Question Number	Answer	Mark
1(a)(i)	2.5	**1**

Question Number	Answer	Mark
1(a)(ii)	P has the same number of outer shell electrons as N	**1**

Question Number	Answer	Mark
1(b)(i)	**M1** ammonium chloride: NH_4Cl ammonium carbonate: **M2** $(NH_4)_2CO_3$	**2**

Question Number	Answer	Notes	Mark
1(b)(ii)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	ALLOW multiples IGNORE state symbols even if incorrect	**1**

Question Number	Answer	Notes	Mark
1(b)(iii)	M1 add sodium hydroxide (solution) M2 test (gas / ammonia) with (damp) red litmus paper / (damp) universal indicator paper M3 (red litmus) turns blue / universal indicator) turns blue / purple	REJECT if solution / ammonium (sulfate) tested with litmus / universal indicator paper	**3**

Question Number	Answer	Notes	Mark
1(c)	M1 2 x 14 ÷ 80 OR 0.35 M2 (0.35 x 100 =) 35 (%)	correct answer without working scores 2 **ALLOW** 1 mark for 17 / 17.5 / 18 (%)	**2**

Question Number	Answer	Notes	Mark
2(a)(i)	M1 copper(II) sulfate (solution) M2 shortest time taken to turn colourless	ALLOW copper sulfate ALLOW gave greatest increase in rate OWTTE ALLOW made reaction happen fastest OWTTE M2 dep on M1	**2**

Question Number	Answer	Notes	Mark
2(a)(ii)	M1 a catalyst provides an alternative pathway M2 of lower activation energy	Any reference to increasing energy/speed of particles scores 0	**2**

Question Number	Answer	Notes	Mark
2(b)(i)	An explanation with following four points M1 the rate of reaction increases/ the reaction is faster/ the reaction speeds up M2 because the particles gain (kinetic) energy/move faster M3 there are more collisions per unit time M4 more of the collisions are successful / more collisions/particles have energy greater than the activation energy	ACCEPT more frequent collisions OWTTE No M4 if refer to lower activation energy there are more frequent successful collisions scores M3 and M4	**4**

Question Number	Answer	Notes	Mark
2(b)(ii)	M1 fewer particles per unit volume M2 (hence) fewer collisions per unit time	ALLOW particles less tightly packed / particles further apart ALLOW decrease in the frequency of collisions between particles Any reference to changing energy/speed of particles scores 0	**2**

Question Number	Answer	Mark
3(a)(i)	C Measuring cylinder	**1**

Question Number	Answer	Notes	Mark
3(a)(ii)	M1 and M2 all the points correct ± half a square	If only one plotting error scores M1	**2**

Question Number	Answer	Notes	Mark
3(a)(iii)	2 straight lines of best fit, ignoring the anomalous point	Left line does not have to go through/use (0.0, 10.0) if point has not been plotted	**1**

Question Number	Answer	Notes	Mark
3(a)(iv)	as the volume of sulfuric acid increases the (electrical) conductivity decreases	IGNORE references to gradient/slope/correlation	**1**

Question Number	Answer	Notes	Mark
3(a)(v)	(the student) forgot to stir the mixture	ALLOW any reference to adding less acid/lower volume (than should have done) OWTTE	**1**

Question Number	Answer	Notes	Mark
3(b)(i)	M1 barium sulfate has a (giant) ionic structure OR has ionic bonding M2 ionic substances do not conduct when solid M3 water has covalent bonding and covalent compounds do not (usually) conduct electricity	 ALLOW only conduct when dissolved/molten ALLOW in solid ions cannot move ALLOW water does not conduct because it is covalent IGNORE explanations of why covalent do not conduct	**3**

Question Number	Answer	Mark
3(b)(ii)	filtration **OR** filtering	**1**

Question Number	Answer	Notes	Mark
4(a)	M1 (put the carbonate in the boiling tube) and the limewater in the test tube M2 heat the carbonate and time how long it takes for the limewater to turn cloudy OWTTE M3 repeat with the same mass / amount / number of moles of another carbonate M4 (the carbonate which decomposes the fastest) will turn the limewater cloudy in the least time	 **ACCEPT** repeat with another carbonate using same volume of limewater OWTTE To score M4 reference to limewater turning cloudy must be mentioned at least once somewhere in answer	**4**

Question Number	Answer	Mark
4(b)(i)	C to stop solid particles leaving the tube	**1**

Question Number	Answer	Mark
4(b)(ii)	2.20 ÷ 44.0 (= 0.0500 mol)	**1**

Question Number	Answer	Notes	Mark
4(b)(iii)	0.05	ALLOW ECF from (ii)	**1**

Question Number	Answer	Notes	Mark
4(b)(iv)	M1 7.40 ÷ 0.05 M2 148	correct answer with or without working scores 2 ALLOW ECF from (iii)	**2**

Question Number	Answer	Notes	Mark
4(b)(v)	M1 A_r of metal = 148-60 OR 88 M2 metal is strontium / Sr	If (iv) correct strontium/Sr scores 2 without working ALLOW ECF from (iv) ALLOW ECF from M1 as long as answer is nearest Group 2 metal	**2**

Question Number	Answer	Notes	Mark
5(a)	M1 shared pair(s) of electrons M2 attracted to (two) nuclei	REJECT nucleus. Must be plural for M2 M2 dep on mention of electrons in M1	**2**

Question Number	Answer	Notes	Mark
5(b)	a pair of electrons in each bond and no non-bonding electrons.	ALLOW dots, crosses or any combination	**1**

Question Number	Answer	Mark
5(c)(i)	Any one from M1 oxygen is a smaller atom/particle than silicon M2 each (atom of) oxygen forms two bonds (to silicon atoms)	**1**

Question Number	Answer	Notes	Mark
5(c)(ii)	M1 silicon dioxide has a giant (covalent) structure M2 (in melting silicon dioxide) strong/many covalent bonds (need to be broken) M3 (in melting silicon hydride) weak intermolecular forces (of attraction need to be overcome/broken) M4 more (thermal/heat) energy is needed to break the (covalent) bonds (in SiO_2) than break/overcome the intermolecular forces (in SiH_4)	 ALLOW description of covalent bonds as long as strong/many mentioned ALLOW weak intermolecular bonds Max 2 if contradictions/references to incorrect forces/particles	**4**

Question Number	Answer	Notes	Mark
5(d)	$SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O$ all formula correct and equation correctly balanced	 IGNORE state symbols ALLOW multiples and fractions	**1**

Question Number	Answer	Notes	Mark
6(a)(i)	M1 $WO_3(s) + 3H_2(g)$ M2 $W(s) + 3H_2O(g \text{ or } l)$	ALLOW upper case	**2**

Question Number	Answer	Mark
6(a)(ii)	heat again to constant mass OWTTE	**1**

Question Number	Answer	Notes	Mark
6(a)(iii)	M1 (mass of tungsten =) 1.84g AND (mass of oxygen =) 0.48g M2 (moles of tungsten) = $\frac{1.84}{184}$ or 0.01 AND (moles of oxygen) = $\frac{0.48}{16}$ or 0.03 M3 therefore ratio is 1:3	 M2 subsumes M1 ALLOW M2 ECF from incorrect masses M3 dep on M2 ALLOW ECF from incorrect M2 only if does give 1:3 when rounded	**3**

Question Number	Answer	Notes	Mark
6(a)(iv)	Any one from M1 use a safety screen M2 position the class some distance from the apparatus OWTTE M3 do the experiment in a fume cupboard	 ALLOW heat proof/safety gloves ALLOW tie back hair	**1**

Question Number	Answer	Notes	Mark
6(b)	Example calculation M1 moles of tungsten oxide = (2784 × 10^6 ÷ 232) = 12 000 000 M2 maximum mass of tungsten = (12 000 000 × 184) = 2208 000 000 g OR 2208 tonnes M3 mass of tungsten (considering 73.5% yield) = (73.5 × 2208 ÷ 100) = 1622.88 (tonnes)	correct answer without working scores 3 ALLOW any number of significant figures ≥2 throughout ALLOW other correct methods ALLOW working in megamoles ALLOW ECF M1×184 ALLOW ECF from M2	**3**