01. 0620_m15_ms_62 Q: 1

(a) thermometer (1)

condenser (1) [2]

(b) **(i)** ethanoic acid (1)

lower boiling point / evaporates first (1) [2]

(ii) temperature reading will rise / gap in liquid coming over / no more collected at 118 °C (1) [1]

(c) larger surface area (1) [1]

(d) test: named indicator / pH meter / pH paper (1)

result: correct colour change / pH < 7 (1) [2]

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02. 0620_m17_ms_62 Q: 2

(a)	initial and final readings completed correctly: 29.6; 4.1	**1**
	difference completed correctly: 25.5	**1**
(b)	initial and final readings and difference completed correctly: 29.1; 24.0; 5.1	**1**
	all readings to 1 d.p.	**1**
(c)	neutralisation	**1**
(d)(i)	solution **O**	**1**
	greater volume of acid was used in the titration	**1**

(d)(ii)	five times as concentrated	**1**
(e)	2.5–2.6	**1**
	unit: cm^3	**1**
(f)	effect on volume: no effect	**1**
	reason: temperature would only affect the rate	**1**
(g)(i)	use a pipette / burette	**1**
(g)(ii)	repeat experiments (and compare / average)	**1**
(h)	**M1** ***fair test*** to equal volumes of each sodium hydroxide solution / solutions **O** and **P** add an equal volume / measured volumes of aqueous calcium chloride	**1**
	M2 ***dependent variable measured*** measure mass / height of precipitate formed / volume of calcium chloride used	**1**
	M3 ***conclusion*** the more concentrated sodium hydroxide solution would form the most precipitate (mass / height) / would require a smaller volume of calcium chloride	**1**

03. 0620_m18_ms_62 Q: 2

(a)	*table of results final reading and difference completed correctly* 11.6		**1**
(b)	*table of results with final reading and difference completed* correctly 23.6 **and** 11.6		**1**
(c)	*final reading completed correctly*	24.1	**1**
	initial reading completed correctly	0.9	**1**
	difference correct	23.2	**1**
(d)	yellow to orange		**1**
(e)	to remove impurities / chemicals / residue / solution / owtte		**1**
(f)	3		**1**

(g)	pipette / burette	1
(h)	*effect* no effect	1
	reason no change in reactant concentrations / owtte	1
(i)(i)	1:2	1
(i)(ii)	different indicators used / owtte	1
(j)	more than one colour change / cannot find end point	1
(k)	repeat (experiments)	1
	compare / average / check spread of results	1

04. 0620_m21_ms_62 Q: 2

Question	Answer	Marks
(a)	final and initial burette reading for Experiment 1 correct (17.9 and 8.0)	1
	final and initial burette reading for Experiment 2 correct (27.3 and 7.5)	1
	both titres correct (9.9 and 19.8)	1
	all volumes recorded to 1 dp or better	1
(b)	(from) yellow (to) orange	1
(c)(i)	to remove any residue from Experiment 1	1
(c)(ii)	larger volume of solution B needed / it would increase	1
	(as there is) more potassium hydroxide / alkali	1
(d)(i)	solution A as lower volume (required).	1
(d)(ii)	2× / twice	1
(e)	can spot anomalous results OR can find a mean/average	1
(f)	39.6 / numerical answer which is twice titre in Experiment 2	1
	cm^3	1
(g)	use a (volumetric) pipette to measure the volume of potassium hydroxide	1
(h)	none	1

05. 0620_s12_ms_61 Q: 1

(a) tripod (1) **accept**: stand spatula (1) not: spoon [2]

(b) fizz/bubbles/effervescence stops (1)
solid/iron/powder visible / no more iron dissolves/reacts (1) [2]

(c) evaporation of water/steam (1) solid/residue/crystals formed (1)
colour change turns brown/darker green (1)
effect of heat on solid solid breaks down (1) max 3 [3]

[Total: 7]

06. 0620_s12_ms_62 Q: 7

(a) use Universal/pH indicator/pH meter (1) ignore: litmus/indicator [1]

(b) **note**: This can be marked via three routes.

If they use a full bottle:
use full bottle (1)
(air-tight) connections (1)
syringe/inverted measuring cylinder/graduated tube to collect gas (1)
heat/shake (1)
until no more gas given off (1)
measure volume of gas (1)
any 6

If they use a sample:
use measured volume (1)
(air-tight) connections (1)
syringe/inverted measuring cylinder/graduated tube to collect gas (1)
heat/shake (1)
until no more gas given off (1)
measure volume of gas (1)
multiply to get full bottle value (1)
max 6

If they do it by loss in mass:
weigh the bottle/sample (1)
heat/shake (1)
until no more gas given off (1)
reweigh bottle (1)
use density to calculate volume (1)
max 5 [6]

[Total: 7]

(b) table of results

initial readings completed correctly (1) 0.0, 9.0

final readings completed correctly (1) 39.0, 22.0

all readings to 1 decimal place (1)

differences completed correctly (1) 39.0, 13.0 [4]

(c) yellow (1) to orange / pink (1) [2]

(d) neutralisation (1) **allow:** endothermic [1]

(e) Experiment 2 (1) **allow:** ecf [1]

(f) **(i)** three times as much used in Experiment 1 (1) **not:** ecf [1]

(ii) solution / acid **G** / 2 (1) [1]

(g) twice value from table result for experiment 2 / 26 (1) cm^3 (1) [2]

(h) use a pipette/burette [1]

(i) to remove acid **F** / clean (1) water would dilute acid **G** / owtte (1) [2]

(j) effect none / owtte (1)

reason no change in concentration / owtte (1) [2]

(k) any correct method that would work- precise details not needed

using same method with different bases = 0

reagents (1) method (1) result (1) [3]
not: method using indicators

e.g. * to hydrochloric acid add named metal, e.g. Mg, Zn (1)

measure temperature change (1)

largest change = strongest / more concentrated solution (1)

* to hydrochloric acid add sodium hydroxide solution (1)

measure temperature change (1)

largest change = strongest solution (1)

* rate experiment

add acid to appropriate reagent (1)

method of rate measurement, e.g. volume of gas (1)

conclusion (1)

---

08. 0620_s14_ms_61 Q: 4

(a) table of results for Experiment 1

initial and final volume boxes completed correctly (1) 0.0 and 16.8

difference box correctly completed (1) 16.8

all readings to one decimal place (1) [3]

(b) table of results for Experiment 2

initial (1) and final volume (1) boxes completed correctly 16.8 (1) and 25.2 (1)

difference box correctly completed (1) 8.4 [3]

(d) to colourless (1) [1]
not: clear

(e) coloured reacting mixture masks colour of phenolphthalein / reaction is finished / solution is acidic (1) [1]

(f) carbonate / carbon dioxide present (1) [1]
allow: hydrogencarbonate

(g) (i) 8.4 (1)
ecf: titre 1 – titre 2

cm^3 (1) [2]

(ii) 16.8 (1) [1]
ecf: 2 × titre 2

(iii) twice volume of acid needed to react with T (1) [1]
ecf: if **(g)(i)** or / and **(g)(ii)** wrong need quantitative link.
not: more (unqualified)

(h) (i) 67.2 cm^3 (1)

33.6 cm^3 (1)

4 × volume of solution R (1) [3]

(ii) volume of acid used > 50 cm^3 / more than burette can hold (1)

set up more than two burettes / 100.8 won't fit into 2 (1) [2]
allow: impurities / contamination (1)

---

09. 0620_s14_ms_63 Q: 6

x cm^3 of vinegar (1)

in named container e.g. beaker (1)

add named indicator (1)

add sodium hydroxide until colour change (1)

record volume sodium hydroxide added (1)

repeat with other vinegar (1)

compare results (1) [7]

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10. 0620_s15_ms_61 Q: 4

(a)	25, 27, 30, 32, 34, 36, 35, 34, 33 all 9 = 3 marks 8 = 2 marks 7 = 1 mark	**3**	please put an 'x' by any incorrectly plotted points
(b)	25, 34, 41, 40, 39, 38, 37, 36, 34 all 9 = 3 marks 8 = 2 marks 7 = 1 mark	**3**	
(c)	all 18 points plotted within half a small square = 3 marks 17 points plotted within half a small square = 2 marks 16 points plotted within half a small square = 1 mark; smooth line graph; labels;	**5**	
(d)	value read from graph, 38.5 °C; indication clearly shown;	**2**	
(e)	exothermic;	**1**	

(f)	to remove traces of acid A / clean; to remove water;	2	
(g)(i)	experiment 2 / acid B;	1	
(g)(ii)	acid B is stronger / dibasic / has a lower pH / more acidic;	1	**I** more reactive / more concentrated
(h)	heat losses / using a measuring cylinder / thermometer / cup not washed; insulate / use burette / digital thermom. / new cup;	2	**I** repeat and average

11. 0620_s15_ms_62 Q: 7

	Generic marking points can be applied to any method: mp1 (fair testing) known or stated volume of tonic water; mp2 (fair testing) repeat with other sample of tonic water; mp3 (reagent) add or react with KOH or Mg turnings etc.; mp4 (method) use of indicator / collect gas etc.; mp5 (endpoint) until colour changes / until no more gas evolved / for one minute etc.; mp6 (measurement) volume of KOH added / volume of gas evolved; mp7 (conclusion) the higher concentration is the one that needs the greater volume of KOH / gives off the most gas etc.;	**max 6**	There are many possible methods. The most common is titration by either adding tonic water to KOH or KOH to tonic water. However, reagents such as Mg or carbonates would also work. **A** a pH meter / probe could work. The volume of the tonic water does not matter, so mp1 should be replaced by constant temperature. **A** use of Universal Indicator with green as the endpoint **A** use of litmus

12. 0620_s15_ms_63 Q: 4

(e)	24, 23, 22, 25 initial temperature boxes completed correctly; 28, 59, 19, 44 maximum temperature boxes completed correctly; 4, 36, –3, 19 temperature changes completed correctly;	3	
(f)	appropriate scale for y axis; all temp differences correctly plotted = 2 marks three temp differences correctly plotted = 1 mark; clearly labelled;	4	highest temperature at least half-way
(g)(i)	exothermic;	1	**A** neutralisation
(g)(ii)	(D is a) carbonate / carbon dioxide formed;	1	
(h)	experiment 2 / solid E;	1	
(i)(i)	acid neutralised / pH increased; (so solid G is a) base / alkali;	2	
(j)	room temperature / initial temperature from table; reaction over;	2	

(k)	temperature change lower / halved; volume of acid larger / doubled;	**2**	
(l)	source: measuring cylinder / thermometer / heat losses; improvement: use burette / digital thermometer / insulate / lag;	**2**	

13. 0620_s16_ms_61 Q: 2

(a)	final readings completed correctly: 13.2, 39.2; initial readings completed correctly: 0.0, 12.8; differences completed correctly: 13.2, 26.4; all readings and differences to 1 decimal place;	**4** 1 1 1 1
(b)	yellow to orange / red / pink;	**1**
(c)	initial and final readings completed correctly: 9.9, 16.5; difference completed correctly: 6.6;	**2** 1 1
(d)	bubbles / fizzing / effervescence;	**1**
(e)	Experiment 2;	**1**
(f)	use a pipette / burette;	**1**
(g)	effect on results: none owtte; reason: no change in concentration owtte;	**2** 1 1
(h)(i)	2:1;	**1**
(h)(ii)	acid **B** is double the concentration of acid **A** ora / acid **B** is more concentrated ora;	**1**
(i)	any suitable correct and different method **M1** method; **M2** reagents; **M3** result;	**3** 1 1 1

14. 0620_s17_ms_62 Q: 2

(a)	initial volume completed correctly: 0.0 final volume completed correctly: 13.0	**1**
	difference: 13.0	**1**
(b)	final volume, initial volume and difference completed correctly: 41.1, 2.1 and 39.0	**1**
	all readings in **(a)** and **(b)** to 1 d.p.	**1**
(c)	there is a colour change at the end-point already	**1**
(d)(i)	solution **C**	**1**
	a greater volume of potassium manganate(VII) / solution **A** was needed	**1**

(d)(ii)	3 × as concentrated	1
(e)(i)	double the volume of solution **C** was used / double the volume of solution **A** was needed	1
	78 cm^3	1
(e)(ii)	problem: volume of potassium manganate(VII) solution added would be greater than 50 cm^3	1
	solution: use more than one burette / refill burette	1
(f)	advantage: easy (to use) / quick	1
	disadvantage: not accurate	1
(g)	can take average or mean / can spot anomalies / more reliable	1

15. 0620_s18_ms_61 Q: 1

(a)	burette	1
(b)	methyl orange / thymolphthalein / litmus	1
(c)(i)	number 2 / 18.9 cm^3	1
(c)(ii)	overshot end point / more than 25 cm^3 KOH in flask	1
(c)(iii)	18.2	1
	cm^3	1
(d)	(wrong conclusion) nitric acid more concentrated / stronger	1
	smaller volume of acid needed	1

16. 0620_s18_ms_62 Q: 4

	any **6** from: □ hydrochloric acid in burette / measuring cylinder (solutions can be reversed) □ measured volume of barium hydroxide solution (solutions can be reversed) □ in named container e.g. beaker / (conical) flask □ (named) indicator (ignore Universal Indicator) **OR** pH meter □ acid added gradually / slowly / dropwise / dripped □ until colour changes / endpoint / neutral / pH 7 □ note volume added / initial and final volumes □ calculation (using volumes and concentration of the acid)	**max 6**

17. 0620_s20_ms_61 Q: 2

Question	Answer	Marks
(a)	all six burette readings correct • 10.2 / 0.0 • 25.9 / 5.5 • 33.0 / 2.4	2
	all readings to 1 dp	1
	initial and final readings the correct way round	1
	all subtractions correct to calculate volume added • 10.2 • 20.4 • 30.6	1
(b)	(from) yellow	1
	(to) red / pink / orange	1
(c)	solution F more concentrated (than solution E)	1
	1.5 times	1
(d)	1:2	1

Question	Answer	Marks
(e)	15.3	1
	cm^3	1
(f)(i)	clean / remove residues from previous experiment	1
(f)(ii)	does not change amount of E / F or volumes / amounts already measured	1
(g)	errors any **two** from: • using measuring cylinder • missing endpoint / misjudging colour change • not repeating improvements any **two** from: • use pipette (in place of measuring cylinder) • add more slowly • repeat (and find mean)	4

18. 0620_s20_ms_62 Q: 4

Question	Answer	Marks
	Any six from: • stated / equal volumes of each cleaner • measured with pipette / measuring cylinder / burette into a beaker or flask • named indicator added • add hydrochloric acid • from a burette • until indicator changes colour • record / calculate volume acid added • biggest volume of acid is most concentrated	6

19. 0620_s21_ms_61 Q: 2

Question	Answer	Marks
(a)	all temperatures and temperature changes completed and all temperatures and temperature changes recorded to the same precision	1
	all temperatures recorded correctly (22.0, 22.0, 22.0, 22.5, 23.0, 23.0) and (19.5, 17.0, 14.5, 13.5, 14.0, 14.0)	2
	all temperature changes calculated correctly (2.5, 5.0, 7.5, 9.0, 9.0, 9.0)	1
(b)	all points plotted correctly	1
	ruler drawn straight line through first 4 points	1
	(ruler) drawn straight line through last three points	1
	straight lines have been extended so that they meet / cross	1
(c)(i)	values read correctly from graph (9.0 °C **and** 3.6 g)	1
	correct indication on graph	1
	units (°C **and** g)	1
(c)(ii)	(all) acid used up / sodium hydrogen carbonate in excess	1
(d)	correct line should be identical to plotted line up to 1.8 g and then becomes horizontal. temp change of between 4.0 and 5.0 where line becomes horizontal / levels off	1
	mass of between 1.0 and 2.5 where line becomes horizontal / levels off	1

Question	Answer	Marks
(e)	change: use a pipette	1
	explanation: more accurate than a measuring cylinder	1
	change: use a polystyrene / styrofoam cup	1
	explanation: insulator / reduces heat gain	1

20. 0620_s21_ms_62 Q: 2

Question	Answer	Marks
(a)	all volumes of dilute hydrochloric acid correct (16, 14, 12, 10, 6)	1
	all volumes recorded correctly, 4 correct scores 1 (56, 49, 44, 37, 26)	2
(b)	suitable scale for *y*-axis	1
	plotting – all 5 correct scores 2, 4 correct scores 1	2
	line drawn is a straight line of best fit	1
(c)(i)	correct reading from graph (usually 29 cm^3)	1
	working shown on graph	1
(c)(ii)	answer to **(c)(i)** ÷ 7	1
(d)(i)	gas escapes before bung is replaced /so that gas does not escape	1

Question	Answer	Marks
(d)(ii)	either • place one reagent in tube inside boiling tube / flask • tip / shake tube to start reaction **OR** • use a divided flask • tip flask to start reaction	2
(e)	more accurate	1
(f)	line drawn is below plotted line	1
	volumes are half of the values of plotted line	1

21. 0620_s21_ms_63 Q: 2

Question	Answer	Marks
(a)	all experiments have volume of sulfuric acid of 25 cm^3	1
	all volumes of water correct (30, 20, 10, 5, 0) and all volumes given to the same precision	1
	all volume of gas collected correct (10, 19, 38, 61, 95), four volumes correct scores 1	2
(b)	plotting – all 5 correct scores 2, 4 correct scores 1	2
	suitable best fit curve	1
(c)	appropriate extrapolation of line to 35	1
	correct reading from extrapolation	1
(d)(i)	correct calculation of volume for experiment 3; 38 / 30 = 1.27)	1
	cm^3 / s	1

Question	Answer	Marks
(d)(ii)	5	1
(e)(i)	more accurate	1
(e)(ii)	slower / takes more time	1
(f)	(gas) syringe	1
(g)	any 2 from: • The reaction can be started by tipping the flask • do not have to replace / remove the bung • so no gas escapes (while the bung is being removed / replaced)	2

22. 0620_w12_ms_63 Q: 3

(a) initial readings [3]

0.0 17.5 8.9

final readings

23.8 40.7 32.3 (2), –1 any incorrect

differences

23.8 23.2 23.4 (1)

(b) titration 2 and 3/23.2 and 23.4 (1) [2]

average = 23.3 (1)

allow: ecf for calculation of average

(c) pipette/burette (1) [1]

(d) blue to red/pink (1) [1]

(e) **(i)** half as much acid S/twice as much HC*l* (1) [1]

(ii) $y = 2$ (1) [1]

23. 0620_w13_ms_61 Q: 2

(a) straight line drawn with a ruler through all points missing point at pH 5 (1) [1]

(b) idea of fair test / comparability (1) [1]

(c) temperature (1) [1]

(d) the lower the pH the greater the % corrosion / or converse / pH 1 is most corrosive (1) [1]

(e) 2.5% (1) [1]

---

24. 0620_w13_ms_61 Q: 3

(a) table of results for Experiment 1
initial, final and difference volume boxes completed correctly (1)
0.0, 38.0 difference 38.0
readings to 1dp (1) [2]

(b) table of results for Experiment 2
initial and final boxes completed correctly (1) 10.0, 29.0
difference (1) [2]

(c) colourless (1) pink (1) [2]

(d) neutralisation / exothermic (1) [1]

(e) 2 × volume for Experiment 1 from table / 76 (1) cm^3 (1) [2]

(f) **(i)** reacts with the acid / neutralised (1) less sodium hydroxide needed (1) [2]

(ii) volume in **(e)** – volume added in Experiment 2 (1) e.g. 76–19
correct value (2) e.g. 57 cm^3 [2]

(iii) estimate based on **(ii)** answer to **(ii)** / 3 divided into 19 × 0.1 + 0.3 = 0.4 g [1]

(g) no effect (1)
reason – reaction not affected by temperature (1) [2]

(h) **(i)** more accurate (1) than a measuring cylinder (1) [2]

(ii) no effect / advantage (1) not measuring temperature changes (1) [2]

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25. 0620_w13_ms_63 Q: 6

stated / known / same volume of hydrochloric acid (1)
use of named measuring apparatus (1)
addition of named indicator (1)
add tablets (1)
until the colour changes / pH =7 (1)
take measurement (1) e.g. number of tablets
repeat with other tablet (1)
compare / conclusion (1) e.g. brand that uses fewer tablets is most effective
allow: other correct methods including loss of mass and collection of gas

max [7]

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26. 0620_w14_ms_61 Q: 4

(a) table of results for Experiment 1
initial volume completed correctly (1)
0 or 24.4
all readings to 1 decimal place (1) [2]

(b) table of results for Experiment 2
final volume completed correctly (1)
6.1
difference correct (1) [2]

(c) **(i)** neutralisation (1) [1]
allow: acid-base

(ii) as an indicator / to show end point (1) [1]

(d) water to remove the solution A of acid (1)
acid B to remove traces of water (1) [2]

(e) **(i)** Experiment 1
ecf from readings (1) [1]

(ii) any correct comparison (1) [1]

(iii) solution B more concentrated / stronger (1) or converse
less volume was needed (1) [2]

(f) half value from table result for experiment 2 (1)
cm^3 (1) [2]

(g) advantage: easy to use / quick / convenient (1)
disadvantage: not accurate owtte (1) [2]

(h) same volume of each solution (1)
add suitable reactant (1)
expected observation (1)
comparison (1) [4]
note: e.g. 10 cm^3 of each acid (1), add strip of magnesium / named carbonate (1)
effervescence (1), more rapid bubbles means stronger acid (1)

27. 0620_w14_ms_62 Q: 6

(a) filter solution (1)
wash with water (1)
dry (1) [3]
do not allow: evaporate to dryness

(b) known volume of oven cleaner (1)
add named acid (1)
with named apparatus (1)
indicator (1)
observe colour change (1)
note volume added (1)
repeat with other sample (1)
valid comparison (1) max [6]

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28. 0620_w14_ms_63 Q: 6

(a) add water (1)
allow: named organic solvent
crush / grind stir / mix / heat plant material / description of (1)
filter (1)
extract each plant material separately / named apparatus (1) [4]

(b) add extract to acid (1)
add extract to alkali (1)
different colours shows suitable indicator (1) [3]
allow: named colours

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29. 0620_w15_ms_62 Q: 1

(a)	pipette; burette;	1 1	**I:** dropper **R:** teat pipette
(b)	named indicator;	1	**I:** references to indicator paper **R:** Universal Indicator
(c)	all volumes correct: 16.3, 16.9, 16.2, 16.1 4 correct = 2 3 correct = 1 2 or fewer correct = 0	2	
(d)(i)	neutralisation / acid-base reaction / exothermic;	1	
(d)(ii)	(indicator) changed colour;	1	**A:** incorrect colour changes
(e)(i)	Experiment 2 / the second one / 16.9;	1	ecf on **(c)**
(e)(ii)	measuring or recording error / overshot end-point / manual error with burette;	1	**A:** incorrect volume of sodium hydroxide used **I:** human error
(e)(iii)	16.2; cm^3;	1 1	ecf on **(c)**
(f)	hydrochloric acid; less volume used than sodium hydroxide;	1 1	

30. 0620_w16_ms_61 Q: 2

(a)	table of results for Experiment 1 all temperature boxes completed correctly 22, 24, 26, 28, 30, 31, 30, 29, 28	**2**
(b)	table of results for Experiment 2 initial and other temperature boxes completed correctly 20, 21, 22, 23, 24, 25, 24, 23, 22	**2**
(c)	all points correctly plotted best-fit smooth line graphs labels	**2** **1** **1**
(d)	value from graph (27 °C) shown clearly	**1** **1**
(e)	phenolphthalein / litmus / suitable named indicator	**1**
(f)	Experiment 1 / solution **N** solution **N** is a stronger acid / has a higher pH	**1** **1**
(g)	measured results / temperature changes / results would be smaller **OR** larger / double volume needed to reach same temperature changes	**1**
(h)	polystyrene is an insulator / copper is a (good) conductor	**1**
(i)	source of error: heat losses / using a measuring cylinder improvement: lag or insulate / use burette	**1** **1**

31. 0620_w16_ms_61 Q: 4

	method adding Agri Lime to acid add weighed amount / known mass of Agri Lime **Q** to a known volume of acid with a named indicator added to the acid until the indicator changes colour note the mass of Agri Lime **Q** added repeat with Agri Lime **R** conclusion, e.g. 'the experiment using the smaller amount of Agri Lime is better' **OR** **method adding acid to Agri Lime** use weighed amount / known mass of Agri Lime **Q** add acid to it gradually / from a burette with a named indicator added to the acid until the indicator changes colour note volume of acid added repeat with Agri Lime **R** conclusion, e.g. 'the experiment using the larger volume of acid is better'	**6**

32. 0620_w19_ms_61 Q: 2

(a)	table of results volume boxes completed 0, 27, 48, 62, 65, 74, 76, 77, 77	**2**
(b)	all points plotted correctly	**2**
	best fit smooth line graph omitting anomalous point at 40 s / 65 cm^3	**1**
(c)(i)	point at 40 s / 65 cm^3	**1**
(c)(ii)	value from graph	**1**
	shown clearly	**1**

(d)	use of a 250 cm^3 measuring cylinder / inaccurate measurements / readings	**1**
	use a gas syringe / 100 cm^3 measuring cylinder	**1**
(e)(i)	35 cm^3	**1**
(e)(ii)	35 / 20 = 1.75	**1**
	cm^3 / s	**1**
(f)	volume of gas less / lower	**1**
	gas / carbon dioxide dissolved in water	**1**
(g)	curve below original	**1**
	approaching same level	**1**

33. 0620_w19_ms_62 Q: 1

(a)	pipette	**1**
	burette	**1**
(b)	methyl orange **or** phenolphthalein	**1**
	yellow to orange / pink / red **or** pink to colourless	**1**
(c)	initial burette reading	**1**
	final burette reading	**1**
(d)	values should be same	**1**
	moles / amount of sodium hydroxide added still same	**1**

34. 0620_w19_ms_63 Q: 2

(a)	table of results for experiments initial and final reading boxes completed correctly 10.2 23.1 6.3 0.0 2.7 1.2	**2**
	differences completed correctly 10.2, 20.4, 5.1	**1**
	all values to 1 or 2 decimal places	**1**
(b)	yellow	**1**
	orange / pink / red	**1**
(c)	no sharp colour change / no (clear) end point	**1**
(d)(i)	(Experiment) 3 (needed smallest) **and** (Experiment) 2 (needed largest)	**1**
(d)(ii)	1 : 2	**1**
(d)(iii)	most concentrated S R least concentrated T	**1**
(e)	no effect / none	**1**
	concentration of reactants not affected / unchanged / same	**1**
(f)	repeat the experiment	**1**
	compare / to check for anomalous results / until concordant results owtte	**1**

(g)	measurement to be taken	1
	use of results to draw conclusion	1
	reactant / method	1
	thermometric • measure temperature (change) • highest temperature (change) is most concentrated • add (xs) hydrochloric acid precipitation of metallic hydroxide • measure mass / height of precipitate • most precipitate is most concentrated • add (xs aqueous) copper sulfate (for example) gas produced • measure volume of gas made • largest volume is most concentrated • add an ammonium salt or aluminium evaporation • mass of solid • most mass is most concentrated • evaporate solution pH meter • measure pH • highest pH is most concentrated • pH meter dissolving • measure time taken for solid to dissolve • shortest time is most concentrated • aluminium / aluminium oxide / zinc / zinc oxide	

35. 0620_w20_ms_61 Q: 2

Question	Answer	Marks
(a)	Measuring cylinder readings: 16; 23; 29; 39; 44; 48	2
(b)	**M1** and **M2** all points plotted correctly **M3** ruler drawn straight line through first 4 points **M4** ruler drawn straight line through last three points **M5** straight lines have been extended so that they meet / cross	5
(c)	working on graph	1
	correct reading from their working on graph	1
(d)	all potassium iodide reacted / used-up	1
(e)	maximum mass of precipitate is 2.55 g	1
	maximum mass reached at half volume of plotted graph	1
(f)(i)	(more) accurate / precise (than a measuring cylinder)	1
(f)(ii)	(pipette measures a) fixed volume / 25 cm^3	1
(g)	filter	1
	wash / rinse residue	1
	dry **and** weigh	1

36. 0620_w20_ms_63 Q: 2

Question	Answer	Marks
(a)	Experiment 1 readings correct and readings recorded correctly with final > initial (37.2; 0.0)	1
	Experiment 2 readings correct and readings recorded correctly with final > initial (17.9; 5.5)	1
	both subtractions to get volume added correct (37.2; 12.4)	1
	all results figures for both experiments recorded to 1 dp or better	1
(b)	many colour changes / keeps changing colour / hard to determine the end point	1
(c)(i)	B (Experiment 2) **and** volume (of B) was less (than volume of A)	1
(c)(ii)	3 (times more concentrated)	1
(d)	12.4 ÷ 2.5 = 4.96 or 5(.0)	1
	cm^3	1

Question	Answer	Marks
(e)	repeat **and** compare the results	1
(f)(i)	more accurate / more precise (than a measuring cylinder)	1
(f)(ii)	(pipette measures a) fixed volume / 25 cm^3	1
(g)(i)	to remove solution A	1
(g)(ii)	to remove (distilled) water	1
(g)(iii)	larger / higher / bigger	1
	the water dilutes solution B / makes solution B less concentrated	1

37. 0620_w21_ms_62 Q: 2

Question	Answer	Marks
(a)	**M1** Experiment 1 burette readings completed correctly (31.6 and 8.0)	1
	M2 Experiment 2 burette readings completed correctly (15.9 and 4.1)	1
	M3 Experiment 3 burette readings completed correctly (26.4 and 2.7)	1
	M4 All subtractions to give volume added correct (23.6, 11.8, 23.7)	1
	M5 All readings / volumes are given to 1 dp or better	1
(b)	(from) red (to) orange	1
(c)	effervescence / fizzing / bubbles	1

Question	Answer	Marks
(d)(i)	**M1** greater volume used in experiment 1 / smaller volume used in experiment 2	1
	M2 twice as much in experiment 1 / half as much in experiment 2	1
(d)(ii)	solution **M** is more concentrated than solution **N**	1
(e)	47.4	1
(f)	to clean / to remove residue from previous experiment	1
(g)	**M1** rinse with solution **L**	1
	M2 to remove water / avoid diluting solution **L** / avoid changing concentration (of L)	1
(h)	to see colour change clearly / easily / accurately / better	1
(i)	repeat the experiments **and** compare the results	1
(j)	**M1** source of error: measuring cylinder / error in volume of solution M	1
	M2 improvement: use a pipette	1