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OCR

RECOGNISING ACHIEVEMENT

FOUNDATION CHEMISTRY

# Mark Scheme 2811
# January 2002

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## ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

| | | |
|---|---|---|
| x | = | incorrect response (errors may also be underlined) |
| ^ | = | omission mark |
| bod | = | benefit of the doubt (where professional judgement has been used) |
| ecf | = | error carried forward (in consequential marking) |
| con | = | contradiction (in cases where candidates contradict themselves in the same response) |
| sf | = | error in the number of significant figures |

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

| | | |
|---|---|---|
| **Abbreviations, annotations and conventions used in the Mark Scheme** | / | = alternative and acceptable answers for the same marking point |
| | ; | = separates marking points |
| | NOT | = answers which are not worthy of credit |
| | ( ) | = words which are not essential to gain credit |
| | ___ | = (underlining) key words which **must** be used to gain credit |
| | ecf | = error carried forward |
| | AW | = alternative wording |
| | ora | = or reverse argument |

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**1. (a)** Mark vertically or horizontally.

| species | number of | |
|---|---|---|
| | protons | electrons |
| $Ca^{2+}$ | 20 | 18 ✓ |
| $Cl^-$ | 17 | 18 ✓ |

[2]

**(b)** $1s^2 2s^2 2p^6 3s^2 3p^6$ ✓ *$4s^0$ is OK*

[1]

**(c) (i)** $CaCl_2$ ✓

[1]

**(ii)** $Ca^{2+}$ ion shown correctly ✓ ; 2 $Cl^-$ ions shown correctly ✓

*For $Ca^{2+}$, either 8 electrons or no electrons*

*For $Cl^-$, dot and crosses required.*

[2]

**(iii)** ionic bonds/ionic bonding/electrostatic or ionic attraction/forces ✓

[1]

**(d) (i)** pH becomes (more) alkaline/increases ✓

$Ca(OH)_2$ forms/hydroxide ions form/$H^+$ is removed by electrolysis ✓

*(2nd mark depends on 1st: it 'explains' why the solution becomes alkaline)*

[2]

**(ii)** 'charge carriers' move in aqueous and do not move in solid ✓

charge carriers are ions ✓

*1st point identifies that something that is charged (electrons/ions/charge carriers) can move **and** not move when solid.*

*2nd point identifies what the carriers are.*

*'Ions move' in isolation scores 1 mark*

[2]

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**(e)** **(i)** $Cl_2$: 0 ✓

HClO +1 *or* 1 *or* 1+ ✓

HCl −1 *or* 1− ✓

[3]

**(ii)** 0.003 / 3 x $10^{-3}$ mol ✓

[1]

**(iii)** purification/sterilisation/disinfect/killing bacteria ow ✓

*but....***not** *'bleach'/* **not** *'cleaning'/* **not** *'swimming pools'*

[1]

**[Total: 16]**

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**2.** **(a)** Energy change when **each atom in 1 mole** ✓ of **gaseous atoms** ✓

**loses an electron** ✓ (to form 1 mole of gaseous 1+ ions).

[3]

**(b)** **(i)** Electrons added to same shell /same or similar shielding ✓

increasing nuclear charge/number of protons ✓

electrons experience greater attraction or *pull* / atomic radius decreases ✓

[3]

**(ii)** Al has an electron in the p sub-shell/ has a p electron /different sub-shell/different type of orbital ✓.

*(**not** a different shell or a different orbital)*

*If Al not stated then assume that response applies to it!*

Al sub-shell at higher energy (than s) ✓

[2]

**(c)** electron is further from nucleus/ electron in a different shell ✓ (***not** sub-shell or orbital*)

electron experiences **more** shielding ✓ (***more** is essential here*)

nuclear attraction decreases /distance or shielding outweighs nuclear attraction / effective nuclear charge decreases ✓

[3]

**(d)** First ionisation energy of Ne = 1600 kJ $mol^{-1}$/ > 1600 kJ $mol^{-1}$ ✓

[1]

**(e)** $Al^{2+}(g) \longrightarrow Al^{3+}(g) + e^-$ equation ✓; state symbols correct ✓

[2]

**[Total: 14]**

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3. **(a)** **(i)** *oxidation* loss of electrons/ increase in oxidation number/gain of O/loss of H ✓

*reduction* gain of electrons/ decrease in oxidation number/loss of O/gain of H ✓

[2]

**(ii)** $2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$ / $Mg(s) + \frac{1}{2} O_2(g) \longrightarrow MgO(s)$

equation ✓ ; state symbols correct ✓

[2]

**(iii)** *oxidation* $Mg \longrightarrow Mg^{2+} + 2e^-$ ✓

*reduction* $O_2 + 4e^- \longrightarrow 2O^{2-}$ / $\frac{1}{2}O_2 + 2e^- \longrightarrow O^{2-}$ ✓

*Ignore state symbols*

[2]

**(b)** **(i)** Solid no longer dissolves/ disappears/solid remains ✓

*Ignore references to changes of pH/use of indicators*

[1]

**(ii)** 25.0 x 2.00/1000 = 0.0500 mol ✓

[1]

**(iii)** 0.0250 mol MgO ✓ *(i.e. answer to (ii)/2)*

[1]

**(iv)** *M*(MgO) = 24.3 + 16 = 40.3 ✓

0.0250 x 40.3 ✓ = 1.0075 g = 1.01 g ✓

*(i.e. answer to (iii) x answer to M(MgO))*

(i.e. 1 mark for sig figs. 10.1 g would automatically score both the marks here.)

*If a candidate uses 24 for Mg, answer to 3 sig figs is 1.00 g.*

[3]

**(v)** **Not** a redox reaction **because** no species changes oxidation number ✓

evidence of working using actual oxidation numbers of **at least one species** ✓

*(2nd point could well in the equation in part (b). Indicate this with an arrow to show this evidence)*

[2]

**(c)** strong forces to be broken/high amount of energy required to break lattice /giant structure ✓

forces between ions/ionic bonding ✓ [2]

**[Total: 16]**

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**4. (a)** attraction of an atom/element for electrons ✓
in a covalent bond/bonded pair/molecule ✓

[2]

**(b)**

| | | |
|---|---|---|
| $^{\delta+}H–N^{\delta-}$ | $^{\delta-}F–B^{\delta+}$ | $^{\delta+}H–I^{\delta-}$ |

all 3 correct ✓ ✓ ; 2 correct scores 1 mark

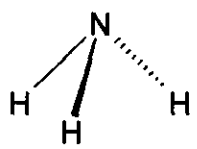
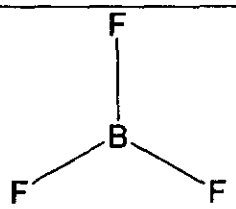
[2]

**(c)**

| dot-and-cross diagram for $NH_3$ ✓ | dot-and-cross diagram for $BF_3$ ✓ |
|---|---|
| $NH_3$ | $BF_3$ |

[2]

**(d)**

|  |  |
|---|---|
| bond angle: 107 ± 1° ✓ | bond angle: 120° ✓ |
| shape: pyramidal ✓ | shape: trigonal planar/planar triangle ✓ |

[4]

**(e)** $NH_3$ has a non-symmetrical shape/ $BF_3$ is symmetrical ✓
**in $NH_3$** dipoles do not cancel *or* there is an uneven charge distribution
/ **in $BF_3$** dipoles cancel *or* there is an even charge distribution ✓

[2]

**(f)** H bond shown from N of one $NH_3$ molecule to H of another $NH_3$ molecule ✓

[1]

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(g) (i) $NH_3$ has a lone pair/ $NH_4^+$ has no lone pair/ $NH_4^+$ has a dative (covalent) or coordinate bond ✓

bonded pair repels less/ lone pair repels more ✓

***not** repelling atoms* [2]

(ii) Add silver nitrate (solution)/ silver ions ✓

yellow precipitate ✓

*or*

Add chlorine/bromine ✓

violet in added organic solvent or blue-black colour with added starch ✓

[2]

**[Total: 17]**

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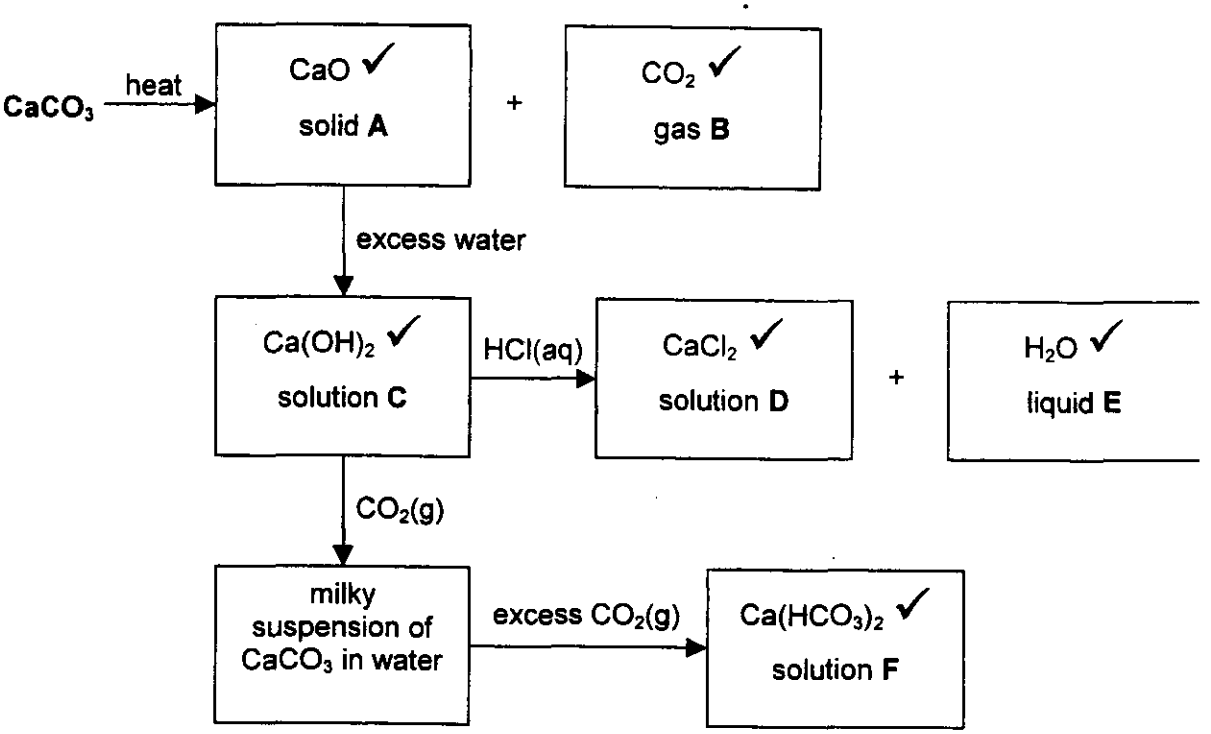
**5. (a)**




*alternative answers as names:*

**A** calcium oxide/qulicklime; **B** carbon dioxide; **C** calcium hydroxide/lime water; **D** calcium chloride; **E** water; **F** calcium hydrogencarbonate/ calcium bicarbonate

[6]

**(b)** *Molar mass* of $CaCO_3$ = 100.1 or 100 ✓

4 x 100.1 or 100 g $CaCO_3$ ✓ = 400.4 or 400

∴ 25 x 400.4 or 400/446.6 kg $CaCO_3$ = 22.41 or 22.39 kg ✓

*Accept 22 kg or 22.4 kg*

[3]

**(c)** **(i)** $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$ ✓ *ignore state symbols*

[1]

**(ii)** $CaCO_3$ reacts with acids ✓

[1]

**[Total: 11]**

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**6.** *In this question, 1 mark is available for the quality of written communication.*

**(a)**

*observations: 2 marks*

*chlorine:*

$Cl_2$ + bromide ⟶ orange/brown/yellow/red in organic solvent ✓

*bromine:*

$Br_2$ + iodide ⟶ orange/brown/yellow/purple with organic solvent ✓

*equations: 2 marks*

*chlorine:*

$Cl_2 + 2Br^- \longrightarrow Br_2 + 2Cl^-$ / $Cl_2 + 2I^- \longrightarrow I_2 + 2Cl^-$ ✓

*bromine:*

$Br_2 + 2I^- \longrightarrow I_2 + 2Br^-$ ✓

*2 'correct' unbalanced equations scores 1 mark*

*reactivity: 1 mark*

Therefore reactivity decreases down group/ $Cl_2 > Br_2 > I_2$ /

/ $Cl_2$ displaces bromine and iodine **AND** bromine displaces iodine

*(this could be shown in a table)* ✓

[sub-total: 5]

**(b)**

*how atom changes: 2 marks*

as group descends, more shells are added/ increasing radius of atom ✓

and increased electron shielding ✓

*result: 1 mark*

down the group,.....

electron to be captured experiences less attraction

/less effective nuclear charge to capture an electron

/electrons gained less easily ✓

*It must be clear that an electron is gained through this process to score the mark*

[sub-total: 3]

8 marking points ⟶ [7 max]

***Q – legible text with accurate spelling, punctuation and grammar*** ✓ [1]

**[Total: 8]**

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**7.** *In this question, 1 mark is available for the quality of written communication.*

**(a)** calculate from weighted mean: 79 x 55.0/100 + 81 x 45.0/100 ✓

$A_r$ = 79.9 ✓

[sub-total: 2]

**(b)** ionisation by electron beam/bombardment/gun ✓

acceleration/shot along/moved ✓

deflection by magnetic field/with a magnet ✓

deflection depends on mass/lighter particles deflected more ✓

particles travelling are ions ✓

relative heights or peak areas gives the abundance ✓

6 marking points ⟶ [5 max]

[sub-total: 5]

***Clear, well-organised, using specialist terms***

required use of **all** these words: ionisation, acceleration, deflection, detection ✓ [1]

**[Total: 8]**

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