OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry B

General Certificate of Secondary Education

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

Mark Scheme for June 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.

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

1. For answers marked by levels of response:
   a. **Read through the whole 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 include:
a. appropriate use of correct scientific terms
b. spelling, punctuation and grammar
c. developing a structured, persuasive argument
d. selecting and using evidence to support an argument
e. considering different sides of a debate in a balanced way
f. logical sequencing.

2. **Annotations**

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt **not** given
	error carried forward
	information omitted
	ignore

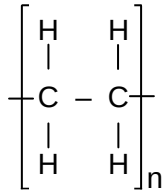
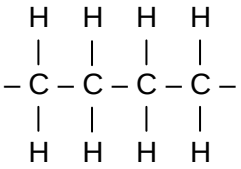
Annotation	Meaning
	reject
	contradiction
	Level 1
	Level 2
	Level 3

3. 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)		gas — percentage **nitrogen** (78%) **oxygen** (21%) (carbon dioxide) **0.035%** **all three correct** (2) **but** **one or two correct** (1)	2	**allow** carbon dioxide between 0.03 and 0.04%
	(b)	(i)	**any two from:** idea that air quality is maintained (1) reduce or prevent harm to living organisms (1) control or reduce smog (1) protect buildings and/or metals (1)	2	**allow** so that air is safe to breathe (1) **allow** reference to reducing asthma (1) **allow** (carbon monoxide) is poisonous or toxic (1) **ignore** just kills people **ignore** damage the environment **allow** reduce damage to ozone layer (1) **allow** greenhouse effect or global warming or acid rain (1) **allow** an effect of damage to ozone layer, global warming or acid rain (1)

Question			Answer	Marks	Guidance
		(ii)	(catalytic converter) changes carbon monoxide into carbon dioxide (1) balanced symbol equation: $2CO + 2NO \rightarrow N_2 + 2CO_2$ formulae (1) balancing (1)	3	**allow** changes nitrogen oxide / NO into nitrogen / N_2 (1) **first marking point can be credited from a symbol equation (even if incorrect)** **allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & balancing mark is dependent on the correct formula **but allow** 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc eg 2CO + 2NO → N2 + 2CO2
	(c)		as (the concentration of) smoke increased, the number of deaths increased / ora (1) as (the concentration of) sulfur dioxide increased, the number of deaths increased / ora (1)	2	**allow** as concentration increases deaths increase (1) **allow** idea that graphs have the same shape (1) **allow** the higher the (concentrations of) smoke and sulfur dioxide, the more deaths (per day) (2)
			Total	**9**	

Question			Answer	Marks	Guidance
2	(a)		(formula) does not contain **only** carbon and hydrogen / (formula) does contain oxygen (1)	1	**not** (formula) contains an oxygen molecule
	(b)		**D** (1)	1	
	(c)		**E** (1)	1	
	(d)		 (1)	1	**allow**  or other carbon chain with even number of CH_2 units
			Total	**4**	

Question			Answer	Marks	Guidance
3	(a)		(solvent) **D** (1) idea that removes more of the stain than **B**, without damaging the fabric / idea that removes majority of the stain, without damaging the fabric (1)	2	**Second marking point is dependent on correct choice of solvent D** **allow** idea that removes a high percentage of the stain, without damaging the fabric (1)
	(b)		**any two from:** repeat the experiment (at each temperature) (1) carry out the experiment with a greater range of temperatures (1) do the experiment for a longer time (1) test on different types of stain (1) test on different types of cotton (1)	2	**allow** specific aspects related to a fair test (1) e.g. use same amount of solvent **ignore** test on different fabrics
			Total	**4**	

Question			Answer	Marks	Guidance
4	(a)		**Level 3 (5–6 marks)** **Comprehensively explains the process of fractional distillation in terms of molecular size, intermolecular forces and boiling points** **AND** **Applies knowledge of temperature gradient in fractionating tower to correctly list the fractions in the order they 'exit' the tower.** Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** **Attempts to explain the process of fractional distillation in terms of molecular size and/or intermolecular forces and boiling points** **AND** **Applies knowledge of temperature gradient in fractionating tower to list the fractions in the order they 'exit' the tower.** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** **Describes the process of fractional distillation, but answer may be simplistic and lacking in detail** **OR** **lists the fractions in the correct order.** Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A*.** **Indicative scientific points at levels 2 and 3 may include:** • smaller molecules, eg LPG / petrol / paraffin, have weaker or fewer intermolecular forces / ora • smaller molecules have lower boiling points with weaker or fewer intermolecular forces / ora • during boiling the weak intermolecular forces break but covalent bonds within the molecule do not. **Indicative scientific points at Level 1 may include:** • crude oil is heated • fractionating column has temperature gradient (cold at top and hot at bottom) • order of fractions, from top, is: LPG petrol paraffin heating oil fuel oils bitumen **Use the L1, L2, L3 annotations in scoris; do not use ticks.**

Question			Answer	Marks	Guidance
	(b)		$C_3H_8 + 3½O_2 \rightarrow 3CO + 4H_2O$ formulae (1) balancing (1)	2	**allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & balancing mark is dependent on the correct formula **but** **allow** 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc eg $C_3H_8 + 3½O2 \rightarrow 3CO + 4H2O$
			Total	**8**	

Question			Answer	Marks	Guidance
5	(a)	(i)	4 (1)	1	
		(ii)	15 (1)	1	
	(b)		**Level 3 (5–6 marks)** **Names <u>both</u> the reagents needed** **<u>AND</u>** **Describes a neutralisation experiment, including how both a neutral solution <u>and</u> solid ammonium sulfate is obtained.** Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** **Names <u>both</u> the reagents needed** **<u>AND</u>** **Attempts to describe a neutralisation experiment.** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** **Names <u>one</u> of the reagents needed** **<u>OR</u>** **Attempts to describe a neutralisation experiment.** Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A*.** **Indicative scientific points may include:** **names of reagents** • acid is sulfuric acid • alkali is (a solution of) ammonia or ammonium hydroxide or ammonium carbonate. **method** • sulfuric acid is added to ammonia solution until a neutral solution is formed • neutral solution obtained by use of pH meter / indicator solution / indicator paper / universal indicator solution • the neutral solution is evaporated until saturated • solution is allowed to stand and crystallise • crystals are filtered off and dried. **allow** idea of 'evaporation to dryness' as an alternative to crystallisation **N.B.** It is not necessary to describe a titration method to get Level 3. **Use the L1, L2, L3 annotations in scoris; do not use ticks.**
			Total	**8**	

Question			Answer	Marks	Guidance
6	(a)	(i)	(copper carbonate is) broken down (using heat) (1)	1	**allow** two or more substances are produced from one substance (by heating) (1) **allow** break up of (copper carbonate) (with heat) (1) **ignore** breaks up bonds **not** heat particles broken down **ignore** decay / dissolve
		(ii)	$2CuO + C \rightarrow 2Cu + CO_2$ formulae correct (1) balancing (1)	2	**allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & **not** '+ heat' in equation balancing mark is dependent on the correct formula **but** **allow** 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc 2CuO + C → 2CU + CO2
	(b)	(i)	at the anode electrons are lost which is oxidation (1) at the cathode electrons are gained which is reduction (1)	2	**allow** 1 mark if oxidation is described as electron loss and reduction as electron gain without identification of the electrodes or with incorrect identification of the electrodes
		(ii)	the anode loses mass because copper ions go into solution (1) the cathode gains mass because the copper ions gain electrons and become copper (1)	2	if ion is missed out in both marking points then **allow** one mark **allow** copper ions move from the anode to the cathode for 1 mark if no other mark awarded

Question			Answer	Marks	Guidance
	(c)		**advantages any one from:** saves resources (because the ore does not have to be extracted) (1) uses less energy (1) idea of less environmental damage (due to quarrying) (1) **problems any one from:** copper has to be collected (1) copper has to be sorted from other metals (1)	2	must be **one** advantage and **one** problem for 2 marks **allow** copper is in short supply (1) **ignore** saves landfill space **allow** loss of jobs mining or extracting copper ore (1)
	(d)		(aluminium because) low(est) density (1) and does not corrode (1) **or** (copper because) best conductor (1) and only corrodes slowly (1)	2	no mark for metal; marks are for explanation **ignore** (aluminium because) it is light **ignore** other factors from the table **allow** (copper because it is) a good conductor (1) **ignore** other factors from the table **allow** one mark for iron because it is strongest
			Total	**11**	

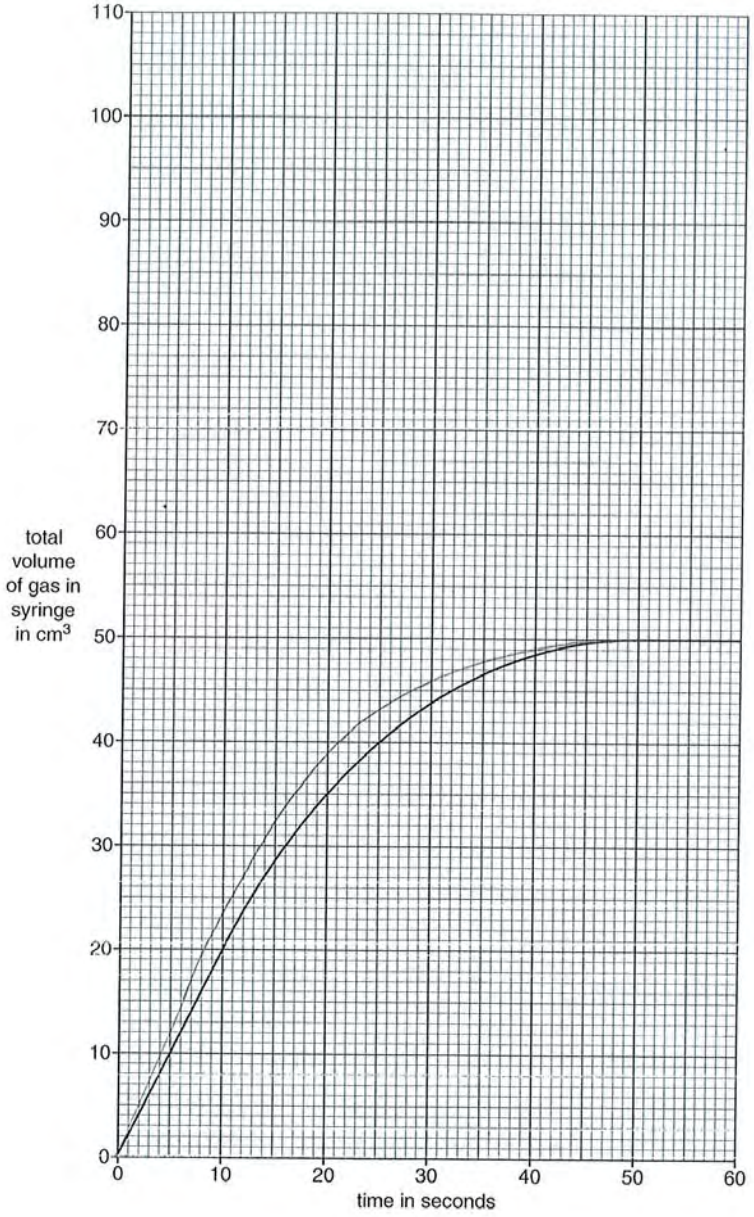
Question			Answer	Marks	Guidance
7	(a)		**B** (1)	1	**allow** correct answer ticked, circled or underlined in list if the answer line is blank
	(b)		**any two from:** the temperature or pressure chosen is a compromise (1) the high temperature gives a high rate of reaction (1) high pressure increases the percentage yield of ethanol (1) at higher temperatures the percentage yield is lower (1) higher pressures are expensive to maintain or generate (1)	2	**allow** answer relating to the risks associated with high pressure (1)
			Total	**3**	

Question			Answer	Marks	Guidance
8	(a)		idea that the lithosphere has a lower density than the inner mantle (1)	1	assume unqualified answer refers to the lithosphere e.g. 'it is less dense than the inner mantle' **allow** idea that the crust and outer mantle have a lower density than the inner mantle / ora (1) **ignore** the crust and the outer mantle are lighter than the inner mantle
	(b)		idea that there is a greater range of evidence (1) idea that (more) scientists have discussed or tested the theory (1)	2	**allow** there is better technology (1)
			Total	**3**	

Question			Answer	Marks	Guidance
9	(a)		allotropes (1)	1	**allow** allotropy (1) **allow** giant structures or giant molecules (1)
	(b)		graphene only contains strong (carbon to carbon) covalent bonds (1) graphite contains weak forces or bonds between the layers (of carbon atoms) (1)	2	**allow** graphene only allows strong bonds between atoms (1) **not** strong ionic bonds / strong intermolecular forces **allow** van der Waals' forces between layers or (weak) intermolecular forces (1) **not** weak covalent bonds between layers **ignore** graphite has layers held loosely together
	(c)		**any two from:** (diamond) has a high melting point (1) (diamond) is very hard (1)	2	 **ignore** other properties from the table **allow** (diamond) is a good thermal conductor (1)
			Total	**5**	

Question			Answer	Marks	Guidance
10	(a)		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ formulae correct (1) balancing (1)	2	**allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & balancing mark is dependent on the correct formula **but** **allow** 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc $Mg + 2HCL \rightarrow MgCl2 + H_2$
	(b)	(i)	47–51 (seconds) (1)	1	
		(ii)	2 (cm^3/s) (1)	1	**allow** 120 cm^3/min (1)
		(iii)	Please see suggested answer on page 15 line drawn to left of original and passing through the origin (1) line ending at same volume (1)	2	 **allow** line drawn to left of original but ending above or below 50 cm^3 (1) **allow** line drawn to right of original but ending at 50 cm^3 (1)
			Total	**6**	

Question 10 (b) (iii)



Question			Answer	Marks	Guidance
11	(a)		**any one from:** idea that pharmaceutical drugs are usually required or made in smaller quantities (1) idea that pharmaceutical drugs are made as required (1) **any one from:** idea that fertilisers are made in large quantities (1) idea that fertilisers are made 24/7 (1)	2	must be **one** comment on pharmaceutical drugs and **one** on fertilisers for two marks **allow** idea that can control each batch for purity (1)

Question			Answer	Marks	Guidance
	(b)		**Level 3 (5–6 marks)** **Calculates the atom economy for the given reaction** **AND** **Explains clearly why an industrial process should have as high an atom economy as possible.** Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** **Calculates the atom economy for the given reaction** **OR** **Gives at least two reasons why an industrial process should have as high an atom economy as possible.** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** **Gives a reason why an industrial process should have as high an atom economy as possible** **OR** **calculates the required formula masses of magnesium nitrate and water.** Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit.	6	**This question is targeted at grades up to A*.** **Indicative scientific points may include:** **reasons for need for high atom economy:** • to reduce the production of unwanted products (makes less waste is **not** sufficient) • to make the process more sustainable • in this reaction water is the only unwanted product so the process is very green. **calculation of atom economy:** • recall $\text{atom economy} = \frac{\text{molecular mass of all of the desired products}}{\text{sum of all of the molecular masses of all of the products}} \times 100\%$ • formula mass of magnesium nitrate = 148 • formula mass of water = 18 • formula mass of all products = 166 • atom economy = 89%. **Use the L1, L2, L3 annotations in scoris; do not use ticks.**
			Total	**8**	

Question			Answer	Marks	Guidance
12	(a)		bond making is exothermic / bond making gives out energy / bond making releases energy (1) more energy taken in than is released / more energy absorbed than given out (1) **but** it takes more energy to break the bonds than the energy released in making new bonds scores (2)	2	**allow** heat instead of energy **ignore** more bonds are broken than are made
	(b)	(i)	energy = 100 × 4.2 × 20 (1) **but** energy = 8400 (J) (2)	2	**allow** full marks for correct answer with no working out **allow** 2.2 x 4.2 x 20 or 184.8 (J) (1) **allow** 8.4 kJ (2)
		(ii)	highest temperature **change** (1) for least amount of fuel burnt (1)	2	**allow** calculation of energy change for each fuel showing that paraffin releases most energy (2) **allow** ecf from (b)(i) for energy calculations based on using the mass of fuel (instead of the mass of water) (2)
			Total	**6**	

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