



RECOGNISING ACHIEVEMENT

Subject: Chemistry Foundation**Code: 2811****Session: January****Year: 2002****Final Mark Scheme****RR****12th JANUARY 2002**

MAXIMUM MARK	90
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1. (a) Mark vertically or horizontally.

species	number of	
	protons	electrons
Ca ²⁺	20	18
Cl ⁻	17	18

✓

✓

[2]

(b) 1s²2s²2p⁶3s²3p⁶ ✓ 4s⁰ is OK

[1]

(c) (i) CaCl₂ ✓

[1]

(ii) Ca²⁺ ion shown correctly ✓ ; 2 Cl⁻ ions shown correctly ✓

For Ca²⁺, 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]

(e) (i) Cl₂: 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]

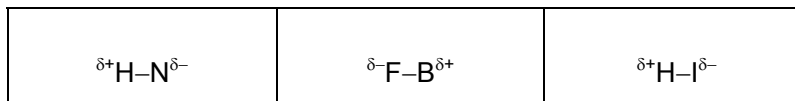
[Total: 16]

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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} / $> 1600 \text{ kJ mol}^{-1}$ ✓ [1]
- (e) $\text{Al}^{2+}(\text{g}) \longrightarrow \text{Al}^{3+}(\text{g}) + \text{e}^{-}$ equation ✓ ; state symbols correct ✓ [2]
- [Total: 14]

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) $2\text{Mg(s)} + \text{O}_2\text{(g)} \longrightarrow 2\text{MgO(s)}$ / $\text{Mg(s)} + \frac{1}{2}\text{O}_2\text{(g)} \longrightarrow \text{MgO(s)}$
equation ✓ ; state symbols correct ✓ [2]
- (iii) *oxidation* $\text{Mg} \longrightarrow \text{Mg}^{2+} + 2\text{e}^-$ ✓
reduction $\text{O}_2 + 4\text{e}^- \longrightarrow 2\text{O}^{2-}$ / $\frac{1}{2}\text{O}_2 + 2\text{e}^- \longrightarrow \text{O}^{2-}$ ✓
Ignore state symbols [2]
- (b) (i) Solid no longer dissolves/ disappears/solid remains ✓
Ignore references to changes of pH/use of indicators [1]
- (ii) $25.0 \times 2.00/1000 = 0.0500 \text{ mol}$ ✓ [1]
- (iii) 0.0250 mol MgO ✓ (*i.e. answer to (ii)/2*) [1]
- (iv) $M(\text{MgO}) = 24.3 + 16 = 40.3$ ✓
 $0.0250 \times 40.3 = 1.0075 \text{ g} = 1.01 \text{ g}$ ✓
(*i.e. answer to (iii) x answer to $M(\text{MgO})$*)
(*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]

4. (a) attraction of an atom/element for electrons in a covalent bond/bonded pair/molecule ✓
[2]

(b)



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: $107 \pm 1^\circ$ ✓	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]

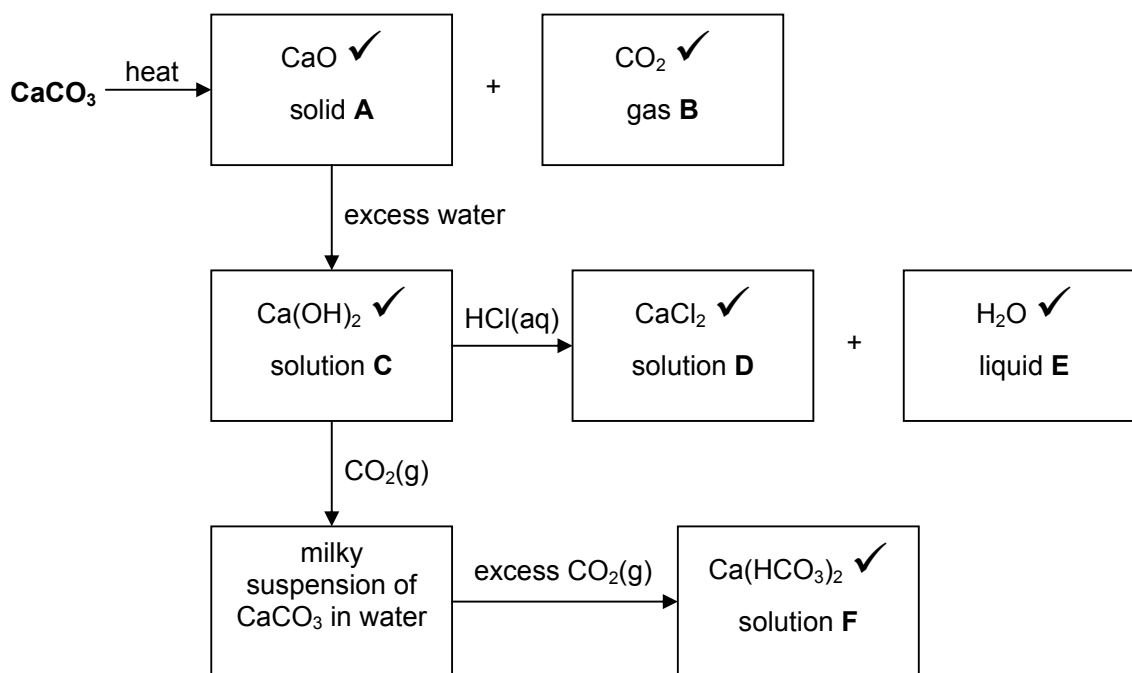
- (g) (i) NH_3 has a lone pair/ NH_4^+ has no lone pair/ NH_4^+ has a dative (covalent) or coordinate bond ✓
bonded pair repels less/ lone pair repels more ✓
not repelling atoms [2]

- (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]

5. (a)



alternative answers as names:

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

[6]

(b) Molar mass of $\text{CaCO}_3 = 100.1$ or 100 ✓

$$4 \times 100.1 \text{ or } 100 \text{ g CaCO}_3 \checkmark = 400.4 \text{ or } 400$$

$$\therefore 25 \times 400.4 \text{ or } 400/446.6 \text{ kg CaCO}_3 = 22.41 \text{ or } 22.39 \text{ kg} \checkmark$$

Accept 22 kg or 22.4 kg

[3]

(c) (i) $\text{Ca(OH)}_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$ ✓ *ignore state symbols*

[1]

(ii) CaCO_3 reacts with acids ✓

[1]

[Total: 11]

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

(a)

observations: 2 marks

chlorine:

$\text{Cl}_2 + \text{bromide} \longrightarrow \text{orange/brown/yellow/red in organic solvent} \checkmark$

bromine:

$\text{Br}_2 + \text{iodide} \longrightarrow \text{orange/brown/yellow/purple with organic solvent} \checkmark$

equations: 2 marks

chlorine:

$\text{Cl}_2 + 2\text{Br}^- \longrightarrow \text{Br}_2 + 2\text{Cl}^- / \text{Cl}_2 + 2\text{I}^- \longrightarrow \text{I}_2 + 2\text{Cl}^- \checkmark$

bromine:

$\text{Br}_2 + 2\text{I}^- \longrightarrow \text{I}_2 + 2\text{Br}^- \checkmark$

2 'correct' unbalanced equations scores 1 mark

reactivity: 1 mark

Therefore reactivity decreases down group/ $\text{Cl}_2 > \text{Br}_2 > \text{I}_2 /$

$/ \text{Cl}_2$ displaces bromine and iodine **AND** bromine displaces iodine

(this could be shown in a table) \checkmark

[sub-total: 5]

(b)

how atom changes: 2 marks

as group descends, more shells are added/ increasing radius of atom \checkmark
and increased electron shielding \checkmark

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 \checkmark

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

[sub-total: 3]

8 marking points \longrightarrow [7 max]

Q – legible text with accurate spelling, punctuation and grammar \checkmark [1]

[Total: 8]

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

(a) calculate from weighted mean: $79 \times 55.0/100 + 81 \times 45.0/100$ ✓

$$A_r = 79.9 \quad \checkmark$$

[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]