Question Number	Answer	Acceptable answers	Mark
1(a)(i)	fractional distillation		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	to make it liquid	liquefy/condense to remove water (vapour) to remove carbon dioxide	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	D weak forces of attraction between the oxygen molecules		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	An description including • shared (electrons) (1) • pair(s) of electrons (between atoms) (1)	Ignore reference to complete/full shells Ignore reference to between two metals Ignore reference to between metal and non-metal Ignore reference to between molecules Any reference to between ions scores 0	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	2.4		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)(iii)	diagram showing • any shared pair of electrons between a carbon and oxygen atom in CO_2 molecule (1) • rest of molecule correct (1)	Must have O C O arrangement If any atom labelled must be correct Ignore inner electrons even if wrong electrons can be on/in ring or no ring Ignore intersecting circles Accept all permutations of dots and crosses	**(2)**

Question number	Answer	Additional guidance	Mark
2(a)(i)	• particles are same size when they should be different sizes (1) • model is in 2D but crystal is 3D (1)	Allow reverse statements giving correct information.	**(2)**

Question number	Answer	Mark
2(a)(ii)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (2 marks): • very strong bonds/ionically bonded (1) • between 2+ cations and 2– anions (1) • so requires lot of energy to separate magnesium and oxide ions to melt the solid (1)	**(3)**

Question number	Answer	Additional guidance	Mark
2(b)(i)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ • all formulae on correct side (2) • balancing (1)	Allow 3/4 formulae (1)	**(3)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	relative formula mass copper carbonate = 63.5 +12.0 +(3 × 16.0) = 123.5 relative formula mass copper oxide = 63.5 + 16.0 = 79.5 (1) mass copper oxide $= \frac{15.0 \times 79.5}{123.5}$ = 9.7 g to 2 s.f. (1) Answer must be to two significant figures OR moles of copper carbonate $= \frac{15.0}{123.5} = 0.121\,45$ (1) mass of copper oxide = moles $CuCO_3$ × 79.5 = 9.7 g to 2sf (1) Answer must be to two significant figures	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
2(c)	2.4/24 moles Mg = 0.1 mol (1) and 0.2 moles H_2O has mass 0.2 × formula mass H_2O = 3.6 g (1) total mass reactants = 2.4 + 3.6 = 6.0 g is the same as total mass products = 5.8 + 0.2 = 6.0 g (1)	Award full marks for correct numerical answer without working.	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	electrons		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	transition (metals/ elements)	transitional ignore transient	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)	An explanation linking the following points • hydrogen chloride {soluble/dissolves} (in water) (1) • forms hydrochloric acid (1)	hydrogen chloride reacts with water	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)	An explanation including **two** of the following points • (orange) colour due to bromine (1) • chlorine displaces bromine (1) • (because) chlorine is more reactive (than bromine) (1)	chlorine displaces bromide (ions) a displacement reaction (occurs)OWTE	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(d)	A description including **three** of the following points • mix solutions (1) • filter (1) • wash (precipitate / solid) with water (1) • dry (precipitate / solid) in oven /leave to dry(1)	pour (both) solutions into {beaker/other suitable container} ignore addition of hydrochloric acid if wrong things mixed allow max 2 from last three points	**(3)**

Question Number	Answers	Acceptable Answers	Mark
4 (a)(i)	<table><tr><td></td><td>chlorine-35</td><td>chlorine-37</td></tr><tr><td>number of protons</td><td>**17**</td><td>**17**</td></tr><tr><td>number of neutrons</td><td>**18**</td><td>**20**</td></tr><tr><td>number of electrons</td><td>**17**</td><td>**17**</td></tr></table> the four 17s (1) the 18 and 20 (1)		**(2)**

Question Number	Answers	Acceptable Answers	Mark
4 (a)(ii)	An explanation linking M1 average (mass of atoms/isotopes present) (1) M2 more chlorine-35 than chlorine-37 / higher {percentage / abundance} of Cl-35 / lower {percentage / abundance} of Cl-37 / (1)	 mean ignore weight 75% chlorine-35 / 25% chlorine-37/ chlorine-35 and chlorine-37 in ratio 3:1 / correct calculation to obtain 35.5 (2) eg[(75x35) + (25x37)]/100	**(2)**

Question Number	Answers	Acceptable Answers	Mark
4 (b)	Diagram showing one carbon and four chlorines four pairs of electrons shared between the carbon and chlorine atoms (1) fully correct (1)	 use of dots or crosses or mixture of both ignore inner shells even if incorrect ignore symbols	**(2)**

Question Number		Indicative Content	Mark
QWC	**4(c)**	A response including some of the following points Note: (carbon to carbon) strong bonds is given in question Diamond: Uses and Properties • in cutting tools/engraving • drill bit • jewellery • diamond very hard/strong • attractive/lustrous • high melting point Explanations • giant molecular/covalent • each carbon atom bonded to four other carbon atoms • three dimensional structure • to break it lots of bonds would need to be broken • would need lot of energy/force Graphite: Uses and Properties • to make electrodes • a lubricant • sporting equipment • in pencils/drawing • graphite conducts electricity • soft Explanations • giant molecular/covalent • each carbon atom bonded to three other carbon atoms • each carbon atom has a free electron • delocalised electrons • (delocalised) electrons move to carry current • layers of carbon atoms • weak forces/bonds between layers/sheets • so layers/sheets can slide/rub off or over each other	**(6)**

Question number	Answer	Additional guidance	Mark
5(a)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • a negative ion must have more electrons than protons in the particle (1) • therefore Z will have a 2– charge (1)	Do not allow any comparison involving neutrons.	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)	40 + 2 × (14 + 16 × 3) (1) = 164 (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
5(c)	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	**(4)**