



# **GCSE MARKING SCHEME**

**SCIENCE - CHEMISTRY**

**SUMMER 2014**

## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	<b>Page</b>
C1	1
C2	19
C3	36

## Chemistry 1 - Foundation tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)			1	copper oxide / (black) solid remains copper oxide / (black) solid stops reacting		an excess blue solution	
		(b)	(i)		1	filter / filtration / filtering			
			(ii)		1	water / H <sub>2</sub> O (ignore incorrect formula if given with correct name)			
		(c)	(i)		1	copper oxide / CuO (ignore incorrect formula if given with correct name)			
			(ii)		1	copper sulfate / CuSO <sub>4</sub> (ignore incorrect formula if given with correct name)		water	

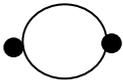
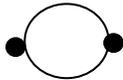
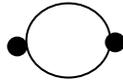
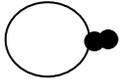
Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)		1	oxygen	O <sub>2</sub>	air O	
		(b)		2	sulfur dioxide (1)  carbon (1)	SO <sub>2</sub>  C	SO	
		(c)		3	(wood) burns forming carbon dioxide / combustion produces carbon dioxide (1)  trees take in carbon dioxide/ photosynthesis uses carbon dioxide (1)  3 <sup>rd</sup> marking point can only be awarded when first two are given  carbon dioxide kept in balance (1)	woods / forests / plants   cancels out / remains equal	'the wood'	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		(a)			2	resists corrosion (1) lasts longer than iron (1) – linked to 1 <sup>st</sup> mark or low density (1) easier to install (1) – linked to 1 <sup>st</sup> mark	less maintenance / weather resistant	iron rusts doesn't rust forms oxide layer	
		(b)	(i)		1	oxide / O <sup>2-</sup>			oxygen O <sub>2</sub> <sup>-</sup>
			(ii)		1	aluminium oxide → aluminium + oxygen	Al <sub>2</sub> O <sub>3</sub> → Al + O <sub>2</sub> (ignore any attempt to balance)	reference to 'molten' aluminium oxide and oxygen 'gas'	
			(iii)		1	liquid / 1			
			(iv)		1	lot / large amount of electricity used lot / large amount of energy used electricity is expensive		a lot of heat needed	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)	(i)		1	sodium and chloride $\text{Na}^+$ and $\text{Cl}^-$			chlorine Na / Cl
			(ii)		1	NaCl	$\text{Na}^+\text{Cl}^-$		
		(b)			1	too little present / concentration very small / concentration of iodide ions much smaller than that of chloride / it would take a lot of seawater to get a small amount of iodide from it	reference to chlorine / iodine	reference to cost or energy quoting numbers from table	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)		1	any value in the range 40-100		a range within the range given e.g. 50-90	
			(ii)		1	15	C <sub>15</sub>		
			(iii)		1	range of boiling points / range of numbers of carbon atoms / chain lengths			all fractions have different boiling points
		(b)			1	10 (ignore any number written in box)			
		(c)			1	cracking			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
6		(a)			1	2.8			2.6
		(b)			1	<p>can agree or disagree with statement – mark awarded for reason</p> <p>Yes .... as percentage fluoridation increases, the mean DMFT decreases</p> <p>or</p> <p>No ..... the mean DMFT decreased most sharply during years when the increase in percentage of children drinking fluoridated water was at its lowest</p>			
		(c)			2	<p>any 2 for (1) each up to 2 max</p> <p>(may) cause cancer / bone cancer discolours teeth / fluorosis poisonous at high concentration / (may cause) brittle bones / (may cause) IBS / (may cause) thyroid problems mass medication / takes away freedom of choice / unethical can get fluoride from toothpaste / mouthwash</p>			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
7		(a)	(i)	1	electrolysis			
			(ii)	I	all points plotted correctly $\pm \frac{1}{2}$ square (1) straight line through all points - ruler must be used (1)			
				II	straight line (ruler used) from (0,0) to (10,10) (2) or straight line from (0,0) and anywhere below hydrogen line (1)			
		(b)		2	 correct representation of a water molecule (1)  two water molecules shown (1)	H—O—H 2 		

## Chemistry 1 - Common questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
8	1	(a)		2	(silicon difficult to classify) because it has metallic and non-metallic properties (1)  response clearly indicating one or more metallic property and contrasting non-metallic property, e.g. it has a high melting point/boiling point like a metal but is brittle like a non-metal (2)	semi-metal / metalloid		it is a metal and a non-metal
		(b)		1	Mg (ignore atomic number / mass number)		magnesium	
		(c)	(i)	1	2			
			(ii)	1	Ag <sub>2</sub> O	Ag <sup>+</sup> <sub>2</sub> O <sup>2-</sup>		
		(d)	(i)	1	antibacterial / antiviral / antifungal	kills germs / kills bacteria / antiseptic	disinfectant reduces smells	
			(ii)	1	silver nanoparticles can get into drinking water / water supplies / lakes / rivers  could be dangerous to health / harmful / toxic don't know the effect / long term effect not known  <i>uncertainty must be implied</i>		reference to the air / atmosphere / rain pollutes water / the environment	

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
9	2	(a)		2	melting points decrease (down the group) / decrease but Mg doesn't fit the pattern (1)  boiling points have no trend (1)		boiling points go up and down	
		(b)		2	extremely fast / explosively / even faster than strontium ..... <i>must imply greater than 'very fast'</i> (1)  reactivity increases down Group 2 / reactivity increases down the group / reaction gets quicker down the group (1)		barium lies below strontium / reaction gets stronger down the group	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
10	3	(a)	(i)	I	1	to burn / act as fuel / heat the furnace  to form carbon monoxide	to reduce iron ore / iron oxide		
				II	1	remove impurities / sand / silica  react with impurities / sand / silica		to form slag purify the iron	
			(ii)	I	1	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$			
				II	1	iron oxide / iron(III) oxide		$\text{Fe}_2\text{O}_3$ iron ore / haematite	Fe
		(b)	(i)		2	<i>basic comment</i> it increases then decreases (1)  <i>higher level comment with use of numerical data</i> it increases to a maximum with 0.8 (% carbon) then decreases / it increases up to 800 (MPa) then decreases (2)			
			(ii)		1	cast iron		3.6	

Question Number		Mark	Answer
FT	HT		
11	4	6 QWC	<p>Indicative content Reference to useful properties of plastics compared with properties of traditional materials</p> <p>Plastic properties: low density, thermal insulator, electrical insulator, waterproof, strong, easily coloured, non-biodegradable (doesn't corrode, erode or rot), cheap, can now be made biodegradable</p> <p>Properties of plastics vs properties of traditional materials for uses, such as: window frames, electrical wire covering, saucepan handles, drain pipes, buckets, carrier bags, bottles etc.</p> <p>5-6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

## Chemistry 1 - Higher tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)			5	A carbon dioxide / $\text{CO}_2$ B magnesium chloride / $\text{MgCl}_2$ C hydrogen / $\text{H}_2$ D sodium chloride / $\text{NaCl}$ E copper(II) oxide / $\text{CuO}$ copper(II) hydroxide / $\text{Cu(OH)}_2$	copper oxide copper hydroxide		$\text{CuCO}_3$
		(b)			1	$\text{ZnCl}_2$	$\text{Zn}^{2+}\text{Cl}^-_2$ $\text{Zn}(\text{Cl})_2$		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	(a)			2	$4.0 - 1.2 = 2.8$ (1) $\frac{2.8}{4.0} \times 100 = 70\%$ (1) consequential marking correct answer only (2)	65 % for 2 <sup>nd</sup> mark		2.6
		(b)			1	toothpaste / mouthwash / fortified milk drinks / fortified yogurt			
		(c)			2	no mark for opinion  answer includes simple reference to one disadvantage or advantage (1)  statement conveys why advantage outweighs disadvantage or vice versa – must reference opposite viewpoint (1)  e.g. Yes – reduces tooth decay but many think it is unethical – 2 marks No – mass medication although it does prevent tooth decay – 2 marks			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	7	(a)		3	all points plotted correctly (2) any 3 correct (1)  line of best fit from the origin (0,0) (using a ruler) (1)			
		(b)		1	experimental results below expected ones / experimental results not on a straight line	less copper formed	reference to accuracy erratic results	
		(c)		2	any 2 sensible possible errors in procedure for (1) each e.g. <ul style="list-style-type: none"> <li>• not all magnesium reacted / insufficient stirring</li> <li>• magnesium not clean / had reacted before experiment / turned to oxide</li> <li>• not all copper retrieved / copper left behind in beaker / filter</li> <li>• not drying sufficiently</li> <li>• inaccurate weighing</li> </ul> (2) max			

(d)			<p>3 displacement / iron removes copper from solution / copper reduced and iron oxidised (1)</p> <p>products named (could be in equation) iron sulfate and copper <math>\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}</math> (1)</p> <p>explanation in terms of reactivity e.g. iron more reactive / higher in reactivity series than copper (1)</p>			
(e)			<p>2 property (1) use (1) <i>must relate to property</i></p> <p>e.g. (good) thermal conductor .....saucepans high melting point..... saucepans does not corrode.....coins/jewellery does not react with water.....(water) pipes malleable ..... pipes/jewellery ductile ..... wiring shiny/coloured/lustrous ..... jewellery sonorous ..... bells</p>			electrical conductivity

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	8	(a)			2	evidence is initially strong then not (1)  increase in solar activity accompanied by increase in temperature / upward trend in both followed by breakdown of trend (1)			
		(b)	(i)		1	increase in the burning of (fossil) fuels / increase in the use of (fossil) fuels	'fuels' = named fuels e.g. coal, petrol, etc.	deforestation	
			(ii)		1	<ul style="list-style-type: none"> <li>• carbon capture</li> <li>• burning less (fossil) fuels <i>any sensible method of using less fossil fuels e.g. walking instead of using the car, switching off lights, etc</i></li> <li>• use alternative energy sources <i>accept a named alternative energy source e.g. solar (panels), wind (turbines), etc</i></li> <li>• reduce deforestation / plant more trees</li> </ul>			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	9	(a)			1	they are used as fuels / it is the petrol fraction / they are easier to burn			C <sub>5</sub> -C <sub>8</sub> produces more energy
		(b)			2	cracking (1)  converting large molecules into smaller ones / converting large molecules into more useful ones (1)			
		(c)			1	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$			

Question Number		Mark	Answer
FT	HT		
	10	6 QWC	<p>Indicative content</p> <p>Reference to reasons relating to choice of process, rationale for conditions, reasons why products are formed at electrodes, electrode equations e.g.  aluminium high in reactivity series / aluminium is a reactive metal  aluminium oxide stable ∴ electrolysis used  molten electrolyte necessary to allow ions to move  electrolysis expensive due to high amount of electricity needed  cryolite added to reduce melting point ∴ reduce amount of energy needed  Al<sup>3+</sup> ions attracted to cathode (– electrode) and O<sup>2–</sup> ions attracted to anode (+ electrode)  electrode equations / overall equation</p> <p>5-6 marks  The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks  The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks  The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks  The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

## Chemistry 2 - Foundation tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)	(i)		1	condenser			
			(ii)		1	chromatography			
		(b)			1	C	distillation		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)		1	C			
		(b)		1	any named metal e.g. sodium, magnesium	symbol e.g. Na, Mg		
		(c)		1	A / D	graphite / metal named in part (b)	carbon	
		(d)		1	B			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		(a)	(i)		1	2, 8, 8			
			(ii)		1	D		Al	
			(iii)		2	B and D – both needed (1)  they have the same number of electrons in their outer shell / they both have three electrons in their outer shell (1)  2 <sup>nd</sup> mark may be awarded if A and C given	boron and aluminium		A and C
		(b)	(i)		1	40			
			(ii)		2	16 ÷ 40 (1)  40 (1)  error carried forward from (i) correct answer only (2)			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT		(i)						
4		(a)	(i)		1	B			
			(ii)		1	water		H <sub>2</sub> O hydrogen oxide	hydroxide
		(b)	(i)		1	8			
			(ii)		1	4			
			(iii)		1	C <sub>2</sub> H <sub>6</sub>	CH <sub>3</sub> CH <sub>3</sub>		$  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)	1	gas escaped during time taken to place the bung in the flask	gas syringe 'sticks'	human error	
			(ii)	3	all points plotted correctly [ $\pm\frac{1}{2}$ square] (2) seven points plotted correctly (1)  smooth curve drawn, not passing through (10,8) (1)	curve through (10,8) if (0,0) not plotted		
			(iii)	1	value read correctly from graph [ $\pm\frac{1}{2}$ cm <sup>3</sup> ]  ecf possible from any curve – except to give 8			8
			(iv)	1	line continues horizontally / volume stops increasing		straight line	
			(v)	2	less time (1)  more time (1)			
		(b)		2	4 days - correct answer only (2)  if answer incorrect (1) for any indication of correct working e.g. from 30-20°C doubles time from 1 day to 2 days			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
6		(a)		1	shape memory polymer → regains original shape when heated  thermoplastic → softens when heated  thermoset → does not change when heated			
		(b)	(i)	1	ethene		C <sub>2</sub> H <sub>4</sub> alkene	
			(ii)	2	D (1)  fluorine atoms present / hydrocarbons include carbon and hydrogen atoms only / doesn't contain hydrogen atoms (1)			
			(iii)	2	B (1)  it has a double bond (1)	ethene  it is unsaturated		
		(c)		1	$  \begin{array}{c}  \text{H} \quad \text{H} \quad \text{H} \\    \quad   \quad / \\  \text{H}-\text{C}-\text{C}=\text{C} \\    \quad \quad \backslash \\  \text{H} \quad \quad \text{H}  \end{array}  $			

## Chemistry 2 - Common questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)			3	sedimentation – removes large particles/objects (1) filtration – removes smaller particles (1) chlorination – kills bacteria (1)			
		(b)			2	removal of salt from seawater (1) distillation (1)	osmosis		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)						
8	2				3	burns - lilac flame (1R) Reserved mark  <ul style="list-style-type: none"> <li>• floats</li> <li>• moves</li> <li>• melts / spherical shape</li> <li>• effervesces / fizzes / bubbles</li> <li>• spits / sparks / pops</li> </ul> any two for (1) each up to 2 max		dissolves disappears produces hydrogen	red / yellow / blue / green flame
			(ii)		1	the piece of potassium could have been too big / could have been too little water / water could have been hot / potassium could have stuck to the side of trough			
		(b)			2	2KOH + H <sub>2</sub> (2)  (1) for KOH if any errors			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
9	3	(a)		3	David – mean of all four values ( $54 \div 4 = 13.5$ ) (1)  Haf – mean of three values, with indication which three were selected (1)  Haf's value is better as she used repeatable values only / discarded the value that appears to be suspect (1)			
		(b)		1	A		8	
		(c)		2	B (1)  some hardness has been removed by boiling but some remains (1)			
		(d)		1	calcium (ion) / magnesium (ion)	$\text{Ca}^{2+} / \text{Mg}^{2+}$		

Question Number		Mark	Answer
FT	HT		
10	4	6 QWC	<p>Indicative content</p> <ul style="list-style-type: none"> <li>• element has a mass number of 35 and atomic number of 17</li> <li>• 17 protons given by atomic number; must have same number of electrons because atoms are neutral</li> <li>• 17 electrons arranged in shells; electronic structure 2, 8, 7</li> <li>• element is in Period 3; number of occupied electron shells</li> <li>• element is in Group 7; number of electrons in the outer shell</li> <li>• element E is chlorine</li> <li>• number of neutrons is 18; difference between mass number and atomic number</li> </ul> <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

## Chemistry 2 - Higher tier only questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)		2	coal dust has a much greater surface area than lumps of coal (1)  greater chance of collision / more collisions per unit time (1)		faster reaction	
		(b)		2	1 day - correct answer only (2)  if answer incorrect (1) for any indication of correct working e.g. from 5-15°C halves time from 8 days to 4 days			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	(a)			2	<p>first mark for sensible suggestion with second mark for linked point/explanation</p> <p>e.g. use more calcium oxide (1) more heat would be released on reaction (1) or use smaller pieces of calcium oxide (1) so that reaction occurs more quickly (1)</p>	<p>less water / better insulation on outer wall of can / thinner metal in inner wall</p>	less food	
		(b)			2	<p>bond making releases energy and bond breaking absorbs energy (1) reactions are exothermic if more energy is released than is absorbed (1)</p> <p>both marks could be gained by one statement e.g. reactions are exothermic if more energy is released in making bonds than is absorbed in breaking bonds (2)</p>			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	7	(a)	(i)		3	diagrammatic representation showing clearly two Na atoms losing 1 outer electron each (1)  one O atom gaining 2 electrons (1)  $\text{Na}^+$ and $\text{O}^{2-}$ (both needed) (1)  there must be no ambiguity e.g. electrons cannot be on atoms and ions at the same time			
			(ii)		1	sodium ion 2, 8  oxide ion 2, 8                      both needed			
		(b)			3	simple molecular (1)  weak bonds between molecules (1)  only a small amount of energy needed to break them (1)	simple covalent	covalent	

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	8	(a)		3	$\text{Fe} + \text{Br}_2$ (1) $\text{FeBr}_3$ (1) 2 3 2 (1) balancing mark only awarded if all formulae are correct			
		(b)		2	silver nitrate (solution) (1) cream / off-white precipitate (1)			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	9	(a)		1	either of following $\begin{array}{ccccccc} & \text{H} & & & & \text{H} & \\ &   & & & &   & \\ \text{H} & - \text{C} & - & \text{C} = & \text{C} & - & \text{C} - \text{H} \\ &   & & &   & &   \\ & \text{H} & & & \text{H} & & \text{H} \end{array}$ $\begin{array}{ccccccc} & \text{H} & & \text{H} & & & \text{H} \\ &   & &   & & & / \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} = & \text{C} \\ &   & &   & & & \backslash \\ & \text{H} & & \text{H} & & & \text{H} \end{array}$	correct structure for 2-methylpropene		
		(b)		4	double bonds open (1R) Reserved mark <ul style="list-style-type: none"> <li>propene molecules join together / form chains (1)</li> <li>(addition) polymerisation (1)</li> <li>repeat unit  <math display="block">\text{---} \left[ \text{C}_3\text{H}_6 \right]_n \text{---} \quad (1)</math> </li> <li>any 2 of high temp / high pressure / catalyst (1)</li> </ul> any 3 up to 3 max			condensation polymerisation

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	10	(a)		3	$M_r(\text{Cu}_2\text{S}) = 64 + 64 + 32 = 160$ (1)  1 mol of $\text{Cu}_2\text{S}$ produces 2 mol of Cu or 160 tonnes of $\text{Cu}_2\text{S}$ produces 128 tonnes of Cu (1)  20.5 tonnes of $\text{Cu}_2\text{S}$ produces $\frac{128}{160} \times 20.5$  $= 16.4$ tonnes of Cu (1)  error carried forward possible correct answer only (3)			
		(b)		2	4.1 tonnes of 'missing product' (1)  $\frac{4.1}{16.4} \times 100 = 25\%$ (1)  error carried forward from (a) correct answer only (2)			

Question Number		Mark	Answer
FT	HT		
	11	6 QWC	<p>Indicative content</p> <ul style="list-style-type: none"> <li>• correct order of reactivity, i.e. chlorine &gt; bromine &gt; iodine</li> <li>• observations relating to the reactions of halogens with iron, e.g. iron glows more brightly in chlorine than bromine</li> <li>• displacement reactions, e.g. chlorine reacts with potassium bromide to give bromine</li> <li>• appropriate word/symbol equations</li> </ul> <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

### Chemistry 3 - Foundation tier only questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)		1	(three) factors needed for a fire to burn / fire goes out if any one factor is removed	heat, oxygen and fuel are needed		
		(b)		3	removes air / oxygen (1) removes heat (1) removes fuel (1)			
		(c)		1	water			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		(a)			1	glucose highest rate of fermentation / reacts faster (both needed)	better <b>rate</b> than the others	biggest bar	
		(b)	(i)		3	opinion needed, unless implied in answer  Yes (1) per reason why ethanol should be used up to 3 max renewable / produces less soot / only produces carbon dioxide and water when burnt  No (1) per reason why ethanol should not be used up to 3 max large areas of land required / engines require modification / less heat per litre  credit possible for use of advantages and disadvantages for argument clearly showing that advantages outweigh disadvantages or vice versa – up to 3 max	no mark for opinion  sensible reason not in table  sensible reason not in table  further qualification of a point credited additional mark e.g. large areas of land required to grow crops (1) therefore less available to grow food crops (1)		
			(ii)		1	carbon dioxide + water <b>both</b> needed	correct formulae for <b>both</b>		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		(a)			3	carbon dioxide → turns limewater milky (1) ammonia → turns damp red litmus blue (1) oxygen → relights a glowing splint (1)			
		(b)			3	yellow flame (1) green flame (1) brown precipitate (1)			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)						
4					2	<b>A</b> and <b>C</b> - <b>both</b> needed (1) <b>B</b> and <b>D</b> - <b>both</b> needed (1)	correct formulae/names for <b>both</b> correct formulae/names for <b>both</b>		
			(ii)		1	<b>E</b>	propene		
		(b)			1	$C_{10}H_{22}$	$H_{22}C_{10}$		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		(a)	(i)		2	sulfur dioxide (1) sulfur trioxide (1)	SO <sub>2</sub> SO <sub>3</sub>		
			(ii)		1	2			
			(iii)		1	far too / very exothermic or acid forms mist / white fumes form or acid is difficult to collect		dangerous / explosive / reactive	
		(b)	(i)		2	5 + 5 + 30 + 30 + 15 (1) 15 (1) follow through error (ft) correct answer only (cao) (2)			
			(ii)		1	ammonia	NH <sub>3</sub>		
			(iii)		3	overgrowth of algae (1) good description of eutrophication – up to (3) gets into water supplies (1) must be some linking of points in explanation for full marks to be awarded	gets into water supplies and can lead to blue baby syndrome (2)	kills fish pollution	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT		(i)						
6		(a)	(i)		1	$25\text{cm}^3 \pm 1\text{cm}^3$			
			(ii)		1	1.5 °C			
		(b)			1	acid <b>A</b> (no mark)  temperature rise is greater / produces more heat – mark can <b>only</b> be awarded if <b>A</b> given			
		(c)			3	add acid slowly from burette (1)  add indicator to sodium hydroxide solution / solution in cup (1)  indicator changes colour (1)	indication of precision  record volume required to change colour of indicator (2)		add indicator to acid/burette

### Chemistry 3 - Common questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)		1	hydrogen	H <sub>2</sub>	H	
		(b)		2	iron (1)  speeds up the reaction / increases the rate of the reaction (1)			
		(c)		2	recycled / returned into reactor (1)  basic qualification required e.g. reduces cost of process / less waste of raw materials (1)	fed back in re-used	more efficient / reacted again / more yield / saves time	
		(d)		2	lower yield with higher temperature (1)  higher yield with a higher pressure (1)	vice versa		
		(e)		3	N <sub>2</sub> + H <sub>2</sub> (1)  NH <sub>3</sub> (1)  (1), 3, 2 (1)  formulae must be correct to award balancing mark			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
8	2	(a)			1	significantly different/ long way out when compared to other two readings		not the same / 6 or 8 out etc.	
		(b)			2	all points plotted correctly (2) 4 points correct (1)  curve not needed so ignore if drawn			
		(c)			2	volume / rate increases with temperature up to an optimum (1)  then volume / rate goes back down (1)	up to maximum / up to 40 °C		
		(d)			2	glucose (1)  ethanol + carbon dioxide (1)	$C_6H_{12}O_6$  $C_2H_5OH + CO_2$		+ yeast
		(e)			1	enzyme	zymase	biological	

Question Number		Mark	Answer
FT	HT		
9	3	6 QWC	<p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• heat required to turn limestone into quicklime; water added to turn quicklime into slaked lime</li> <li>• limestone glows and becomes crumbly when heated; sizzling/ steam being released when water is added</li> <li>• thermal decomposition causes calcium carbonate to decompose forming carbon dioxide gas and calcium oxide; water reacts with calcium oxide to form calcium hydroxide</li> <li>• <math>\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2</math> ; <math>\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2</math></li> </ul> <p><b>5-6 marks:</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3-4 marks:</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1-2 marks:</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks:</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

### Chemistry 3 - Higher tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)		1	air			
	4		(ii)		2	dissolve sulfur trioxide in concentrated sulfuric acid (1)  dilute with water to produce concentrated sulfuric acid (1)		add to oleum	
			(iii)		1	vanadium pentoxide	V <sub>2</sub> O <sub>5</sub>		
		(b)			2	acid dehydrates the sugar removing the <b>elements of water / hydrogen and oxygen</b> (1)  carbon remains (1)	C		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	5	(a)		2	alcohols (1)  alkenes (1)			
		(b)		2	add bromine water (1)  stays brown/orange/no reaction with <b>C</b> and <b>E</b> turns from brown/orange to colourless (1)	add bromine		red
		(c)	(i)	1	same molecular formula but different structure	same type and number of atoms but arranged differently	same atoms	same compound
			(ii)	1	$  \begin{array}{ccccc}  & \text{H} & & \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}  $			
		(d)		2	<b>D</b> (1)  $  \begin{array}{ccccc}  & \text{H} & & \text{OH} & & \text{H} \\  &   & &   & &   \\  \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\  &   & &   & &   \\  & \text{H} & & \text{H} & & \text{H} \\  & & & & & \\  & & & & & (1)  \end{array}  $	ether isomer of <b>B</b> or <b>D</b>		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	6	(a)	(i)	1	sodium chloride / sodium carbonate			
			(ii)	1	sodium carbonate / lithium carbonate			
		(b)		3	add silver nitrate solution (1)  white <b>precipitate</b> with potassium chloride (1)  yellow <b>precipitate</b> with potassium iodide (1)  allow (1) for <b>both</b> colours correct if precipitate not used in either case	answer based on displacement reaction – bromine water; description of colour changes	add HNO <sub>3</sub> flame test	
		(c)		2	ammonia (1)  turns (damp) red litmus blue (1)			
		(d)		3	Fe <sup>3+</sup> + 3OH <sup>-</sup> (1) Fe(OH) <sub>3</sub> (1) correct state symbols (1)			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	7	(a)			2	number of moles = 0.05 (1) concentration = 0.2 (1)  follow through error (ft) cao (2)			
		(b)			4	calculation of mean 22.5 cm <sup>3</sup> (1)  0.2 × 0.0225 (1)  0.0045 / 0.025 (1)  0.18 (1)  follow through error (ft) cao (4)	mean of 22.65 cm <sup>3</sup>		0.2 without workings

Question Number		Mark	Answer
FT	HT		
	8	6 QWC	<p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• observations made when both acids react with metals, carbonates and bases e.g. temperature rise, liberation of gas, time to dissolve</li> <li>• difference in rate of reaction and explanation in terms of strong/weak acid</li> <li>• salts formed</li> <li>• word / chemical equations</li> </ul> <p><b>5-6 marks:</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3-4 marks:</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1-2 marks:</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks:</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p>



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