac{1 \times 10^{-14}}{7.58..... \times 10^{-14}}$ **OR** 0.1318 ..... (mol dm^{-3}) ✓

$n(OH^-)$ in 250 $cm^3 = \dfrac{0.1318.....}{4}$ **OR** 0.0329..... (mol) ✓

$n(Ba(OH)_2)$ or n(BaO) $= \dfrac{0.0329.....}{2}$ **OR** 0.0164..... (mol) ✓

Mass of BaO = 0.0164..... × 153.3 = 2.53 (g) 3SF ✓

[5 marks]

ALLOW ECF *and 3SF throughout.*

ALLOW *calculation process in any order.*

IGNORE *rounding errors past 3SF*

Calculator: $7.58577575 \times 10^{-14}$

Calculator: 0.1318256739

ALLOW *alternative approach using pOH for first 2 marks.*

$p[OH^-] = 14 - 13.12 = 0.88$

$[OH^-] = 10^{-0.88} = 0.1318.....$

Calculator: 0.03295641846

0.033(0) comes from $[OH^-] = 0.132$

Calculator: 0.01647820923

Calculator: 2.526109475

Common errors

4 marks

5.05g	Not dividing by 2
2.82g	Use of M_r for $Ba(OH)_2$
5.06g	rounds to 0.132 in M2 then not dividing by 2

3 marks

5.65g	not dividing by 2 and using M_r for $Ba(OH)_2$

21(b)(ii)

$Ba^{2+}(aq) + 2H^+(aq) + SO_4^{2-}(aq) + 2OH^-(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$ ✓

[1 mark]

ALLOW *multiples*

ALLOW

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

OR

$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

21(c)(i)

FIRST CHECK THE ANSWER ON ANSWER LINE

If answer = 731(g) award 3 marks

$n(Z)$

$n(Ca_5NH_4(NO_3)_{11}\cdot 10H_2O) = \frac{1500}{1080.5}$ **OR** 1.388246... ✓

Mass of limestone

$n(CaCO_3)$ = 1.388246... × 5 **OR** 6.94123...

AND

mass $CaCO_3$ = 6.94123... × 100.1 **OR** 694.8 g ✓

mass limestone = $\frac{694.8 \times 100}{95.0}$ = 731 g (3SF) ✓

[3 marks]

ALLOW ECF *throughout*

ALLOW *calculation process in any order.*

IGNORE *rounding errors past 3SF*

DO NOT ALLOW *100 for M_r of $CaCO_3$*

Common errors

2 marks

146g	no x 5 for moles of $CaCO_3$
660g	use of 95.0/100
29.3g	divide by 5 rather than x5

21(c)(ii)

$Mg_3Ca(CO_3)_4(s) + 8HCl(aq) \rightarrow 3MgCl_2(aq) + CaCl_2(aq) + 4H_2O(l) + 4CO_2(g)$

ALLOW *multiples*

M2 dependent on M1

Correct formulae ✓

Balanced **AND** state symbols ✓

[2 marks]

IGNORE *incorrect state symbol for* $Mg_3Ca(CO_3)_4$

Q3 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q10 · [1 mark]

Answer: **B**

carbonate, sulfate, halide

Q4 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q7 · [1 mark]

Answer: **B**

$MgSO_4$

Q5 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q9 · [1 mark]

Answer: **A**

$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

Q6 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q4 · [1 mark]

Answer: **B**

Hydroxides

Q7 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q6 · [1 mark]

Answer: **D**

$4HCl + MnO_2 \rightarrow MnCl_2 + Cl_2 + 2H_2O$

Q8 · June 2025 · AS Paper 1 (Breadth in chemistry) · Q22 · [11 marks]

OCR MARK SCHEME

22(a)

Disproportionation

Oxidation and reduction of the same element/bromine

OR

Bromine has been oxidised and bromine has been reduced ✓

Oxidation numbers and redox

Br is oxidised from 0 (in Br_2) to +1 in NaBrO ✓

Br is reduced from 0 (in Br_2) to –1 in NaBr ✓

IGNORE *oxidation numbers shown in equation*

(treat as rough working)

BUT

EXAMINER GUIDANCE

'Atom' is insufficient for element

ALLOW *1 out of 2 redox marks if NaBrO AND NaBr omitted, i.e.*

Br is oxidised from 0 to +1 **AND**

Br is reduced from 0 to –1

ALLOW *1 out of 2 redox marks if oxidation number changes are BOTH correct*

...BUT reduction/oxidation is incorrectly assigned, i.e.

Br is reduced from 0 (in Br_2) to +1 in NaBrO

If no oxidation numbers in explanation, or if oxidation numbers are not linked to substances, look at equation for annotations which may be worthy of credit

[3 marks]

Br is oxidised from 0 (in Br_2) to –1 in NaBr

ALLOW *1 out of 2 redox marks for 3 oxidation numbers correct but no mention of words oxidation/reduction: e.g.*

0 in Br_2 **AND** –1 in NaBr **AND** +1 in NaBrO

General:

ALLOW *number before sign in ox no,*

i.e. 1+ for +1 1– for –1

IGNORE *ionic charges, e.g.* Br^{1+}

IGNORE *'1' (signs required)*

IGNORE *'+' and '-' (numbers required)*

IGNORE *references to electron loss/gain (even if wrong)*

22(b)(i)

Atomic radius

Cl has a smaller atomic radius (than Br)

OR Cl has fewer shells

OR Cl has less shielding ✓

Attraction

Nuclear attraction is more in Cl

OR (outer) electrons in Cl are more attracted (to nucleus)

OR Decreased distance / shielding in Cl outweighs decreased nuclear charge ✓

Ease of gaining electron

Easier to gain an electron in Cl ✓

[3 marks]

Comparison required throughout

ORA *throughout*

ALLOW *'down the group' if the group is clearly identified as group 7/halogens*

For fewer shells, **ALLOW** lower energy level

IGNORE *fewer orbitals* ***OR*** *fewer sub-shells*

IGNORE *'different shell'*

ALLOW *Cl has more nuclear pull*

IGNORE *more effective nuclear charge*

IGNORE *'nuclear charge' for nuclear attraction*

ALLOW *easier to reduce chlorine*

IGNORE *comments about energy/electronegativity*

22(b)(ii)

toxic/poisonous

IGNORE *'harmful'/'dangerous'*

OR

(forms) chlorinated/halogenated hydrocarbons

OR

(forms) carcinogenic compounds / toxic compounds ✓

IGNORE *chlorine is carcinogenic/causes cancer dangerous for health/causes breathing problems*

IGNORE *forms HCl*

[1 mark]

22(c)

Identification of halide

Add (aqueous) silver nitrate **OR** $AgNO_3$

OR Ag^+/silver ions ✓

Observations – mark independently

Any 2 precipitate colours from

Chloride/Cl^- gives white precipitate

Bromide/Br^- gives cream precipitate

Iodide/I^- gives yellow precipitate ✓

Precipitate/solid seen at least once

Correct equation for at least one halide

e.g. $Ag^+ + Cl^- \rightarrow AgCl$

ALLOW $Ag^+ + X^- \rightarrow AgX$ ✓

IGNORE *state symbols (ppt already assessed)*

Solubility

AgCl/precipitate dissolves in dilute $NH_3(aq)$

AND

AgBr/precipitate dissolves in concentrated $NH_3(aq)$,

AND

AgI/precipitate does not dissolve (in concentrated $NH_3(aq)$) ✓

IGNORE *addition of HNO_3 but HCl/H_2SO_4 is a CON for $AgNO_3$*

IGNORE *addition of $Ba(NO_3)_2$ but $BaCl_2$ is a CON for $AgNO_3$*

ALLOW *Cl/chlorine for chloride, etc. (credit is for the colours and precipitate)*

ALLOW *ppt/ptte for precipitate*

ALLOW *equation with Br^-* ***OR*** *I^-*

e.g. $Ag^+ + Br^- \rightarrow AgBr$

ALLOW *'ammonia' or NH_3 for $NH_3(aq)$*

Answer needs to be clear it is the solid/AgX which is dissolving

[4 marks]

Q9 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q14 · [1 mark]

Answer: **B**

Only 1 and 2

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