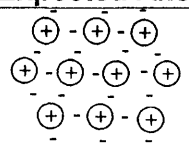
Question	Expected Answers	Marks
1 (a)	isotope / protons / neutrons / electrons nickel-58 / 28 / 30 / 28 nickel-60 / 28 / 32 / 28 nickel-62 / 28 / 34 / 28 ✓ / ✓ / ✓ For ecf, 3rd column same as first column.	[3]
(b) (i)	mass spectrometry ✓ mass spec... /mass spectrometer should also be credited	[1]
(ii)	average mass/weighted mean mass **of an atom** ✓ compared with carbon-12 ✓ 1/12th of mass of carbon-12/on a scale where carbon-12 is 12 ✓ *mass of 1 mole **of atoms** (of an element) mass of 1 mole of carbon-12 is equivalent to first two marks* *"mass of the element that contains the same number of atoms as are in 1 mole of carbon-12" ⟶ 2 marks (mark lost because of mass units)*	[3]
(iii)	63.0 x 77.2/100 + 65.0 x 22.8/100 / 63.456 ✓ = 63.5 (mark for significant figures) ✓	[2]
(iv)	copper/ Cu ✓	[1]
(c) (i)	mass of Ni = 2.0.g ✓ moles of Ni = 2.0/58.7 mol = 0.0341/0.034 mol ✓ (1 mark would typically result from no use of 25% → 0.136 mol) 2nd mark is for the mass of Ni divided by 58.7	[2]
(ii)	number of atoms of Ni = $6.02 \times 10^{23} \times 0.0341$ = 2.05×10^{22} / 2.1×10^{22} atoms ✓ Can be rounded down to 2.1 or 2.0 or 2 (if 2.0) From 8 g, ans = $8.18/8.2 \times 10^{22}$ (and other consequential responses)	[1]
		Total: 13

Question			Expected Answers	Marks
2	(a)	(i)	 positive ions/cations ✓ and negative electrons ✓ Can be described in words only for both marks	[2]
		(ii)	contain free/mobile/delocalised electrons ✓	[1]
	(b)	(i)	shared **pair of** ✓electrons ✓ *i.e. 'shared electrons' is worth 1 mark. pair of electrons for second marks*	[2]
		(ii)	correct dot-and cross diagram ✓	[1]
	(c)	(i)	electrostatic attraction ✓ between oppositely charged ions ✓ (charged or electrostatic for 1st mark)	[2]
		(ii)	correct dot-and cross diagram ✓ correct charges ✓	[2]
		(iii)	$Mg \longrightarrow Mg^{2+} + 2e^-$ ✓ $F_2 + 2e^- \longrightarrow 2F^-$ ✓ *– sign not required with electron*	[2]
		(iv)	solid: ions cannot move /in fixed positions in lattice ✓ solution: ions are free to move ✓	[2]
				Total: 14

Question	Expected Answers	Marks
3 (a)	NaClO, oxidation state = +1 ✓ NaCl, oxidation state = –1 ✓ OR Oxidation number decreases from NaClO ⟶ NaCl ✓ by 2 ✓	[2]
(b) (i)	84/24000 = 3. 5 x 10^{-3} mol ✓	[1]
(ii)	3.5 x 10^{-3} mol ✓ *ans to (i)*	[1]
(iii)	3.5 x 10^{-3} x 1000/5 = 0.70 mol dm^{-3} ✓ *ans to (ii) x 1000/5*	[1]
(c)	molar mass of NaClO = 23 + 16 + 35.5 = 74.5 (g mol^{-1}) ✓ concentration = 0.70 x 74.5 = 52.15 g (dm^{-3}) ✓ *ans to (iii) x 74.5* bleach is 5.215 g per 100 cm^3 and the information is correct (as this value exceeds 4.5%) ✓ *response depends upon answer to (b)(iii). Could be opposite argument if ans < 4.5%* *OR* molar mass of NaClO = 23 + 16 + 35.5 = 74.5 (g mol^{-1}) ✓ moles of NaOCl = 4.5/74.5 = 0.0604 mol (in 100 cm^3) ✓ bleach is 10 x 0.0604 = 0.604 mol dm^{-3} which is less than answer to (b)(iii) and therefore label is correct. ✓ *response depends upon answer to (b)(iii). Could be opposite argument if ans 0.604*	[3]
(d)	$2HCl + NaClO \longrightarrow Cl_2 + NaCl + H_2O$ ✓✓ *Award one mark for:* $HCl + NaClO \longrightarrow Cl_2 + NaOH$	[2]
		Total: 10

Question			Expected Answers	Marks
4	(a)	(i)	Answer is inclusive of 9 – 14 inclusive ✓	[1]
		(ii)	Ca(s): $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ ✓ $Ca(OH)_2(aq)$: $1s^2 2s^2 2p^6 3s^2 3p^6$ ✓	[2]
	(b)	(i)	Identity of precipitate A: calcium carbonate / $CaCO_3$ ✓ Equation: $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$ ✓ *equation alone would score 2 marks unless contradicted by identity*	[2]
		(ii)	Formula of solution B: $Ca(HCO_3)_2$ ✓ Equation: $CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$ ✓ *equation alone would score 2 marks unless contradicted by identity*	[2]
		(iii)	$CaCl_2$ ✓	[1]
	(c)		barium atoms are larger ✓ barium atoms have more shielding ✓ this outweighs the increase in nuclear charge ✓ barium electrons are lost more easily /less energy required /ionisation energy decreases ✓	[4]
				Total: 12

Question	Expected Answers	Marks
5 (a)	H_2O H bonding from O of 1 molecule to H of another ✓ dipoles shown or described ✓ with lone pair of O involved in the bond ✓ CH_4 van der Waals' forces from oscillating dipoles/ temporary dipoles/ transient dipoles/ instantaneous dipoles ✓ leading to induced dipoles ✓ caused by uneven distribution of electrons ✓	[3] [3] **sub-total: 6**
(b)	Two properties from: Ice is less dense/lighter than water/floats on 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 ✓ *Not just high* *Accept: 'unusually high/strangely high/relatively high'* *explanation*: H bonds need to be broken ✓ *must imply that intermolecular bonds are broken* High surface tension ✓ *explanation* strength of H bonds across surface ✓	[2] [2] [2] **mark 2 properties only → 4 max**
	QoWC over whole question – legible text with accurate spelling, punctuation and grammar ✓	[1]
		Total: 11