

Chemistry B

General Certificate of Secondary Education

Unit **B741/01**: Modules C1, C2, C3 (Foundation Tier)

Mark Scheme for January 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.




All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

Annotation	Meaning
	correct response
	incorrect response
BOD	benefit of the doubt
NBOD	benefit of the doubt not given
ECF	error carried forward
	information omitted
I	ignore
L1	Level 1
L2	Level 2
L3	Level 3
R	reject
CON	contradiction

Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
allow	=	answers that can be accepted
not	=	answers which are not worthy of credit
reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant
()	=	words which are not essential to gain credit
<u> </u>	=	underlined words must be present in answer to score a mark (although not correctly spelt unless otherwise stated)
ecf	=	error carried forward
AW	=	alternative wording
ora	=	or reverse argument

Question		Answer	Marks	Guidance
1	(a)	<p>food additive</p> <p>job</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 150px; height: 40px; margin-bottom: 10px;">emulsifier</div> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;">stops food reacting with oxygen</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 150px; height: 40px; margin-bottom: 10px;">flavour enhancer</div> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;">improves colour of food</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;"></div> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;">stops food going off</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;"></div> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;">helps oil and water mix and not separate</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;"></div> <div style="border: 1px solid black; padding: 5px; width: 100px; height: 40px; margin-bottom: 10px;">improves the taste of food</div> </div> <p>line drawn between emulsifier and helps oil and water mix and not separate and line between flavour enhancer and improve the taste of food (1)</p>	1	if only 1 line drawn or more than two lines or if one line is incorrect no marks
	(b) (i)	4 (1)	1	

Question		Answer	Marks	Guidance
	(ii)	lime water / calcium hydroxide (solution) (1) (limewater) turns milky / cloudy / chalky / forms white precipitate / forms white solid (1)	2	result mark cannot be awarded if reagent is incorrect allow Ca(OH)_2 (1) allow goes foggy or misty or creamy (1) allow bicarbonate indicator (1) changes from red to yellow (1)
		Total	4	

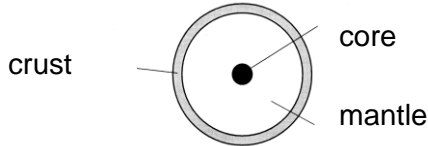
Question		Answer	Marks	Guidance
2	(a)	takes a long time to form (1) are used up faster than they are formed or cannot be made again or finite (1)	2	allow takes (many) years to form or thousands or millions of years to form (1) ignore takes hundreds of years to form allow once it's gone, its gone / can't be replaced (1) ignore cannot be used again allow runs out eventually / will run out of fossil fuels or named fossil fuel e.g.coal (1)
	(b)	bitumen (1) (bitumen) has the highest boiling point (range) (1)	2	allow phonetic spelling this mark is dependent on the correct fraction being chosen allow hottest boiling point (1) allow needs the highest temperature to be boiled (1) allow its boiling point is above 350°C (1) allow it's the highest temperature at the bottom (1) ignore it's the hottest
	(c) (i)	14 (1)	1	
	(ii)	propane and butane contain carbon and hydrogen (atoms) (1) only (1) has (carbon to carbon) single bonds only / contains single (covalent) bonds only (1)	3	not is a mixture of carbon and hydrogen (only) not contains carbon and hydrogen molecules Only must be linked to first marking point and is not independent allow has no (carbon to carbon) double bonds (1) allow they are saturated compounds (1) allow has general formula C_nH_{2n+2} (1)
Total			8	

Question		Answer	Marks	Guidance
3	(a)	C and E (1)	1	both required for 1 mark
	(b)	octane + oxygen → carbon dioxide + water (1)	1	allow = instead of → not and or & for + allow mix of formulae and words but equation does not have to be balanced e.g. $C_8H_{18} + O_2 \rightarrow$ carbon dioxide + H_2O (1)

Question	Answer	Marks	Guidance
(c)	<p>Level 3 (5–6 marks) Candidates recall that carbon monoxide is made by incomplete combustion or when there is not enough oxygen supplied to the fuel AND recognises a problem of both carbon monoxide AND of oxides of nitrogen. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2 (3–4 marks) Candidates recall that carbon monoxide is made by incomplete combustion / when there is not enough oxygen supplied to the fuel AND recognises a problem of carbon monoxide OR of oxides of nitrogen. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1 (1–2 marks) States that carbon monoxide is made from burning petrol / fuel in a car engine OR gives a problem caused by carbon monoxide OR gives a problem caused by oxides of nitrogen. Quality of written communication impedes communication of science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to grade E</p> <p>Relevant points at levels 2 and 3 may include:</p> <ul style="list-style-type: none"> • carbon monoxide is made by incomplete combustion or when there is not enough oxygen supplied to the fuel <p>AND</p> <ul style="list-style-type: none"> • carbon monoxide is poisonous • carbon monoxide can kill humans <p>AND</p> <ul style="list-style-type: none"> • oxides of nitrogen cause photochemical smog • oxides of nitrogen cause acid rain • acid rain kills plants, kills aquatic life, erodes stonework and corrodes metals • oxides of nitrogen or smog causes respiratory problems e.g. asthma <p>allow level 2 (3 marks) if answer includes correct problems of both carbon monoxide and oxides of nitrogen but no reference to incomplete combustion.</p> <p>Relevant points at level 1 may include:</p> <ul style="list-style-type: none"> • carbon monoxide and /or oxides of nitrogen made when fuel / petrol / diesel burn • carbon monoxide is poisonous • carbon monoxide can kill humans • oxides of nitrogen cause photochemical smog • oxides of nitrogen cause acid rain <p>Use the L1, L2 and L3 annotations in scoris; do not use ticks</p>
	Total	8	

Question		Answer	Marks	Guidance
4	(a)	C because it is flexible, waterproof and breathable (2)	2	marks are for evaluation, not for choice of C but for two marks properties must relate to correct choice of C for two marks all three properties must be listed allow one mark for C and two properties listed allow one mark for E and because it is flexible and waterproof ignore reference to not breathable if E mentioned.
	(b)	poly(ethene) (1)	1	allow polythene (1) allow polyethene (1)
Total			3	

Question		Answer	Marks	Guidance
5		idea that thermochromic paints change colour when heated or cooled / the paint is a different colour when hot or cold / the paint is a different colour at different temperatures (1) the colour of the paint or pigment will show when the milk is at the right temperature (to drink) (1)	2	allow so you can see if the milk is warm or cold (1) allow idea that the milk is safe for the baby to drink (1)
Total			2	

Question		Answer	Marks	Guidance
6	(a)	 <p>crust</p> <p>core</p> <p>mantle</p> <p>core and mantle labelled correctly (1)</p>	1	<p>both required</p> <p>allow inner or outer core</p>
	(b)	<p>volcanoes (1)</p> <p>earthquakes (1)</p>	2	<p>allow tsunamis (1)</p> <p>allow subduction or correct description of subduction (1)</p> <p>allow new land is formed if it is clear that two plates are moving apart (1)</p>
	(c)	<p>magma – (molten rock) beneath Earth's surface or inside the volcano (1)</p> <p>lava – (molten rock) at the Earth's surface or outside the volcano(1)</p>	2	<p>allow magma is underground (1)</p>
Total			5	

Question		Answer	Marks	Guidance															
7	(a)	add universal indicator (paper or solution) (1) match colour to test card (1)	2	allow pH paper allow use a pH meter (2) 2 nd mark is dependent on 1 st being awarded allow colour corresponds to a pH value (1) allow correct colours in acid and/or alkali (1) ignore to see what colour it goes															
	(b)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>acid</th> <th>base</th> <th>salt</th> </tr> </thead> <tbody> <tr> <td>sulfuric acid</td> <td>copper oxide</td> <td>copper sulfate</td> </tr> <tr> <td>nitric acid</td> <td>sodium carbonate</td> <td>sodium nitrate (1)</td> </tr> <tr> <td>hydrochloric acid (1)</td> <td>zinc oxide</td> <td>zinc chloride</td> </tr> <tr> <td>sulfuric acid</td> <td>magnesium oxide / magnesium hydroxide / magnesium carbonate (1)</td> <td>magnesium sulfate</td> </tr> </tbody> </table>	acid	base	salt	sulfuric acid	copper oxide	copper sulfate	nitric acid	sodium carbonate	sodium nitrate (1)	hydrochloric acid (1)	zinc oxide	zinc chloride	sulfuric acid	magnesium oxide / magnesium hydroxide / magnesium carbonate (1)	magnesium sulfate	3	allow correct formulae i.e. NaNO ₃ (1) HCl (1) MgO / Mg(OH) ₂ / MgCO ₃ (1)
acid	base	salt																	
sulfuric acid	copper oxide	copper sulfate																	
nitric acid	sodium carbonate	sodium nitrate (1)																	
hydrochloric acid (1)	zinc oxide	zinc chloride																	
sulfuric acid	magnesium oxide / magnesium hydroxide / magnesium carbonate (1)	magnesium sulfate																	
	(c)	CuCl ₂ or H ₂ O (1)	1	allow CuCl ₂ and H ₂ O (1)															
	(d)	benefits – any one from: increased crop yield (1) crops grow faster (1) increased food supply (1) provides essential elements / provides nitrogen or phosphorus or potassium (1) problem – any one from: runs off into rivers and lakes (1) idea of algal bloom (1) causes death of water organisms (1) eutrophication (1)	2	allow bigger crops (1) ignore better crops ignore to help crops grow (healthy) allow blue baby syndrome (1) ignore just 'causes pollution' allow correct description of eutrophication (1)															
Total			8																

Question	Answer	Marks	Guidance
8	<p>Level 3 (5–6 marks) Applies knowledge of properties to identify at least two correct properties AND analyses table of data to choose metal B and fully explains their choice to include references to lowest density. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2 (3–4 marks) Applies knowledge of properties to identify at least two sensible properties AND metal B is identified or metal D identified based on greatest strength. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1 (1–2 marks) Applies knowledge of properties to identify one sensible property OR suggests metal B for making the wings and/or body. Quality of written communication impedes communication of science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to C.</p> <p>Relevant points include:</p> <ul style="list-style-type: none"> • metal needs to have a low density • metal needs to have high strength • metal must not corrode easily • melting point of metal must not be too low <p>ignore references to thermal conductivity</p> <p>Metal B is best. This is because:</p> <ul style="list-style-type: none"> • it has the lowest density or lightest metal • and a high strength • it has the highest melting point.
	Total	6	

Question		Answer	Marks	Guidance
10	(a)	46 (1)	1	ignore units
	(b)	280 (g) (1)	1	unit not needed ignore incorrect units
	(c)	atom economy = $\frac{60}{60 + 18} / \frac{60}{46 + 32} / \frac{60}{78}$ (1) but atom economy = $\frac{60}{60 + 18} \times 100 / \frac{60}{46 + 32} \times 100 /$ $\frac{60}{78} \times 100$ (2)	2	allow atom economy formula in words for one mark i.e. atom economy = $\frac{\text{total Mr of desired products}}{\text{total Mr of all products}} \times 100$ (1) or atom economy = $\frac{\text{total Mr of desired products}}{\text{total Mr of all reactants}} \times 100$ (1)
	(d)	percentage yield = $\frac{9.5}{9.8}$ (1) but percentage yield = $\frac{9.5}{9.8} \times 100$ (2)	2	allow percentage yield formula in words for one mark e.g. percentage yield = $\frac{\text{actual yield}}{\text{predicted yield}} \times 100$ or percentage yield = $\frac{\text{am}}{\text{pm}} \times 100$
	(e)	has high(er) atom economy / 100% atom economy / less atoms are wasted (1)	1	allow reverse argument e.g. process 1 has low(er) atom economy (1) ignore references to percentage yield allow no or less waste products (1) ignore no waste
Total			7	

Question		Answer	Marks	Guidance
11	(a)	nitrogen + oxygen \rightarrow nitrogen monoxide (1)	1	allow symbol equation even if not balanced $N_2 + O_2 \rightarrow NO$ (1) allow = for \rightarrow not & or and for +
	(b)	reaction which absorbs energy / reaction which gains energy / reaction which takes in energy (1)	1	allow heat or enthalpy for energy allow a reaction in which surroundings get colder (1)

Question	Answer	Marks	Guidance
(c)	<p>Level 3 (5–6 marks) Identification of at least three ways of making the reaction go faster AND applies reacting particle model correctly, including mention of collisions, to explain one way. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2 (3–4 marks) Identification of at least two ways of making the reaction go faster AND makes an attempt to apply reacting particle theory to one of the ways (theory only partly correct). Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1 (1–2 marks) Identification of two ways of making the reaction go faster. Quality of written communication impedes communication of science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to C.</p> <p>Relevant points include:</p> <p>Reacting particle theory</p> <ul style="list-style-type: none"> • increasing concentration or pressure gives more crowded nitrogen and oxygen molecules / molecules are closer together / more nitrogen and oxygen molecules in the same volume so there is an increased number of collisions (per second) / more collisions • increasing temperature has nitrogen or oxygen molecules moving faster / molecules have more energy so more (successful) collisions (per second) • adding a catalyst means there are more successful collisions (per second). <p>allow one correct way of making the reaction go faster and a complete explanation level 2 (4 marks)</p> <p>Ways of making reaction faster</p> <ul style="list-style-type: none"> • increase temperature • increase pressure • increase concentration • add a catalyst.
	Total	8	

Question		Answer	Marks	Guidance
12	(a)	<p>any two from: hard (1)</p> <p>does not conduct electricity (1) (good) conductor of heat (1) high melting point (1) insoluble in water (1) shiny / lustrous (1) transparent (1)</p>	2	<p>ignore hard to break or cut ignore strong</p>
	(b)	conducts electricity (1)	1	<p>ignore it is a good conductor allow it is inert / has a high melting point (1) allow it is insoluble in water (1)</p>
Total			3	

Question		Answer				Marks	Guidance																								
13	(a)	<table border="1"> <thead> <tr> <th>fuel</th> <th>molecular formula</th> <th>number of atoms in a molecule</th> <th>temperature increase in °C</th> </tr> </thead> <tbody> <tr> <td>methanol</td> <td>CH₄O</td> <td>6</td> <td>9</td> </tr> <tr> <td>ethanol</td> <td>C₂H₆O</td> <td>9</td> <td>12</td> </tr> <tr> <td>propanol</td> <td>C₃H₈O</td> <td>12</td> <td>14</td> </tr> <tr> <td>butanol</td> <td>C₄H₁₀O</td> <td>15</td> <td>16</td> </tr> <tr> <td>pentanol</td> <td>C₅H₁₂O</td> <td>18</td> <td>15</td> </tr> </tbody> </table> <p>Correct number of atoms (1)</p> <p>Correct temperature increases (1)</p>				fuel	molecular formula	number of atoms in a molecule	temperature increase in °C	methanol	CH ₄ O	6	9	ethanol	C ₂ H ₆ O	9	12	propanol	C ₃ H ₈ O	12	14	butanol	C ₄ H ₁₀ O	15	16	pentanol	C ₅ H ₁₂ O	18	15	2	
fuel	molecular formula	number of atoms in a molecule	temperature increase in °C																												
methanol	CH ₄ O	6	9																												
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butanol	C ₄ H ₁₀ O	15	16																												
pentanol	C ₅ H ₁₂ O	18	15																												
	(b)	<p>identification of pentanol as odd result (1)</p> <p>explanation with a correct reason for yes or no (1)</p>				2	<p>e.g. the rest of the temperature increases go up with the number of atoms (1)</p> <p>e.g. pentanol has less of a temperature rise than butanol (2)</p> <p>e.g. pentanol is an anomaly (1)</p> <p>allow ecf from table but apply same principles</p>																								
Total					4																										

Question		Answer	Marks	Guidance
14	(a)	<p>need to have one point from each section for 1 mark</p> <p>continuous process continuous takes place all the time continuous takes place 24/7 continuous has no down time continuous cannot change what is made</p> <p>batch process batch process not done 24/7 batch process is done and later on is done again batch process has down time batch process can change what is made batch process done on demand</p>	1	
	(b)	<p>any two from: to see if they have pharmaceutical activity / see if the drug works / aw (1)</p> <p>to test to see if there are any side-effects (1)</p> <p>to find out the dosage needed (1)</p>	2	<p>allow idea of checking that drug is safe (1) allow references to checking that drug is not harmful or poisonous (1)</p>
		Total	3	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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