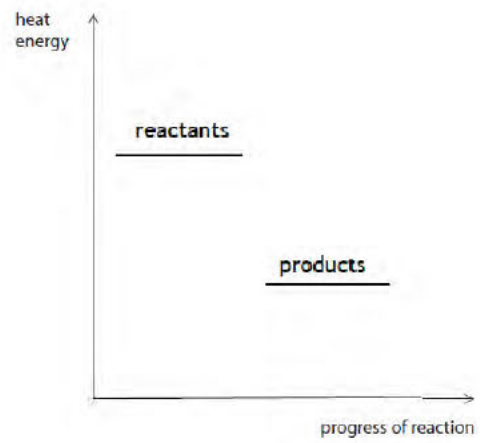
Question Number	Answers	Acceptable Answers	Mark
1 (a)(i)	An explanation linking • (substance which) speeds up / increases the rate of (a reaction) **(1)** • (but is chemically) unchanged (at end of reaction) / not used up (in reaction) /mass remains the same **(1)**	Ignore any reference to enzymes Ignore changes/alters the rate Allow provides an alternative route for the reaction with a lower energy / lowers the activation energy / reduces the energy needed for {a reaction to take place/successful collisions} **(1)** Do not allow catalyst is a reactant /product Ignore does not change products of reaction Ignore {does not take part/is not used/is not involved} in the reaction	**(2)**

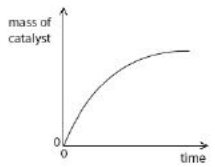
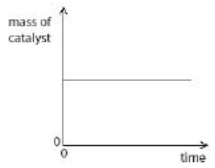
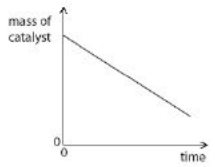
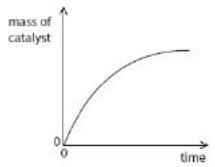
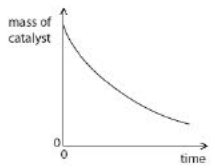
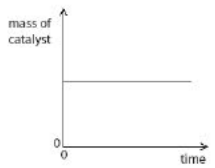
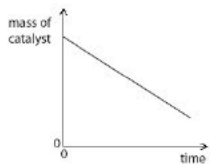
Question Number	Answers	Acceptable Answers	Mark
1 (a)(ii)	 • labelled horizontal reactant line above product line line can be labelled reactants /carbon monoxide + oxygen /CO + O_2 **(1)** • labelled horizontal product line to right of reactant line line can be labelled product(s) / carbon dioxide / CO_2 **(1)**	Allow 2 lines in the correct positions unlabelled/ with incorrect labels **(1)** Allow reactants and products written in the correct positions without horizontal lines **(1)** Ignore additional curves and arrows Ignore incorrect formulae if written in addition to correct words /names	**(2)**

Question Number	Answers	Acceptable Answers	Mark
1 (a)(iii)	$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$ • correct formulae on lhs $C_7H_{16} + O_2$ **(1)** • correct formulae on rhs $CO_2 + H_2O$ **(1)** • balancing correct formulae **(1)**	Accept multiples Accept = for → Ignore state symbols, even if incorrect	**(3)**

Question Number	Answers	Acceptable Answers	Mark
1 (b)	An explanation linking • more particles (in the same volume) **(1)** • more frequent collisions (between solute particles) **or** (solute particles) collide more often **or** higher rate of collisions (between solute particles) **or** more collisions (between solute particles) in given time **(1)**	Maximum **(1)** if particles have more energy / move faster Accept this shown in diagrams Accept specific particles – molecules or ions but not atoms Allow (reacting) particles are closer together **(1)** Ignore just "more ({productive/ successful/ effective}) collisions" Ignore collisions are more likely Ignore greater {chance/ probability} of collisions Ignore faster collisions/collide more quickly	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)	A use hydrochloric acid which is more dilute		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	An explanation linking two of M1 {particles/reactants/collisions} have more energy (1) M2 more frequent collisions (1) M3 more {productive/successful/effective} collisions (1)	 atoms/ions/molecules as alternatives to particles reject electrons particles move faster more collisions per unit time ignore collisions are more likely/greater chance/probability of collisions/faster collisions more particles have required activation energy	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	☐ A  ☐ B  ☐ C  ☐ D  ☐ A  ☐ B  ☐ C  ☐ D 		(1)

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	$2H_2O_2 \rightarrow 2H_2O + O_2$ (2) all formulae correct (1) balancing correct formulae (1)	multiples or halves reject other reactants or products ignore heat on arrow or elsewhere ignore state symbols ignore use of lower case h, lower case o, or use of superscripts or large numbers inside the formulae	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)	An explanation linking M1 energy needed to break bonds / energy released when bonds formed (1) M2 more heat / energy is released than needed (1) M2 dependent on scoring M1	 bond breaking is endothermic / bond making is exothermic if any contradictory statements made in M1, the mark cannot be awarded (and so M2 cannot be awarded either) ignore numbers of bonds eg more bonds formed than broken "more energy is released forming bonds than needed to break bonds" (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ reactants (1) products (1)	Accept multiples If not correctly balanced max 1 Must be subscripts where relevant	**(2)**

Question Number		Indicative Content	Mark
QWC	***3(a)**	A description including some of the following points **general points** • reactions occur when particles collide • more frequent collisions cause higher rate of reaction • mass and size of zinc pieces same so no effect on rate of reaction • because same surface area • two factors have been altered in the same experiment • cannot be certain of effect of each **concentration** • experiment 2 higher/triple concentration of acid • so more particles (in same volume) • so more frequent collisions between particles • more successful collisions **temperature** • experiment 2 higher temperature • particles move faster • particles have more energy • so more frequent collisions between particles (so increased rate) • more successful collisions • so more energetic collisions between particles • more particles have enough energy to react (activation energy) when they collide	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. temperature is higher and concentration is higher so reaction is faster e.g. temperature is higher so particles move faster so reaction is faster • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	a simple description e.g. temperature is higher so particles move faster and concentration is higher so more particles so reaction is faster eg when concentration is higher there will be more particles so more frequent collisions so faster reaction e.g. when temperature is higher particles move faster so more successful collisions so faster reaction the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology	

		appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description e.g. higher concentration of acid so more particles so more frequent collisions so faster reaction and higher temperature so particles have more energy so more successful collisions so faster reaction • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	B displacement		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	Shown on diagram • horizontal reactant line above product line (1) • horizontal product line to right of reactant line (1)	lines must be correctly labelled eg reactants/Zn + $CuSO_4$ and products/ $CuSO_4$ and Cu ignore any extra lines/curves/labels if not drawn lines but just labels in correct relative positions max 1 If two lines drawn in correct positions but no labels max 1	**(2)**

Question number	Answer	Additional guidance	Mark
4(a)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ • LHS (1) • RHS (1)	Allow products in any order	(2)

Question number	Answer	Mark
4(b)(i)	(line B) less steep/(line B) flattens later (1)	(1)

Question number	Answer	Mark
4(b)(ii)	• Slope = 60 ÷ 72 (1) • = 0.83(3) ($cm^3\ s^{-1}$) (1)	(2)

Question number	Answer	Mark
4(c)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning/justification – knowledge (1 mark): • fewer particles/as the reactants are used up there will be fewer particles to react/lower concentration of particles (1) • this will result in a lower frequency of collisions so fewer particles reacting in a given time (1)	(2)

Question number	Answer	Mark
4(d)	C	(1)

Question number	Answer	Mark
4(e)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • the decrease in temperature will cause a decrease in rate of reaction (1) • and the increase in pressure will cause an increase in rate of reaction (1) • because the changes have opposite effects on the rate it is not possible which has the greater effect (1)	(3)

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	Independent marking points • a curve/line starting at the origin showing a lower gradient than the 50^{o} curve (1) • levels out at the same volume as the 50^{o} curve (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	An explanation linking the following • (zinc powder) has a larger surface area (1) • therefore there are <u>more</u> (frequent) collisions (between the particles) (1)	reject particle size is smaller more particles <u>in contact</u> more successful collisions reject increase in energy for 2nd marking point	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(iii)	2		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(iv)	An explanation linking the following • breaking bonds requires/needs {heat/energy} / breaking bonds is an endothermic process (1) • forming bonds produces/releases {heat/energy} / forming bonds is an exothermic process (1) • more {heat/energy} is given out than is taken in (1)		**(3)**

Question Number	Answer	Acceptable answers	Mark
5(b)	makes the reaction go faster/increases speed/increase rate	lower activation energy	**(1)**