OCR
RECOGNISING ACHIEVEMENT

GCSE

# 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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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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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:

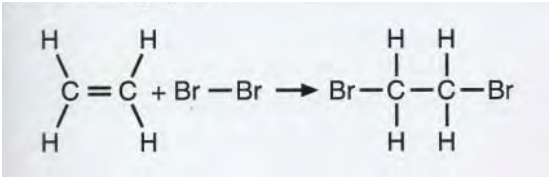
- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument of a debate in a balanced way
- logical sequencing.

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.

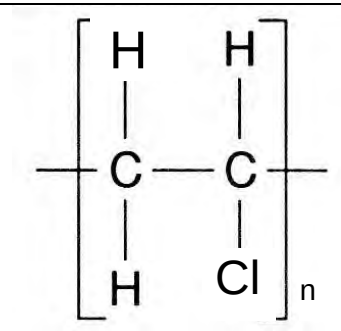
| | | |
|---|---|---|
| / | = | alternative and acceptable answers for the same marking point |
| **(1)** | = | separates marking points |
| **allow** | = | answers that can be accepted |
| **not** | = | answers which are not worthy of credit |
| **reject** | = | answers which are not worthy of credit |
| **ignore** | = | statements which are irrelevant |
| ( ) | = | words which are not essential to gain credit |
| __ | = | 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<br>**allow** fits the general formula $C_nH_{2n+2}$<br>**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<br>**ignore** $CH_3COOH$<br>**not** C2H4O2 / $C_2H^4O_2$/ $C^2H^4O^2$ |
| | (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<br>  <br>**allow = for →**<br>**not and & for +** |
| | | | **Total** | **4** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 2 | (a) | | oil<br><br>because<br>• oil is easy to use / coal is not easy to use (1)<br>• oil is available / natural gas is not available (1) | 2 | **marks are for explanation**<br><br>**not** oil is the cheapest but **allow** oil is the cheapest fuel that is available<br><br>**ignore** oil is cheap / oil is cheaper |
| | (b) | | $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$<br><br>correct reactants and products (1)<br><br>correct balancing (1) | 2 | **allow** any correct multiple, including fractions<br>**allow** = / ⇌ instead of →<br>**not** and / & / '+ energy' if included award 0 marks for the question<br><br>balancing mark is dependent on the correct formulae but<br>**allow** 1 mark for a balanced equation with a minor error in subscripts / formulae<br>eg $C_3H_8 + 5O2 \rightarrow 3CO2 + 4H_2O$ |
| | | | **Total** | **4** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | (a) | | solvent evaporates / water evaporates (1) | 1 | **allow** liquid evaporates<br>**ignore** binding medium oxidises<br>**not** binding medium evaporates |
| | (b) | | pigment **C**<br><br>because<br>(pigment **C**) is a thermochromic pigment / changes colour when temperature increases (1)<br><br>(pigment will) act as a warning as the kettle heats up / indicates when the water is boiling / indicates when the water is hot<br>(1) | 2 | **marks are for explanation**<br><br>no marks if wrong pigment is chosen<br><br>**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)<br><br>(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<br><br>**allow** pigment or solid particles are too small to separate from the liquid<br><br>**not** reference to emulsifiers or detergents |
| | | | **Total** | **5** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 4 | | | **[Level 3]**<br>One explanation why the levels of pollution have decreased **and** an explanation as to why it is important that atmospheric pollution is controlled.<br>Explanations illustrated by a balanced symbol equation or word equation.<br>Quality of written communication does not impede communication of the science at this level<br>(5 – 6 marks)<br><br>**[Level 2]**<br>One explanation why the levels of pollution have decreased **and** an explanation as to why it is important that atmospheric pollution is controlled.<br>Quality of written communication partly impedes communication of the science at this level<br>(3 – 4 marks)<br><br>**[Level 1]**<br>One explanation why the levels of pollution have decreased **or** an explanation as to why it is important that atmospheric pollution is controlled.<br><br>Quality of written communication impedes communication of the science at this level<br>(1 – 2 marks)<br>**[Level 0]**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br>(0 marks) | 6 | **This question is targeted at grades up to A.**<br>**Indicative scientific points at level 3 must include:**<br>• $2CO + 2NO \rightarrow N_2 + 2CO_2$<br>• $2CO + O_2 \rightarrow 2CO_2$<br>• $2NO \rightarrow O_2 + N_2$<br>• carbon monoxide + nitric oxide → nitrogen + carbon dioxide<br>• carbon monoxide + oxygen → carbon dioxide<br>• nitric oxide → nitrogen + oxygen<br>**Relevant points at all levels could include explanations**<br>• carbon monoxide and oxides of nitrogen emissions from road transport has decreased due to increased used of catalytic converters on vehicles<br>• catalytic converter removes carbon monoxide and oxides of nitrogen and converts them to nitrogen and carbon dioxide<br>• less sulfur dioxide because less coal is burnt or sulfur is now removed from diesel<br>• more efficient combustion of fuels to reduce carbon monoxide<br>**needs to be controlled because:**<br>• air pollution travels everywhere<br>• atmospheric pollution affects the environment<br>• atmospheric pollution affects people's health / can trigger asthma<br>• these effects will get worse unless atmospheric pollution is controlled<br>• want to have less acid rain (due to sulfur dioxide)<br>• sulfur dioxide or nitrogen oxides causes acid rain<br>• carbon monoxide is toxic<br>• want to have less photochemical smog<br>• want to reduce greenhouse gases |
| | | | **Total** | **6** | |

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

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

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 7 | (a) | | **any one from:**<br><br>equipment required to predict eruptions is expensive (1)<br>not enough geologists (to study all the volcanoes in the world) (1)<br>eruptions may occur in remote parts of the world / eruptions may be underwater (1)<br>difficult to research magma beneath the Earth's surface (1) | 1 | **allow** insufficient evidence to predict eruptions / difficult to spot the indicators of an eruption / no warning signs (to help predict eruption)<br>**allow** there were new volcanoes that had not erupted before<br>**ignore** idea of uncertainty in prediction<br><br>**allow** have not got equipment to investigate the mantle |
| | (b) | | **any two from:**<br><br>It explains a wide range of evidence / there is (now) more evidence / there is (now) lots of evidence (1)<br><br>subsequent research has supported the theory (1)<br><br>it has been tested (1) | 2 | **allow** examples of specific evidence eg<br>• similar fossils found in Africa and South America<br>• evidence of sea-bed spreading<br>• accurate measuring of the movement of tectonic plates |
| | | | **Total** | **3** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 8 | | | **[Level 3]**<br>Candidates describe reinforced concrete as a mixture of materials<br>**and**<br>uses the table of information to explain why reinforced concrete is a better construction material than concrete.<br>Quality of written communication does not impede communication of the science at this level<br>(5 – 6 marks)<br>**[Level 2]**<br>Candidates describe reinforced concrete as a mixture of materials<br>**and**<br>uses the table of information to give one advantage of reinforced concrete over concrete.<br>Quality of written communication partly impedes communication of the science at this level<br>(3 – 4 marks)<br>**[Level 1]**<br>Candidates describe reinforced concrete as a mixture of materials<br>**or**<br>uses the table of information to give one advantage of reinforced concrete over concrete.<br>Quality of written communication impedes communication of the science at this level<br>(1 – 2 marks)<br>**[Level 0]**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br>(0 marks) | 6 | **This question is targeted at grades up to A.**<br><br>**Indicative scientific points at level 3 can include:**<br><br>• buildings made of reinforced concrete will be able to flex more without collapsing<br>• reinforced concrete is more flexible because of the flexibility of steel<br>• both materials are very hard<br>• steel is stronger than concrete so reinforced can hold a bigger load without breaking<br><br>**Indicative scientific points at levels 1 and 2 can include**<br><br>• reinforced concrete steel is more flexible<br>• reinforced concrete is stronger<br>• reinforced concrete is a composite material because it is a mixture of steel and concrete<br>• a composite material is a mixture |
| | | | **Total** | **6** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 9 | (a) | | $2SO_2 + O_2 \rightarrow 2SO_3$<br><br>formulae correct (1)<br>balancing (1)<br><br>balancing mark is conditional on correct formulae | 2 | **allow** = instead of →<br>**not** and / & / instead of +<br>**allow** any correct multiples, including fractions<br>**allow** one mark for correct balanced equation with minor errors of case, subscript and superscript<br>eg 2SO2 + $O_2$ → 2SO3 |
| | (b) | (i) | (increasing the temperature) reduces the yield of sulfur trioxide (1) | 1 | |
| | | (ii) | catalyst increases rate of reaction (1)<br><br>a lower temperature would give a better yield but would slow the reaction (1)<br><br>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 | <br><br>**allow** ora<br><br>must specify the actual cost involved<br>**allow** ora |
| | | | **Total** | **6** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 10 | (a) | | $2Cl^- - 2e^- \rightarrow Cl_2$ / $2Cl^- \rightarrow Cl_2 + 2e^-$<br>formulae correct (1)<br>balancing (1) | 2 | balancing mark is conditional on correct formulae<br>**allow** = / ⇌ instead of →<br>**allow** any correct multiples<br>**allow** one mark for correct balanced equation with minor errors of case and subscript and superscript<br>eg $2Cl^- - 2e^- \rightarrow Cl2$<br>**allow** $Cl^- - e^- \rightarrow Cl$ (1)<br>**not** $2Cl^- + 2e^- \rightarrow Cl_2$ |
| | (b) | | sodium hydroxide (1) | 1 | **allow** caustic soda<br>**allow** NaOH |
| | | | **Total** | **3** | |

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

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 12 | (a) | | $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$<br><br>formulae (1)<br>balancing (1) | 2 | **allow** any correct multiple, including fractions<br>**allow** = / ⇌ instead of →<br>**not** and / & / '+ energy'<br><br>balancing mark is dependent on the correct formulae but<br>**allow** 1 mark for a balanced equation with a minor error in subscripts / formulae<br>eg $CaCO3 + 2HCl \rightarrow CaCl2 + CO2 + H_2O$ |
| | (b) | (i) | any value within range 5½ - 6 (minutes) (1) | 1 | |
| | | (ii) | 15 / 15.0 (1)<br><br>$cm^3$/min or $cm^3$/minute (1) | 2 | <br><br>**allow** 0.25 (1) $cm^3/s$ (1)<br>**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<br><br>answer must be **comparative**<br><br>**allow** rate is 15 for first 2 minutes and 8 for second 2 minutes<br><br>**allow** reaction starts to slow down |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 12 | (c) | | **[Level 3]**<br>Answer applies understanding of the reacting particle model to comprehensively explain **both** ways of increasing the rate of reaction.<br>Quality of written communication does not impede communication of the science at this level<br>(5 – 6 marks)<br><br>**[Level 2]**<br>Answer applies understanding of the reacting particle model to comprehensively explain **one** way of increasing the rate of reaction.<br>Quality of written communication partly impedes communication of the science at this level<br>(3 – 4 marks)<br><br>**[Level 1]**<br>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.<br>Quality of written communication impedes communication of the science at this level<br>(1 – 2 marks)<br><br>**[Level 0]**<br>Quality of written communication impedes communication of the science at this level<br>(0 marks) | 6 | **This question is targeted at grades up to A.**<br><br>**allow** 'tablet' for calcium carbonate<br>**ignore** faster collisions / quicker collisions<br>**ignore** reference to 'more particles'<br>**ignore** successful in terms of collisions but particles have more energy or move faster is not correct<br>**not** atoms colliding<br><br>**Indicative scientific points at level 2 and 3 can include:**<br><br>**concentration of hydrochloric acid**<br>• idea of increased collision frequency between acid particles and calcium carbonate / more collisions per second between acid particles and calcium carbonate<br><br>**crushed tablet**<br>• idea of increased collision frequency between acid particles and calcium carbonate / more collisions per second between acid particles and calcium carbonate<br><br>**Indicative scientific points at level 1 can include:**<br><br>**concentration of hydrochloric acid**<br>• idea of more crowded acid particles / more acid particles in the same volume / more $H^+$ ions in the same volume / acid particles closer together<br>• idea of more collisions between acid particles and particles of the tablet<br><br>**crushed tablet**<br>• 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)<br><br>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<br><br>**allow** demand for drug may be seasonal<br><br>**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<br>labour costs are high is **not** sufficient<br>**more** workers is not sufficient<br><br>**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)<br>**but**<br><br>$\frac{6.0}{8.0} \times 100$ (2) | 2 | **allow** $\frac{\text{am}}{\text{pm}} \times 100$ (1) **or** $\frac{6.0}{8.0} = 0.75$ (1)<br><br>0.75 x 100 (1)<br><br>No mark for 75% |
| | | (ii) | **any two from:**<br>to reduce wasting **reactants** (1)<br><br>to reduce costs / to make more money / to make more profit (1)<br><br>saves wasting energy (1) | 2 | **ignore** reduces waste / reduces waste products / waste materials<br><br>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<br><br>**ignore** use the same equipment<br><br>**ignore** using the same starting temperature |
| | | (ii) | repeat experiment / AW (1) | 1 | **allow** compare with results from other students |
| | (b) | | energy released = 100 x 4.2 x 25 / 10 500 (1)<br><br>10 500 ÷ 0.6g = 17500 / energy per gram = 17 500 (1) | 2 | **units not needed**<br><br>17 500 on its own scores (2)<br><br>if answer not to 3 sig figs, eg 17 500.00, then one mark only<br><br>**allow** ecf from wrong energy released to include 3 sig figs<br>ie energy released ÷ 0.6 |
| | (c) | | evidence of calculation of energy per gram for ethanol and/or petrol (1)<br><br>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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