AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.2.6

Strong and weak acids (HT only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**12**
Available paper years	**2008–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.4.2.6 Strong and weak acids (HT only)

Answer 01 · Mark scheme January 2008 | CHY3H | Original Q5 | Legacy

(a)(ii)	5.6 **or** from their graph		1
(a)(iii)	10 – 5.6 = 4.4	their reading at 15ºC – their (a)(ii) answer from their figures	1 1
(a)(iv)	Yes: the value at 15°C because have values either side owtte **or** No: more error in a smaller number owtte	accept converse answers based on 50°C accept converse answers based on 50°C	1
(b)(i)	balanced view / involving people / debate / gather information / democracy	owtte any sensible answer ignore 'trout might die'	1
(b)(ii)	undue weight / bias may be given to high status and very experienced people **or** less experienced/lower status may reduce status of enquiry	owtte any sensible answer	1

continued…

4.4.2.6 Strong and weak acids (HT only)

CHY3H

Question 2 continued…

question	answers	extra information	mark
(b)(iii)	(A) Management: any **one** from: • small amounts may be fine • can cope for short periods • could spread throughout the day • fish still getting (enough) oxygen • rate of photosynthesis could be increased to balance loss of oxygen • water will cool down (quickly) (B) Council: any **one** from: • any rise in temperature would reduce / affect (dissolved) oxygen • water will still be too hot • trout will die above 26°C	any sensible answer any sensible answer	1 1
total			9

4.4.2.6 Strong and weak acids (HT only)

CHY3H

Question 3

question	answers	extra information	mark
(a)	scale – (solid) formed when heat decomposes dissolved calcium / magnesium compounds owtte	allow: scale is formed when hard water is heated / boiled (to leave magnesium / calcium compounds)	1
	scale is calcium carbonate / $CaCO_3$ or magnesium carbonate / $MgCO_3$	ignore evaporate	
	scum – (ppt) formed when soap reacts with calcium / magnesium (ions) owtte	allow scum is formed when hard water reacts with soap	1
	scum is calcium stearate / magnesium stearate		
(b)	calcium (ions) / Ca^{2+} / magnesium (ions) / Mg^{2+}		1
	replaced by hydrogen ions / H^+ / sodium ions / Na^+		1
total			4

4.4.2.6 Strong and weak acids (HT only)

CHY3H

Question 4

question	answers	extra information	mark
(a)(i)	undiscovered elements owtte		1
(a)(ii)	they would be in the wrong group / have the wrong / different properties / don't fit the pattern owtte	allow atomic weights may have been wrong	1
(b)(i)	any **three** from: • elements arranged in proton / atomic number order • group: elements in the same group / column have same number of outer electrons owtte • group: number of shells increase down group • period: elements in the same period / row have the same number of shells / energy levels • period: number of protons / electrons increase across period • atomic number: link of atomic number to number of protons • atomic number gives number of electrons	ignore mass number / atomic weight / neutrons throughout	3
(b)(ii)	it would mean splitting a proton / electron **or** implication of splitting proton / electron		1

continued…

4.4.2.6 Strong and weak acids (HT only)

CHY3H

Question 4 continued…

(c)		must be a comparison	
	(outer) electron closer (to nucleus)	accept fewer (electron) shells / energy levels	1
		fluorine is the smaller/est	
	stronger/est attraction (to nucleus) owtte	do **not** allow magnetic / intermolecular forces	1
	or		
	less screening (by inner electrons)		
	electron gained more easily		1
		need some indication of outer electron shell somewhere in explanation otherwise max of **2** marks	
total			9

4.4.2.6 Strong and weak acids (HT only)

CHY3H

Question 5

question	answers	extra information	mark
(a)		**must** be description of a titration no titration = no marks	
	NaOH in burette	do **not** accept biuret etc	1
	add NaOH until (indicator) changes colour	if specific colour change mentioned, must be correct – colourless to pink / red **or** 'goes pink / red' do **not** accept 'clear' for colourless	1
	note (burette) volume used **or** final reading	accept 'work out the volume'	1
	one other point: eg repeat	accept: (white) tile **or** add dropwise / slowly **or** white background **or** swirling / mix **or** read meniscus at eye level **or** wash apparatus	1
(b)	0.054	for **2** marks (0.1 × 13.5)/25 for **1** mark	2
(c)	don't know – insufficient evidence to decide **or** depends on whether acid level is considered safe or unsafe	owtte any sensible answer	1
	yes, safe – acid level low / weak acids / low compared with stomach acid	owtte any sensible answer	
	no, unsafe – acid level (too) high / other substances or bacteria may be present / insufficient evidence to decide	owtte any sensible answer	

continued…

CHY3H

Question 5 continued…

question	answers	extra information	mark
(d)	(methyl orange) would have changed colour (well) before the end-point / pH7 / neutral	owtte	1
	weak acid present	weak acid-strong base (titration) allow methyl orange used for strong acid-weak base titration	1
total			9

4.4.2.6 Strong and weak acids (HT only)

Answer 01 · Mark scheme January 2008 | CHY3H | Original Q5 | Legacy

CHY3H

Answer 02 · Mark scheme June 2008 | CHY3H | Original Q1 | Legacy

question	answers	extra information	mark
1(a)(i)	hydrogen / H^+ / H^+ (aq)	allow H_3O^+ (aq) ignore H alone	1
1(a)(ii)	any valid test linked comparison eg magnesium **or** any (named) carbonate any **one** from: • weak(er) acid: slower rate / fewer bubbles **or** less gas • weak(er) acid longer for Mg to disappear **or** UI **or** pH paper / solution / meter / full range indicator (1) any **one** from: (1) • weak(er) acid has higher pH • correct comparison of colours **or** conductivity test (1) weak acid conducts less **or** bulb (1) less bright	 **NB** titration = 0 allow zinc / iron do **not** allow calcium **or** alkali metals independent mark allow converse for strong(er) **not** litmus **or** any other paper independent mark allow converse for strong(er) acid pH values must be below 7 ie strong = red / pink weak = orange / yellow allow converse for stronger	1 1

Question 1 continued on next page...

COMPONENT NUMBER: CHY3H

COMPONENT NAME: Chemistry

STATUS: Final

DATE: June 2008

Question 1 continued...

question	answers	extra information	mark
1(b)(i)	any **two** from eg: • nicotine kills people • nicotine causes cancer / diseases • nicotine is harmful / dangerous • nicotine is addictive • cost to NHS	any plausible answer allow it would save lives allow it kills people ignore references to pollution / passive smoking	2
1(b)(ii)	any **two** from eg: • nicotinic acid / vitamin B3 / niacin has different properties to nicotine • it is in many / listed foods **or** nicotine in food is not dangerous • more health risks to people / pellagra / diarrhoea / dermatitis / dementia / it will cause deaths or save lives • it is a vitamin **or** important part of diet • tobacco raises money / taxes • human rights issues • can't give up straight away / are addicted to it **or** perceived benefit of smoking	any sensible answer ignore if you ban nicotine, nicotinic acid cannot be made ignore malnutrition ignore just 'illness'	2
Total			**7**

4.4.2.6 Strong and weak acids (HT only)

Answer 02 · Mark scheme

June 2008 | CHY3H | Original Q1 | Legacy

COMPONENT NUMBER: CHY3H

COMPONENT NAME: Chemistry

STATUS: Final

DATE: June 2008

4.4.2.6 Strong and weak acids (HT only)

Answer 03 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)	some mention that a proton is a hydrogen ion / H^+ (as an acid) it / aminoethanoic acid has lost / donated a proton / hydrogen ion (as a base) it / aminoethanoic acid has gained / accepted a proton / hydrogen ion	this mark can be gained in either part	1 1 1
7(b)(i)	0.11(04)	correct answer with or without working = **2** marks if answer incorrect (0.15 × 18.4) / 25 gains **1** mark	2
7(b)(ii)	phenolphthalein	allow any correct single acid-base indicator that changes colour in the appropriate pH range (8 – 10) do **not** accept UI / litmus / methyl orange	1
Total			**7**

4.4.2.6 Strong and weak acids (HT only)

Answer 03 · Mark scheme

January 2010 | CHY3H | Original Q7 | Legacy

CHY3H

4.4.2.6 Strong and weak acids (HT only)

Answer 04 · Mark scheme

Question 6

question	answers	extra information	mark
6(a)(i)	H^+ and CH_3COO^-	allow H_3O^+ for H^+ allow $CH_3CO_2^-$ for CH_3COO^-	1
6(a)(ii)	not fully ionised / dissociated	accept partially / slightly ionised / dissociated accept does not ionise well ignore (does not produce many ions) do **not** accept ions ionise	1
6(a)(iii)	proton donor(s)	do **not** accept H^+ ions	1
6(b)(i)	colour change in right (pH) range **or** this is a weak acid and strong alkali titration	it = phenolphthalein accept methyl orange does not change colour **or** methyl orange changes in the wrong (pH) range accept methyl orange is for strong acid and weak alkali titration.	1

Question 6 continues on the next page

CHY3H

Question 6 contd

question	answers	extra information	mark
6(b)(ii)		must be description of an acid / alkali titration ie quantitative measures of volume no titration = **0** marks vinegar = ethanoic acid = acid	
	NaOH / alkali in burette	accept phonetic spelling do **not** accept biuret	1
	add NaOH until (indicator) changes from colourless to pink **or** until (indicator) changes colour	do **not** accept incorrect indicator **or** incorrect colour change allow unit indicator changes	1
	note (burette) volume used **or** final volume	allow work out the volume **or** see how much is used	1
	any **one** other point from • repeat • white tile / background • add dropwise / slowly • swirling / mix • read meniscus at eye level • some indication that some apparatus has been washed	ignore stir (with rod)	1

Question 6 continues on the next page

4.4.2.6 Strong and weak acids (HT only)

CHY3H

Question 6 contd

question	answers	extra information	mark
6(c)	0.06	correct answer with or without working = **2** marks if answer is incorrect (0.1 x 15)/25 **or** 0.0015 x 40 gains **1** mark	2
Total			**10**

4.4.2.6 Strong and weak acids (HT only)

Answer 04 · Mark scheme

January 2011 | CHY3H | Original Q6 | Legacy

CHY3H

Answer 05 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)(i)	(test ammonia / gas with red) litmus (goes) blue **OR** (conc.) HCl (1) white fumes / smoke / solid (1) **OR** (test ammonia / gas with) Universal Indicator (1) blue / purple (1)	incorrect test or no test = **0** mark testing the solution **or** using blue litmus = **0** mark accept any acid-base indicator with correct result allow white gas / vapour	1 1
5(a)(ii)	add barium chloride / $BaCl_2$ (solution) **or** add barium nitrate / $Ba(NO_3)_2$ (solution) white precipitate / solid (formed)	incorrect test or no test = **0** marks do **not** accept H_2SO_4 added allow Ba^{2+} solution / aqueous added allow white barium sulfate / $BaSO_4$ ignore barium sulfate / $BaSO_4$ alone	1 1
5(b)(i)	fully / completely ionised / dissociated **or** hydrogen ions fully dissociated	accept has more ions than weaker acid / alkali of same concentration ignore strongly ionised do **not** accept ions are fully ionised ignore concentrated **or** reference to concentrations of ions	1

Question 5 continues on the next page

Question 5 continued

question	answers	extra information	mark
5(b)(ii)	methyl orange	accept correct spelling only accept any strong acid-weak base indicator do **not** allow phenolphthalein / litmus / universal indicator	1
5(b)(iii)	32 × 0.05/1000 **or** 0.0016 (mole H_2SO_4) (reacts with) 2 × 0.0016 **or** 0.0032 (mole NH_3 in $25cm^3$) (0.0032 × 1000/25 =) 0.128	accept (0.05 x 32) = (V x 25) **or** 0.05 x 32 / 25 accept dividing rhs by 2 **or** multiplying lhs by 2 allow ecf from previous stage correct answer 0.128 **or** 0.13 with or without working gains all **3** marks	1 1 1
5(b)(iv)	2.176 **or** 2.18 **or** ecf from candidate's answer to (b)(iii) **or** 2.55 if 0.15 moles used	correct answer with or without working if answer incorrect or no answer 0.128 × 17 **or** 0.13 x 17 **or** their (b)(iii) × 17 **or** 0.15 × 17 gains **1** mark	2
Total			**11**

4.4.2.6 Strong and weak acids (HT only)

Answer 05 · Mark scheme

June 2011 | CHY3H | Original Q5 | Legacy

CHY3H

4.4.2.6 Strong and weak acids (HT only)

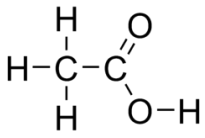
Answer 06 · Mark scheme

June 2017 | CH3HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	any **one** from: • for undiscovered elements • so elements with similar properties were in same column / group	ignore so they fit the pattern	1	**AO1** 3.1.1b
3(a)(ii)	any **one** from: • they have different properties from elements above them • they are (transition) metals .	ignore electronic configuration ignore they did not fit the pattern allow transition elements	1	**AO1** 3.1.1a,b
3(b)(i)	7 electrons in outer shell / highest energy level	ignore gain of 1 electron	1	**AO2** 3.1.2b
3(b)(ii)	for bromine: outer shell closer to nucleus stronger force of attraction (to nucleus) electron more easily gained to outer shell	‘outer’ must be mentioned once for 3 marks. comparatives required. ignore references to bromide / iodide allow converse for iodine allow fewer shells allow smaller atom allow less shielding	1 1 1	**AO1** **AO2** 3.1.3g,h

4.4.2.6 Strong and weak acids (HT only)

Answer 06 · Mark scheme

3(c)(i)	yellow precipitate	allow yellow or dark yellow or light yellow or pale yellow allow dark yellow or light yellow or pale yellow precipitate allow dark yellow or light yellow or pale yellow ppt allow dark yellow or light yellow or pale yellow solid do **not** allow yellow solution	1	**AO1** 3.4.1e
3(c)(ii)	green precipitate	allow green or dark green or light green or pale green or dirty green allow dark green or light green or pale green or dirty green precipitate allow dark green or light green or pale green or dirty green ppt allow dark green or light green or pale green or dirty green solid do **not** allow green solution	1	**AO1** 3.4.1b
3(d)	one colour obscures the other	allow colours mix / blend allow only one colour seen	1	**AO3** 3.4.1a
3(e)(i)		allow -OH in the structure without the -O-H bond shown	1	**AO1** 3.6.2a

4.4.2.6 Strong and weak acids (HT only)

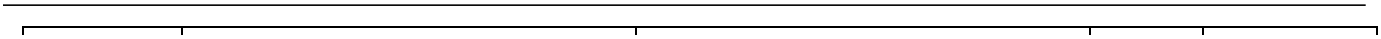
Answer 06 · Mark scheme

3(e)(ii)	weak acid (because) ethanoic acid is not fully ionised / dissociated	allow converse for hydrochloric acid allow (the solution) has a lower concentration of hydrogen ions allow (produces) fewer hydrogen ions. do **not** allow ionising	1 1	**AO3** 3.6.2a,b
Total			**12**	

4.4.2.6 Strong and weak acids (HT only)

Answer 06 · Mark scheme

June 2017 | CH3HP | Original Q3 | Legacy



4.4.2.6 Strong and weak acids (HT only)

Answer 07 · Mark scheme June 2018 | 8462/1H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(strong because) completely ionised (in aqueous solution)	ignore pH allow dissociated for ionised do **not** accept hydrogen is ionising do **not** accept H^+ are ionised	1	AO1 4.3.4 4.4.2.6
	(dilute because) small amount of acid per unit volume	ignore low concentration	1	AO1 4.3.4 4.4.2.6
09.2	5.0	allow 5	1	AO2 4.4.2.6

4.4.2.6 Strong and weak acids (HT only)

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	(titre): chooses titrations 3, 4, 5	an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps	1	AO2 4.3.4 4.4.2.5
	average titre = 22.13 (cm^3)	allow average titre = 22.13(3…) (cm^3) allow a correctly calculated average from an incorrect choice of titrations	1	
	(calculation): (moles NaOH = $\frac{22.13}{1000} \times 0.105 = 0.002324$)	allow use of incorrect average titre from step 2	1	
	(moles H_2SO_4 = ½ × 0.002324 =) 0.001162	allow use of incorrect number of moles from step 3	1	
	(concentration = $\frac{0.001162}{25} \times 1000$) = 0.0465 ($mol/dm^3$)	allow use of incorrect moles from step 4	1	
		alternative approach for step 3, step 4 and step 5 $\frac{2}{1} = \frac{22.13 \times 0.105}{25.0 \times \text{conc. } H_2SO_4}$ (1) (concentration H_2SO_4 =) $\frac{22.13 \times 0.105}{25.0 \times 2}$ = 0.0465 (mol/dm^3) (1) an answer of 0.046473 **or** 0.04648 correctly rounded to at least 2 sig figs scores marking points 3, 4 and 5 an answer of 0.092946 **or** 0.09296 **or** 0.185892 **or** 0.18592 correctly rounded to at least 2 sig figs scores marking points 3 and 5		

4.4.2.6 Strong and weak acids (HT only)

Answer 07 · Mark scheme

June 2018 | 8462/1H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	pipette measures a fixed volume (accurately) (but) burette measures variable volume	 allow can measure drop by drop	1 1	AO1 4.4.2.5
09.5	 (moles =) $\frac{30}{1000} \times 0.105$ **or** 0.00315 (mol) **or** (mass per dm^3 =) 0.105×40 **or** 4.2 (g) (mass = $\frac{30}{1000} \times 0.105 \times 40$) = 0.126 (g)	an answer of 0.126 (g) scores **2** marks an answer of 126(g) scores **1** mark an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps	 1 1	AO2 4.3.2.5 4.3.4 4.4.2.5
Total			**12**	

4.4.2.6 Strong and weak acids (HT only)

Answer 08 · Mark scheme

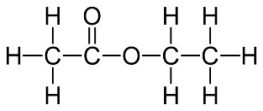
November 2020 | 8462/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	HCOOH propanoic acid	allow HCO_2H	1 1	AO1 4.7.2.4
07.2	incomplete / partial ionisation (because) reaction is reversible	allow incomplete / partial dissociation allow (because) reaction is in equilibrium	1 1	AO3 4.7.2.4
07.3	mass (of flask and contents) decreases (because) carbon dioxide is produced (and) carbon dioxide escapes (from the flask)	allow **1** mark for the gas produced escapes (from the flask)	1 1 1	AO1 AO2 AO2 4.3.1.3 4.7.2.4
07.4	(0.01 mol/dm^3) methanoic acid has a lower pH (so 0.01 mol/dm^3) methanoic acid has a higher concentration of hydrogen ions (therefore) more collisions per unit time	allow converse argument for ethanoic acid allow (0.01 mol/dm^3) methanoic acid is a stronger acid	1 1 1	AO2 AO2 AO3 4.6.1.2 4.6.1.3 4.7.2.4
07.5	ethyl ethanoate		1	AO1 4.7.2.4

4.4.2.6 Strong and weak acids (HT only)

Question 7 (continued)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6			1	AO2 4.7.2.4 4.7.3.2

Total			12

4.4.2.6 Strong and weak acids (HT only)

Answer 09 · Mark scheme

November 2021 | 8462/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	a dilute solution of a strong acid		1	AO2 4.3.2.5 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	1.0 mol/dm^3 hydrogen chloride solution		1	AO2 4.4.2.4 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	any **two** from: • swirl (the solution) • white tile (under the flask) • add (ethanedioic) acid dropwise (near the endpoint) • repeat **and** calculate mean		2	AO3 4.4.2.5 RPA2

4.4.2.6 Strong and weak acids (HT only)

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	(concentration = 90 × 0.0480 =) 4.32 (g/dm^3)		1	AO2 4.3.2.1 4.3.2.5 4.3.4
	(mass = 4.32 × $\frac{250}{1000}$) = 1.08 (g)	allow correct use of an incorrectly calculated value of concentration in g/dm^3	1	
	alternative approach: (moles = 0.0480 × $\frac{250}{1000}$ =) 0.012 (mol) (1)			
	(mass = 0.012 × 90) = 1.08 (g) (1)	allow correct use of an incorrectly calculated value of number of moles		

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	(moles $H_2C_2O_4 = \frac{15.0}{1000} \times 0.0480$) = 0.00072 (mol)		1	AO2 4.3.4 4.4.2.5 RPA2
	(moles NaOH = moles $H_2C_2O_4 \times 2$ =) 0.00144 (mol)	allow correct use of an incorrectly calculated value of number of moles of $H_2C_2O_4$	1	
	(concentration= $\frac{0.00144}{25.0} \times 1000$) = 0.0576 ($mol/dm^3$)	allow 0.058 (mol/dm^3) allow correct use of an incorrectly calculated value of number of moles of NaOH	1	
	alternative approach: $\frac{\text{volume} \times \text{conc (acid)}}{\text{volume} \times \text{conc (NaOH)}} = \frac{1}{2}$ (1)	allow inverse		
	(conc NaOH =) $2 \times \frac{15.0 \times 0.0480}{25.0}$ (1)	allow correct use of incorrect mole ratio		
	= 0.0576 (mol/dm^3) (1)			

Total			9

4.4.2.6 Strong and weak acids (HT only)

Answer 10 · Mark scheme

June 2023 | 8462/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(the acid is only) partially ionised (in aqueous solution)		1	AO1 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the mass of acid dissolved is doubled and the volume of the solution is halved		1	AO2 4.3.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	methyl orange from yellow to red / orange / pink **OR** phenolphthalein (1) from pink to colourless (1) **OR** litmus (1) from blue to red (1)	MP2 is dependent on the award of MP1 if no other marks awarded, allow **1** mark for universal indicator turns from purple / blue to green / yellow / orange / red	1 1	AO1 4.4.2.5 RPA2

4.4.2.6 Strong and weak acids (HT only)

Answer 10 · Mark scheme

June 2023 | 8462/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	OH^-		1	AO1 4.4.2.4

4.4.2.6 Strong and weak acids (HT only)

Answer 10 · Mark scheme

June 2023 | 8462/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(moles $Na_2CO_3 = \frac{25.0}{1000} \times 0.124$) = 0.0031(0)		1	AO2 4.3.4 4.4.2.5 RPA2
	(moles HNO_3 = 2 × 0.0031(0)) = 0.0062(0)	allow correct use of an incorrectly determined number of moles of Na_2CO_3	1	
	(concentration =) $\frac{0.0062(0)}{23.6} \times 1000$	allow correct use of an incorrectly determined number of moles of HNO_3	1	
	= 0.262711864		1	
	= 0.263 (mol/dm^3)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all the data in the question	1	
	alternative approach:			
	$\left(\text{ratio } \frac{\text{moles } HNO_3}{\text{moles } Na_2CO_3} = \right)$	allow inverted expression		
	$\frac{2}{1} = \frac{23.6 \times \text{concentration}}{25.0 \times 0.124}$ (2)	allow **1** mark for the expression with an incorrect mole ratio		
	(concentration =) $\frac{2 \times 25.0 \times 0.124}{23.6}$ (1)	allow correct use of the expression with an incorrect mole ratio		
	= 0.262711864 (1)			
	= 0.263 (mol/dm^3) (1)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all the data in the question		

4.4.2.6 Strong and weak acids (HT only)

Answer 10 · Mark scheme

June 2023 | 8462/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	3.16×10^{-3} (mol/dm^3)		1	AO2 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	argon / Ar		1	AO2 4.1.2.4 4.2.1.2

Total Question 5	**12**

4.4.2.6 Strong and weak acids (HT only)

Answer 11 · Mark scheme

June 2024 | 8462/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(an acid which) is partially ionised	allow (an acid which) is partially dissociated	1	AO1 4.4.2.4 4.4.2.6
	in aqueous solution	allow (when dissolved) in water MP2 is dependent on the award of MP1	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	pH increases		1	AO2 4.4.2.6
	(because) the concentration of hydrogen ions decreases		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	use a (volumetric) pipette to add the alkali		1	AO1 4.4.2.5 RPA2
	any **two** from: • into a conical flask • add an indicator (to the alkali) • take the initial burette reading • use a white tile (under a conical flask)	ignore beaker allow named indicator do **not** accept add universal indicator	2	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	(volume of HCl = $\frac{0.0045}{0.15}$) = 0.030 (dm^3)		1	AO2 4.3.4 4.4.2.5 RPA2
	(conversion 0.030 dm^3 =) 30 (cm^3)	allow correct conversion of an incorrectly determined volume in dm^3	1	
	alternative approach $\left(\text{concentration} = \frac{0.15}{1000} =\right)$ 0.00015 (mol/cm^3) (1)			
	$\left(\text{volume} = \frac{0.0045}{0.00015} =\right)$ 30 (cm^3) (1)	allow correct use of an incorrectly determined concentration in mol/cm^3		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5		allow converse arguments in terms of magnesium allow energy level for shell		AO2 4.1.2.3 4.2.1.2 4.4.1.2
	(calcium's) outer shell / electrons are further from the nucleus	allow calcium has more shells ignore calcium atoms are larger	1	
	(so) the outer electrons are less strongly attracted to the nucleus	allow (so) the outer electrons are more shielded from the nucleus	1	
	(so) positive ions are formed more easily	allow (so) electrons are more easily lost	1	

Total Question 9	12

4.4.2.6 Strong and weak acids (HT only)

Answer 12 · Mark scheme

June 2025 | 8462/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	OH^-		1	AO1 4.4.2.4

4.4.2.6 Strong and weak acids (HT only)

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any **two** from: (improvement) use phenolphthalein (instead of universal indicator) (reason) so that the colour change is sharp **or** (improvement) use a pH probe (reason) so the pH probe shows a sharper endpoint (than universal indicator) **OR** (improvement) add the sodium hydroxide solution drop by drop (near the end point) (reason) the volume (of sodium hydroxide solution) used is more accurate **OR** (improvement) read burette at eye level (reason) the volume (of sodium hydroxide solution) used is more accurate **OR** (improvement) rinse burette with sodium hydroxide **and** pipette with acid (reason) remove contaminants	**1** mark for improvement, **1** mark for reason reason must be linked to the corresponding improvement allow methyl orange for phenolphthalein allow any named single change indicator for phenolphthalein allow universal indicator changes colour too gradually allow universal indicator has too many colour changes ignore specific colour changes allow add the alkali drop by drop (near the end point) allow so the end point is more accurate allow read (volume) at the bottom of the meniscus allow to reduce parallax error	4	AO3 4.4.2.5 RPA 2

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	24.70 (cm^3)	allow 24.7 (cm^3)	1	AO2 4.4.2.5 RPA 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	$\left(\text{moles acid} = \frac{25.0 \times 0.216}{1000} =\right)$ 0.00540		1	AO2 4.3.2.5 4.4.2.5 RPA 2
	(moles alkali = 0.00540 × 2 =) 0.0108	allow correct use of incorrectly determined number of moles of acid	1	
	(concentration =) $0.0108 \times \frac{1000}{11.25}$	allow correct use of incorrectly determined number of moles of alkali	1	
	= 0.960 (mol/dm^3)	allow = 0.96 (mol/dm^3)	1	
	alternative approach:			
	$\left(\frac{\text{moles acid}}{\text{moles alkali}} =\right)$			
	$\frac{2}{1} = \frac{11.25 \times \text{conc}}{25.0 \times 0.216}$ (2)	allow inverted expression allow **1** mark for the expression with an incorrect mole ratio		
	(concentration =) $\frac{2 \times 25.0 \times 0.216}{11.25}$ (1)	allow correct use of the expression with incorrect mole ratio		
	= 0.960 (mol/dm^3) (1)	allow = 0.96 (mol/dm^3)		

4.4.2.6 Strong and weak acids (HT only)

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	the HCl is a more dilute and stronger acid than the HCN		1	AO2 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	(HCl has a) higher concentration of hydrogen ions	allow HCN has a lower concentration of hydrogen ions	1	AO2 4.3.2.5 4.4.2.6
	(because) concentration of hydrogen ions in HCl is 0.1 (mol/dm^3) **and** concentration of hydrogen ions in HCN is 0.0002 (mol/dm^3)		1	

Total Question 8	**13**

Answer 07 · Examiner comments

June 2018 | 8462/1H | Original Q9

Question 9 (standard / high and high demand)

09.1 46% of students could explain the idea of a strong acid correctly, but few could articulate the idea of a dilute acid using correct scientific ideas. Most referred either to a low concentration (which merely expresses the opposite of the word dilute) or adding water, explaining the word diluted rather than dilute. To gain the mark, the idea of few particles per unit volume was required. Some students tried to explain the ideas in terms of pH, failing to realise that pH is itself affected by both the strength of an acid and by its concentration.

09.2 This question, on a new area of the specification, was answered well, with 68% of students giving the correct answer.

09.3 This question discriminated very well. The highest-attaining students gave excellent answers, with clearly set out working which was easy to follow. 20% of students achieved full marks, and 41% were able to achieve at least two marks, usually for calculating the correct average titre from concordant results.

Some working was very hard to follow, making it difficult to give partial marks. This was particularly the case when students wrote numbers around a pair of triangles rather than giving a step by step process. It is as important to communicate how the answer is obtained as it is to get an answer. It is also hard to follow working when partial answers are left as fractions bearing no relation to the actual data; a calculator display should always be converted to decimal form for intermediate steps as well as the final answer.

Some students had a correct answer but then took their final answer down to one significant figure. Having done a required practical, students should know that titration is a very accurate technique so that an answer to one significant figure would never be appropriate.

09.4 There was little understanding of the reasons for using different apparatus to measure the two volumes. Answers often did not mention volume at all but referred vaguely to ‘amount’ or ‘how much’. Both a pipette and a burette measure accurately and precisely – the difference is that a pipette can only measure one single volume, but a burette measures variable volumes.

09.5 32% of students achieved both marks. The most common errors were to forget to divide by 1000 when calculating the number of moles, or to calculate the mass per dm^3 but not then scale to 30 cm^3.

4.4.2.6 Strong and weak acids (HT only)

Answer 07 · Examiner comments

June 2018 | 8462/1H | Original Q9

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.4.2.6 Strong and weak acids (HT only)

Answer 08 · Examiner comments — November 2020 | 8462/2H | Original Q7

Question 7 (standard, standard / high and high demand)

07.1 Propanoic acid was named correctly much more often than a correct formula was given for methanoic acid. CHCOOH was a commonly seen error here.

07.2 Many students scored at least one mark here. A common misconception was that incomplete / partial ionisation means that each CH_3COOH molecule produces only one H^+ ion, i.e. that the three hydrogen atoms in the CH_3COO^- ion would also form H^+ ions if ionisation were complete.

Answer 08 · Examiner comments — November 2020 | 8462/2H | Original Q7

07.3 This part was quite well answered. Most students stated that the mass decreases. Not all of the students who identified carbon dioxide as a product of the reaction went on to explain that it is the escape of this gas that causes the mass to decrease.

07.4 This part was poorly answered by many students. Many recognised that the pH of methanoic acid was lower but far fewer made the link to hydrogen ion concentration. Only a small proportion of students referred to collisions between particles and, of those that did, a significant minority referred to 'more collisions', which was insufficient for the mark, or incorrectly justified the increased collision frequency in terms of the particles having more energy.

07.5 A minority of students were able to name ethyl ethanoate.

07.6 A majority of students were able to identify the displayed structural formula of ethyl ethanoate.

4.4.2.6 Strong and weak acids (HT only)

Answer 09 · Examiner comments

November 2021 | 8462/1H | Original Q9

Question 9 (standard, standard / high and high demand)

09.3 Many students included reading the bottom of the meniscus at eye level; this is just normal technique rather than an improvement to the method given. Many suggested repeating the titration, but this is pointless unless a mean of the accurate results is taken.

09.4 As with other calculations, students often failed to explain what they were doing, which made it difficult for the examiners to award partial credit. Numbers were scattered around without helpful words such as 'moles =' or 'mass ='. Although most students convert the volume of a solution to dm^3 for a titration calculation, far fewer did in this calculation, so their calculated number of moles was 1000 times the correct value.

09.5 Many students were successful at this straightforward titration calculation. Most used the mole ratio, although some tried to apply this to concentrations or volumes rather than moles. Some students tried to bring relative formula mass into their calculation.

Concluding Remarks

The paper was broadly comparable with previous papers. Students did poorly on the questions on ionic bonding and electrolysis but performed well on the question on extraction of metals. There continues to be a lack of precision when recalling definitions and other statements from the specification.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.4.2.6 Strong and weak acids (HT only)

Answer 10 · Examiner comments June 2023 | 8462/1H | Original Q5

Question 5 (standard, standard/high and high demand)

05.1 More than half of the students were able to state that a weak acid is one which is only partially ionised or dissociated in aqueous solution. Common incorrect responses were

Answer 10 · Examiner comments

that the acid is partially ionising (it does not ionise other species) or that hydrogen ions are ionised (it is the acid molecule which ionises to form H^+ ions). Attempted responses in terms of pH were not accepted.

05.2 The great majority of students gave the correct response. The most common distractor was the mass of acid dissolved is halved and the volume of the solution is doubled, which would decrease the concentration. The other two options would not change the concentration.

05.3 Fewer than a third of students could recall the name of an appropriate indicator and the correct colour change from this required practical. Any single acid-base indicator was allowed, with its associated colour change. Phenolphthalein was the most popular choice of indicator; with phonetic spellings accepted. The colour change was often the wrong way round, as acid is being added to the alkali, and some students described the final colour incorrectly as 'clear' rather than colourless.

05.4 About three fifths of students knew that the OH^- ion is responsible. When asked for a formula, an equation is not an appropriate response.

05.5 This question discriminated very well. Some scaffolding was given to help the students and bring the demand of the question down. This resulted in two fifths of students scoring full marks on the question and nearly three quarters scoring at least one mark.

Some intermediate marks were not awarded because students didn't convert the volume into dm^3 when calculating the number of moles of sodium carbonate. A second mark was then often not awarded in calculating the concentration of nitric acid because students divided by a volume in cm^3 instead of dm^3. Those students who tried to bring relative formula masses into the calculation (when no data had been given to enable them to do so) rarely scored more than two marks; one for applying the mole ratio and one for rounding an answer to 3 significant figures if all the data supplied had been used.

A few students did not use the method suggested, but used a ratio method instead. On this occasion full credit was given to these answers. However, students should be aware that purely mathematical methods, which do not demonstrate an understanding of the chemical principles, are not always appropriate.

05.6 Over a third of students scored the mark in this high demand question. As the pH has decreased by a factor of 2, the concentration of hydrogen ions increases by a factor of 10^2. However, many students did not realise this and attempted to calculate a concentration by applying a linear, instead of logarithmic, scale factor. Some students divided by 100 instead of multiplying.

05.7 Only two fifths of the students worked out that the element must be argon. Sulfur was a popular incorrect response (one electron subtracted instead of added), but other halogens were also popular.

4.4.2.6 Strong and weak acids (HT only)

Answer 11 · Examiner comments

June 2024 | 8462/1H | Original Q9

Question 9 (standard, standard/high and high demand)

09.1 Over a half of students knew that a weak acid is one which is partially ionised, although many forgot to state that this was in aqueous solution. Some students incorrectly stated that an acid is ionising (ionises other species) rather than ionised (is itself ionised). Some incorrectly stated that it was H^+ ions which are ionised or dissociated, rather than the acid molecules. The H^+ ions are the result of the ionisation or dissociation.

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Answer 11 · Examiner comments

09.2 Two thirds of students realised that the pH would increase. Some did not give the direction of the change, saying the pH would become 'closer to 7' but not saying from which direction. Far fewer were able to articulate the reason in terms of the decrease in concentration of hydrogen ions. There were, however, some excellent answers in terms of the decrease of the number of hydrogen ions per unit volume.

09.3 Many students gave three or four correct steps in the procedure. However, many omitted to say that the alkali should be measured with a (volumetric) pipette, which is an essential step, so did not gain full marks. Most students remembered to add an indicator, although some suggested using universal indicator, which is not suitable for a titration. Most also suggested using a white tile, and many correctly said that the titration should be carried out in a conical flask. Carrying out the titration in a beaker did not gain credit because of the risk of spillage while swirling. Those who suggested taking the initial burette reading, or filling to a particular reading, often expressed themselves poorly; a burette does not give readings of 'amount.'

09.4 Over two thirds of students scored one mark, but fewer than a half scored both. The most common approach was to calculate the volume in dm^3 and then convert to cm^3. Students who took this approach very often scored at least one mark, either by converting an incorrect volume to cm^3 or getting the first step right but forgetting to convert the units. A common error was to multiply the moles and concentration together.

Students who took the alternative approach, converting the concentration to mol/cm^3 first, were less successful; they often multiplied by 1000 in the first step instead of dividing and then did not know how to use the number of moles.

09.5 This high demand question discriminated well; fewer than a third of students scored all three marks but nearly three quarters scored at least one mark. The best answers picked up on the information that calcium atoms are larger, and applied knowledge about reactivity in Group 1 metals to this unfamiliar context. Imprecise language lost some students credit: 'electrons are further away' mentions neither the outer electrons nor the nucleus; 'force between the outer electrons and the nucleus' does not specify an attractive force; 'more outer shells' is not correct because 'outer' is always taken to mean the one shell furthest from the nucleus. It was not uncommon to see the force between the nucleus and the outer electrons described incorrectly as intermolecular. Some students referred to the larger size of the atom as if this referred to a lump of calcium and tried to answer in terms of larger surface area for the acid to attack giving a higher rate of reaction.

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4.4.2.6 Strong and weak acids (HT only)

Answer 11 · Examiner comments

Mark Ranges and Award of Grades

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4.4.2.6 Strong and weak acids (HT only)

Answer 12 · Examiner comments

June 2025 | 8462/1H | Original Q8

Question 8 (standard, standard/high and high demand)

08.1 Three quarters of students could give the correct formula for the hydroxide ion. The most common error was H^+. A surprising number did not attempt to answer.

08.2 This was surprisingly answered less successfully, with fewer than two thirds gaining a single mark and very few scoring all four. Many suggested using phenolphthalein or methyl orange instead of Universal Indicator, but few were able to express the reason

Answer 12 · Examiner comments

in terms of a sharp or sudden colour change rather than the gradual change seen with Universal Indicator. The next most common improvement was to add the sodium hydroxide solution dropwise near the end point, but again the reason was not clear, with 'results' or 'amount' often stated instead of 'volume', and 'precise' instead of 'accurate'. These words are not synonymous.

There were many spurious 'improvements' such as having the acid in the burette and the alkali in the flask; it does not matter which way round the solutions are used. Some think that a measuring cylinder is more accurate than a pipette – they are confusing a pipette used for measuring volume with a dropping pipette.

08.3 The vast majority gave the correct reading. The most common error was 25.3 cm^3.

08.4 This question discriminated well. Nearly a half gave fully correct answers, while two thirds were able to score at least one mark, often for applying the correct mole ratio. A common error was to use the mole ratio the wrong way round, giving an answer of 0.24 mol/dm^3, or to ignore the mole ratio completely, giving an answer of 0.48 mol/dm^3. Sometimes the volumes were not converted to dm^3, leading to incorrect statements such as 'moles acid = 5.4'. Whilst these responses often led to the answer of 0.96 mol/dm^3, they did not gain full credit. Sometimes the volume conversion was attempted but incorrect, eg multiplying cm^3 by 1000. Students who tried to bring masses into the calculation were rarely able to make any progress.

08.5 The vast majority chose the correct statement, but a minority thought that the hydrochloric acid was more concentrated as well as stronger.

08.6 Students struggled with this high demand question, with only one in ten scoring one mark. The question demanded precise use of technical terms and use of the data in the table. Few mentioned the concentration of hydrogen ions, so could not gain credit; they referred to 'number' of hydrogen ions or 'more' hydrogen ions (in an unspecified volume) or concentration of 'acid'. Even fewer calculated the concentration of hydrogen ions in each acid from the data in the table, to back up their argument. Many students seem to think that pH depends only on the strength of an acid. pH depends on the hydrogen ion concentration, which in turn depends on a combination of both the strength and the concentration of acid molecules. Many also seem to think that acids are ionising, rather than ionised.