01. 0620_m15_ms_62 Q: 2

(a) Table of results

volume boxes completed correctly (3),
all 7 correct (3)
6 correct (2)
5 correct (1)
4 or fewer correct (0)

0, 45, 48, 72, 74, 75, 75 [3]

(b) points plotted correctly, including origin (3),
all 7 correct (3)
6 correct (2)
5 correct (1)
4 or fewer correct (0)

Smooth line graph(1) [4]

(c) (i) point at 2 min / 3rd point / 48 cm^3 (1)

off curve (1) [2]

(ii) reading from graph, 62–64 (cm^3) (1)

indication (1) [2]

(d) curve to left of original (1)

to same level (1) [2]

---

02. 0620_m16_ms_62 Q: 2

(a)	In each column: 4 correct = [2] 3 correct = [1] average temperature boxes completed correctly: 16, 27, 41, 50; times completed in seconds correctly: 128, 58, 27, 18;	**4**
(b)	all points plotted correctly = [3] smooth line graph;	**4**
(c)	value from graph: 12–13 s; extrapolation;	**2**
(d)(i)	Experiment 4;	**1**
(d)(ii)	any **2** from: highest temperature; more energy; more (chance of) collisions;	**2**
(e)(i)	more accurate; than a measuring cylinder;	**2**

(e)(ii)	insulation / use a lid; to reduce heat losses; OR repeats; average results; OR measure water or sulphuric acid or methyl orange using a burette / use a 2 d.p. stopwatch / digital thermometer; reference to accuracy;	**2**

03. 0620_m18_ms_62 Q: 4

			max 6

	gas volume	*mass loss*
M1	Mg added to sulfuric acid	Mg added to sulfuric acid
M2	in a suitable container with ability to have a bung	in a suitable container
M3	methods of measuring gas volume (gas syringe, downward displacement of water using a measuring cylinder)	on a balance
M4	start timer / timing (when added together)	start timer / timing (when added together)
M5	measure volume of gas	measure mass loss
M6	at set time / at end of experiment / at (regular) known intervals	at set time / time to end of experiment / at (regular) known intervals
M7	rate = volume ÷ time	rate = mass loss ÷ time

04. 0620_m19_ms_62 Q: 4

4	6 from: Weighed amount / x gram of magnesium Add known volume of dilute hydrochloric acid gas syringe / measuring cylinder over water Use of stop-clock / timer Measure volume of hydrogen at fixed time or time for a fixed volume to be made Repeat using different temperatures Compare results / conclusion	**6**

05. 0620_m20_ms_62 Q: 2

Question	Answer	Marks
(a)(i)	exothermic	**1**
(a)(ii)	use a water bath	**1**
(b)	all volumes of distilled water completed correctly (12, 10, 8, 4, zero / 0 / none / –)	**1**
	all times completed correctly, all five correct scores 2, four correct scores 1 (72, 45, 33, 23, 16)	**2**
	all times to number of seconds only	**1**
(c)	suitable *y*-axis scale	**1**
	plotting – all five correct scores 2, four correct scores 1	**2**
	suitable best fit line	**1**

Question	Answer	Marks
(d)(i)	correct reading from graph (expected 54–56)	1
	working shown on graph	1
(d)(ii)	11 (cm^3)	1
(e)(i)	0.56 ecf from results table (correct calculation of 40 / time for experiment 1)	1
	cm^3 / s	1
(e)(ii)	5	1
(f)	more accurate	1
(g)(i)	gas escapes (before bung inserted) / gas not collected	1
(g)(ii)	any description of method that prevents gas loss such as partitioned container, suspend magnesium on thread, etc.	1

06. 0620_p20_ms_60 Q: 2

(a) volume boxes completed correctly 0, 13, 22, 30, 36, 43, 49
note: all 7 correct = 2, 6 correct = 1, <6 correct = 0 [2]

(b) volume boxes completed correctly 0, 5, 10, 13, 17, 20, 23
note: all 7 correct = 2, 6 correct = 1, <6 correct = 0 [2]

(c) appropriate scale on *x*-axis and *y*-axis **and** labels **and** units; [1]
note: scale should cover at least half of grid
points plotted to ± half a small square accuracy;; [2]
note: >12 correct = 2, 10–12 correct = 1, <10 correct = 0
two labelled smooth line graphs **and** must plot volume at t = 0; [1]

(d) Experiment 1 / acid **X and** statement that acid **X** is stronger or more concentrated / ora [1]

(e) 71–73 s **and** indication shown on graph; [1]
allow: ecf from incorrect graph

(f) 13 □ 30 = 0.43; [1]
allow: 0.4
allow: ecf on plotting
cm^3 / s / $cm^3 s^{-1}$ / cm^3 per s; [1]
allow: sec

(g) advantage: convenient / easy / quick to use; [1]
disadvantage: reference to inaccurate measurement; [1]

(h) graduated pipette / burette / gas syringe / mass of magnesium rather than strips / repeats and take average / take more frequent readings / suitable method for reducing initial loss of gas **and** any suitable comment on improved accuracy; [1]
note: explanation must relate to reason

07. 0620_s12_ms_62 Q: 2

(a) smooth curve starting at origin and missing anomalous point (1) [1]

(b) point at 1.5 min/4th point/0.32 g (1) **ignore**: 3rd point [1]

(c) reaction finished/no more gas (1)
magnesium carbonate used up (1) [2]

(d) rising part of sketch curve below the original/less steep (1)
to half final level/0.25 g (1) [2]

[Total: 6]

---

08. 0620_s12_ms_62 Q: 4

(a) fizzing/bubbles stopped/no more gas produced (1) [1]

(b) **(i)** W little/no effect/slight increase (1)
X no effect/(slight) decrease (1)
Y speeds up reaction (1) [3]
note: The question is about rate, if candidates quote three different time differences, penalise first then allow the 'correct' answers (–11 s, +2 s, –199 s).
It must be clear that the increase in rate is less for W than Y for these 2 marks.

(ii) Y (1) [1]

(c) repeat experiments (1) take average/compare results/see if there is a difference (1) [2]

[Total: 7]

---

09. 0620_s12_ms_63 Q: 3

(a) volumes completed correctly
0, 30, 45, 52, 56, 54, 60, 60 –1 for each incorrect [3]

(b) points plotted correctly (3) –1 for each incorrect
smooth curve (1) [4]

(c) point at 100 seconds/54 cm^3/point 6 (1) off curve/owtte (1) [2]

(d) 20 cm^3 ±½ small square (1) indication on graph (1) [2]

(e) reaction finished/all peroxide decomposed owtte (1) [1]

(f) **(i)** in an ice bath (1) **allow**: in a refrigerator [1]

(ii) curve less steep (1) to same level (1) [2]

[Total: 15]

---

10. 0620_s13_ms_63 Q: 5

(a) volumes completed correctly in table (2), –1 each incorrect

0, 38, 59, 73, 78, 79, 79 [2]

(b) appropriate scale for *y*-axis (1)

points plotted correctly including origin (2)

smooth curve (1) [4]

(c) 90 s (1) indication (1) [2]

(d) sketch to right of graph (1) levelling out at 39–40 cm^3 (1) [2]

(e) particles moving slower / have less energy (1) fewer collisions (1) [2]

---

11. 0620_s14_ms_62 Q: 4

(c) Experiment 1: Table of results

initial temperature boxes completed correctly (2) 27, 28, 31, 30, 31

highest temperature boxes completed correctly (2) 33, 36, 42, 45, 49

temperature changes correct (1) 6, 8, 11, 15, 18 [5]

(d) All points correctly plotted (3)
guidance: 5 correct (3); 4 correct (2); 3 correct (1); 2 or fewer correct (0)

best fit straight line graph drawn with a ruler (1) [4]
note: does not need to go through origin

(e) value from graph (1), e.g. 21

°C (1)

extrapolation to 8 cm / indication shown (1) [3]

(f) magnesium smaller / disappears / fizzing / bubbles / effervescence (1) [1]
ignore: gas

(g) **(i)** Experiment 5 (1) [1]
allow: 7 cm

(ii) more / most / longest / 7 cm magnesium used (1) [1]
ignore: reactant / sulfuric acid / surface area

(h) temperature change / reaction faster (1)
ignore: temperature rise

more surface area (1) [2]

(i) 3 (°C)
allow: 2–5

(j) shows gas collected over water (1)

in labelled measuring cylinder / graduations shown on collection vessel (1)

OR

shows gas collected in a gas syringe (1)

in labelled (gas) syringe / graduations shown (1) [2]

(k) error…heat losses / using measuring cylinder / oxide layer (1)
ignore: initial temperature

improvement…insulation / use burette or pipette / clean / repeat (1) [2]

---

12. 0620_s14_ms_63 Q: 2

(a) labels on both graphs, i.e. Experiment 2 on that levelling at 60 and Experiment 1 on graph levelling at 30 (1) [1]

(b) **(i)** water (1)

25 cm^3 of dilute acid + 25 cm^3 of water / equal volumes (1) [2]

(ii) graph less steep than others (1)

levelling at 15 (1) [2]

(c) gas syringe **or** measuring cylinder inverted in trough of water (1)

labelled collection vessel / graduations shown on collection vessel (1) [2]

(d) heat / increase temperature (1)

particles have more energy / move faster (1)

more frequent / more successful / more collisions(1)

OR

catalyst (1)

lowers activation energy (1)

more successful collisions (1) [3]

---

13. 0620_s15_ms_61 Q: 6

	step 1
	add copper oxide or catalyst to hydrogen peroxide;
	measure volume of gas / mass loss / collect gas / count bubbles;
	over time;
	known volume of hydrogen peroxide;
	compare to hydrogen peroxide on its own;
	test gas with glowing splint;
	splint relights;
	
	step 2
	filter copper(II) oxide;
	dry;
	weigh;
	compare to original mass;
	OR
	filter (copper(II) oxide) / evaporate to dryness;
	add to hydrogen peroxide;
	measure rate of reaction;
	compare to first experiment;
		max 8	

14. 0620_s15_ms_62 Q: 4

(f)	volume of sodium thiosulfate: 50, 40, 35, 30, 20 volume of water: 0, 10, 15, 20, 30 all 10 correct = 1 mark; time: 45, 55, 66, 78, 140 all 5 correct for 2 marks 4 correct =1 mark; **all** times in seconds;	**4**	**I** decimal places **A** '–' for '0'
(g)	all 5 points plotted correctly (2 marks); smooth line graph;	**3**	
(h)(i)	correct value from graph, 90-110; units; indication shown on graph;	**3**	**A** s / sec / seconds
(h)(ii)	line must be above original;	**1**	the lines must **not** meet at any point
(i)(i)	experiment 1 / 50 cm^3 sodium thiosulfate / 45 s / no water;	**1**	
(i)(ii)	more particles of thiosulfate / particles closer together / more concentrated / no water / more (frequent) collisions;	**1**	
(j)	volume over 50 cm^3 / changing total volume; so not a fair test / so depth greater / cannot compare with other results;	**2**	**A** (result) not valid
(k)(i)	*any two from:* • more accurate (measurement of volume); • comparison to measuring cylinder; • less accurate measurement of time; • as it takes longer to add the acid;	**2**	**A** more precise
(k)(ii)	time shorter / cross disappears faster; depth greater;	**2**	**R** reacts faster

15. 0620_s15_ms_63 Q: 2

(a)	0, 35, 50, 57, 61, 59, 65, 65 All 8 = 3 marks 7 = 2 marks 6 = 1 mark;	**3**	
(b)	all 8 points plotted within half a small square = 3 marks 7 points plotted within half a small square = 2 marks 6 points plotted within half a small square = 1 mark; best fit smooth line;	**4**	
(c)(i)	at 150 s / 59 cm^3 of hydrogen;	**1**	
(c)(ii)	63–65; cm^3;	**2**	
(d)(i)	use a fridge / ice bath;	**1**	**A** freezer
(d)(ii)	curve below original; towards same final level;	**2**	

16. 0620_s16_ms_62 Q: 2

(a)	all 6 times completed correctly (2 marks) (22, 43, 64, 86, 105, 126) 5 times completed correctly (1 mark); in seconds;	**3** 2 1
(b)	appropriate scale for *y*-axis / increasing at 20 s per large square; *y*-axis is a linear scale; all 6 points plotted correctly ± half a small square (2 marks); 5 points plotted correctly ± half a small square (1 marks); best-fit straight-line graph;	**5** 1 1 2 1
(c)(i)	value from graph ± half a small square (typically 167–170); units / s; extrapolation;	**3** 1 1 1
(c)(ii)	sketch line below original line and diverging;	**1**
(d)	as an indicator;	**1**
(e)(i)	(more) accurate;	**1**
(e)(ii)	solution slow to run out of pipette; difficult to know when to start timer / reaction does not start at once / inaccurate time measurement owtte;	**2** 1 1
(f)	difficulty in swirling / mixing / shaking;	**1**

17. 0620_s17_ms_63 Q: 2

(a)	all volume boxes completed correctly: 0, 13, 25, 38, 48, 59, 70, 79, 88, 96	**3**
(b)	origin plotted	**1**
	other points correctly plotted	**1**
	two smooth lines	**1**
	labelled	**1**
(c)	Experiment 1	**1**
	more concentrated / stronger acid / the acid has a lower pH	**1**

(d)	volume of gas at 30 s	1
	correct calculation of rate	1
	unit: cm^3/s **OR** $cm^3 s^{-1}$	1
(e)	all the magnesium will have reacted	1
(f)	faster reaction / increased rate	1
	magnesium powder has a higher surface area	1
(g)	advantage: easy to use / quick	1
	disadvantage: not accurate	1
(h)	use of burette / pipette / gas syringe / weighed amount of magnesium / repeat experiment (and average) / clean the magnesium / remove oxide layer	1

18. 0620_s18_ms_61 Q: 2

(a)	volume boxes completed correctly in seconds 0, 10, 15, 20, 40	1
	time boxes completed correctly 27, 33, 45, 66, 201	2
(b)	all points plotted correctly (□ half a small square)	2
	smooth line graph	1
(c)(i)	value from graph	1
	with clear indication	1
(c)(ii)	1 □ value from **(c)(i)**	1
(d)(i)	experiment 1	1

(d)(ii)	more particles of thiosulfate (in a given volume)	1
	more chance of collision	1
(e)	use a pipette / burette	1
(f)	times would be shorter	1
	idea of depth of solution is greater	1
(g)	sketch curve roughly same shape and above original	1

19. 0620_s19_ms_63 Q: 2

(a)	temperature boxes completed: 25, 25, 25, 41,46, 46, 45, 44	2
(b)	temperature boxes completed: 27, 27, 27, 57, 79, 79, 77, 75	1
(c)	temperature boxes completed: 23, 23, 23, 25, 26, 27, 28, 29	1
(d)	all points plotted correctly	1
	3 best fit smooth line graphs	1
	axes labelled	1

(e)	working shown clearly on graph for Experiment 2 at 75 seconds	1
	reading taken from graph	1
(f)(i)	Experiment 2	1
	temperature (change) is greatest	1
(f)(ii)	Experiment 1 is faster (than Experiment 3)	1
	because surface area greater / more (frequent) collisions	1
(g)	initial temperature from table / room temperature	1
	reaction finished	1
(h)	more readings / points	1
	better / smoother graph	1
(i)	copper is a (good) conductor (of heat)	1
	(high) heat loss (to surroundings) / lower temperatures	1

20. 0620_s20_ms_62 Q: 2

Question	Answer	Marks
(a)	lengths completed correctly (1, 2, 3, 5, 6)	1
	10 correct thermometer readings (23 × 5, 24, 26, 29, 36, 40)	2
	All temperature increases worked out correctly (1, 3, 6, 13, 17)	1
(b)	5	1
(c)	scale has one big square = 5	1
	all five points plotted correctly	2
	best fit line through points	1
	which passes within half a small square of (0, 0)	1
(d)	there is no reaction (with no magnesium)	1

Question	Answer	Marks
(e)	working shown on graph	1
	correct reading	1
	units of °C shown	1
(f)(i)	(polystyrene is a better) insulator	1
(f)(ii)	sketch line starts at same point as plotted line for 0 cm magnesium and then is above plotted line at all non-zero lengths of magnesium.	1
(g)(i)	more accurate	1
(g)(ii)	slower	1

21. 0620_s21_ms_61 Q: 4

Question	Answer	Marks
	Any 6 from: • stated / set / same / measured volume of acid • stated / set / same / measured mass of calcium carbonate • add / combine / put together **and** start timing • Repeat (with acid) at higher / lower temperature **then:** • graphical method: • measure / record mass at known / regular / specified times • plot graph • steepest line is fastest **OR** mass loss in a set time • measure / record mass at a specified time • calculate / measure mass lost • largest mass loss is fastest or calculates rate by mass loss ÷ time **OR** time to end of reaction • react until mass stops changing / reaction stops • record time • shortest time is fastest or calculates rate by mass loss ÷ time **OR** time to lose a set mass • react until it reaches / loses a certain mass • record time • shortest time is fastest or calculates rate by mass loss ÷ time **OR** mass of calcium carbonate left after a set time • filter after a set time • find mass of calcium carbonate left • lower mass of calcium carbonate is fastest or calculates rate by mass **loss** ÷ time	6

22. 0620_w12_ms_61 Q: 4

(a) Table of results for Experiments [5]

all initial temperature boxes completed correctly (2)

25 41 47 62 72

all final temperature boxes completed correctly (2)

23 27 39 42 48

average temperatures completed correctly (1)

24 34 43 52 60

(b) points plotted correctly (4) [5]

smooth line graph (1)

(c) value from graph at 72 °C (1) ≈ 30–35 s [2]

extrapolation shown on grid (1)

(d) as an indicator owtte/check iodine present (1) [1]

(e) **(i)** experiment 5 (1) [1]

(ii) highest temperature (1) [2]

particles have more energy/more collisions/move faster (1)

(f) time longer/more/increase (1) [2]

speed slower/decrease (1)

(g) more accurate (1) [1]

23. 0620_w12_ms_62 Q: 2

(a) straight line drawn with a ruler missing point at concentration 0.15 (1)
through origin (1) [2]

(b) 0.56/0.57/0.58 (1)
extrapolation shown (1) [2]

(c) line to right hand side of original and goes through origin (1) [1]

(d) **(i)** catalyst/to speed up the reaction (1) [1]

(ii) slower/owtte (1)
less surface area (1) [2]

---

24. 0620_w13_ms_61 Q: 5

(a) volumes completed correctly (4), –1 each incorrect [4]

time / s	catalyst R	catalyst S
0	0	0
30	23	16
60	34	36
90	59	51
120	66	63
150	71	69
180	72	72

(b) points plotted correctly (3) smooth curves (2) labels (1) [6]

(c) result at 60s / volume 34 / third result (1) [1]

(d) R (1) rate faster (1) [2]

(e) sketch to left of R graph / steeper (1) to same level (1) [2]

---

25. 0620_w13_ms_62 Q: 6

x cm^3 of hydrogen peroxide / solution H (1)
add MnO_2 (1)
method to collect gas that works (1)
measurement of (total) volume of gas produced / counting bubbles in time interval (1)
repeat using solution J (1)
comparison / conclusion (1) max [5]
ignore: reference to heat
not: speed of relighting a glowing splint

---

26. 0620_w14_ms_61 Q: 2

(a) smooth curve missing anomalous point (1) [1]

(b) **composition of mixture**
double volume / 100 cm^3 of hydrogen peroxide (1)
more than 1 g of manganese(IV) oxide / powdered (1) [2]
ignore: references to water
note: double the concentration is valid for (2)

explanation
double volume of gas (1)
faster reaction (1) [2]

(c) catalyst / increase the rate of the reaction (1) [1]

(d) sketch graph less steep than original for Experiment 1 (1)
to same level (1) [2]

27. 0620_w14_ms_63 Q: 2

(a) mass of beaker + contents column completed correctly
all 11 correct (2)
10 correct (1)
9 or fewer correct (0)
total loss column correct (1) [3]
note: if all readings are not to 1dp, max 2

time / min	mass / g	total loss / g
0	95.0	0.0
1	93.0	2.0
2	92.0	3.0
3	91.3	3.7
4	91.2	3.8
5	90.5	4.5
6	90.3	4.7
7	90.1	4.9
8	90.0	5.0
9	90.0	5.0
10	90.0	5.0

(b) points plotted correctly including origin (2)
smooth curve missing anomalous point (1) [3]

(c) gas / carbon dioxide evolved / formed / escapes / given off (1) [1]

(d) **(i)** result at 4 minutes / fifth point / 91.2 / 3.8 g [1]

(ii) 4.2 (g) ± 0.1 (1) [1]

(e) sketch with steeper graph than original (1)
starting at origin levelling at same height (1) [2]

---

28. 0620_w15_ms_62 Q: 3

(a)	all temperatures correctly recorded: 23, 36, 47, 58, 70, 79 6 correct = 3 5 correct = 2 4 correct = 1 3 or fewer correct = 0	**3**	
(b)	all points correctly plotted: 23, 36, 47, 58, 70, 79 6 correct = 2 5 correct = 1 4 correct = 0 smooth curve;	**2** **1**	
(c)	third point / at 47 °C or 99 s; not on smooth line / curve;	**1** **1**	
(d)	118; seconds / sec / s; indication on the graph;	**1** **1** **1**	
(e)(i)	(it) increases / higher the temperature faster reaction;	**1**	**I:** references to time (rather than rate)

(e)(ii)	particles have more energy / move faster; more (chance of / successful) collisions;	1 1	
(f)(i)	slower reaction / longer time; smaller surface area;	1 1	
(f)(ii)	sketch above the curve not touching the original at any point;	1	**A:** curve above but touching the anomalous point
(g)	to prevent escape of / splash of acid; to allow carbon dioxide / gas to escape;	1 1	**R:** prevent spillages

29. 0620_w15_ms_63 Q: 6

	6 from: • uses different (at least two) concentrations of sulfuric acid; • made by diluting with water; • same total volume of (diluted) sulfuric acid; • same mass / amount / size / length / surface area of magnesium (ribbon); • measure time (or run at the same time); • for magnesium to dissolve or react or disappear / y cm^3 gas to collect / volume collected (set time) / bubbles to stop / mass to decrease by x g / mass to stop decreasing; • compare times of reaction / results;	6	**A:** implication of this last two marking points are dependent on measuring time

30. 0620_w16_ms_62 Q: 2

(a)	table of results volume boxes completed correctly (30), 44, 57, 62, 78, 85, 88, 89, 90, 90	2
(b)	all points correctly plotted smooth line graph	2 1
(c)(i)	point at 60 s / 62 cm^3 / fourth point / measurement 4	1
(c)(ii)	misread measuring cylinder / read too early	1
(c)(iii)	value from graph (68–70) shown clearly	1 1
(d)	the Reaction has finished all the acid has reacted / HCl is the limiting factor	1 1
(e)(i)	value from graph or table (57–44 = 13 cm^3)	1
(e)(ii)	13 / 20 = 0.65 cm^3 / s	1 1

(f)	steeper curve to same level	1 1
(g)	air is displaced (when the acid is added)	1
(h)	improvement explanation use a burette / graduated pipette / gas syringe improves accuracy **OR** use cotton thread to hold a test-tube (containing the acid) in the flask no air is collected **OR** repeat the experiment take average / more frequent readings	1 1

31. 0620_w17_ms_61 Q: 2

(a)	average temperatures completed for all five experiments: 18, 31, 41, 53, 63	1
	times completed for all five experiments: 210, 111, 84, 66, 54	1
	all times in seconds	1
(b)	all five points plotted	3
	smooth line graph	1
(c)	value from graph for average temperature 72 °C	1
	unit (s)	1
	shown clearly	1
(d)	line above experimental line	1
(e)(i)	Experiment 5	1
(e)(ii)	particles move faster / particles have more energy	1
	more (frequent) collisions / greater chance of collisions	1
(f)(i)	more accurate	1
	comparison to measuring cylinder	1
(f)(ii)	time shorter / cross disappears faster	1
	depth greater	1

32. 0620_w18_ms_61 Q: 2

(a)	mass boxes correctly completed to 1 dp 86.0, 85.0, 84.4, 84.1,84.0, 83.9, 83.9, 83.9	2
	Loss in mass boxes correctly completed 0.0, 1.0, 1.6, 1.9, 2.0, 2.1, 2.1, 2.1	1
(b)	points correctly plotted:	2
	smooth line graph;	1
(c)	**M1** mass loss from graph at 30 seconds (0.5)	1
	M2 mass in M1 / 30 calculated (= 0.017)	1
	M3 g / s;	1
(d)	Sketch steeper than original graph	1
	To same level	1

(e)(i)	gas / carbon dioxide given off	1
(e)(ii)	Allow gas to escape	1
	Prevent loss of acid;	1
(e)(iii)	Reaction finished	1
	All nitric acid has reacted	1
(f)	Advantage: more accurate;	1
	Disadvantage: slow	1

33. 0620_w18_ms_62 Q: 2

(a)	Table of results for experiments 1–5 Times completed 29, 39, 56, 65, 111	3
	in seconds	1
(b)	All points plotted correctly	3
	Smooth line graph	1
(c)	Value from graph	1
	indication on graph	1
	unit	1

(d)(i)	Experiment 1	1
(d)(ii)	More particles (of solution L present per unit volume)	1
	more frequent collisions / particles collide more often / higher collision rate	1
(e)(i)	More accurate	1
(e)(ii)	Too slow / slower addition of solution / takes longer to add	1
	Measuring time taken less accurate / results less accurate	1
(f)	Repeat **and** average / compare results	1

34. 0620_w18_ms_63 Q: 2

(a)	Table of results for experiments 1–4 average temperature boxes completed correctly 22, 30, 39, 48	1
	Time boxes completed correctly 98, 42, 26, 22	2
	Times completed in seconds	1
(b)	All points plotted correctly	3
	Smooth line graph (curve)	1

(c)	indication on graph	1
	Value from graph	1
	°C	1
(d)(i)	Experiment 4	1
(d)(ii)	**M1** particles (of solution L) have more / most (kinetic) energy / move faster	1
	M2 more frequent collisions / particles collide more often	1
(e)	**M1** Insulation / use a lid	1
	M2 To reduce heat losses	1
(f)	**M1** Too slow / slower addition of solution	1
	M2 Measuring time-taken / results less accurate	1

35. 0620_w19_ms_63 Q: 1

(a)	measuring cylinder	1
(b)	volume of gas / oxygen	1
	time	1
(c)(i)	concentration of hydrogen peroxide / reactant decreases	1
(c)(ii)	all hydrogen peroxide / reactant decomposed	1
(d)(i)	filtration	1
(d)(ii)	**method 1** □ dry / evaporate water □ (re-)weigh (the manganese(IV) oxide / catalyst after the reaction) □ mass should be unchanged / 0.5 g **OR** **method 2** □ use same sample MnO_2 / dry MnO_2 □ repeat experiment □ results would be the same	3

36. 0620_w20_ms_62 Q: 2

Question	Answer	Marks
(a)	all volumes of sodium metabisulfite completed as 5	1
	all volumes of water (15, 17, 21, 23, 25) correct.	1
	all times recorded correctly (38, 42, 53, 61, 72)	2
	all five times in seconds only	1
(b)	all 5 points plotted correctly	2
	suitable best fit curve drawn. Line must go through / within half a square of correctly plotted points	1
(c)(i)	correct working shown on graph	1
	time correct for their working	1
(c)(ii)	19	1
(d)	line is below plotted line and does not meet / touch plotted line.	1
(e)(i)	0.02	1

Question	Answer	Marks
(e)(ii)	1	1
(f)	to keep total volume constant / so concentration of sodium metabisulphite does not change	1
(g)	change: use a pipette / burette (in place of a measuring cylinder)	1
	explanation: more accurate / precise (than a measuring cylinder)	1
(h)	repeat **and** compare the results	1

37. 0620_w21_ms_61 Q: 2

Question	Answer	Marks
(a)	mark syringe diagrams only. 0, 12, 20, 27, 32, 36	2
(b)	thermometer diagrams Experiment 1: 23 **and** Experiment 2: 44	1
	syringe diagrams 0, 25, 35, 40,40,40	1
(c)	all 12 points plotted correctly	2
	smooth curve for Experiment 1	1
	smooth curve for Experiment 2, must level off	1
	lines labelled either with Experiment 1/2, (a)/(b) or temperature	1
(d)	correct indication/construction shown on graph	1
	correct reading for their indication/construction	1
(e)	gas volume constant / stays at 40 cm^3	1

Question	Answer	Marks
(f)	40	1
	same amount of reactants/acid as Experiment 2	1
(g)	more data / more points	1
	can plot a better graph / see trend more clearly	1
(h)	any two from • insulate the tube / use a waterbath • use a pipette/burette in place of the measuring cylinder • use a divided flask / description of this **max 2**	2
(i)	description of how the acid would be cooled, such as place acid in fridge or freezer / stand tube in ice bath	1

38. 0620_w21_ms_63 Q: 4

Question	Answer	Marks
	Any 6 from: **MP1** weigh copper(II) oxide / stated mass copper oxide **MP2** add to known volume of hydrogen peroxide / stated volume of hydrogen peroxide **MP3** measure volume of gas made in set time **MP4** filter off copper(II) oxide **MP5** dry and weigh **MP6** repeat experiment with no copper oxide added **OR** compare gas volume to with no copper oxide added **MP7** bigger volume **AND** catalyst mass the same means it is a catalyst max 6	6