



RECOGNISING ACHIEVEMENT

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

<b>MAXIMUM MARK</b>	<b>90</b>
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1. (a) Mark vertically or horizontally.

species	number of	
	protons	electrons
Ca <sup>2+</sup>	20	18
Cl <sup>-</sup>	17	18

✓

✓

[2]

(b) 1s<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>3s<sup>2</sup>3p<sup>6</sup> ✓ 4s<sup>0</sup> is OK

[1]

(c) (i) CaCl<sub>2</sub> ✓

[1]

(ii) Ca<sup>2+</sup> ion shown correctly ✓ ; 2 Cl<sup>-</sup> ions shown correctly ✓

For Ca<sup>2+</sup>, either 8 electrons or no electrons

For Cl<sup>-</sup>, 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)<sub>2</sub> forms/hydroxide ions form/H<sup>+</sup> 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 ✓

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

2<sup>nd</sup> point identifies what the carriers are.

'ions move' in isolation scores 1 mark

[2]

(e) (i) Cl<sub>2</sub>: 0 ✓

HClO +1 or 1 or 1+ ✓

HCl -1 or 1- ✓

[3]

(ii) 0.003 / 3 x 10<sup>-3</sup> mol ✓

[1]

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

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

[1]

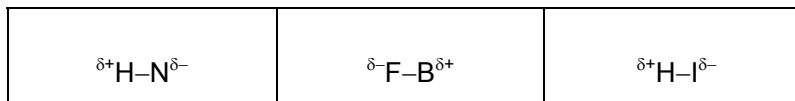
[Total: 16]

- 
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<sup>-1</sup> / > 1600 kJ mol<sup>-1</sup> ✓ [1]
- (e) Al<sup>2+</sup>(g) → Al<sup>3+</sup>(g) + e<sup>-</sup> 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)  $0.0250 \text{ mol MgO}$  ✓ (*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(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 $\text{NH}_3$ ✓	dot-and-cross diagram for $\text{BF}_3$ ✓
$\text{NH}_3$	$\text{BF}_3$

[2]

(d)

bond angle: $107 \pm 1^\circ$ ✓	bond angle: $120^\circ$ ✓
shape: pyramidal ✓	shape: trigonal planar/planar triangle ✓

[4]

- (e)  $\text{NH}_3$  has a non-symmetrical shape/  $\text{BF}_3$  is symmetrical ✓  
in  $\text{NH}_3$  dipoles do not cancel or there is an uneven charge distribution  
/ in  $\text{BF}_3$  dipoles cancel or there is an even charge distribution ✓  
[2]

- (f) H bond shown from N of one  $\text{NH}_3$  molecule to H of another  $\text{NH}_3$  molecule ✓  
[1]

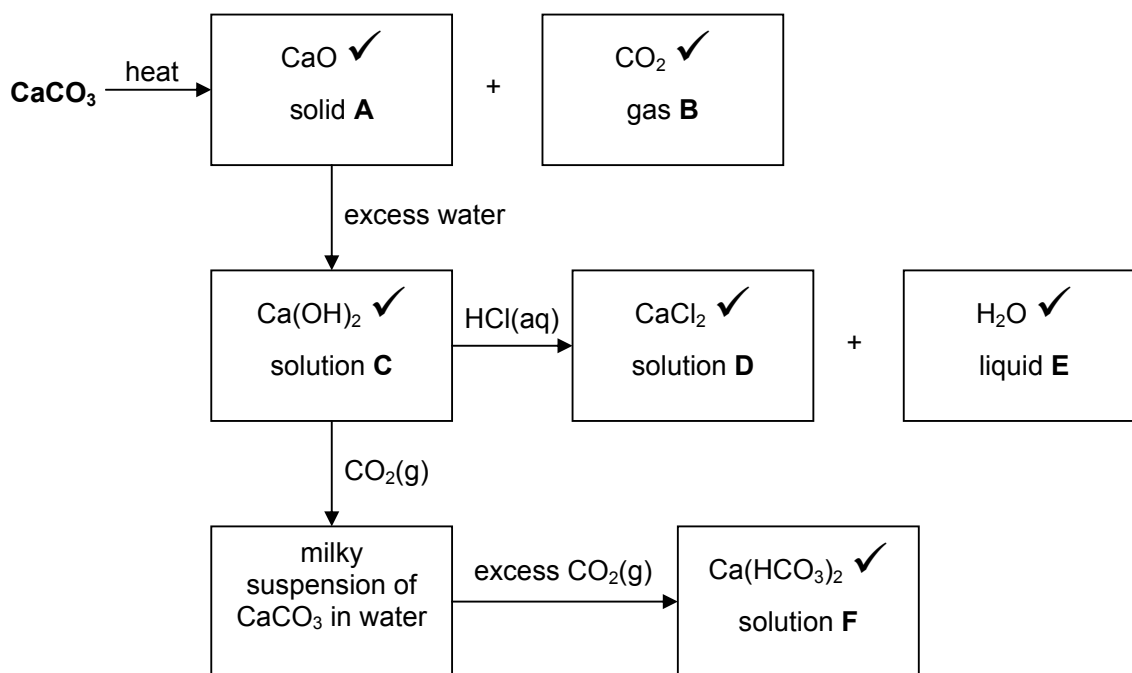
- (g) (i)  $\text{NH}_3$  has a lone pair/  $\text{NH}_4^+$  has no lone pair/  $\text{NH}_4^+$  has a dative (covalent) or coordinate bond ✓  
bonded pair repels less/ lone pair repels more ✓  
*not repelling atoms* [2]

- (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)  $\text{CaCO}_3$  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]**

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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]**