

Chemistry B

General Certificate of Secondary Education

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

Mark Scheme for June 2012

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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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For answers marked by levels of response:

- a. **Read through the answer from start to finish**
- b. **Decide the level that best fits** the answer – match the quality of the answer to the closest level descriptor
- c. **To determine the mark within the level**, consider the following:













Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

- d. Use the **L1, L2, L3** annotations in Scoris to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6-mark extended writing questions may include:

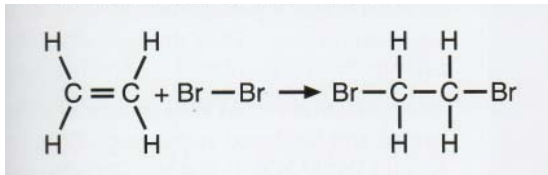
- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument of a debate in a balanced way
- logical sequencing.

Annotations used in scoris

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	Level 1
	Level 2
	Level 3
	reject
	contradiction

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

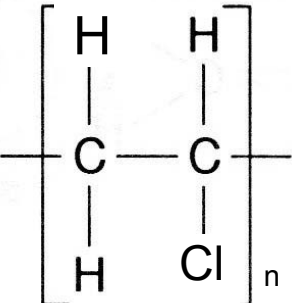
/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
allow	=	answers that can be accepted
not	=	answers which are not worthy of credit
reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant
()	=	words which are not essential to gain credit
<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)	contains single (covalent) bonds only / AW (1)	1	allow does not have a double bond allow fits the general formula C_nH_{2n+2} ignore reference to saturation
	(b)	ethene	1	allow C_2H_4 / correct displayed formula / ethylene
	(c)	$C_2H_4O_2$	1	allow symbols in any order ignore CH_3COOH not $C_2H_4O_2$ / $C_2H^4O_2$ / $C^2H^4O^2$
	(d)	$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$	1	allow correct equation using displayed formulae or mixture of molecular, correct structural and correct displayed formulae  allow = for \rightarrow not and & for +
		Total	4	

Question		Answer	Marks	Guidance
2	(a)	oil because <ul style="list-style-type: none"> • oil is easy to use / coal is not easy to use (1) • oil is available / natural gas is not available (1) 	2	marks are for explanation not oil is the cheapest but allow oil is the cheapest fuel that is available ignore oil is cheap / oil is cheaper
	(b)	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ correct reactants and products (1) correct balancing (1)	2	allow any correct multiple, including fractions allow = / \rightleftharpoons instead of \rightarrow not and / & / '+ energy' if included award 0 marks for the question balancing mark is dependent on the correct formulae but allow 1 mark for a balanced equation with a minor error in subscripts / formulae eg $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
		Total	4	

Question		Answer	Marks	Guidance
3	(a)	solvent evaporates / water evaporates (1)	1	allow liquid evaporates ignore binding medium oxidises not binding medium evaporates
	(b)	pigment C because (pigment C) is a thermochromic pigment / changes colour when temperature increases (1) (pigment will) act as a warning as the kettle heats up / indicates when the water is boiling / indicates when the water is hot (1)	2	marks are for explanation no marks if wrong pigment is chosen allow it changes colour as it is heated but not changes colour as heat increases
	(c)	pigment is dispersed throughout the mixture / solid scattered throughout the mixture / solid is dispersed throughout the mixture (1) (pigment or solid) particles are sufficiently small so as not to settle to the bottom (of the liquid) (1)	2	not pigment or solid dissolves allow pigment or solid particles are too small to separate from the liquid not reference to emulsifiers or detergents
		Total	5	

Question	Answer	Marks	Guidance
4	<p>[Level 3] One explanation why the levels of pollution have decreased and an explanation as to why it is important that atmospheric pollution is controlled. Explanations illustrated by a balanced symbol equation or word equation. Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p>[Level 2] One explanation why the levels of pollution have decreased and an explanation as to why it is important that atmospheric pollution is controlled. Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p>[Level 1] One explanation why the levels of pollution have decreased or an explanation as to why it is important that atmospheric pollution is controlled. 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>	6	<p>This question is targeted at grades up to A. Indicative scientific points at level 3 must include:</p> <ul style="list-style-type: none"> • $2\text{CO} + 2\text{NO} \rightarrow \text{N}_2 + 2\text{CO}_2$ • $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$ • $2\text{NO} \rightarrow \text{O}_2 + \text{N}_2$ • carbon monoxide + nitric oxide \rightarrow nitrogen + carbon dioxide • carbon monoxide + oxygen \rightarrow carbon dioxide • nitric oxide \rightarrow nitrogen + oxygen <p>Relevant points at all levels could include explanations</p> <ul style="list-style-type: none"> • carbon monoxide and oxides of nitrogen emissions from road transport has decreased due to increased used of catalytic converters on vehicles • catalytic converter removes carbon monoxide and oxides of nitrogen and converts them to nitrogen and carbon dioxide • less sulfur dioxide because less coal is burnt or sulfur is now removed from diesel • more efficient combustion of fuels to reduce carbon monoxide <p>needs to be controlled because:</p> <ul style="list-style-type: none"> • air pollution travels everywhere • atmospheric pollution affects the environment • atmospheric pollution affects people's health / can trigger asthma • these effects will get worse unless atmospheric pollution is controlled • want to have less acid rain (due to sulfur dioxide) • sulfur dioxide or nitrogen oxides causes acid rain • carbon monoxide is toxic • want to have less photochemical smog • want to reduce greenhouse gases
	Total	6	

Question		Answer	Marks	Guidance
5	(a)		1	<p>allow formula with or without 'n' after bracket</p> <p>allow formula without brackets</p> <p>allow a section of the polymer drawn eg with at least two repeat units</p> <p>answer must have free bonds at either end but bonds do not have to cross the bracket</p>
	(b)	<p>any two from:</p> <p>insoluble in water / does not dissolve in water / water-proof / leak-proof / not porous (1)</p> <p>does not corrode / does not react with water (and air) / non-biodegradable (1)</p> <p>non-toxic (1)</p>	2	<p>ignore does not rust</p> <p>allow strong</p> <p>ignore hard / hard wearing / tough / low density / lightweight</p>
	(c) (i)	<p>weak intermolecular forces / forces or bonds between polymer chains are weak (1)</p> <p>so polymer molecules can slide over one another / intermolecular forces are easy to break / AW (1)</p>	2	<p>allow polymer chains are not connected together</p> <p>allow it has no cross-linking</p> <p>allow no bonds between polymer chains</p> <p>any reference to bonds within the molecule are weak or weak</p> <p>covalent bonds scores 0 marks</p> <p>allow molecules are easy to separate (from one another)</p>
	(ii)	<p>cross links (between the polymer molecules) / strong bonds between the polymer molecules (1)</p>	1	<p>allow strong intermolecular bonds</p> <p>allow covalent bonds between polymer molecules</p> <p>ignore strong intermolecular forces</p> <p>ignore polymer has strong bonds – must have idea of bonds between polymer molecules</p>
Total			6	

Question		Answer	Marks	Guidance
6	(a)	<p>any two from: replaces essential elements (used by previous crop) / provides extra essential elements / provides two named essential elements (1)</p> <p>(more) nitrogen used to make plant protein (so increased growth) / nitrogen used to make amino acids (1)</p> <p>(more) phosphorus used to make ATP (1)</p>	2	<p>ignore reference to nitrates, ammonium and phosphates</p> <p>ignore reference to minerals and nutrients</p> <p>the essential elements are nitrogen, phosphorus and potassium</p>
	(b)	20 / twenty (1)	1	
	(c) (i)	potassium hydroxide (1)	1	<p>allow KOH</p> <p>allow potassium carbonate / potassium hydrogencarbonate / K_2CO_3 / $KHCO_3$</p> <p>ignore potassium oxide</p>
	(ii)	hydrogen ions reacted with hydroxide ions (to make H_2O) (1)	1	<p>allow $H^+ + OH^- \rightarrow H_2O$</p> <p>allow H^+ react with OH^-</p> <p>allow H^+ counteracted by OH^- / H^+ balanced by OH^-</p>
		Total	5	

Question		Answer	Marks	Guidance
7	(a)	<p>any one from:</p> <p>equipment required to predict eruptions is expensive (1)</p> <p>not enough geologists (to study all the volcanoes in the world) (1)</p> <p>eruptions may occur in remote parts of the world / eruptions may be underwater (1)</p> <p>difficult to research magma beneath the Earth's surface (1)</p>	1	<p>allow insufficient evidence to predict eruptions / difficult to spot the indicators of an eruption / no warning signs (to help predict eruption)</p> <p>allow there were new volcanoes that had not erupted before</p> <p>ignore idea of uncertainty in prediction</p> <p>allow have not got equipment to investigate the mantle</p>
	(b)	<p>any two from:</p> <p>It explains a wide range of evidence / there is (now) more evidence / there is (now) lots of evidence (1)</p> <p>subsequent research has supported the theory (1)</p> <p>it has been tested (1)</p>	2	<p>allow examples of specific evidence eg</p> <ul style="list-style-type: none"> • similar fossils found in Africa and South America • evidence of sea-bed spreading • accurate measuring of the movement of tectonic plates
		Total	3	

Question	Answer	Marks	Guidance
8	<p>[Level 3] Candidates describe reinforced concrete as a mixture of materials and uses the table of information to explain why reinforced concrete is a better construction material than concrete. Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p>[Level 2] Candidates describe reinforced concrete as a mixture of materials and uses the table of information to give one advantage of reinforced concrete over concrete. Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p>[Level 1] Candidates describe reinforced concrete as a mixture of materials or uses the table of information to give one advantage of reinforced concrete over concrete. 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>	6	<p>This question is targeted at grades up to A.</p> <p>Indicative scientific points at level 3 can include:</p> <ul style="list-style-type: none"> • buildings made of reinforced concrete will be able to flex more without collapsing • reinforced concrete is more flexible because of the flexibility of steel • both materials are very hard • steel is stronger than concrete so reinforced can hold a bigger load without breaking <p>Indicative scientific points at levels 1 and 2 can include</p> <ul style="list-style-type: none"> • reinforced concrete steel is more flexible • reinforced concrete is stronger • reinforced concrete is a composite material because it is a mixture of steel and concrete • a composite material is a mixture
	Total	6	

Question		Answer	Marks	Guidance
9	(a)	$2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ formulae correct (1) balancing (1) balancing mark is conditional on correct formulae	2	allow = instead of \rightarrow not and / & / instead of + allow any correct multiples, including fractions allow one mark for correct balanced equation with minor errors of case, subscript and superscript eg $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
	(b) (i)	(increasing the temperature) reduces the yield of sulfur trioxide (1)	1	
	(ii)	catalyst increases rate of reaction (1) a lower temperature would give a better yield but would slow the reaction (1) a higher pressure would increase the yield but a higher pressure would increase plant cost / higher pressure would increase the yield but increase energy cost / higher pressure increases the yield but increases the safety risks (1)	3	allow ora must specify the actual cost involved allow ora
		Total	6	

Question		Answer	Marks	Guidance
10	(a)	$2Cl - 2e^- \rightarrow Cl_2$ / $2Cl \rightarrow Cl_2 + 2e^-$ formulae correct (1) balancing (1)	2	balancing mark is conditional on correct formulae allow = / \Rightarrow instead of \rightarrow allow any correct multiples allow one mark for correct balanced equation with minor errors of case and subscript and superscript eg $2Cl - 2e^- \rightarrow Cl_2$ allow $Cl - e^- \rightarrow Cl(1)$ not $2Cl + 2e^- \rightarrow Cl_2$
	(b)	sodium hydroxide (1)	1	allow caustic soda allow NaOH
		Total	3	

Question		Answer	Marks	Guidance
11		<p>aluminium is a good conductor of electricity / aluminium has a low density (1)</p> <p>aluminium is not strong enough on its own so has to be supported by iron (1)</p>	2	<p>for 2 marks mention must be made of the use of iron</p> <p>allow aluminium is lightweight but ignore light</p> <p>allow iron is used because it is stronger than aluminium</p> <p>allow using iron brings the cost down / iron is less expensive than aluminium</p> <p>ignore reference to conductivity of iron</p>
		Total	2	

Question		Answer	Marks	Guidance	
12	(a)	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$ formulae (1) balancing (1)	2	allow any correct multiple, including fractions allow = / \rightleftharpoons instead of \rightarrow not and / & / '+ energy' balancing mark is dependent on the correct formulae but allow 1 mark for a balanced equation with a minor error in subscripts / formulae eg $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$	
	(b)	(i)	any value within range 5½ - 6 (minutes) (1)	1	
		(ii)	15 / 15.0 (1) cm ³ /min or cm ³ /minute (1)	2	allow 0.25 (1) cm ³ /s (1) not cm ³ /m
		(iii)	rate of reaction for first 2 minutes is greater than between 2 and 4 minutes / ora (1)	1	it is faster / it goes slower are not sufficient answer must be comparative allow rate is 15 for first 2 minutes and 8 for second 2 minutes allow reaction starts to slow down

Question		Answer	Marks	Guidance
12	(c)	<p>[Level 3] Answer applies understanding of the reacting particle model to comprehensively explain both ways of increasing the rate of reaction. Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p>[Level 2] Answer applies understanding of the reacting particle model to comprehensively explain one way of increasing the rate of reaction. Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p>[Level 1] Answer shows appreciation that the rate of reaction is increased by having more collisions in one of the two contexts or explains concentration using particles or uses surface area to explain crushed tablet. Quality of written communication impedes communication of the science at this level (1 – 2 marks)</p> <p>[Level 0] Quality of written communication impedes communication of the science at this level (0 marks)</p>	6	<p>This question is targeted at grades up to A.</p> <p>allow 'tablet' for calcium carbonate ignore faster collisions / quicker collisions ignore reference to 'more particles' ignore successful in terms of collisions but particles have more energy or move faster is not correct not atoms colliding</p> <p>Indicative scientific points at level 2 and 3 can include:</p> <p>concentration of hydrochloric acid</p> <ul style="list-style-type: none"> idea of increased collision frequency between acid particles and calcium carbonate / more collisions per second between acid particles and calcium carbonate <p>crushed tablet</p> <ul style="list-style-type: none"> idea of increased collision frequency between acid particles and calcium carbonate / more collisions per second between acid particles and calcium carbonate <p>Indicative scientific points at level 1 can include:</p> <p>concentration of hydrochloric acid</p> <ul style="list-style-type: none"> idea of more crowded acid particles / more acid particles in the same volume / more H⁺ ions in the same volume / acid particles closer together idea of more collisions between acid particles and particles of the tablet <p>crushed tablet</p> <ul style="list-style-type: none"> idea of increased surface area of calcium carbonate or tablet / more calcium carbonate or tablet particles exposed to the acid
		Total	12	

Question			Answer	Marks	Guidance
13	(a)	(i)	ammonia is needed in large amounts / ammonia is needed in high demand / AW (1) drugs or medicines are made on a relatively small scale / easy to switch to making a different drug / drugs are needed in small amounts / AW (1)	2	allow ammonia needed all year round allow demand for drug may be seasonal allow a batch can be re-called if there is a problem
		(ii)	making drugs is more labour intensive / more specialised or qualified workers to make a drug / less automation is possible when making drugs / more research and testing in drug manufacture / raw materials for drug manufacture may be rare or expensive to extract from plants / legislative demands (1)	1	allow ora for fertiliser labour costs are high is not sufficient more workers is not sufficient allow idea of need to have careful testing (of batches) / idea need to have more quality control
	(b)	(i)	percentage yield = $\frac{\text{actual yield}}{\text{predicted yield}} \times 100$ (1) but $\frac{6.0}{8.0} \times 100$ (2)	2	allow $\frac{\text{am}}{\text{pm}} \times 100$ (1) or $\frac{6.0}{8.0} = 0.75$ (1) 0.75 x 100 (1) No mark for 75%
		(ii)	any two from: to reduce wasting reactants (1) to reduce costs / to make more money / to make more profit (1) saves wasting energy (1)	2	ignore reduces waste / reduces waste products / waste materials to make money is not sufficient / to make a profit is not sufficient / to save money is not sufficient
			Total	7	

Question			Answer	Marks	Guidance
14	(a)	(i)	same mass or volume or amount of water (in copper can) / same distance between burner and copper can / use same burner each time / same copper can / same size flame or wick (1)	1	ignore same mass of fuel ignore use the same equipment ignore using the same starting temperature
		(ii)	repeat experiment / AW (1)	1	allow compare with results from other students
	(b)		energy released = $100 \times 4.2 \times 25 / 10\ 500$ (1) $10\ 500 \div 0.6\text{g} = 17500$ / energy per gram = 17 500 (1)	2	units not needed 17 500 on its own scores (2) if answer not to 3 sig figs, eg 17 500.00, then one mark only allow ecf from wrong energy released to include 3 sig figs ie energy released $\div 0.6$
	(c)		evidence of calculation of energy per gram for ethanol and/or petrol (1) idea that paraffin transfers more than twice the energy transferred by petrol/ethanol, but is only slightly more expensive (1)	2	allow evidence of using temperature change per gram instead
			Total	6	

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