

# **Chemistry B**

General Certificate of Secondary Education

Unit **B642/02**: Modules C4, C5, C6 (Higher 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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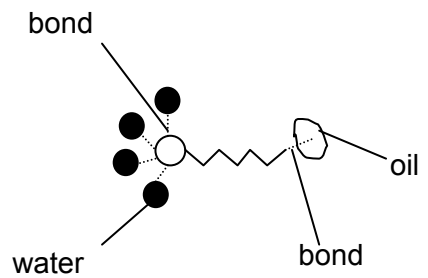
## Annotations

Annotation	Meaning
	correct response
	incorrect response
	benefit of doubt
	benefit of doubt <b>not</b> given
	error carried forward
	information omitted
	ignore
	reject
	contradiction

## Subject-specific Marking Instructions

Abbreviations, annotations and conventions used in the detailed mark scheme

/	=	alternative and acceptable conventions used in the detailed mark scheme
(1)	=	separates marking points
allow	=	answers that cannot 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 earn 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)	saves energy / can wash delicate clothes / colour does not become paler (1)	1	<p><b>allow</b> reduces the carbon footprint / less greenhouse gases / less global warming / aw  <b>allow</b> clothes will not lose colour / clothes will not shrink / clothes will not be damaged  <b>allow</b> enzymes are not denatured  <b>ignore</b> reference to cost  <b>ignore</b> reference to environmentally friendly  <b>allow</b> less carbon dioxide made (during energy production)</p>
(b) (i)	Drawing showing hydrophobic tail and hydrophilic head labelled (1)	1	<p><b>allow</b> polar head and non-polar tail</p>  <p style="text-align: center;">hydrophobic <span style="margin-left: 100px;"></span> hydrophilic</p>
(ii)	<p>hydrophobic end of detergent molecule is attracted to oil or stain / hydrophobic end forms intermolecular forces with oil or stain / hydrophobic end bonds to oil or stain (1)</p> <p>hydrophilic end of detergent is attracted to water / hydrophilic end forms intermolecular forces with water / hydrophilic end bonds to water to oil or stain (1)</p>	2	<p><b>if no other marks awarded</b>  <b>allow</b> tail is surrounded by oil molecules and the head by water molecules</p> <p><b>allow</b> as alternative to bonds sticks to, attached, joined the hydrophobic end sticks into oil is <b>not</b> sufficient</p> <p><b>all</b> marks can be awarded from a <b>labelled</b> diagram but to get two marks must clearly show bonding to rather than surrounded by</p>  <p style="text-align: center;">bond <span style="margin-left: 100px;"></span> oil</p> <p style="text-align: center;">water <span style="margin-left: 100px;"></span> bond</p> <p><b>allow</b> ecf from (b)(i)</p>
(c)	does not use water (1)	1	<b>ignore</b> it does not get wet
<b>Total</b>		<b>5</b>	

Question		Answer	Marks	Guidance
2	(a)	46.7 (%) (1)	1	<b>allow</b> 46.67 / 46.667 / 47 / any correctly rounded up calculator value
	(b)	<p><b>any two from:</b>            provides nitrogen / replaces nitrogen used up in soil (1)</p> <p>(nitrogen) gets used by plant to make plant proteins (1)</p> <p>idea that plant proteins are needed for growth (1)</p>	2	<p><b>not</b> contains potassium or phosphorus  <b>not</b> provides protein</p> <p><b>allow</b> (nitrogen) used to make amino acids / (nitrogen) used to make polypeptides</p> <p><b>allow</b> idea that amino acids or polypeptides needed for growth</p>
	(c)	phosphoric (acid) <b>and</b> ammonia / ammonium hydroxide (1)	1	<p><b>both needed</b>  <b>allow</b> ammonium carbonate / <math>(\text{NH}_4)_2\text{CO}_3</math>  <b>allow</b> <math>\text{NH}_3</math> / <math>\text{NH}_4\text{OH}</math> and <math>\text{H}_3\text{PO}_4</math>  <b>allow</b> acid-ammonia <b>and</b> alkali-phosphoric <u>acid</u>  <b>not</b> phosphorus (acid)  <b>not</b> ammonium / ammonia hydroxide</p>
	(d)	80 (1)	1	
<b>Total</b>			<b>5</b>	

Question		Answer	Marks	Guidance
3	(a)	carbon dioxide + hydrogen $\rightarrow$ methanol (1)	1	<p><b>allow</b> <math>\text{CO}_2 + \text{H}_2 \rightarrow \text{CH}_3\text{OH}</math>  <b>allow</b> mix of formulae and names  <b>allow</b> equilibrium sign / = instead of the arrow</p> <p><b>not</b> and / &amp; instead of +</p> <p><b>ignore</b> state symbols</p>
	(b)	reaction is faster / lowers activation energy / reaction time is shorter / can use a lower temperature / can use a lower pressure / less energy needed (1)	1	<p><b>allow</b> more successful collisions to happen</p> <p><b>ignore</b> increases the yield  <b>ignore</b> speeds up reaction time</p> <p><b>not</b> increases the percentage yield</p>
	(c)	<p><b>any two from:</b></p> <p>higher temperature (1)</p> <p>higher pressure (1)</p> <p>uses more energy / needs more power / needs more heat (1)</p>	2	<p><b>allow</b> uses more temperature /</p> <p><b>allow</b> uses more pressure / needs stronger containers for the reaction vessel</p> <p><b>ignore</b> method 1 uses only 1 substance as a catalyst but method 2 uses a mixture of 2 substances</p>
<b>Total</b>			<b>4</b>	

Question		Answer	Marks	Guidance
4	(a)	<p><b>any two from:</b></p> <p>nanotubes have a large surface area (1)</p> <p>catalyst can be attached to the nanotube (1)</p> <p>reacting molecules cannot escape / can cage molecules (1)</p> <p>idea that there are more collisions if molecules are trapped within the nanotube (1)</p>	2	<b>allow</b> particles, substances or reactants instead of molecules
	(b)	<p><b>any two from:</b></p> <p>semiconductors (1)</p> <p>reinforce graphite / tennis rackets / fishing rods (1)</p> <p>microchips (1)</p> <p>supply drugs / deliver medicines (1)</p> <p>allows chemical reactions to take place inside the cage (1)</p>	2	<b>ignore</b> reference to catalysts <b>ignore</b> used in electrical wiring / to conduct electricity
<b>Total</b>			<b>4</b>	

Question		Answer	Marks	Guidance
5		124 g makes 80g / 248 g makes 160 g / (moles of) $\text{CuCO}_3 = 0.2$ (1)  16.0 / 16 (1)	2	<b>allow</b> 64.5% or 65% of $\text{CuCO}_3$ is $\text{CuO}$  <b>allow</b> full marks for correct answer with no working out
		<b>Total</b>	<b>2</b>	



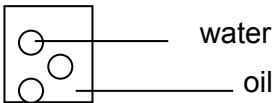
Question		Answer	Marks	Guidance
6	(a)	$C_2H_2O_4$ (1)	1	<b>allow</b> any order of atomic symbols <b>not</b> C2H2O4 / C <sup>2</sup> H <sup>2</sup> O <sup>4</sup>
	(b)	$H^+$ (1)	1	<b>allow</b> other ways of indicating correct response e.g. ringing or ticking the correct answer <b>but</b> answer line takes precedence
	(c)	will react with metal / will react with the element / corrodes the kettle (1)	1	<b>allow</b> strong(er) acid / it is strong(er) / it has too low a pH the kettle, metal or element is damaged is <b>not</b> sufficient <b>ignore</b> it is toxic / erode
		<b>Total</b>	<b>3</b>	

Question		Answer	Marks	Guidance
7	(a)	NaO (1)	1	<b>allow</b> other ways of indicating correct response e.g. ringing or ticking the correct answer <b>but</b> answer line takes precedence
	(b)	evidence that 3.90 is one half of 7.8 (1) 0.8 (g) (1)	2	<b>allow</b> full marks for correct answer on the answer line whether or not there is any working out <b>allow</b> (moles of) $\text{Na}_2\text{O}_2 = 0.05$
	(c)	carbon-12 (1)	1	<b>allow</b> other ways of indicating correct response e.g. ringing or ticking the correct answer <b>but</b> answer line takes precedence
<b>Total</b>			<b>4</b>	

Question	Answer	Marks	Guidance
8 (a)	they are the most reliable results / they are within 0.2 cm <sup>3</sup> / they are consistent results / they are most consistent / AW (1)	1	<b>allow</b> other result is anomalous / results are concordant / titres that are closest to one another / titres will be more accurate / all around 25 cm <sup>3</sup>
(b)	moles of HCl = $0.004 / 0.02 \times 0.2 / \frac{20}{1000} \times 0.2$ (1) moles of KOH = 0.004 (1) average titre = $25.0 \text{ cm}^3 / 25 \text{ cm}^3 / 0.025 \text{ dm}^3$ (1) concentration of KOH = 0.16 (1)	4	unit <b>not</b> needed  <b>allow</b> ecf for moles of KOH / moles KOH = moles HCl  unit <b>not</b> needed assume average titre is in cm <sup>3</sup> unless specified otherwise look for average titre in the expression for the concentration  unit <b>not</b> needed <b>allow</b> ecf for concentration / concentration = $\frac{\text{moles of KOH}}{0.025}$ or $\frac{\text{moles of KOH} \times 1000}{25}$ or $\frac{\text{moles of KOH}}{\text{titre}}$ or $\frac{\text{moles of KOH} \times 1000}{\text{titre}}$  <b>allow</b> full marks for concentration of KOH = 0.16 even if no working out shown  <b>allow</b> use of one of the titre values (rather than the average) to work out the concentration but this will have a maximum of three marks for the question
(c)	because it is neutralised / alkali that is added has a pH above 7 / AW (1)	1	<b>allow</b> it reacts / hydroxide ions are being added / hydrogen ions are removed / there are fewer hydrogen ions present <b>allow</b> it has reached neutralisation point
<b>Total</b>	<b>6</b>		

Question		Answer	Marks	Guidance
9	(a)	ions cannot move in solid / ions are fixed in solid / ions can only vibrate in solid (1)  ions can move in liquid (1)	2	<b>allow</b> charge carrier instead of ions <b>not</b> electrons can move or are fixed but penalise just once in the question <b>ignore</b> atoms can move or are fixed
	(b)	$\text{Pb}^{2+} + 2\text{e}^{-} \rightarrow \text{Pb}$  correct formulae including electrons (1);  balancing - dependent on correct formulae (1)	2	<b>allow</b> any correct multiple including fractions  <b>allow</b> = instead of arrow <b>allow</b> e for an electron  <b>allow</b> one mark for balanced equation with minor errors of superscript, subscript and/or case e.g. $\text{Pb}^{2+} + 2\text{e}^{-} \rightarrow \text{Pb}$
<b>Total</b>			<b>4</b>	

Question	Answer	Marks	Guidance
10	<p><b>any three from:</b></p> <p>idea that lower than 450 °C and the rate is too low (1)</p> <p>idea that higher than 450 °C moves the position of equilibrium to the left / aw (1)</p> <p>at atmospheric pressure the position of equilibrium is on the right hand side (1)</p> <p>increase in pressure will increase safety risks / increase in pressure will increase costs (1)</p>	3	<p><b>allow</b> use of percentage yield rather than position of equilibrium e.g. so equilibrium shifts to the left is the same as percentage yield decreases</p> <p><b>allow</b> (optimum) temperature that gives a fast rate of reaction without shifting position of equilibrium too much to the left for <b>two</b> marks</p>
	<b>Total</b>	<b>3</b>	

Question			Answer	Marks	Guidance
11	(a)	(i)	(A) has a (carbon-carbon) double bond	1	
		(ii)	bromine (water) (1)  goes red-brown to colourless / yellow to colourless / decolourised (1)	2	<b>allow</b> 2 marks for bromine water is decolourised  this mark is <b>dependent</b> on correct reagent or near miss e.g. bromide <b>allow</b> any shade of brown / orange <b>allow</b> goes colourless <b>ignore</b> goes clear  <b>not</b> goes discoloured
	(b)		saponification (1)	1	<b>allow</b> correct answer ticked, circled or underlined in list but answer line takes precedence.
	(c)		 small circles / droplets labelled water rest of space labelled oil (1)	1	<b>allow</b> any number of water droplets
<b>Total</b>				<b>5</b>	

Question		Answer	Marks	Guidance
12	(a)	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$  correct reagents and products (1)  correct balancing dependent on correct formulae (1)	2	<b>allow</b> any correct multiple including fractions <b>allow</b> = instead of $\rightarrow$ <b>not</b> and instead of + / + heat <b>allow</b> correct balanced equation with minor errors of subscripts, superscripts and case for one mark e.g. $2\text{H}_2\text{O} + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
	(b)	<b>any one from:</b>  fossil fuel running out / diesel or petrol is non-renewable / hydrogen and oxygen are renewable (1)  less or no greenhouse gases / water is only waste product (1)  fuel cell more efficient / fuel cell has direct energy transfer / ora for fossil fuel (1)	1	<b>ignore</b> more economic (cost in stem)  <b>allow</b> fuel cell is a renewable energy source <b>ignore</b> so we stop burning fossil fuels / reduces amount of fossil fuel burnt  <b>allow</b> less polluting / less carbon dioxide made <b>ignore</b> environmentally friendly / less damaging to environment / greener <b>allow</b> reduces carbon footprint / reduces carbon emissions  <b>allow</b> waste less energy
	(c)	$\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^- / \text{H}_2 - 2\text{e}^- \rightarrow 2\text{H}^+$  correct formula including electrons (1)  balancing dependent on correct formulae (1)	2	<b>allow</b> = for $\rightarrow$ <b>not</b> and for +  <b>allow</b> e for an electron  <b>allow</b> correct balanced equation with minor errors of subscripts, superscripts and case for one mark egg $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$
<b>Total</b>			<b>5</b>	

Question		Answer	Marks	Guidance
13	(a)	equation <b>B</b> (1) electrons are gained (by the O <sub>2</sub> ) (1)	2	this mark is dependent on identification of reaction <b>B</b>
	(b)	galvanising is putting a layer of zinc over the iron (1)  <b>and any two from:</b> (zinc) acts as a barrier to water / acts as a barrier to oxygen / aw (1)  zinc is more reactive than iron / zinc loses electrons more easily than iron (1)  zinc reacts (with water or oxygen) instead of iron (1)	3	<b>allow</b> zinc is above iron in the reactivity series <b>allow</b> ora if iron is specified  <b>allow</b> zinc acts as a sacrificial metal <b>ignore</b> zinc rusts instead of iron
<b>Total</b>			<b>5</b>	



Question		Answer	Marks	Guidance
14	(a)	$C_nH_{2n+2}O$ (1)	1	<b>allow</b> $C_nH_{2n+1}OH$ <b>allow</b> any order of symbols
	(b)	$C_4H_{10}O$ (1)	1	<b>allow</b> $C_4H_9OH$ <b>allow</b> any order of symbols
	(c) (i)	water / $H_2O$ (1)	1	<b>allow</b> steam
	(ii)	<b>any two from:</b> acid / phosphoric acid / catalyst (1) high temperature / heat (1) high pressure (1)	2	<b>not</b> the name of an incorrect catalyst  <b>allow</b> any temperature above 200 °C / hot  <b>allow</b> any pressure above atmospheric pressure
<b>Total</b>			<b>5</b>	

**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

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