

GCSE

Chemistry B

Unit **B741/02**: Modules C1, C2, C3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2014

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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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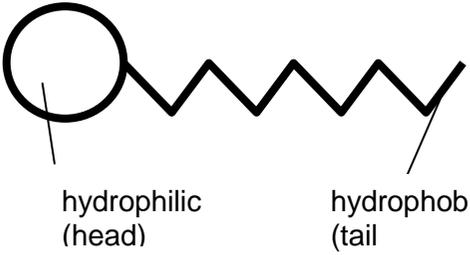
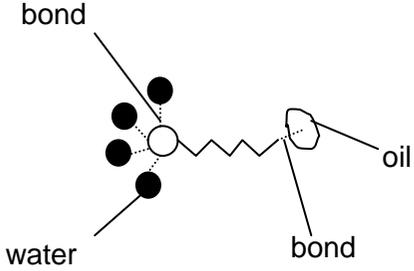
Annotations used in scoris

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction

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

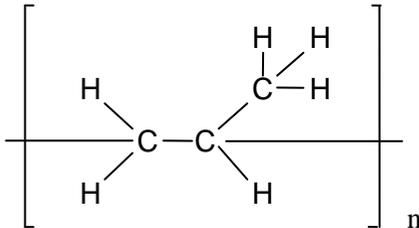
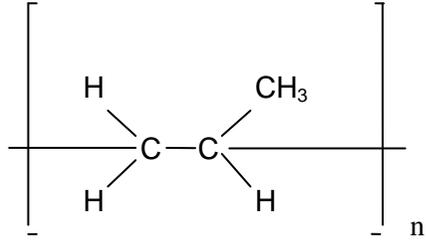
- / = alternative and acceptable answers for the same marking point
- (1) = separates marking points
- allow = answers that can be accepted
- not = answers which are not worthy of credit
- reject = answers which are not worthy of credit
- ignore = statements which are irrelevant
- () = words which are not essential to gain credit
- = 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	C_2H_6 / H_6C_2 (1)	1	the numbers must clearly be subscripts not $C^2H^6 / C2H6$
b	B contains carbon and hydrogen (1) only / AW (1) C contains oxygen / has oxygen in the formula / does not contain only carbon and hydrogen (1)	3	allow (formula) has only (1) H and C (1) the only is not an independent mark and must be linked to the carbon and hydrogen not contains carbon and hydrogen molecules / contains a mixture of carbon and hydrogen not hydro atoms but ignore for the third marking point allow C has three elements / C has three different atoms (1) not C contains oxygen molecules
c	A and F (1)	1	both needed
	Total	5	

Question	Answer	Marks	Guidance
2 a i	hydrophilic (head) and hydrophobic (tail) (1)	1	 <p>hydrophilic (head) hydrophobic (tail)</p> <p>allow polar (head) and non-polar (tail) (1) allow ionic (head) and hydrocarbon (tail) (1) ignore water loving and water hating</p>
a ii	<p>hydrophobic end or tail is attracted to oil / hydrophobic end or tail forms intermolecular forces with oil / hydrophobic end or tail bonds to oil (1)</p> <p>hydrophilic end or head is attracted to water / hydrophilic end or head forms intermolecular forces with water / hydrophilic end or head bonds to water (1)</p>	2	<p>if no other marks awarded allow tail is surrounded by oil molecules and the head by water molecules</p> <p>allow sticks to or attached or joined or combines with as alternative to 'bonds', but the hydrophobic end goes into oil is not sufficient ignore hydrophilic head loves water / hydrophobic tail loves oil ignore ideas of repelling water / oil all marks can be awarded from a labelled diagram but to get two marks must clearly show bonding to rather than surrounded by</p>  <p>allow ecf from (a)(i) for 1 mark e.g. hydrophobic head bonds to oil and hydrophilic tail bonds to water, if labels the wrong way round in (a)(i)</p>

Question	Answer	Marks	Guidance
b	protein (molecules) (1) permanently change shape / irreversible change of shape (1)	2	allow polypeptide (molecules) (1) ignore enzymes allow proteins become cross-linked (2) allow molecular structure changes permanently (1) allow one mark for denaturing if no other mark awarded
Total		5	

Question	Answer	Marks	Guidance
3 a	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ correct reactants and products (1) balancing – dependent on correct reactants and products (1)	2	allow any correct multiple, including fractions allow = / \rightleftharpoons instead of \rightarrow not and / & balancing mark is dependent on the correct formulae but allow 1 mark for a balanced equation with minor errors in subscripts / formulae e.g. $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
b	(sea water because) any two from: removes more of the pollutant / removes 9% more of nitrogen dioxide / 99% of nitrogen dioxide removed (1) does not form a waste product (1) cheap(er) (1) readily available (near the coast) (1) OR (limestone because) idea of does not have to be pumped (a long way) from the sea (1) need less mass of material (1)	2	No marks for sea water or for limestone – the marks are for the explanation allow does not produce waste (1) allow only a small amount needed (1)
Total		4	

Question	Answer	Marks	Guidance
4 a	correct atoms and bonds without the double bond (1) brackets and n (1)	2	<p>second marking point is dependent on the first allow more than 1 repeat unit</p>  <p>The diagram shows the structural formula of a polyethene repeat unit enclosed in square brackets with a subscript 'n'. A horizontal line passes through the two carbon atoms. The left carbon is bonded to two hydrogen atoms (one above, one below). The right carbon is bonded to two hydrogen atoms (one above, one below).</p> <p>allow round brackets</p> <p>allow</p>  <p>The diagram shows the structural formula of a polypropene repeat unit enclosed in square brackets with a subscript 'n'. A horizontal line passes through the two carbon atoms. The left carbon is bonded to two hydrogen atoms (one above, one below). The right carbon is bonded to one hydrogen atom (below) and one methyl group (CH₃, above).</p>

Question	Answer	Marks	Guidance
4 b	<p>Level 3 <u>Two</u> properties needed by the plastic are explained AND the flexibility of poly(propene) is explained in terms of the structure and bonding. Quality of communication does not impede communication of science at this level. (5-6 marks)</p> <p>Level 2 The flexibility of poly(propene) is explained in terms of the structure and bonding OR <u>two</u> properties needed by the plastic are explained OR <u>one</u> property of the plastic is explained and an attempt to explain why poly(propene) is flexible. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 <u>One</u> property needed by the plastic is explained OR an attempt to explain why poly(propene) is flexible. Quality of communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A*</p> <p>Indicative scientific points for level 3 may include:</p> <ul style="list-style-type: none"> • Poly(propene) molecules are attracted to one another by weak intermolecular forces or bonds that are easy to overcome • Poly(propene) molecules need very little energy to be separated • Poly(propene) molecules can slide over each other • Poly(propene) has atoms held together by strong covalent bonds <p>Indicative scientific points for all levels may include:</p> <ul style="list-style-type: none"> • Non-biodegradable so the plastic does not rot or decay • Insoluble in water or waterproof so that the sandwich box can be washed clean / so it will not dissolve / so moist foods can be stored • Non-toxic material so it will not contaminate the food or make the food dangerous to eat • Non-reactive or inert so will not react with chemicals in the food • Non-permeable so water doesn't reach the food <p>ignore references to can be coloured / is strong / tough / durable / light or lightweight / hard / easily moulded / insulator / does not melt (in hot water)</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks</p>
Total		8	

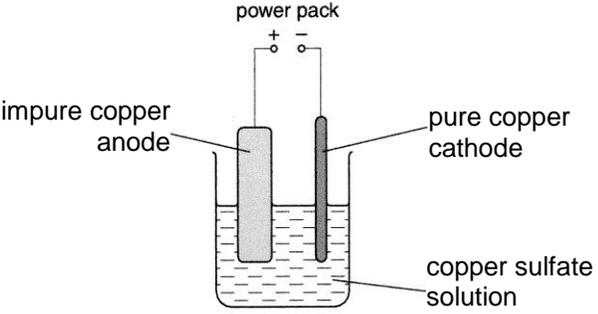
Question	Answer	Marks	Guidance
5 a	absorbs or takes in energy (in the light) (1) (then) releases or emits energy (in the dark) (1)	2	allow stores energy from light in the day (1) allow light instead of energy not reference to radioactive emissions
b	reacts with oxygen / it is oxidised (1)	1	
	Total	3	

Question	Answer	Marks	Guidance
6 a i	transparent (1)	1	<p>allow insoluble (in water) / waterproof / does not react with water (1)</p> <p>allow clear / see through / colourless (1)</p> <p>allow does not biodegrade / does not decompose / does not decay (1)</p> <p>allow does not photodegrade (1)</p> <p>ignore shatterproof / strong</p>
a ii	(aluminium car body) will corrode less / does not corrode (1)	1	<p>assume unqualified answer refers to aluminium</p> <p>allow (aluminium car body) will have a longer lifetime (1)</p> <p>allow aluminium does not rust (1) but not aluminium does not rust as easily (0)</p> <p>allow aluminium does not oxidise (in air) (1)</p> <p>ignore aluminium is less corrosive</p> <p>allow car will have better fuel economy (1)</p> <p>allow ora for steel</p> <p>ignore aluminium is easier to mould / is more flexible</p> <p>not stronger</p>
b	(PVC) has high flexibility / is flexible / aw (1) (PVC) has low (electrical) conductivity / is a poor (electrical) conductor / does not conduct (electricity) / aw (1)	2	<p>ignore references to density</p> <p>allow is an (electrical) insulator (1)</p>
Total		4	

Question	Answer	Marks	Guidance										
7 a	<table border="1" data-bbox="456 277 911 596"> <thead> <tr> <th></th> <th>Number of atoms</th> </tr> </thead> <tbody> <tr> <td>nitrogen</td> <td>2</td> </tr> <tr> <td>hydrogen</td> <td>8</td> </tr> <tr> <td>sulfur</td> <td>1</td> </tr> <tr> <td>oxygen</td> <td>4</td> </tr> </tbody> </table> <p style="text-align: right;">(1)</p>		Number of atoms	nitrogen	2	hydrogen	8	sulfur	1	oxygen	4	1	
	Number of atoms												
nitrogen	2												
hydrogen	8												
sulfur	1												
oxygen	4												
b	<p>names of reactants: (acid is) sulfuric acid (1) (alkali is) ammonia / ammonium hydroxide / ammonium carbonate / ammonium hydrogencarbonate (1)</p> <p>AND</p> <p>any one from:</p> <p>acid is titrated with alkali using an indicator / idea of controlled addition of acid to alkali with use of indicator (1)</p> <p>(heat to) evaporate water / leave solution to crystallise (1)</p>	3	<p>allow correct formulae or mix of formula and name H_2SO_4 NH_3 / NH_4OH / $(NH_4)_2CO_3$ / NH_4HCO_3 not ammonium / NH_4 / ammonia hydroxide</p> <p>allow acid is added to alkali (or vice versa) until a neutral solution is obtained (1) allow idea of controlled addition of acid to alkali with use of pH meter or test with indicator paper (1)</p>										

Question	Answer	Marks	Guidance
<p> c</p>	<p>[Level 3] Answer describes advantages AND disadvantages of conditions used AND includes the balanced symbol equation for the reaction. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Answer describes an advantage AND a disadvantage of conditions used OR includes the balanced symbol equation for the reaction. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Answer describes <u>either</u> an advantage <u>or</u> a disadvantage of conditions used OR includes the symbol equation for the reaction (may not be balanced). Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	<p>6</p>	<p>This question is targeted at grades up to A*</p> <p>Indicative scientific points may include:</p> <p>Symbol equation $\text{NH}_3 + 2\text{O}_2 \rightarrow \text{HNO}_3 + \text{H}_2\text{O}$ allow any correct multiple, including fractions allow = / \rightleftharpoons instead of \rightarrow not and / & instead of '+'</p> <p>Advantages of conditions listed</p> <ul style="list-style-type: none"> • high temperature or temperature of 900°C increases rate of reaction • (platinum) catalyst reduces costs • (platinum) catalyst increases rate of reaction • atmospheric pressure means lower energy costs • atmospheric pressure means lower plant costs <p>Disadvantages of conditions listed</p> <ul style="list-style-type: none"> • high temperature or temperature of 900°C increases energy use or expensive • high temperature reduces percentage yield • (platinum) catalyst is (initially) expensive • atmospheric pressure means slower rate of reaction <p>allow answers in terms of position of equilibrium e.g. more moles on LHS so should use higher pressure e.g. if reaction is exothermic equilibrium is on LHS at higher temperature</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
	<p>Total</p>	<p>10</p>	

Question	Answer	Marks	Guidance
8 a	crust is too thick (to drill through) / need to use seismic waves produced by earthquakes/ need to use seismic waves produced by man-made explosions (1)	1	allow mantle is too hot / core is too hot / idea that layers below the crust are too hot (1) allow ideas of not being able to dig deep enough (1)
b i	any two from: (Wegener) suggested continental drift theory (1) idea that continental drift theory was not accepted by scientists at the time (1) (later) extra evidence obtained such as sea floor spreading or measurement of continental drift (1)	2	allow evidence such as continents fitting together (1) ignore references to subduction / earthquakes & volcanoes
b ii	idea that (most scientists now accept the theory as) subsequent research has supported the theory (1)	1	allow there's more evidence to support it (1) allow examples of extra evidence that supports theory e.g. similar fossils in South America and Africa (1) ignore similar animal breeds
	Total	4	

Question	Answer	Marks	Guidance
9 a	<p>(copper because) good resistance to corrosion (1)</p> <p>or</p> <p>(aluminium because) good resistance to corrosion (1)</p> <p>low density (1)</p> <p>or</p> <p>(stainless steel because) good resistance to corrosion (1) strong (1) cheap(est) (1)</p> <p>or</p> <p>(titanium because) good resistance to corrosion (1) strong (1) low density (1)</p>	3	<p>No mark for the metal – the mark is for the correct reason ignore other properties</p> <p>allow copper does not rust (1) but not copper does not rust as easily</p> <p>allow aluminium does not rust (1) but not aluminium does not rust as easily allow lightweight (1), but ignore just light</p> <p>allow only £900 per tonne (1)</p> <p>allow titanium does not rust (1) but not titanium does not rust as easily allow lightweight (1), but ignore just light</p>
b		2	<p>all three labels correct scores 2 marks</p> <p>one or two labels correct scores 1 mark</p>
Total		5	

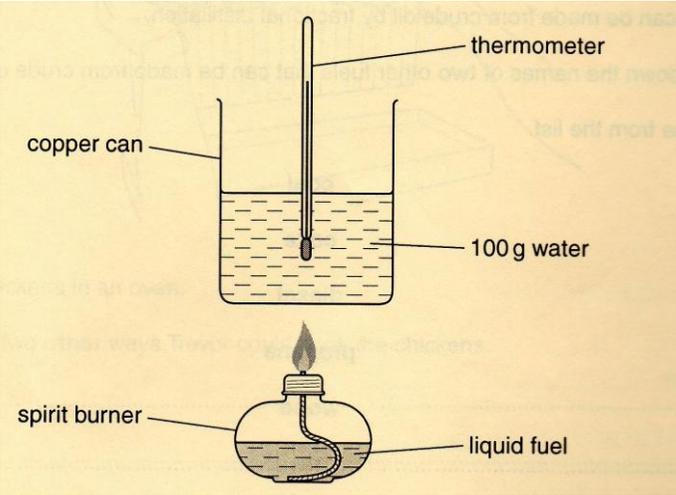
Question	Answer	Marks	Guidance
10 a	$2\text{Br}^- - 2\text{e}^- \rightarrow \text{Br}_2$ (1)	1	allow any correct multiple, including fractions not any additional symbols, other than balancing
b	(oxidation because) electrons are lost (from Br^-) (1)	1	allow oxidation number of Br increases (1) not bromine (atoms) lose electrons but allow ions lose electrons (1)
Total		2	

Question	Answer	Marks	Guidance
11 a	slippery / layers can slide over one another (1) (black / grey so) can be seen on the paper (1)	2	allow weak forces (of attraction) or weak bonds between layers (1) allow leaves mark on the paper / comes off onto the paper (1)
b i	has free electrons / mobile electrons / electrons that can move / delocalised electrons (1)	1	not has free ions ignore has spare electrons
ii	idea of a giant structure / has many covalent bonds (1) idea that strong bonds need to be broken / bonds need lots of energy to break (1)	2	not ionic bonds / (strong) intermolecular forces / bonds between carbon molecules – 0 marks for the question allow bonds are difficult to break (1) allow many strong covalent bonds are broken for 2 marks
Total		5	

Question	Answer	Marks	Guidance
12 a	<p>[Level 3] Explanation that the results (in relation to <u>both</u> volume of acid & mass of magnesium) do not support the prediction with reference to experimental data AND an explanation <u>using collision frequency</u> that reaction in experiment 4 is faster, or has a shorter reaction time, than experiment 3. Quality of communication does not impede communication of science at this level. (5-6 marks)</p> <p>[Level 2] Explanation that the results (in relation to <u>both</u> volume of acid & mass of magnesium) do not support the prediction with reference to experimental data AND an explanation that the reaction in experiment 4 is faster, or has a shorter reaction time, than experiment 3 <i>using idea of more collisions rather than collision frequency</i></p> <p>OR an explanation <u>using collision frequency</u> that reaction in experiment 4 is faster or has a shorter reaction time than experiment 3. Quality of written communication partly impedes communication of the science at this level. (3-4 marks)</p> <p>[Level 1] Explanation that the results (in relation to <u>either</u> volume of acid <u>or</u> mass of magnesium) do not support the prediction with reference to experimental data OR an explanation that the reaction in experiment 4 is faster or has a shorter reaction time than experiment 3 <i>using idea of more collisions rather than collision frequency</i>. Quality of communication impedes communication of the science at this level (1-2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A*</p> <p>Indicative scientific points for explanation may include:</p> <ul style="list-style-type: none"> • results show as volume increases reaction time does not change • results show that as mass increases reaction time does not change <p>Indicative scientific points for experiments 3 and 4 may include:</p> <ul style="list-style-type: none"> • concentration is higher in experiment 4 • acid particles are more crowded in experiment 4 / acid particles are closer together / more acid particles per unit volume / more acid particles per cm³ / more acid particles in the same space • more (successful) collisions per second / collisions more often / increased collision frequency / more chance of a collision <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks</p>

Question	Answer	Marks	Guidance
12 b	(acid) particles have more energy / (acid) particles are moving faster / more collisions per second (1) more successful collisions / more energetic collisions / more collisions above the activation energy / more effective collisions (1)	2	ignore particles vibrate more or vibrate faster ignore particles move more allow more successful collisions per second / more frequent energetic collisions for two marks ignore harder collisions / faster collisions allow more collisions (1), if no other mark awarded allow rate increases / reaction is faster (1), if no other mark awarded
	Total	8	

Question	Answer	Marks	Guidance
13 a	no undesired products made / no waste products made / all the atoms that react end up in the product / only one product made (1)	1	not the same number of atoms on each side of the equation
b i	idea that 164g of sodium ethanoate makes 120g of ethanoic acid / idea that 82g of sodium ethanoate makes 60g of ethanoic acid (1) but mass is 6 (2)	2	units not needed
b ii	$\frac{(2 \times 60)}{(2 \times 60) + 142} \times 100$ or $\frac{120}{262} \times 100$ or $\frac{(2 \times 60)}{(2 \times 82) + 98} \times 100$ or $\frac{120}{164 + 98} \times 100$ (1) but 45.8% (2)	2	allow full marks for correct answer despite working out allow 46% (2)
c i	46 % (2) but 46.2 / 46.15 / 46.154 (1)	2	answer must have two sig figs for two marks allow one mark for $\frac{2.4}{5.2} \times 100$
ii	waste a lot of starting material / wastes reactants (1)	1	ignore waste products ignore just 'a lot of waste' ignore wastes lots of resources
Total		8	

Question	Answer	Marks	Guidance
14	<p>any four from:</p> <p>correct use of a spirit burner (1)</p> <p>container of water above (spirit) burner (1)</p> <p>measures the change in temperature of the water (1)</p> <p>idea of measuring the mass of paraffin in the correct context (1)</p> <p>idea of repeating appropriate experiment (1)</p>	4	<p>if experiment is unsafe, or incorrect experiment, max 1</p> <p>allow paraffin burner</p> <p>not Bunsen burner</p> <p>allow reference to ΔT or change in temperature in equation (1)</p> <p>allow measure the temperature of the water at the start and at the end (1)</p> <p>allow marks from a labelled diagram</p> 
Total		4	

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