

Question 1

1(c)(i)	gas syringe drawn / measuring cylinder (or burette) dipping into water drawn (1) apparatus closed, i.e. no air gaps (1)	2
1(c)(ii)	increases / goes faster	1
1(c)(iii)	increases / goes faster	1

Question 2

2(a)(i)	27 (cm ³)	1
2(a)(ii)	steeper initial gradient starting at 0-0 (1) line levels off at 44 cm ³ (1)	2
2(b)(i)	(rate) decreases / reaction slows down	1
2(b)(ii)	(rate) decreases / reaction slows down	1

Question 3

3(a)(i)	1.0 (mol / dm ³) 2.0 (mol / dm ³) 1.5 (mol / dm ³)	1
3(a)(ii)	takes longer time / time increases	1
3(a)(iii)	takes shorter time / time decreases	1

Question 4

4(a)(i)	29 cm ³	1
4(a)(ii)	steeper initial gradient starting at 0-0 (1) line levels off above 42 cm ³ (1)	2
4(b)(i)	rate faster / rate increases / reaction speeds up	1
4(b)(ii)	rate slower / rate decreases	1
4(c)	iron(II) chloride / iron chloride (1) hydrogen (1)	2
4(d)	substance that increases the rate of reaction (1) and is unchanged (at the end of the reaction) (1)	2

Question 5

5(a)(i)	reaction complete / reaction finished / no more sulfuric acid left	1
5(a)(ii)	3 min / 180 s (unit needed)	1
5(a)(iii)	line with steeper gradient and starting at (0,0)	1
	line ends at same volume and before the line already drawn	1
5(b)	faster reaction / rate increases / reaction speeds up	1
	(zinc) powder has a larger surface area ORA	1

Question 6

6(c)	large pieces: (rate) decreases / (reaction gets) slower (1) catalyst: (rate) increases / (reaction gets) faster (1) lower concentration: (rate) decreases / (reaction gets) slower (1)	3
------	--	---

Question 7

7(a)	180.42	1
7(b)	initial gradient steeper and line starts at 181.00 (1) line is curved and ends at same final volume (1)	2
7(c)	catalyst: rate increases / reaction faster / rate higher / reaction speeds up (1) concentration: rate decreases / reaction slower / rate lower / reaction slows down (1)	2
7(d)	95 (cm ³)	1

Question 8

8(b)(i)	1.0 2.0 0.5	1
8(b)(ii)	takes longer / time increases	1

Question 9

9(b)(v)	M1 kinetic energy of particles increases (1) M2 frequency of collisions between particles increases (1) M3 higher percentage / proportion / fraction of collisions / particles have energy greater than / equal to activation energy (1) or more of the collisions / particles have energy greater than / equal to activation energy	3
---------	--	---

Question 10

10(a)	M1 increases the rate of reaction / speeds up a reaction(1) M2 unchanged at the end of the reaction(1)	2
10(b)(i)	oxygen escapes from the flask or apparatus	1
10(b)(ii)	concentration of hydrogen peroxide is highest at the start / particles of hydrogen peroxide are closest together at the start OR collision frequency is highest at the start	1
10(b)(iii)	the hydrogen peroxide is used up / ALL the hydrogen peroxide has reacted or decomposed	1

10(c)	M1 kinetic energy of particles increases(1) M2 frequency of collisions between particles increases(1) M3 more or higher percentage or higher proportion or higher fraction of particles have energy greater than / equal to activation energy OR more of the collisions or higher percentage or higher fraction of collisions have energy greater than or equal to activation energy(1)	3
10(d)	M1 $(50.0 \times 0.200 \div 1000 =) 0.01(1)$ M2 0.005(1) M3 0.16(0)(1)	3
10(e)	no effect	1

10(f)	2HgO → 2Hg + O ₂ M1 all formulae correct(1) M2 equation correct(1)	2
-------	---	---

Question 11

11(a)	<i>test: relights AND observations: a glowing splint</i>	1
11(b)(i)	lower gradient (at t2)	1
11(b)(ii)	M1 concentration (of H_2O_2 particles) decreases (1) M2 frequency of collisions between particles decreases (1)	2
11(b)(iii)	M1 steeper curve which does not cross original curve and levels off before the original curve (1) M2 finishes at same volume (1)	2

Question 12

12(a)(i)	gradient decreases	1
12(a)(ii)	concentration of HC ? is decreasing OR answers in terms of numbers of reactant molecules decreasing	1
12(a)(iii)	200 seconds	1
12(b)	new line steeper than printed line, starts at origin and levels off before 200 seconds	1
	new line reaches same final volume as printed line	1
12(c)(i)	minimum energy that colliding particles must have to react	1
12(c)(ii)	(particles) have more energy and so move faster more frequent collisions between particles a greater percentage of collisions / particles have energy greater than the activation energy, E_a	1 1 1

Question 13

13(d)(i)	gradient (of line) decreases	1
13(d)(ii)	concentration of particles (of acid) decreases lower rate of collisions of particles	2
13(d)(iii)	a new line steeper than printed line and starts at origin and levels off earlier than printed line levels off at the same volume	2

Question 14

14(g)	M1 rate decreases and particles have less energy (1) M2 less collisions (between particles) occur per second / per unit time (1) M3 less of the particles/collisions have energy equal to or above the activation energy (1) or less of the particles / collisions have sufficient energy to react or a lower percentage / proportion / fraction of collisions (of particles) <ul style="list-style-type: none">• are successful or• have energy equal to or above activation energy	3
-------	---	---