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GCE

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Chemistry (6241/01)

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Mark Scheme (Results)

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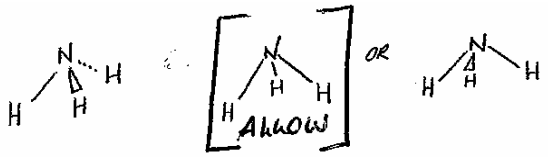
1	(a)		$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ formula $Ca(OH)_2$ **(1)** correct equation **(1)** *ignore state symbols* *incorrect symbol for calcium, penalise once*	**(2)**	
			Any one from each line (max 2) Gets warm **(1)** Effervescence/fizzing/bubbles/mist/steam/bobs up & down **(1)** white ppt/white solid/cloudy/milky/white suspension **(1)** Ca disappears/gets smaller / dissolves **(1)** *If more than two answers given and one or more wrong max 1*	**(2)**	**(4 marks)**
	(b)		Increases		**(1 mark)**
	(c)	(i)	24.4/40=0.61 17.1/14=1.22 58.5/16=3.66 *if rounded to 1dp, must be correct* (0.61/0.61) =1 (1.22/0.61) = 2 (3.66/0.61) =6 (Therefore it is CaN_2O_6) *penalise use of atomic number once* *OR* first correct % **(1)**, next two correct **(1)** e.g. Ca % = $\frac{40 \times 100}{40 + 28 + 96} = \frac{4000}{164} = 24.4\ \%$ **(1)** N % = $\frac{28 \times 100}{164} = 17.1\ \%$ O % = $\frac{96 \times 100}{164} = 58.5\ \%$ **(1)**	**(1)** **(1)**	**(2 marks)**
		(ii)	Cation/group 2 ion (radius) larger **(1)** same charge stated or shown **(1)** [lower charge density/charge:size ratio of ion award **(1)** of first two marks] polarises/distorts anion/nitrate/negative ion **(1)** *NOT* just "polarising" *ALLOW* LE of oxide and nitrate decrease down the group **(1)** LE of oxide decreases faster **(1)** So nitrate becomes more stable relative to oxide **(1)**		**(3 marks)**
					Total 10 marks

2	(a)	Trigonal pyramidal diagram  *IGNORE lone pair* *If trigonal planar/octahedral stated (-1)* *Allow tetrahedral stated,* *must be some attempt at 3D i.e. must NOT look planar*		**(1)**	
		106 - 108^0 marked on diagram *OR* stated		**(1)**	
		4 pairs (of electrons)/3 bond pairs and 1 lone pair repel to maximum separation/minimum repulsion		**(1)**	
		lone pair(-bond pair) repulsion > bond pair(-bond pair) repulsion		**(1)**	**(4 marks)**
	(b)	N more electronegative than H / N and H different electronegativity / (N-H) bonds polar/ δ^- δ^+ N – H		**(1)**	
		Dipoles do not cancel/dipoles not symmetrical (*ALLOW* molecule not symmetrical)/ centres of positive and negative charge do not coincide **so polar molecule**		**(1)**	
		ALLOW vector diagram **(1)** explanation **(1)**			**(2 marks)**
	(c)	ammonia has H bonding (but PH_3 does not)		**(1)**	
		phosphine has induced dipole(–induced dipole) / dispersion/London/van der Waals *IGNORE* dipole-dipole		**(1)**	
		Hydrogen bonding **stronger** so more **energy/heat** needed (to separate ammonia molecules)		**(1)**	
		Comparison mark only if two forces correctly identified.			**(3 marks)**
	(d)	(i)	**lone pair** on **N** forms **dative** / **co-ordinate** bond with $\mathbf{H^+}$	**(1)** **(1)**	**(2 marks)**
		(ii)	p=11 e=10	**(1)** **(1)**	**(2 marks)**
					Total 13 marks

3	(a)	(i)	moles Na = 92/23=4 = moles NaCl mass NaCl=4 x 58.5=234 (g) *Penalise use of atomic numbers once* *Incorrect answer scores (1) only if moles (NaCl) mentioned* OR 23g Na => 58.5g NaCl **(1)** Mass NaCl = $\frac{92 \times 58.5}{23}$ = 234 (g) **(1)**	**(1)** **(1)**	**(2 marks)**
		(ii)	$\frac{4}{10}$ = 0.40 **mol dm^{-3}** *OR* $\frac{234}{10}$ = 23.4 **g dm^{-3}** *consequential on (a)(i)* *units required*		**(1 mark)**
		(iii)	moles chlorine = 2 vol = 2 x 24 = 48 (dm^3) *Consequential on (a)(i)* *Correct answer (some working)* **(2)** *Correct answer (no working)* **(1)** *Incorrect answer scores* **(1)** only *if moles of Cl_2 mentioned*	**(1)** **(1)**	**(2 marks)**
	(b)		Regular pattern or lattice of (sodium) **ions** in a sea of electrons / delocalised electrons *ALLOW* "cloud of electrons" electrons are mobile / free to move (under an applied potential and so conduct electricity) *NOT* 'free' on its own or carry the charge	**(1)** **(1)** **(1)**	**(3 marks)**
	(c)		NaCl: attraction between (oppositely charged) ions *ALLOW* ionic bonds Cl_2: intermolecular forces/dispersion / van der Waals / London/induced dipole(-induced dipole) *NOT* dipole-dipole Ionic bonds stronger than intermolecular forces so more energy (allow heat) needed (to separate particles) *3rd mark dependent on correctly identifying the two forces*	**(1)** **(1)** **(1)**	**(3 marks)**

	(d)	(i)	Energy (allow enthalpy) required per mole to remove 1 electron (per atom) from gaseous atoms *OR* $X(g) \rightarrow X^{+}(g) + e$ Species **(1)** State symbols **(1) –** *only on correct equation* *Electron affinity defined (0)*	**(1)** **(1)** **(1)**	**(3 marks)**
		(ii)	chlorine has more protons / nucleus more positive Same shielding / same number of inner electrons/atomic radius less *ALLOW* outer electron(s) in same shell (so more energy required) OR effective nuclear charge increases (**1**)	**(1)** **(1)**	**(2 marks)**
					Total 16 marks

4	(a)	Substance which accepts/gains electrons (from another species) / which removes electrons			**(1 mark)**
	(b)	(i)	Fluorine/F_2 *ACCEPT* Flourine / Flurine / Florine *NOT* F or Fl_2		**(1 mark)**
		(ii)	Chlorine/Cl_2 *NOT* Cl		**(1 mark)**
		(iii)	(Red/brown/orange (or combination) and/or volatile) liquid		**(1 mark)**
	(c)	Red/brown / orange *or* combinations of these colours *NOT* yellow or any other colours Steamy/ misty (fumes) *NOT* white *If incorrect product linked to observation (0)*			**(1 mark)**
	(d)	+1 / 1+ / +I / I+ / I +5 / 5+/ +V / V+ / V *"+" can be sub or superscript*		**(1)** **(1)**	**(2 marks)**
	(e)	$2OH^- + Cl_2 \rightarrow Cl^- + OCl^- + H_2O$ *OR* $6OH^- + 3Cl_2 \rightarrow 5Cl^- + ClO_3^- + 3H_2O$ Chlorine species ie Cl_2 , Cl^- , OCl^- or Cl_2 , Cl^-, ClO_3^- **(1)** *ALLOW* Cl_2, NaCl, NaOCl/$NaClO_3$ Balancing **(1)** *Correct ionic equation only, spectator ions* **(0)** Explanation in terms of oxidation number e.g. chlorine (allow Cl_2/Cl) is oxidised 0 to +1 **(1)** and is reduced from 0 to -1 **(1)** *ALLOW* If chlorine "goes" from 0 to +1 and 0 to -1 **(1 out of 2)** *Consequential on the disproportionation equation*			**(4 marks)**
	(f)	(i)	$Cl(g) + e^- \rightarrow Cl^-(g)$ species **(1)** state symbols **(1) –** *only for correct equation and* $X(g) + e^- \rightarrow X^-(g)$ **max 1**		**(2 marks)**
		(ii)	(ion and electron) both negatively charged *OR* electron added to a negative ion (energy required to overcome) repulsion	**(1)** **(1)**	**(2 marks)**
					Total 15 marks

5	(a)	(i)	$(1s^2)\ 2s^2 2p^6 3s^2 3p^1$		**(1 mark)**
		(ii)	3rd IE roughly in line with first two in third row (including lines) 4th IE well above this line ≥ difference between 2nd and 3rd + two squares	**(1)** **(1)**	**(2 marks)**
	(b)	(i)	$Al \rightarrow Al^{3+} + 3e^-$ *OR* $-3e^-$ on LHS *ALLOW multiples* *IGNORE state symbols*		**(1 mark)**
		(ii)	$O_2 + 4e^- \rightarrow 2O^{2-}$ (NOT $O + 2e^- \rightarrow O^{2-}$) (NOT $O_2 \rightarrow 2O^{2-} - 4e^-$) *ALLOW multiples* *IGNORE state symbols*		**(1 mark)**
		(iii)	$4Al + 3O_2 \rightarrow 2Al_2O_3$ *ALLOW multiples* *Stand alone* *NOT consequential on bi and ii* *NOT* $4Al^{3+} + 6O^{2-}$		**(1 mark)**
				Total 6 marks	
					TOTAL FOR PAPER: 60 MARKS