



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme

June 2003

GCSE

Chemistry

3421

Higher

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HIGHER TIER 3421/H

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

- 2.1 In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following lines is a potential mark.
- 2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of ‘it’

Answers using the word ‘it’ should be given credit only if it is clear that the ‘it’ refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

- (a) A candidate who calculates average speed using $\text{speed} = \text{time}/\text{distance}$ **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.
- (b) A candidate who incorrectly calculates average speed using $\text{speed} = \text{distance}/\text{time}$ and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(.....) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.



**GCSE Chemistry
Higher Tier 3421/H**

3421/H Q1

question	answers	extra information	mark
(a)(i)	accurate plotting of points ($\pm \frac{1}{2}$ square)	2 marks for all points 1 mark for 3 or 4 points	2
	sensible smooth curve	reasonable attempt do not accept double lines or dot to dot	1
(ii)	accurately read from <u>their</u> graph to $\pm \frac{1}{2}$ square		1
(b)(i)	(as temperature increases) rate <u>increases</u>	accept speeds up, gets faster, gets quicker accept higher speed do not accept gets bigger / higher unqualified do not accept answers about time on its own	1
(ii)	Quality of written communication <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i>	<i>maximum 2 marks if ideas not expressed well</i>	3
	any three from: particles have more energy particles move faster more collisions more energetic / successful / harder collisions	for converse maximum 2 marks higher kinetic energy do not accept move more or vibrate more accept greater rate of collisions more particles have activation energy	
(c)	concentration (of solutions) or volume (of solutions)	accept 'how much of' accept references to intensity of colour accept same endpoint accept rate of stirring / shaking do not accept reference to solids or catalysts etc ignore containers do not accept pH	1
total			9

3421/H Q2

question	answers	extra information	mark
(a)(i)	5(%)		1
(ii)	0.35	$\frac{5}{100} \times 7$ for 1 mark	2
(b)(i)	reduction	accept (it's) reduced do not accept redox / deoxidation	1
(ii)	heat with / reduce / react with or (chemical) reaction with a metal / element / substance higher in reactivity or electrolysis: molten (1) electrolysis (1)	ignore displace accept higher <u>named</u> elements or symbol accept carbon monoxide / coal / coke correct word equation for 2 marks correct formulas for 1 mark correct <u>balanced</u> symbol equation for 2 marks	1 1
total			6

3421/H Q3

question	answers	extra information	mark
(a)	magnesium is <u>higher</u> in reactivity (than iron) or Mg is <u>more</u> reactive (than Fe)	must be a comparison do not accept Mg corrodes <u>faster</u> (than Fe)	1
	magnesium corrodes / reacts / loses electrons instead (of iron)	sacrificial idea do not accept magnesium 'rusts' instead of iron	1
(b)	sensible answers such as: difficult to repair / paint or replace a long underground pipe or easier to replace magnesium or easier to carry out inspections	accept to stop pipes corroding causing <u>leaks</u> accept idea of cost of replacing pipe accept damage to pipe do not accept pollution do not accept corrosion unqualified	1
total			3

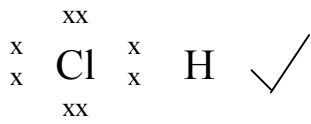
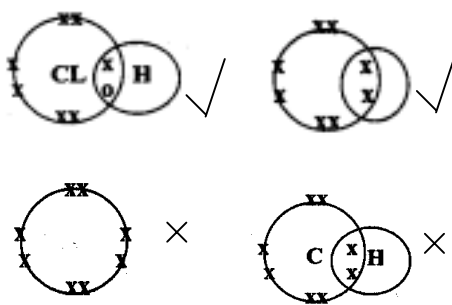
3421/H Q4

question	answers	extra information	mark
(a)	coke / carbon / C	do not accept coal	1
	<u>hot</u> air	do not accept oxygen	1
	slag / calcium silicate / CaSiO ₃		1
(b)(i)	2 3	accept <u>correct</u> multiples do not accept any added different chemicals	1
(ii)	iron oxide or Fe ₂ O ₃ / iron (III) oxide	ignore iron ore / haematite do not accept iron (II) oxide do not accept Fe ³⁺	1
(c)(i)	160	ignore units (2 × 56) + (3 × 16) for 1 mark	2
(ii)	70	$\frac{2 \times 56}{160} (\times 100)$ for 1 mark allow ecf from part (i)	2
(iii)	700	allow ecf from part (ii)	1
total			10

3421/H Q5

question	answers	extra information	mark
(a)	<p>any three from:</p> <p><u>less</u> / little / not much carbon dioxide or give a %age < 1%</p> <p>more / a lot of nitrogen or give 78-80%</p> <p>(more) / (some) oxygen or give a %age 20-21%</p> <p>references to pollutant gases in general or named examples</p> <p>more / some water (vapour)</p> <p>some / 1% argon</p> <p>ozone (layer) on earth</p>	<p>accept reverse answers if unambiguous</p> <p>do not accept just different throughout</p> <p>do not accept more "other gases"</p> <p>e.g. CO, SO₂, NO, NOX etc.</p> <p>ignore other noble gases</p>	3
(b)	<p>any two from:</p> <p>removed carbon dioxide</p> <p>released oxygen</p> <p>caused carbon from carbon dioxide to become locked in sedimentary rocks</p> <p>the oxygen they produced reacted with methane and ammonia</p> <p>produced nitrogen (must be linked to fourth point)</p>	<p>ignore reference to respiration / photosynthesis unless qualified</p> <p>accept correct word / symbol equation for photosynthesis for 2 marks</p> <p>converted / changed CO₂ to oxygen for 2 marks</p>	2
total			5

3421/H Q6

question	answers	extra information	mark
(a)	bonding pair in the overlap and 6 other electrons arranged around the chlorine 	must have either circles or symbols need not be pairs but must not be in the overlap region accept without H and Cl if clear accept all x's or all o's 	1
(b)	$\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$	accept multiples or fractions accept correct formulae but not balanced for 1 mark correctly balanced equation containing 'correct' lower / upper case symbols gets 1 mark e.g. $\text{h}_2 + \text{cl}_2 \rightarrow 2\text{HCL}$	2
(c)	MgCl_2	accept $\text{Mg}^{2+}(\text{Cl}^-)_2$	1
(d)	because magnesium chloride is made of ions or is ionic hydrogen chloride is made of molecules or is covalent	accept there are strong forces of attraction between the ions / particles in MgCl_2 or strong electrostatic attractions accept more energy to separate particles in MgCl_2 do not accept MgCl_2 molecules do not accept reference to breaking bonds accept there are only weak forces of attraction (between the particles / molecules) in HCl do not accept weak covalent bonds do not accept reference to breaking bonds do not accept MgCl_2 is a solid and HCl is a gas	1 1
total			6

3421/H Q7

	answers	extra information	mark
(a)	water came into contact with rocks / ground / soil	ignore mountains erode gets first mark	1
	ions or compounds or chemicals or they dissolved / soluble / leached / reacts / forms a solution	do not accept gets picked up accept water dissolves them from the rocks for 2 marks	1
(b)(i)	calcium or magnesium	accept Ca ²⁺ or Mg ²⁺ or Ca or Mg do not accept Ca ⁺ alone	1
(ii)	answers must involve both calcium and magnesium Ridgway: Ca + Mg = 53 Homeland: Ca + Mg = 27	totals required for 2 marks accept there is (almost) twice as much Magnesium and Calcium in Ridgway water for 1 mark	1 1
	(iii)	equal volumes / quantities / amounts of water add soap with shaking / mixing / agitation the harder sample (Ridgway) needs 2× more soap to give lather or the less hard sample (Homeland) needs half as much soap to give lather can get twice as much scum with harder (Ridgway) sample	1 1 1
total			8

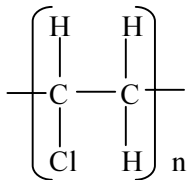
3421/H Q8

	answers	extra information	mark
(a)(i)	not fully ionised / dissociated or partially ionised	accept weak acids produce fewer H ⁺ if equal concentration or equal amounts of acid specified do not accept just weakly ionised	1
(ii)	Test: Universal Indicator / pH indicator / full range indicator	do not accept other indicators	1
	Result: e.g. stronger is a darker red or weaker is orange, yellow, paler red etc. or correct pH numbers < 7 or pH meter (1) correct pH values (1) or Test: Mg / Zn / Fe / Sn or a carbonate / hydrogencarbonate (1) Result: e.g. stronger is quicker / faster rate / more bubbles / more gas / more correctly named gas (1)	accept redder accept pink for paler red do not accept green result linked Any suitable test but not titration	1
(b)	Quality of written communication <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i> acids produce hydrogen ions acids are proton donors Link: hydrogen ions (Arrhenius) and protons (Bronsted-Lowry)	<i>maximum 2 marks if ideas not well expressed</i>	1 1 1
total			6

3421/H Q9

	answers	extra information	mark
(a)	aluminium is high in / near the top of the reactivity series / very reactive	more reactive than iron or copper or zinc do not accept just reactive	1
(b)	sodium hydroxide or potassium hydroxide	accept NaOH / KOH	1
(c)	(dilute) sulphuric acid	accept H ₂ SO ₄ do not accept concentrated sulphuric acid	1
(d)	$4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$	accept multiples or fractions	1
total			4

3421/H Q10

question	answers	extra information	mark
(a)	not broken down by microorganisms or not bio-degradable	accept alternative answers such as: do not rot / corrode / fade / react with atmosphere etc any answers which imply the inertness or non-biodegradability of this plastic accept they don't react, they are 'inert' ignore rusting do not accept weathering	1
(b)(i)	(have a) double bond or do not have maximum number of (hydrogen) atoms attached	accept can add / react with hydrogen accept can take part addition reactions do not accept it is a double bond do not accept additional reactions do not accept has 'spare' / 'free' bond do not accept alkene alone	1
(ii)	single bond between carbon atoms all atoms correct + 2 'linking' bonds (linking bonds need not go through bracket) n moved to bottom right of <u>bracket</u> i.e. is below $\frac{1}{2}$ way on the right	 first 2 marks are possible for chain structures accept $[-CHCl-CH_2-]_n$	1 1 1
(iii)	many molecules or many monomers joined / bonded / linked or form long chain molecules / large molecules or to form a long chain polymer	accept many alkenes or many (ethene) molecules do not accept many ethene alone etc. to form a long polymer is not enough for 2 nd mark	1 1
(iv)	no other substances formed (A + B → C)	allow because double bond breaks so other atoms can add allow one product only do not accept saturation occurs	1
total			8

3421/H Q11

question	answers	extra information	mark
(a)	use a fume cupboard or wear <u>gas</u> mask / breathing equipment	do not accept well ventilated room ignore gloves etc.	1
	because the gas is toxic / poisonous / lethal	accept so it will kill you (owtte)	1
(b)(i)	electrons	do not accept answers in terms of oxygen any mention of oxygen = 0 marks	1
	are lost	n.b. second mark must be linked to electrons i.e. protons are lost gets 0 marks accept increase in oxidation number for 1 mark -1 to 0 gets 2 nd mark	1
(ii)	any one from: because both oxidation and reduction take place chlorine is reduced (and bromide ions are oxidised) chlorine gains electrons (while the bromide ions lose electrons) oxidation state chlorine decreases and bromide / bromine increases	do not accept electrons passed between the atoms unqualified do not accept chlorine is reduced and bromine is oxidised	1
(iii)	chlorine atom is <u>smaller</u> or outer energy level <u>closer</u> (to nucleus) or less / fewer shells / energy levels	outer not mentioned gets max 2 marks accept converse statements where clear	1
	outer energy level / electrons <u>more</u> strongly attracted (to nucleus) or <u>less</u> shielding		1
	(extra) electron gained <u>more</u> easily / <u>easier</u>		1
total			8

3421/H Q12

question	answers	extra information	mark
(a)	$\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$ or $\text{H}_3\text{O}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$	mark for correct equation mark for state symbols any other symbols = 0 marks accept correct spectator ions e.g. $\text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) + \text{H}^+(\text{aq})$ $+ \text{Cl}^-(\text{aq}) \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$ $+ \text{H}_2\text{O}(\text{l})$	1 1
(b)(i)	<u>nitric acid</u> and ammonia (solution) HNO_3 NH_3 / NH_4OH	mark for both accept ammonium hydroxide / NH_4OH instead of ammonia do not accept <u>ammonia</u> hydroxide do not accept hydrogen nitrate solution accept correct formulae	1
(ii)	provides oxygen or oxidising (agent) or oxidant	do not accept it contains oxygen alone or rich in oxygen	1
total			4

3421/H Q13

question	answers	extra information	mark
(a)	6 or 16	or transition metal or F block element or actinide	1
(b)	(elements in group 6 have) six (electrons) in the outer shell or needs 2 electrons to gain a full shell	accept has 98 electrons	1
total			2

3421/H Q14

question	answers	extra information	mark
(a)	<p>comment + relevant example gets 1 + 1 marks third marking point can be either a comment or an example unrelated to first comment i.e. 3 comments would be max 2 marks</p> <p>(could be many answers)</p> <p>e.g. many elements in the groups have very dissimilar properties e.g. Cu + K (= 2 marks)</p> <p>two elements in one place on the table e.g. Ce or La (= 2 marks)</p> <p>no clear division between metals and non-metals or metals and non-metals jumbled / mixed up (could give example from table)</p> <p>Newlands didn't allow spaces for new elements</p>	ignore references to music	max 3
(b)	<p>any two from:</p> <p>elements with dissimilar properties are separated or grouped elements with similar properties</p> <p>gaps left for elements to be added when discovered</p> <p>relative atomic mass order not followed in all cases (so that elements go in groups with other similar elements) or Mendeleev in proton number order</p> <p>groups related to electronic structure or group number equals number of outer electrons</p> <p>new groups created or iron, cobalt nickel in a group or eight groups instead of seven</p> <p>correct elements in periods 2 and 3</p> <p>reactivity trends in groups or reactivity trends across periods</p> <p>separates metals and non-metals</p>		2
total			5

3421/H Q15

question	answers	extra information	mark
(a)(i)	<u>high</u> temperature	accept temperature given if $\geq 400^{\circ}\text{C}$ ignore value if “high” stated, unless silly value	1
	endothermic or reaction takes in energy or ΔH is +ve	independent marks	1
(ii)	<u>low</u> pressure	or up to and including 10 atmospheres	1
	(low pressure) favours a reaction in which more molecules are formed	2 moles \rightarrow 4 moles (2 molecules \rightarrow 4 molecules) independent marks	1
(iii)	<u>nickel</u> and it is a transition / transitional element / metal (owtte) or nickel and variable oxidation state / number or it is similar to other named transition elements e.g. iron		1
(b)(i)	(bonds broken =) 2005 (kJ)		1
	(bonds formed =) 2046 (kJ)		1
	energy change = $2005 - 2046 = (-)41$	for correct subtraction ignore sign	1
(ii)	(exothermic)	if in part (b)(i) answer is <u>not</u> 41 answer is consequential on endothermic or exothermic shown accept correct reasoning for incorrect answer from (b)(i)	
	energy given out forming new bonds	do not accept energy <u>needed</u> to form new bonds	1
	greater than energy put in to break old bonds	accept exothermic and more energy given out than taken in for 1 mark accept negative value for energy change or energy in products less than energy in reactants for 1 mark	1
total			10

3421/H Q16

question	answers	extra information	mark
(a)(i)	<p>Quality of written communication <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i></p>	<p>maximum 2 marks if ideas not expressed well</p>	
	layers / lattice / giant structure / regular pattern of atoms (diagram)	<p>allow layers / lattice / giant structure / regular pattern of ions</p> <p>do not accept particles</p>	1
	outer (shell) electrons	accept valence electrons	1
	(free to) move (through whole structure)	accept delocalised / mobile / free	1
(ii)	the <u>free</u> electrons (allow the metal to conduct electricity)	accept electrons move / mobile / delocalised	1
(iii)	atoms / ions / layers can slide / slip / move over each other		1
(b)(i)	copper oxide formed or Cu reacts with oxygen or Cu is oxidised		1
	this is a poor conductor or gets in the way of free moving electrons or fewer mobile electrons	do not accept electricity	1
	or oxygen atoms / oxygen molecules / oxide ions in metal (1)	do not accept oxygen pockets / bubbles	(1)
	prevents / disrupts flow of electrons / current or fewer mobile electrons (1)	do not accept macro explanations do not accept electricity	(1)
(ii)	hydrogen reacts with oxygen or water is formed or hydrogen reduces copper oxide etc.		1
total			8

3421/H Q17

question	answers	extra information	mark
(a)	168g → 44g		1
	1g → $\frac{44}{168}$		1
	11g → <u>2.88g (2.9g)</u>	care with rounding	1
	or		
	M _r values 84 and 44		(1)
	moles hydrogen carb = $\frac{11}{84} = 0.13$		(1)
	mass of CO ₂ = $\frac{0.13}{2} \times 44 = \underline{2.9g}$	answer 2.88 to 2.9 gets 3 marks answer of 3 gets 2 marks	(1)
(b)	a number of answers are possible depending on the method used and rounding e.g. 1581.8 or 1582 from 2.9 1571 or 1570.9 from 2.88	$\frac{\text{their (a)}}{44} \times 24000$ or $\frac{11}{168} \times 24000$ for 1 mark or alternative method of calculation (error carried forward from (a))	2
(c)	to make the cake rise (owtte)	ignore speed up	1
total			6

3421/H Q18

	answers	extra information	mark
	any series of chemical tests that work should be given credit	each mark is for test + result + inference	
	Identifying all 4 substances unambiguously with no errors gains 5 marks		
	e.g.		
	<ul style="list-style-type: none"> Flame test: yellow / orange $\Rightarrow \text{Na}^+ \Rightarrow$ sodium sulphate 	ignore incorrect flame test colours for other compounds	1
	<ul style="list-style-type: none"> Add NaOH to remaining 3 samples: no (white) ppt / ammonia \Rightarrow $\text{NH}_4^+ \Rightarrow$ ammonium sulphate (white) ppt \Rightarrow magnesium ions or aluminium ions 	no need to test for ammonia	1
	<ul style="list-style-type: none"> add excess NaOH to the 2 samples which gave a (white) ppt: ppt dissolves \Rightarrow aluminium sulphate ppt insoluble \Rightarrow magnesium sulphate 		1
	or		
	<ul style="list-style-type: none"> Add NaOH: no ppt: ammonia $\Rightarrow \text{NH}_4^+ \Rightarrow$ ammonium sulphate the other one is sodium sulphate 	(damp red) litmus* goes blue $\Rightarrow \text{NH}_3 \Rightarrow$ ammonium sulphate the other one is sodium sulphate	(1)
	<ul style="list-style-type: none"> Add excess NaOH to the 2 samples which gave the white ppt ppt dissolves \Rightarrow aluminium sulphate ppt insoluble \Rightarrow magnesium sulphate 		(1)
			(1)
		*or UI/pH indicator goes blue/purple	(1)
total			5

3421/H Q19

	answers	extra information	mark
(a)(i)	e.g. moles NaOH = moles of acid $= 0.2 \times \frac{45}{1000} = 0.009$ rounding to 0.01 loses mark	or formula: $15M_1 = 0.2 \times 45$	1
	$= 0.009 \times \frac{1000}{15} = 0.6(M)$ ecf for arithmetical error	$M_1 = 0.6(M)$ correct answer 2 marks	1
(ii)	36	ecf – (a)(i) $\times 60$ correct answer 2 marks 0.6×60 gets 1 mark relative formula mass of ethanoic acid = 60 for 1 mark $0.6 \times$ incorrect molar mass gains second mark only	2
(b)(i)	A = hydrogen / H_2		1
(ii)	B = sodium hydroxide / NaOH or sodium oxide / Na_2O		1
(iii)	C = ethyl ethanoate (acetate) / $CH_3COOC_2H_5$ / $CH_3CO_2C_2H_5$		1
(iv)	D = (concentrated) sulphuric acid / H_2SO_4	do not accept dilute sulphuric acid	1
(v)	E = sodium ethanoate (acetate) / CH_3COONa / CH_3CO_2Na		1
total			9

3421/H Q20

	answers	extra information	mark
(a)	e.g. overall, oxygen is lost or titanium (in TiCl_4) gains electrons	accept titanium changes from Ti(IV) to Ti(0) or oxidation number of Ti is reduced	1
(b)	sodium or magnesium used	do not accept potassium	1
	(metal) used is more reactive than titanium	noble gas as reducing agent loses first two marks	
	<u>argon</u> used	mark independently	1
	e.g. inert or does not react with Ti or get TiO_2 if air present etc. or does not react with Na	if other noble gases or nitrogen used, can gain final mark	1
total			5

3421/H Q22

	answers	extra information	mark
(a)	$ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \begin{array}{ccc} \text{H} & & \text{H} \\ & & \\ \text{H}-\text{C} & - & \text{C} & - & \text{C}-\text{H} \\ & & & & \\ \text{H} & & & & \text{H} \\ & & & & \\ \text{H} & - & \text{C} & - & \text{H} \\ \\ \text{H} \end{array} \end{array} $	accept $ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	1
(b)	closer packing of molecules in pentane or closer packing of molecules in unbranched stronger forces of attraction or stronger intermolecular forces	accept larger (area of) contact accept stronger van der Waals' forces do not accept stronger 'bonds' alone accept converse statements no marks if covalent bonds breaking	1 1
total			3