

**GCSE**

**Chemistry B**

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

General Certificate of Secondary Education

**Mark Scheme for June 2016**

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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## Annotations

Annotation	Meaning
	correct response
	incorrect response
<b>BOD</b>	benefit of the doubt
<b>NBOD</b>	benefit of the doubt <b>not</b> given
<b>ECF</b>	error carried forward
	information omitted
<b>I</b>	ignore
<b>R</b>	reject
<b>CON</b>	contradiction

**ADDITIONAL OBJECTS:** You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

When you open the script if the message appears that there are additional objects you must check these additional objects.

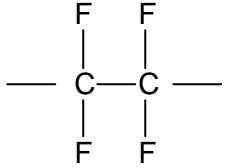
The additional objects are normally additional sheets of answers that must be marked. You should immediately link each extra answer with the appropriate question using the paper clip icon.

**PLEASE ASK YOUR TEAM LEADER IF YOU DO NOT KNOW HOW TO DO THIS.**


It is vitally important that all parts of the candidate's answer are marked.

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

/	= alternative and acceptable answers for the same marking point
(1)	= separates marking points
<b>allow</b>	= answers that can be accepted
<b>not</b>	= answers which are not worthy of credit
<b>reject</b>	= answers which are not worthy of credit
<b>ignore</b>	= 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	E (1)	1	<b>allow</b> ethene / C <sub>2</sub> H <sub>4</sub> (1)
b	C and F (1)	1	<b>allow</b> butane <b>and</b> methylpropane (1)
c	C <sub>8</sub> H <sub>18</sub> (1)	1	<b>allow</b> any order of symbols not C <sup>8</sup> H <sup>18</sup> / C8H18
d	<div style="text-align: center;">  </div> <p>(1)</p>	1	structure <b>must</b> have the <b>free</b> bonds at both ends  <b>allow</b> with or without brackets  <b>allow</b> with or without n  <b>allow</b> two or more repeat units, but must be an even number of C atoms (1)
<b>Total</b>	<b>Total</b>	<b>4</b>	

Question	Answer	Marks	Guidance
2 a	do not contain carbon and hydrogen <b>only</b> / contain more elements than just hydrogen and carbon (1)	1	<p><b>allow</b> C and H for carbon and hydrogen (1)</p> <p><b>allow</b> it contains oxygen / has three elements / has the symbol O in the formula (1)</p> <p><b>not</b> contains an oxygen <b>molecule</b> (in the formula)</p> <p><b>not</b> reference to a <b>mixture</b></p> <p><b>not</b> does not contain carbon and hydrogen <b>molecules</b> or <b>compounds</b> only</p> <p><b>not</b> does not contain carbon and hydro only</p>
b i	any value between 147 and 157 °C (1)	1	
ii	<p><b>Any two from:</b></p> <p>(not suitable as a nail varnish remover)</p> <p>idea that (boiling point is quite high so) it does not evaporate easily (1)</p> <p>idea that (pentyl ethanoate) will not dissolve very well (in water) (1)</p> <p>(cannot tell)</p> <p>idea that melting point is below room temperature / it is a liquid (1)</p> <p>idea that no obvious <b>trend</b> in solubility (so cannot tell if it dissolves or not) (1)</p>	2	<p><b>marks are for explanation – ignore yes / no / cannot tell</b></p> <p><b>allow</b> ecf from (b)(i)</p> <p><b>ignore</b> answers simply quoting data</p>
<b>Total</b>		<b>4</b>	

Question	Answer	Marks	Guidance
<p><b>3</b> </p>	<p><b>[Level 3]</b> Explains how photosynthesis <u>and</u> combustion and/or respiration keep the percentage of each gas almost constant <b>AND</b> explains two possible changes in the composition of the air due to increasing population. Quality of communication does not impede communication of science at this level. (5-6 marks)</p> <p><b>[Level 2]</b> Identifies <u>two</u> of the three processes of photosynthesis, combustion, respiration <b>AND</b> explains a possible change in the composition of the air due to increasing population <b>OR</b> explains how photosynthesis <u>and</u> combustion and/or respiration keep the percentage of each gas almost constant. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Identifies <u>two</u> of the three processes of photosynthesis, combustion and respiration <b>OR</b> explains a possible change in the composition of the air due to increasing population. Quality of communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p><b>This question is targeted at grades up to A*</b></p> <p><b>Indicative scientific points for processes may include:</b></p> <ul style="list-style-type: none"> <li>• Photosynthesis increases percentage of oxygen and decreases percentage of carbon dioxide</li> <li>• Respiration and combustion decrease percentage of oxygen and increase percentage of carbon dioxide</li> <li>• Idea of a balance between respiration and/or combustion with photosynthesis</li> </ul> <p><b>allow</b> burning for combustion <b>ignore</b> breathing (for respiration) <b>ignore</b> references to nitrogen</p> <p><b>Indicative scientific points for change in composition may include:</b></p> <ul style="list-style-type: none"> <li>• More carbon dioxide or less oxygen because more energy production using fossil fuels</li> <li>• More carbon dioxide or less oxygen because increase in population leads to more deforestation</li> <li>• More carbon dioxide or less oxygen because more transportation using fuels that burn</li> <li>• Increased population leads to more carbon dioxide or less oxygen due to more respiration</li> </ul> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks</b></p>
<b>Total</b>		<b>6</b>	

Question	Answer	Marks	Guidance
4	$\text{CH}_4 + \text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{C}$  correct reactants and products (1)  balancing dependent on correct formulae (1)	2	<b>allow</b> correct multiples  correct products must include $\text{H}_2\text{O}$ and C  <b>allow</b> equations making carbon, carbon monoxide and carbon dioxide so long as carbon is made e.g. $3\text{CH}_4 + 4\frac{1}{2}\text{O}_2 \rightarrow 6\text{H}_2\text{O} + \text{C} + \text{CO} + \text{CO}_2$ $2\text{CH}_4 + 2\frac{1}{2}\text{O}_2 \rightarrow 4\text{H}_2\text{O} + \text{C} + \text{CO}$ $3\text{CH}_4 + 4\text{O}_2 \rightarrow 6\text{H}_2\text{O} + \text{C} + 2\text{CO}$  <b>allow</b> one mark for correctly balanced equations with minor errors of case and subscript e.g. $\text{CH}_4 + \text{O}_2 \rightarrow 2\text{H}_2\text{o} + \text{C}$
	<b>Total</b>	<b>2</b>	



Question	Answer	Marks	Guidance
5 a	pie chart (1)	1	<b>allow</b> correct answer ticked, circled or underlined in list if answer line is blank (1)
b	bar chart (1)	1	<b>allow</b> correct answer ticked, circled or underlined in list if answer line is blank (1)
c	solvent evaporates / solvent turns into a vapour or gas (1) oil reacts with oxygen / oil is oxidised (1)	2	<b>not</b> solution or water evaporates <b>allow</b> oil reacts with air (1) <b>allow</b> binding medium reacts with air (1)
d	<b>Any two from:</b> idea that <b>particles</b> are too small (to settle at bottom of paint) (1) idea that <b>particles</b> are mixed or dispersed (within a liquid) (1) <b>particles</b> do not settle because bombarded by other particles (1)	2	<b>allow</b> idea that pigment is mixed or dispersed (within a liquid) (1) <b>allow</b> there is charge repulsion between particles (1) <b>allow</b> the oil is dissolved in the solvent (1)
<b>Total</b>		<b>6</b>	

Question	Answer	Marks	Guidance
6 a	(because) holes in membrane are too small to let (liquid) water droplets through (1)  (but) holes are large enough to let water <b>vapour</b> to pass through (1)	2	<b>allow</b> rain for (liquid) water droplets (1) <b>ignore</b> water molecules or water particles  <b>not</b> water for water vapour <b>not</b> just sweat <b>allow</b> big enough to let sweat or water <b>evaporate</b> (1)  <b>allow</b> the (liquid) water droplets do not pass through but water <b>vapour</b> does (2)
b	Gore-tex <sup>®</sup> is breathable but nylon is not / nylon is only waterproof / nylon is not breathable (1)	1	assume unqualified answer refer to Gore-tex <sup>®</sup>  <b>allow</b> description of breathable ie allows sweat / water vapour to pass through if term breathable is not used
	<b>Total</b>	<b>3</b>	

Question	Answer	Marks	Guidance															
7 a	<table border="1"> <thead> <tr> <th>Alloy</th> <th>Metals in the alloy</th> </tr> </thead> <tbody> <tr> <td>amalgam</td> <td><b>mercury</b></td> </tr> <tr> <td><b>brass</b></td> <td>copper and zinc</td> </tr> <tr> <td>solder</td> <td><b>lead and tin</b></td> </tr> </tbody> </table>	Alloy	Metals in the alloy	amalgam	<b>mercury</b>	<b>brass</b>	copper and zinc	solder	<b>lead and tin</b>	2	<p><b>all</b> correct (2)  <b>one</b> or <b>two</b> correct (1)</p> <p>for amalgam, <b>allow</b> mercury and zinc / silver / copper / tin</p>							
Alloy	Metals in the alloy																	
amalgam	<b>mercury</b>																	
<b>brass</b>	copper and zinc																	
solder	<b>lead and tin</b>																	
b	$4Al + 3O_2 \rightarrow 2Al_2O_3$ formulae (1) balancing - mark is conditional on correct formulae (1)	2	<p><b>allow</b> correct multiples e.g. <math>2Al + \frac{3}{2}O_2 \rightarrow Al_2O_3</math>  <b>allow</b> = or = instead of <math>\rightarrow</math>  <b>not</b> 'and' or &amp; instead of +</p> <p><b>allow</b> one mark for correct balanced equation with minor errors of case, subscript and superscript            e.g. <math>4AL + 3O^2 \rightarrow 2Al_2o_3</math> (1)</p>															
c i	<table border="1"> <thead> <tr> <th>Alloy</th> <th>Advantages</th> <th>Disadvantages</th> </tr> </thead> <tbody> <tr> <td><b>A</b></td> <td>low density / high strength</td> <td>high cost</td> </tr> <tr> <td><b>B</b></td> <td>high strength</td> <td>high density</td> </tr> <tr> <td><b>C</b></td> <td>high strength / low cost</td> <td>high density</td> </tr> <tr> <td><b>D</b></td> <td>low density / low cost</td> <td>low strength</td> </tr> </tbody> </table> <p>all <b>eight</b> cells in table correct (3)</p>	Alloy	Advantages	Disadvantages	<b>A</b>	low density / high strength	high cost	<b>B</b>	high strength	high density	<b>C</b>	high strength / low cost	high density	<b>D</b>	low density / low cost	low strength	3	<p><b>five, six</b> or <b>seven</b> correct (2)  <b>three</b> or <b>four</b> correct (1)</p> <p><b>allow</b> AW eg cheap / expensive / strong / weak / dense / lightweight  <b>ignore</b> light / heavy</p> <p><b>ignore</b> medium cost in relation to <b>B</b>  <b>ignore</b> answers which merely quote numbers from the table</p>
Alloy	Advantages	Disadvantages																
<b>A</b>	low density / high strength	high cost																
<b>B</b>	high strength	high density																
<b>C</b>	high strength / low cost	high density																
<b>D</b>	low density / low cost	low strength																
ii	<b>A</b> (1)	1																
	<b>Total</b>	<b>8</b>																

Question	Answer	Marks	Guidance
8	<b>any two from:</b>  idea that it explains a wide range of evidence (1)  idea that it has been discussed and/or tested by other scientists (1)  idea that subsequent research has supported the theory (1)	2	<b>allow</b> reference to specific pieces of evidence such as sea floor spreading / evidence such as continents fitting together (1) <b>ignore</b> references to subduction / earthquakes & volcanoes
<b>Total</b>		<b>2</b>	

Question	Answer	Marks	Guidance
9	<p><b>[Level 3]</b>  <b>Extracts the correct conditions from the graph AND explains why both the temperature <u>and</u> the pressure giving the highest yield are not used.</b>            Quality of written communication does not impede communication of the science at this level.            (5 – 6 marks)</p> <p><b>[Level 2]</b>  <b>Extracts the correct conditions from the graph AND explains why the temperature <u>or</u> the pressure giving the highest yield is not used.</b>            Quality of written communication partly impedes communication of the science at this level.            (3 – 4 marks)</p> <p><b>[Level 1]</b>  <b>Extracts the correct conditions from the graph OR explains why the temperature <u>or</u> the pressure giving the highest yield is not used.</b>            Quality of written communication impedes communication of the science at this level.            (1 – 2 marks)</p> <p><b>[Level 0]</b>            Insufficient or irrelevant science. Answer not worthy of credit.            (0 marks)</p>	6	<p><b>This question is targeted at grades up to A*</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• any temperature from 350°C or below</li> <li>• any pressure from 400 atmospheres or above</li> </ul> <p><b>Explanations</b></p> <ul style="list-style-type: none"> <li>• 400 atm / high pressure is expensive to maintain / generate</li> <li>• cost of equipment / plant for high pressure is expensive</li> <li>• safety risks increase as pressure increases</li> <li>• at 350°C the rate of reaction is too slow</li> <li>• 450°C gives a lower yield at a higher rate</li> <li>• higher temperature means higher energy costs</li> </ul> <p><b>Simply extracting the correct conditions from the graph restricts the answer to L1</b></p> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>
		6	

Question	Answer	Marks	Guidance
10 a	so they can be absorbed by plants (through the roots) (1)	1	<b>allow</b> so they can be taken in through the roots (1)
b	<p><b>LEVEL OF RESPONSE MARK SCHEME</b></p> <p><b>Level 1</b> (1 mark) idea that fertiliser or nitrates increase the growth of water plants</p> <p><b>Level 2</b> (2 marks) idea that algal bloom blocks off (sun)light (from other plants which then die)</p> <p><b>Level 3</b> (3 marks) idea that in addition to level 2, (aerobic) bacteria use up the oxygen in the water</p>	3	<p><b>Mark scheme is hierarchical</b> – level 1 is required before level 2 can be awarded and levels 1 &amp; 2 required before level 3 can be awarded</p> <p><b>allow</b> algal bloom for increased growth of water plants idea that fertiliser kills or poisons fish does not score, but does not negate other correct science at level 1</p> <p><b>allow</b> idea that plants below surface cannot photosynthesis for level 2</p> <p><b>allow</b> decomposers or microbes or micro-organisms for bacteria</p> <p><b>allow</b> idea that the outcome is that living organisms in the water die (1), if no other mark awarded</p>
c	$\begin{array}{ccccccc} \text{potassium} & & \text{nitric} & & \text{potassium} & & \\ \text{hydroxide} & + & \text{(acid)} & \rightarrow & \text{nitrate} & + & \text{water} \end{array}$ <p>one correct product, ie potassium nitrate / water (1)</p> <p>rest of word equation correct (1)</p>	2	<p>equation must be totally correct for 2 marks</p> <p><b>allow</b> correct formulae or mix of names and formulae i.e. <math>\text{KOH} + \text{HNO}_3 \rightarrow \text{KNO}_3 + \text{H}_2\text{O}</math></p> <p><b>allow</b> hydrogen oxide</p>
<b>Total</b>		<b>6</b>	

Question	Answer	Marks	Guidance
11 a	idea that (metal <b>A</b> ) does not corrode in damp air (1)	1	<p><b>allow</b> the result in damp air (1)  <b>allow</b> idea that (metal <b>A</b>) <b>only</b> corrodes in damp acidic air  <b>allow</b> ORA ie all the other metals corrode in damp air</p> <p><b>ignore</b> references to dry air  <b>ignore</b> references to rusting</p>
b i	iron + water + oxygen → hydrated iron(III) oxide (1)	1	<p>order of reactants is unimportant</p> <p><b>allow</b> hydrated iron oxide  <b>not</b> iron(III) oxide / iron oxide  <b>ignore</b> incorrect oxidation state</p> <p><b>allow</b> <math>\text{Fe} + \text{H}_2\text{O} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}</math> (1)</p> <p><b>allow</b> mix of correct formulae and words</p>
ii	involves reaction with oxygen / forms an oxide (1)	1	<p><b>allow</b> addition of oxygen (1)  <b>allow</b> (iron) loses electrons / (iron) loses an electron (1)  <b>allow</b> oxidation number (of iron) increases (1)</p>
	<b>Total</b>	<b>3</b>	

Question	Answer	Marks	Guidance
12 a	LHS is 168 (1) RHS is 106 + 44 + 18 = 168 (1)	2	
b i	0.631 x 2.5 = 1.578 (1)	1	<p><b>allow</b> <math>\frac{2.500}{1.000} = 2.5</math> and <math>0.631 \times 2.5 = 1.578</math> (1)</p> <p><b>allow</b> <math>\frac{1.000}{2.500} = 0.4</math> and <math>0.631 \div 0.4 = 1.578</math> (1)</p> <p><b>allow</b> 2.500 g makes <math>\frac{106}{168} \times 2.5</math> g (1)</p> <p><b>allow</b> correct working that shows both masses are 63% of original mass (1)</p>
ii	<p><b>LOOK FOR ANSWER FIRST OF ALL IF % YIELD = 71.2 AWARD 2 MARKS</b></p> <p><math>\frac{1.124}{1.578} \times 100</math> (1)</p> <p>71.2 (1)</p>	2	<p>answer must have <b>three sig figs</b> <b>but</b> 71 scores (1)</p> <p><b>allow</b> <math>\frac{\text{actual}}{\text{predicted}} \times 100</math> or <math>\frac{am}{pm} \times 100</math> (1)</p>
	<b>Total</b>	<b>5</b>	



Question	Answer	Marks	Guidance
13 a	<p><b>[Level 3]</b>  <b>Describes two stages of extracting drug from plant material</b>  <b>AND</b>  <b>Explains why the drug is impure using <u>both</u> melting point and chromatography data.</b>            Quality of communication does not impede communication of science at this level.            (5-6 marks)</p> <p><b>[Level 2]</b>  <b>Describes one stage of extracting drug from plant material AND explains why the drug is impure using <u>either</u> melting point <u>or</u> chromatography data</b>  <b>OR</b>  <b>Describes two stages of extracting drug from plant material</b>  <b>OR</b>  <b>Explains why the drug is impure using <u>both</u> melting point and chromatography data.</b>            Quality of written communication partly impedes communication of the science at this level.            (3 – 4 marks)</p> <p><b>[Level 1]</b>  <b>Describes one stage of extracting drug from plant material</b>  <b>OR</b>  <b>Explains why the drug is impure using <u>either</u> melting point <u>or</u> chromatography data.</b>            Quality of communication impedes communication of the science at this level.            (1 – 2 marks)</p> <p><b>[Level 0]</b>  <b>Insufficient or irrelevant science. Answer not worthy of credit.</b>            (0 marks)</p>	6	<p><b>This question is targeted at grades up to C</b></p> <p><b>Indicative scientific points for extraction may include:</b></p> <ul style="list-style-type: none"> <li>• Crushing (plant material)</li> <li>• Boiling (with a solvent)</li> <li>• Dissolving (with a solvent) / solvent extraction</li> <li>• Chromatography</li> <li>• Crystallisation</li> <li>• Evaporation</li> <li>• Filtration</li> </ul> <p><b>Indicative scientific points for analysis may include:</b></p> <ul style="list-style-type: none"> <li>• Drug is impure</li> <li>• Chromatography shows that there are (at least) two substances (so not pure)</li> <li>• Melting point is below that of the pure sample so not pure</li> <li>• Melting point is a range so not pure</li> </ul> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks</b></p>

Question	Answer	Marks	Guidance
b	<p><b>any two from:</b></p> <p>idea that takes a (very) long time to get results (1)</p> <p>idea that need to test on humans which has ethical issues (1)</p> <p>idea the side effects may take a long time to show (1)</p> <p>idea that strict safety laws have to be met (1)</p>	2	<p><b>allow</b> idea that many tests need to be carried out (in developing a drug) (1)</p> <p><b>allow</b> idea that animal testing has ethical issues (1)</p> <p><b>allow</b> idea that difficult to find human volunteers to test drugs (1)</p> <p><b>ignore</b> references to cost / need for skilled workers</p>
	<b>Total</b>	<b>8</b>	

Question	Answer	Marks	Guidance
14 a	32 000 (1)	1	unit not needed
b	<p><b>LOOK FOR ANSWER FIRST OF ALL IF <math>\Delta T = 76.2</math> AWARD 3 MARKS</b></p> <p>Correct substitution into equation i.e.  <math>32\,000 = 100 \times 4.2 \times \Delta T</math> (1)</p> <p>Correct rearrangement of equation i.e.  <math display="block">\Delta T = \frac{32000}{100 \times 4.2} /</math> <math display="block">\Delta T = \frac{\text{energy}}{\text{mass} \times 4.2} \quad (1)</math></p> <p><math>\Delta T = 76.2</math> (1)</p>	3	<p><b>allow</b> 76 / 76.19 unit not needed</p> <p><b>allow</b> ecf from (a)</p> <p><b>allow</b> max 2 marks for correct rearrangement of equation using mass of 2g, or incorrect energy other than ecf,  ie <math>\Delta T = \frac{32000}{2 \times 4.2} / 3809.5</math> <b>or</b> <math>\frac{16000}{100 \times 4.2} / 38.1</math></p> <p><b>allow</b> max 1 mark for correct rearrangement of equation using incorrect mass and energy</p>
c	<p>bond breaking absorbs energy / bond breaking is endothermic (1)</p> <p>bond making releases energy / bond making is exothermic (1)</p> <p>more energy released than absorbed (1)</p>	3	<p><b>allow</b> bond breaking needs energy (1)</p> <p><b>not</b> bond making needs energy</p> <p><b>allow</b> heat instead of energy <b>ignore</b> references to more bonds</p>
	<b>Total</b>	<b>7</b>	

Question	Answer	Marks	Guidance
15 a	$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ (1)	1	<b>allow</b> correct multiples <b>allow</b> = or = instead of $\rightarrow$ <b>not</b> 'and' or & instead of +  <b>all</b> subscripts and case <b>must</b> be correct
b i	1.47 (1)	1	<b>allow</b> 1.46 / 1.5 (1) <b>unit not needed</b>
ii	60 (1)	1	<b>unit not needed</b>
c	particles more crowded / particles closer together / more particles in the same volume / more particles per unit volume (1)  more collisions (1)	2	<b>allow</b> particles more concentrated / more particles in the same area <b>not</b> just more particles <b>not</b> particles have more energy / move faster / more energetic collisions  <b>allow</b> higher level answers e.g. more frequent collisions / more collisions per second / collisions more often / more chance of collisions (1)
<b>Total</b>		<b>5</b>	

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