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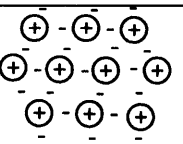
Question			Expected Answers	Marks
1	(a)	(i)	atoms of same element/same atomic number..... with different numbers of neutrons/different masses ✓	[1]
		(ii)	isotope protons neutrons electrons ^{46}Ti 22 24 22 ✓ ^{47}Ti 22 25 22 ✓	[2]
	(b)		$A_r = \frac{(46 \times 8.9) + (47 \times 9.8) + (48 \times 81.3)}{100}$ / 47.724 ✓ = 47.7 ✓	[2]
	(c)		$1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$ ✓	[1]
	(d)	(i)	 positive ions ✓ electrons ✓ (must be labelled)	[2]
		(ii)	electrons move ✓	[1]
	(e)	(i)	moles Ti = 1.44/47.9 = 0.0301 mol/0.03 mol (accept use of answer from (b))	[1]
		(ii)	mass of Cl = 5.70-1.44 = 4.26 g ✓ moles Cl = 4.26/35.5 = 0.120 mol ✓ 5.70/35.5 = 0.161 mol gets 1 mark	[2]
		(iii)	Ti:Cl = 0.0301 : 0.12 = 1:4. Empirical formula = $TiCl_4$ ✓ 0.0301 : 0.161 mol gives $TiCl_5$ for 1 mark	[1]
		(iv)	$Ti + 2Cl_2 \longrightarrow TiCl_4$ ✓ (ecf possible from (iii)	[1]
		(v)	covalent ✓ simple molecular ✓	[2]
				Total: 16

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uestion	**Expected Answers**	**Marks**
(a)	$RaCl_2$ ✓	[1]
(b)	Reduction is gain of electrons/decrease in oxidation number ✓ Ra^{2+} gains 2 electrons ⟶ Ra/ Oxidation state goes from +2 in $RaCl_2$ ⟶ 0 in Ra ✓	[2]
(c) (i)	effervescence/bubbles ✓ Ra disappears/dissolves ✓	[2]
(ii)	8-14 ✓	[1]
(d) (i)	First ✓ ionisation (energy) ✓ $Ra(g) \longrightarrow Ra^+(g) + e^-$ ✓✓ 1 mark for equation 1 mark for state symbols '–' not required on 'e'	[2] [2]
(ii)	atomic radii of Ra > atomic radii of Ca/ Ra has electrons in shell further from nucleus than Ca/ Ra has more shells ✓ Ra has **more** shielding than Ca ✓ :*'more' is essential* Ra electron held less tightly/less attraction on electron✓	[3]
		Total: 13

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Question	**Expected Answers**	**Marks**
3 (a)	...$Mg(OH)_2$(s) + **2**...HCl(aq) → ....$MgCl_2$(aq) + **2**...H_2O(l) ✓	**[1]**
(b) (i)	moles HCl = 0.108 x 500/1000 = 0.054 ✓	**[1]**
(ii)	moles $Mg(OH)_2$ = ½ x moles HCl = 0.027 ✓ molar mass of $Mg(OH)_2$ = 24.3 + 17x2 = 58.3 ✓ (do not penalise 24) mass $Mg(OH)_2$ = 58.3 x 0.027 = 1.57 g / 1.5741 g ✓ (accept ans from (ii) x 0.027 = 1.566 g) (mass $Mg(OH)_2$ of 3.15 g would score 2 marks as 'ecf' as molar ratio has not been identified)	**[3]**
(iii)	Too much **if** 2.42 g (dose) > ans to (ii) ✓ (If answer to (ii) > 2.42 g then 'correct' response here would be 'Not enough'	**[1]**
(c)	$CaCO_3$ reacts with (or neutralises) HCl ✓ (or $CaCO_3$ + HCl in an equation) $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$ ✓ (correct equation would score both marks)	**[2]**
		Total: 8

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Question	**Expected Answers**	**Marks**
(a)	$Cl_2(g) \longrightarrow NaOCl(aq)$: $Cl(0) \longrightarrow Cl(+1)$ ✓ $Cl_2(g) \longrightarrow NaCl(aq)$: $Cl(0) \longrightarrow Cl(-1)$ ✓ Cl is both oxidised (in forming NaOCl) and reduced (in forming NaCl)/disproportionation Cl reduces Cl to form NaCl AND Cl oxidises Cl in forming NaOCl ✓	[3]
(b) (i)	$Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ ✓✓ 1 mark for species. 1 mark for balancing	[2]
(ii)	Cl atom is smaller/has less shells ✓ electron to be captured will be attracted more ✓	[2]
		Total: 7

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Question	**Expected Answers**	**Marks**
5 (a) (i)	H bonding from O of 1 H_2O molecule to H of another ✓ dipoles shown ✓ with lone pair involved in bond ✓	**[3]**
(ii)	Two properties from: Ice is lighter than water/ max density at 4°C ✓ *explanation:* H bonds hold H_2O molecules apart / open lattice in ice / H-bonds are longer ✓ Higher melting/boiling point than expected ✓ *explanation*: strength of H bonds that need to be broken ✓ *must imply that intermolecular bonds are broken* High surface tension/viscosity ✓ *explanation* strength of H bonds across surface ✓	**[4]**
(b)	NH_3: 107° ✓ (range 106 – 108°) electron pairs repel other electron pairs ✓ lone pair has more repulsion ✓ electron pairs get as far apart as possible ✓	**[4]**
(c)	N has less protons than O (ora) ✓ electrons are in same shell /have same or similar shielding ✓ weaker nuclear attraction in N (ora) ✓ shell drawn in less by nuclear charge in N (ora) ✓ watch for distinction between nuclear **attraction** and nuclear **charge** in candidates' scripts.	**[4]**
	QoWC: links together two statements in at least two of the sections (a)(ii), (b) and (c) ✓	**[1]**
		Total: 16