



# **GCSE MARKING SCHEME**

**SCIENCE - CHEMISTRY**

**SUMMER 2013**

## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 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.

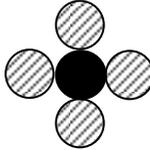
It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

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

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### Chemistry 1 - Foundation Tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			1	helium	He		
		(b)			2	chlorine (1) iodine (1)	Cl <sub>2</sub> / Cl I <sub>2</sub> / I		
		(c)			2	chlorine (1) iodine (1)	Cl <sub>2</sub> / Cl I <sub>2</sub> / I		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		(a)			3	calcium and chlorine (1) copper(II) oxide / copper oxide (1) MgBr <sub>2</sub> (1)		Ca and Cl / Cl <sub>2</sub>	
		(b)	(i)		1	carbon ● oxygen ○      both needed			
			(ii)	I	1				
				II	1		follow through (ft) from (b)(i)		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
3		(a)		2	$7 + 27 + 20 + 11$ (1) $100 - 65 = 35\%$ (1)  correct answer only (cao) (2)			
		(b)		2	increased temperature of Earth's atmosphere / global warming (1)  ice caps melting <b>faster</b> / climate change / <b>more</b> flooding / <b>more</b> extreme weather / changing weather patterns (1)			
		(c)		1	any <b>one</b> from: use renewable energy sources e.g. solar panels / wind turbines / hydroelectric / tidal / biomass nuclear power carbon capture and storage	use less electricity e.g. by using power saving light bulbs – <b>must give example</b>		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
4		(a)		1	magnesium zinc copper (must be correct order)	Mg Zn Cu		
		(b)		2	copper (metal) (1)  magnesium sulfate (solution) (1)	Cu  MgSO <sub>4</sub>		
		(c)		1	ZnSO <sub>4</sub>			
		(d)	(i)	1	2 PbO            2 Pb  <b>both</b> needed			
			(ii)	2	carbon (1)  as it gains oxygen (1)	C  loses electrons	reacts with oxygen	
			(iii)	1	any <b>one</b> from: aluminium is more reactive (than carbon) aluminium is too reactive carbon is less reactive (than aluminium) carbon is not reactive enough	Al is above C in reactivity series	Al is very reactive	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		(a)			1	the greater the percentage drinking fluoridated water the lower the DMFT – must clearly link graphs			
		(b)			2	sodium fluoride is used as a rat poison / toxic  bone cancer (in high concentrations)  brittle bones  discolours teeth / fluorosis  can be taken in other ways e.g toothpaste, mouthwash  mass medication / takes away individual's choice  credit (1) for mention of any of above up to (2) max or (2) for one point and some detail	unethical		



## Chemistry 1 - Common questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)		1	<b>B and F</b> (both needed)			
		(b)		1	<b>D</b>			
		(c)	(i)	2	it is a semi metal / metalloid / shows properties of both metal and non-metal (1)  must give example of one property of a metal and one of non-metal e.g. conducts electricity but low density etc. (1)	idea of conflicting properties	<b>A</b>	
			(ii)	1	<b>D and E</b> (both needed)			
		(d)	(i)	2	310 – 250 (1) 540 / 60 = 9 g/cm <sup>3</sup> (1)  cao (2)			
			(ii)	2	measurements are inaccurate / not precise / incorrect  credit (1) for basic idea and additional (1) for sensible reason e.g. measuring cylinder not precise enough, only measures to nearest 10cm <sup>3</sup> (2)  accept any other sensible answers e.g. sample is impure / oxidised or volume (liquid or solid) changes with temperature		human error	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)	(i)		1	battery acid			
			(ii)		1	blood			
			(iii)		1	<b>pure</b> water			
		(b)			3	<b>A</b> copper carbonate (1) <b>B</b> copper oxide (1) <b>C</b> sodium hydroxide (1)	CuCO <sub>3</sub> CuO NaOH		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
9	3				3	nanosilver has antibacterial / antiviral / antifungal properties / kills germs (1)  could be absorbed through skin / breathed in (1)  long term effects <b>unknown</b> (1)	toxic  could be released into environment		<b>can</b> cause ...

Question Number		
FT	HT	
10	4	<p><b>Indicative content:</b></p> <p><b>copper</b> – good conductor of electricity = electrical wiring; good conductor of heat = saucepan bases; malleable = water pipes; ductile = electrical wiring; attractive colour and lustre = jewellery</p> <p><b>titanium</b> – hard and strong = hip replacements and rotor blades; low density = rotor blades; resistant to corrosion = rotor blades / hip replacements / pipes in chemical industry; high melting point = rotor blades.</p> <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 1 - Higher Tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			3	calcium, oxygen and hydrogen (1)  Na <sub>2</sub> CO <sub>3</sub> (1)  Ca(NO <sub>3</sub> ) <sub>2</sub> (1)			
		(b)			1	H <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	symbols in any order		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	(a)			1	melting point increases (down group)			
		(b)			1	value between $-248$ and $-187$			
		(c)			1	<b>all</b> boiling points are below $20^{\circ}\text{C}$ / below room temperature	<b>all</b> boiling points are negative values / below $0^{\circ}\text{C}$	low boiling points	
		(d)			1	unreactive / inert / not flammable		any property from table non-toxic	
		(e)			1	2 3 2	other correct multiples		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	7	(a)			3	<p>coal contains sulfur impurities (1)</p> <p>(impurities burn to produce sulfur dioxide) which dissolves in rainwater to produce <b>acid rain</b> (1)</p> <p>acid rain kills fish / trees / erodes limestone statues or buildings / causes metals to rust quicker (1)</p>		kills <b>marine</b> life	ozone layer global warming
		(b)	(i)		2	<p>as the amount of coal burnt increases the emission of sulfur dioxide decreases / more coal used as time goes on but less sulfur dioxide released (1)</p> <p>would expect more sulfur dioxide to be released as more coal is burnt (1)</p>			
			(ii)		1	<p>(introduction of techniques to remove sulfur dioxide from smoke) e.g. sulfur scrubbing coal burnt has lower sulfur content</p>	sulfur dioxide neutralised / reacted with limestone	new technology	carbon capture and storage

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)		1	a compound containing hydrogen and carbon <b>only</b>			mixture
		(b)		1	each fraction collected across a range of temperatures / several compounds have similar boiling points		melting points	
		(c)	(i)	1	(catalytic) cracking			
			(ii)	1	polymerisation			
		(d)		2	double bond breaks / turns in to single bond (1)  molecules join together to form (long) chains (1)			
		(e)		1	non-biodegradable / increased use of landfill / depletion of raw materials produce toxic / harmful gases when burned	can harm wildlife	'harmful' – unless linked to burning	

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	9	(a)		1	0.65			
		(b)		1	the greater the current, the more hydrogen produced			
		(c)		2	difference to mean = 0.1 (1) $(0.1 \div 1.3) \times 100 = 7.7\%$ (1)  cao (2)			
		(d)		2	2, 2 (1) 2, 4 (1)			
		(e)		2	<b>must clearly imply an opinion</b> if yes – award (1) each for up to two advantages if no – award (1) each for up to two disadvantages  advantages = doesn't produce carbon dioxide / doesn't contribute to global warming / water is only product / readily available / renewable  disadvantages = explosive / storage issues / availability / extraction costs (need for electricity)	don't know – (1) each for one advantage and one disadvantage  (2) if opinion given and clearly states that one advantage outweighs one disadvantage (or vice versa)		

Question Number		Answer
FT	HT	
	10	<p><b>Indicative content:</b> definition of electrolysis i.e. use of electricity to split compounds; anode is positive electrode; cathode is negative electrode; electrolyte is substance being broken down; electrolyte conducts electricity; needs to be molten for ions to move freely; positive aluminium ions attracted to cathode where they gain electrons to form aluminium atoms; negative oxide ions attracted to anode where they lose electrons to form oxygen gas; electrode equations</p> <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 2 - Foundation Tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)						
1			(i)	1	proton		p		
			(ii)	1	lithium	Li			
		(b)		2	nitrogen and hydrogen – both needed (1)		N and H		
					covalent (1)		simple	giant	

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
2		(a)		2	graphite ——— giant covalent potassium ——— metallic sodium chloride ——— giant ionic  three correct answers (2) one correct answer (1)			
		(b)		1	graphite		giant covalent	
		(c)		1	carbon dioxide, water, etc	CO <sub>2</sub> , H <sub>2</sub> O, etc		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
3		(a)		2	negative / -1 (1)			
				1	(1)			
		(b)		1	19			
					9 – both needed			
		(c)		2	17 (1)			
					20 (1)			
		(d)		1	2,8,1			
		(e)		1	2,8,8,2			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)		1	thermochromic pigment			
		(b)		3	heat both / place in hot water (1)		change temperature	
					thermoplastic softens or melts (1)	stays the same		
					the shape memory polymer returns to its original shape / form (1)			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		(a)			1	C	98 and 890		
		(b)			1	to prevent sodium reacting with air/oxygen/water (vapour)	prevent from oxidising / corroding	because it reacts with air/oxygen/water (vapour)	
		(c)	(i)		1	yellow yellow/orange	orange		
			(ii)		2	sodium + oxygen (1) sodium oxide (1)	Na + O <sub>2</sub> (1) Na <sub>2</sub> O (1) – ignore balancing		
			(iii)		1	2Na + Cl <sub>2</sub> → 2NaCl			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
6		(a)		1	$C_4H_{10}$			
		(b)		2	propane (1)  $  \begin{array}{ccccccc}  & H & & H & & H & \\  &   & &   & &   & \\  H & - C & - & C & - & C & - H \\  &   & &   & &   & \\  & H & & H & & H &   \end{array}  $ (1)			
		(c)		1	$C_3H_6$			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
7		(a)	(i)		2	collection of gas (e.g. in a gas syringe or gas jar) (1)  experiment repeated with different particle size of zinc (1)	mass method disappearing zinc		
			(ii)		2	same mass (or amount) of zinc / same volume (or amount) of acid / same concentration of acid / same temperature or room temperature – any two for (1) each		repeat readings same apparatus	
			(iii)		1	the fastest is the experiment that gives the volume of gas in the least time	fastest reaction is the one giving off most bubbles in a given time		
		(b)	(i)		1	less time / time decrease		faster reaction	
			(ii)		1	volume of gas remains the same			

## Chemistry 2 - Common questions

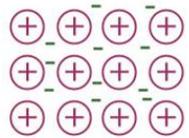
Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
8	1	(a)		1	solubility of sodium carbonate increases (until 40-43°C) and then decreases			
		(b)		3	plotting 7 correct points (2) plotting 6 correct points (1) suitable line – must be curve (1)			
		(c)		1	sodium carbonate sodium bromate sodium chloride – correct order			
		(d)		3	recognise that sodium chloride is soluble and silver chloride is not (1)  add (enough/excess) water (to remove/dissolve all the sodium chloride) (1)  filter (1)			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)						
9	2				2	436 + 242 (1) = 678 (1) – correct answer only (cao) (2)			
			(ii)		2	2 × 431 (1) = 862 (1) – cao (2)			
		(b)			1	exothermic since energy given out (as bonds made) > energy needed (to break the bonds)  energy given by reaction is negative / –184  credit ‘endothermic’ with correct reason if calculation error followed through (ft)			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)		1	A – requires the most soap – both needed			
			(ii)		2	<p>D (1)</p> <p>some hardness removed by boiling but not all / temporary hardness removed by boiling but permanent hardness remained (1)</p> <p>Alternative answer accepted for all candidates due to very common mis-interpretation of question on Welsh-medium papers</p> <p>A contains permanent hardness and C contains temporary hardness (1)</p> <p>A loses none of its hardness through boiling and C loses all of its hardness (through boiling) (1)</p>			
		(b)			2	<p>same trend / A still the hardest / B still the softest / D still contains both permanent and temporary hard water (1)</p> <p>different amount of water used / different concentration of soap solution / shaken for a different amount of time / different amount of lather formed (1)</p>			

Question Number		Mark	Guidance
FT	HT		
11	4	6	<p>Indicative content: This method of separation is called fractional distillation. Crude oil is a mixture of hydrocarbons. The crude oil is heated and vaporised before entering the column. Smaller/lower boiling hydrocarbons will rise in the column and condense higher up the column. Hydrocarbons with similar boiling points condense at the same level in the column. (Boiling point depends on the size of the molecule – larger molecules have higher boiling points.)</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 - Higher Tier only questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	5	(a)		1	2,8,1			
		(b)		2	 <p>positive ions fixed positions electrons mobile / sea</p> <p>– all four points (2) – two/three points (1)</p>			
		(c)	(i)	1	floats moves fizzes / bubbles goes into a round shape / melts – any two		vigorous reaction dissolves	
			(ii)	1	sodium hydroxide and hydrogen – both needed	NaOH + H <sub>2</sub>	H	
		(d)		1	potassium burns / lilac flame		potassium moves faster	yellow / orange / red / green flame
		(e)		2	atoms get bigger / greater distance between the (positive) nucleus and the (outer) electron (1)  outer electron more weakly held (1)			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept	
FT	HT	(a)	(i)	1	polytetrafluoroethene / PTFE		Teflon		
	6		(ii)	I	1	$\left( \begin{array}{cc} \text{CH}_3 & \text{H} \\   &   \\ -\text{C} & - & \text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right)_n$			
				II	1	addition			additional
		(b)		2	<p>both have long or large molecules / long chains of carbon atoms / polymer chains (1)</p> <p>(only) thermosets have crosslinking / strong bonds between chains (1)</p>				reference to layers

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	7	(a)			1	lithium / Li <sup>+</sup>	Li Ca Sr		
		(b)	(i)		1	cream precipitate	off white ppt		pale yellow ppt
			(ii)		2	Ag <sup>+</sup> + Br <sup>-</sup> (1) AgBr (1)			
		(c)	(i)		1	chlorine / fluorine	Cl <sub>2</sub> / F <sub>2</sub>	Cl / F	
			(ii)		1	displacement	redox		

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	8	(a)			1	any one from: some copper had not reacted reaction had not been completed heated to constant mass			
		(b)			3	mass of copper = $37.7 - 25.0 = 12.7$ mass of oxygen = $40.9 - 37.7 = 3.2$ (1)  $n(\text{Cu}) = 12.7/63.5$ $n(\text{O}) = 3.2/16$ (1)  ratio $0.2/0.2 : 0.2/0.2$ ie 1:1 formula CuO (1)			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	9	(a)		3	<p><i>two discrete diagrams needed:</i></p> <ul style="list-style-type: none"> <li>- <i>diagram 1 showing transfer of electrons</i></li> <li>- <i>diagram 2 showing ions</i></li> </ul> <p>diagram 1 two lithium atoms losing 1 electron each (1) one sulfur atom gaining 2 electrons (1)</p> <p>diagram 2 <math>2 \times \text{Li}^+</math> and <math>\text{S}^{2-}</math> formed (1)</p>			
		(b)		2	<p>magnesium and/or oxide ions have a greater charge than sodium and/or chloride ions (1)</p> <p>this gives a greater attraction between the ions / stronger ionic bonds / more energy is needed to break bonds (1)</p>			
		(c)		2	<p>shared electron pair between H atoms and adjacent O atoms and between the two O atoms (1)</p> <p>8 electrons in outer shell of both O atoms (1)</p>			

Question Number		Mark	Guidance
FT	HT		
	10	6	<p>Indicative content: For a chemical reaction to take place the reactant particles must collide. Increasing the concentration increases the number of particles in the same volume which gives a greater chance of the particles colliding, giving an increase in the rate of the reaction. As the temperature increases the reactant particles are moving faster, increasing the chance of a collision. At higher temperature the particles also have higher energy which increases the possibility of having sufficient energy during collision to overcome the activation energy and become a 'successful collision'. Therefore increasing the temperature also increases the speed of a reaction.</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 3 - Foundation Tier only questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
1	HT	(a)		3	methane (1)			
					C <sub>3</sub> H <sub>8</sub> (1)			
					$  \begin{array}{cccc}  \text{H} & \text{H} & \text{H} & \text{H} \\    &   &   &   \\  \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\    &   &   &   \\  \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $ (1)			
		(b)	(i)	1	A			
			(ii)	1	E			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)						
2			(i)		1	air and natural gas – both needed	methane		nitrogen and hydrogen
			(ii)		1	3 : 2			
			(iii)		1	catalyst / speeds up reaction / increases rate			
			(iv)		1	remove / separate / get ammonia (from the unreacted gases)		condenses ammonia / turns ammonia to liquid	
			(v)		1	re-use (unreacted nitrogen and hydrogen) not to waste (unreacted nitrogen and hydrogen) not having to make more nitrogen and hydrogen	conserves natural gas less energy needed		
		(b)			1	ammonium nitrate			
		(c)	(i)		1	increases crop yield			
			(ii)		1	increases soil acidity			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		(a)		2	$32 + 35 + 12 + 12 + 6 = 97$ (1) $100 - 97 = 3$ (1) – correct answer only (cao) (2) – follow through error (ft)				
		(b)		2	dust noise / blasting (heavy) lorries / traffic destroys landscape / ruins landscape / unsightly destroys habitats / ruins habitats / destroys wildlife – any two for (1) each		pollution		
		(c)	(i)	1	calcium oxide + water → calcium hydroxide			reference to quicklime and/or slaked lime	
			(ii)	2	steam / water boils quicklime crumbles / expands / ‘puffs up’ / breaks up hisses – any two for (1) each	fizzes	explodes heat released		

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)		1	fermentation / fermenting			
		(b)		1	any one from: (yeast/it) doesn't change acts as a catalyst is not used up not a reactant		increases rate 'catalyst'	
		(c)		1	30			
		(d)	(i)	1	distillation			fractional distillation
			(ii)	2	ethanol's boiling point is lower (than that of water / glucose solution) ethanol boils at 80°C and water / glucose solution boils at any value between 100-110°C (1)  ethanol distils over first / boils leaving the glucose solution behind / ethanol is collected first (1)		ethanol and glucose solution have <i>different</i> boiling points	
		(e)		1	any one from: drink driving / road accidents domestic violence aggressive behaviour argumentative behaviour		time wasted by emergency services / cost of emergency services being drunk	alcohol poisoning / death by choking on vomit / depression / liver disease

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
5		(a)		1	burette			
		(b)		1	indicator(s)			pH indicator universal indicator
		(c)		2	<p>adding smaller volume of acid (at a time) / adding 0.1 cm<sup>3</sup> acid (at a time) / <i>accept any volume below 0.5 cm<sup>3</sup></i> (1)</p> <p>to obtain the exact end point value / to get the exact volume indicator turns red / changes colour to get the exact volume when complete neutralisation occurs (1)</p> <p><i>answer must imply a 'better'/more accurate volume reading obtained</i></p>	adding drops (at a time)	repeat readings	
		(d)		1	<p>B</p> <p>need the <i>most</i> acid</p> <p>– both needed</p>		needs lot of acid / more acid	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
6		(a)			3	brick-red (for $\text{Cu}^{2+}$ flame test) (1) yellow precipitate (for $\text{Cl}^-$ ion test) (1) white (precipitate for $\text{Fe}^{3+}$ test) (1)			
		(b)			1	sodium chloride, water and ammonia – all needed			

### Chemistry 3 - Common questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	(i)	I	1	sulfur / S			
				II	1	vanadium(V) oxide / vanadium oxide / vanadium pentoxide / V <sub>2</sub> O <sub>5</sub>		VO	
				III	1	sulfuric acid / H <sub>2</sub> SO <sub>4</sub>	oleum	dilute / conc	
		(ii)			3	reactants: SO <sub>2</sub> + O <sub>2</sub> (1) product: SO <sub>3</sub> (1) balancing: 2(SO <sub>2</sub> ) 2(SO <sub>3</sub> ) (1) – reactants and product must be correct before balancing mark awarded			
		(b)			2	(blue hydrated copper(II) sulfate) turns white (1) (crystalline hydrated copper (II) sulfate) turns powdery / turns crumbly / loses its crystalline appearance (1)		changes colour	

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
8	2	(a)			3	all points plotted correctly ( $\pm\frac{1}{2}$ square) (2) any five points plotted correctly (1)  smooth continuous curve through all points – judgement by eye (1)			
		(b)			1	any one from: same surface area (of substances) same concentration (of peroxide solution) same temperature / all at room temperature			
		(c)			1	any one from: liver contains the most catalase / enzyme carrot contains the least catalase / enzyme any correct comparison in terms of catalase e.g. liver contains more catalase than apple / apple contains more catalase than potato / potato contains more catalase than carrot catalase present in all substances			
		(d)			1	re-lights a glowing splint – both needed			lighted splint burns brighter

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)	(i)		1	sodium carbonate / $\text{Na}_2\text{CO}_3$	sodium hydrogencarbonate / $\text{NaHCO}_3$		
			(ii)		1	magnesium ethanoate / $(\text{CH}_3\text{COO})_2\text{Mg}$			
		(b)			1	(ethanoic acid/it) is a weaker acid / has a higher pH (than that of sulfuric acid) ethanoic acid pH is 3/4 and sulfuric acid pH is 1/2 ethanoic acid has a lower $\text{H}^+$ ion concentration than sulfuric acid	less acidic	ethanoic acid pH is 3/4	
		(c)			1	ethanol / $\text{C}_2\text{H}_5\text{OH}$			

Question Number		Mark	Guidance
FT	HT		
10	4	6	<p>Indicative content: Reference to <i>principle</i> of fire triangle – fuel, heat and air (oxygen) are needed, removing any one factor will put fire out</p> <p>Types of fire fighting methods related to examples</p> <ul style="list-style-type: none"> <li>• heat removed by water e.g. house fires, bonfires</li> <li>• air removed: <ul style="list-style-type: none"> <li>○ fire blanket e.g. chip pan fire, person on fire</li> <li>○ CO<sub>2</sub> / powder e.g. indoor fires, chemical fire, electrical fire</li> <li>○ foam e.g. aeroplane fire</li> </ul> </li> <li>• fuel removed: <ul style="list-style-type: none"> <li>○ fire-break e.g. forest fire</li> <li>○ gas supply switched off e.g. natural gas fire</li> </ul> </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 - Higher Tier only questions

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	5	(a)		2	(glucose) solution / add water (to glucose) warm / warm temperature / any temperature in the range 20-40°C absence / lack of oxygen pH 4-7  – any two for (1) each		yeast optimum / ‘right’ temperature	
		(b)		1	2 : 2			
		(c)	(i)	1	filtration / filtering / filter	decant		
			(ii)	1	distillation			fractional distillation
		(d)		1	renewable (fuel / energy resource) carbon-neutral reduces demand on fossil fuels doesn't produce sulfur dioxide (so doesn't cause acid rain)		cleaner / less pollution / less carbon dioxide / more environmentally friendly	more efficient

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	(a)	(i)		3	reactants: CaO + H <sub>2</sub> O (1) product: Ca(OH) <sub>2</sub> (1) balancing: 1 : 1 : 1 (1) – reactants and product must be correct before balancing mark awarded			
			(ii)	I	1	2			
				II	1	1			
			(iii)		1	(bubble in) carbon dioxide (limewater) turns milky – both needed			
		(b)			2	<i>Opinion and response must match to be awarded marks</i> Yes and advantages given e.g. building material, (local) jobs, used in blast furnace / used to extract iron, used to make cement / used to make mortar / used to make concrete, used to make glass, used to neutralise acid soil / manufacture of medicinal antacids, aggregate for roads, abrasive in toothpastes – any two for (1) each No and disadvantages given e.g. dust, noise / blasting, (heavy) lorries / traffic, landscape destruction, habitat destruction / wildlife destruction – any two for (1) each NB – Accept the counter argument i.e. ‘even though’ / ‘but’ statements e.g. No – provides jobs but only in the local areas not country wide Yes – landscape destroyed but can be reclaimed			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	7	(a)		1	$C_nH_{2n+1}OH$	$C_nH_{2n+2}O$		
		(b)		2	$  \begin{array}{ccccccc}  & H & H & H & & & \\  &   &   &   & & & \\  H & -C & -C & -C & -O & -H & \\  &   &   &   & & & \\  & H & H & H & & &   \end{array}  $ <p style="text-align: right;">(1)</p> $  \begin{array}{ccccccc}  & H & H & H & & & \\  &   &   &   & & & \\  H & -C & -C & -C & -H & & \\  &   &   &   & & & \\  & H & OH & H & & &   \end{array}  $ <p style="text-align: right;">(1)</p>	$CH_3CH_2CH_2OH$  $CH_3CH_2CH_3$ $\quad  $ $\quad OH$		
		(c)		2	propene	(1)		
					$  \begin{array}{ccccccc}  & H & H & H & & & \\  &   &   &   & & & \\  H & -C & =C & -C & -H & & \\  & & &   & & & \\  & & & H & & &   \end{array}  $ <p style="text-align: right;">(1)</p>			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			3	A $\text{NH}_4\text{Cl}$ B $\text{Na}_2\text{CO}_3$ C $\text{CuSO}_4$  all ions correctly identified (2) 3, 4 or 5 ions correctly identified (1)  all formulae correct (1)	correct names only for all three compounds (2)		
		(b)			1	D			

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT							
	9	(a)		1	25.0	25		
		(b)		3	number of moles NaOH = concentration $\times$ volume $= 0.1 \times 25/1000$ $= 0.0025$ (1)  (stoichiometry / equation shows 1:1) 0.0025 mol CH <sub>3</sub> COOH : 0.0025 mol NaOH (1)  concentration CH <sub>3</sub> COOH $=$ number of moles $\div$ volume $= 0.0025 \div 25/1000$ $= 0.1$ (1)  – correct answer only (cao) (3) – follow through error (ft)	$cV = cV$ $c \times 25 = 0.1 \times 25$ (2)  $c = \frac{0.1 \times 25}{25} = 0.1$		
		(c)	(i)	1	60			
			(ii)	2	number of moles = concentration $\times$ volume $= 0.1 \times 100/1000$ $= 0.01$ (1)  number of moles = mass / $M_r$ mass = number of moles $\times M_r$ $= 0.01 \times 60 = 0.6$ g ( $\therefore$ label information incorrect) (1)	number of moles in $100\text{cm}^3 = 0.083$ (1)  concentration calculated above as $0.1 \text{ mol/dm}^3$ – not $0.83 \text{ mol/dm}^3$ (1)		

Question Number		Mark	Guidance
FT	HT		
	10		<p>Indicative content: Explanation of choice of temperature and pressure conditions and rationale of presence of catalyst e.g.</p> <p>reversible reaction, left to right reaction required to produce ammonia</p> <p>(left to right reaction is exothermic and) higher yield is favoured by lower temperature however lower temperature results in lower rate so compromise made – moderately high temperature increases rate at the expense of yield rate further increased by using iron catalyst</p> <p>higher yield is favoured by higher pressure however increasing pressure increases plant costs and is potentially more hazardous – moderate pressure chosen provides moderate yield</p> <p>lower yield acceptable because unreacted nitrogen/hydrogen can be easily separated and returned to reaction vessel</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>



WJEC  
245 Western Avenue  
Cardiff CF5 2YX  
Tel No 029 2026 5000  
Fax 029 2057 5994  
E-mail: [exams@wjec.co.uk](mailto:exams@wjec.co.uk)  
website: [www.wjec.co.uk](http://www.wjec.co.uk)