OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry B

General Certificate of Secondary Education

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

Mark Scheme for January 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.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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:

- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides 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

Annotation	Meaning
	ignore
	reject
	contradiction

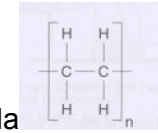
Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/ = 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)		carbon dioxide / CO_2 (1)	1	**ignore** CO2 / CO^2 **ignore** steam
	(b)		the protein molecule is denatured / the shape of the protein molecule changes (1)	1	**ignore** protein molecule is broken down **allow** structure changes **allow** intermolecular forces are broken
			Total	**2**	

Question			Answer	Marks	Guidance
2	(a)		78 % (1)	1	**allow** any percentage between 77% and 79%
	(b)		no (0) idea that people were not burning fossil fuels to the same extent prior to 1800 (1) up to 1800 the level of carbon dioxide remained constant (1) BUT idea that despite the increase in population up to 1800 the carbon dioxide levels remained constant (2)	2	**allow** yes (0) because both the carbon dioxide level and the population increased from 1800 or because as the population increases the demand for energy e.g. burning fuels / using cars increases (1) **ignore** references to respiration
			Total	**3**	

Question			Answer	Marks	Guidance
3	(a)		because they contain carbon and hydrogen (atoms) (1) only (1)	2	**allow** are compounds containing carbon and hydrogen (1) only (1) second mark is dependent on the first **allow** contains carbon and hydrogen molecules **only** (1) **but** contains carbon and hydrogen molecules (0) **allow** contains C and H **only** (1) **allow** contains a mixture of carbon and hydrogen **only** (1) **but** contains a mixture of carbon and hydrogen (0)
	(b)		C_4H_{10} (1)	1	**allow** $H_{10}C_4$ **not** C4H10 / C^4H^{10}
	(c)		contains a double bond (between the carbon atoms)	1	

Question			Answer	Marks	Guidance
3	(d)		**[Level 3]** Describe polymerisation of ethene and apply their knowledge of polymerisation to draw the displayed formula of poly(ethene). Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Applies knowledge of polymerisation to draw the displayed formula of poly(ethene) **or** describes polymerisation to make a polymer or poly(ethene) **and** gives one of the conditions needed. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Partially describes polymerisation in terms of the reaction of monomers **or** gives one of the conditions needed for polymerisation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A/A*** **At Level 3 answer must include:** • a correctly drawn displayed formula  **Indicative scientific points may include:** • an attempt to show an equation showing the formation of a polymer • monomer is unsaturated or contains a double bond • idea that ethene is the monomer • idea that **many** monomers are used • idea that polymer is saturated • idea that monomers are alkenes • idea that the double bond breaks (in the monomer) • attempt to draw the displayed formula of the polymer, e.g. structure showing a double bond or omitting the n • conditions are high pressure and a catalyst but **ignore** references to temperature
			Total	**10**	

Question			Answer	Marks	Guidance
4	(a)		**any one from – arguments for** UK dependent on oil from other countries (1) reserves of oil in the UK are fast running out (1) the UK does not produce enough oil of its own (1) **any one from – arguments against** countries could block pipeline / cut us off (1) countries can charge what they like for the oil (1) transportation can lead to pollution or environmental damage (1)	2	**ignore** any reference to oil being cheaper **ignore** oil is needed for transport **allow** paying unstable countries for oil will help them **allow** alliances / beneficial relationships will be formed **allow** money they get from oil can be spent on weapons / money could be used to bolster the corrupt government
	(b)		**any two from** because LPG is a smaller molecule than petrol (1) LPG has weaker intermolecular forces than petrol / LPG has fewer intermolecular bonds (1) less energy is required to break the forces **between** the molecules in LPG (1)	2	**assume** answer refers to LPG if no reference **allow** LPG has smaller chains **ignore** all references to few carbon atoms in LPG / is a short chain hydrocarbon unless there is a direct comparison with petrol **allow** weaker forces or weaker bonds **between** LPG molecules
	(c)		correct identification of one fraction in low demand (1) a fraction in low demand is converted / broken down into petrol (1)	2	**allow** heating oil or paraffin or fuel oil or bitumen **allow** 12% of fuel oil and bitumen not required / 4% of heating oil not required / 5% of paraffin not required **allow** cracking is the breaking down of large hydrocarbon molecules into smaller more useful ones if no the mark has been given **ignore** conditions for cracking
	(d)		**either** (hydrogen) most energy produced / more energy than petrol (1) only water produced / no greenhouse gases (1) **or** (LPG) is (readily) available (1) more energy than petrol (1)	2	no mark is given for fuel on its own

Question			Answer	Marks	Guidance
4	(e)		$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ (2) formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae **allow** = instead of → **not** 'and' or '&' instead of + **allow** correct multiples **allow** one mark for correct balanced equation with minor errors of case and subscript eg $C_2H4 + 3O_2 \rightarrow 2CO2 + 2H_2O$
			Total	**10**	

Question			Answer	Marks	Guidance
5	(a)		granite (1) because it is the hardest (1)	2	**allow** granite because its hardness is 7 (1)
	(b)		steel (1) because it is the strongest (1)	2	**allow** steel (1) because it is (very) strong (1) **allow** steel (1) because its relative strength is 400 (1)
	(c)		list one advantage and one disadvantage for any of the materials (1) link property with the use once (1) second link of property with use (1)	3	(advantage) granite is hard (disadvantage) wood is soft scores 1 e.g. granite or marble is hard and scratch resistant scores 1 and with a second property e.g. wood is soft and not scratch resistant scores 3 but granite is hard and scratch resistant but wood is soft scores 2
			Total	**7**	

Question			Answer	Marks	Guidance
6	(a)		idea of reduces costs (1)	1	**allow** saves starting materials **ignore** can be reused **allow** improves percentage yield **allow** idea of increased sustainability **allow** to make sure nothing is wasted
	(b)		36 (%) (1)	1	**allow** any value between 35 and 36
	(c)	(i)	pressure = 600 (atmospheres) **and** temperature = 350(^{o}C) (1)	1	**both** required
		(ii)	iron catalyst used to speed up the reaction (1) reaction is too slow or slower at 350^{o}C **and** a higher temperature decreases percentage yield (1) idea that very high pressures are expensive to generate or a lower pressure decreases percentage yield (1)	3	**allow** idea that optimum conditions give the lowest cost rather than the fastest reaction or highest percentage yield for **one** mark if no other mark
			Total	**6**	

Question			Answer	Marks	Guidance
7	(a)		salt (1)	1	
	(b)		acid – nitric acid / HNO_3 (1) base – potassium hydroxide / KOH (1)	2	 **allow** potassium oxide / K_2O(1) **allow** potassium carbonate / K_2CO_3 (1) **allow** potassium hydrogencarbonate / $KHCO_3$ (1)
	(c)		20 / twenty (1)	1	
			Total	**4**	

Question			Answer	Marks	Guidance
8	(a)		**[Level 3]** Answer comprehensively describes the theory of plate tectonics and uses this to explain subduction. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** An attempt is made to describe the theory of plate tectonics **and** subduction. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** An attempt is made to describe the theory of plate tectonics **or** subduction. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A/A*** **Indicative scientific points at Level 3 may include:** • convection currents in the mantle cause plates to move • ocean floor (oceanic plate) more dense than continents (continental plates) • plates cooler at ocean margins so sink and pull plates down, ocean floor goes under continent • (partial) re-melting occurs • tectonic plates are less dense than the mantle **Indicative scientific points at Levels 1 and 2 may include:** • upper layer of Earth is made up of tectonic plates • idea that the tectonic plates move slowly • subduction happens when two plates collide • oceanic and continental plates collide • subduction may cause mountain forming and/or volcanic ctivity • during subduction one plate goes underneath the other

Question			Answer	Marks	Guidance
8	(b)		**any two from:** because idea that crust is too thick (to drill through) / AW (1) references to increased temperature (as mantle or core or centre of Earth is approached) / AW (1) scientists need to use seismic waves / shock waves produced by earthquakes or man made explosions (1)	2	**allow** idea that no-one has dug all the way to the mantle (1) e.g. can't get deep enough **allow** it is too hot (inside the Earth) (1)
			Total	**8**	

Question			Answer	Marks	Guidance
9	(a)		pharmaceutical drugs may be wanted on demand / pharmaceutical drugs are not wanted all the year round / only small amounts of pharmaceutical drugs are needed / you can make a range of drugs not just one (1)	1	**allow** batches can be tracked
	(b)		**any two from** more labour intensive / larger workforce (1) need to have specialised workers / need to have trained personnel (1) rare raw materials / starting materials difficult to get hold of (1) less automation possible (1) legislative demands / costs of patents (1) need to have sterile conditions / need to have a high purity product produced (1)	2	**ignore** any cost related to testing have to pay workforce or labour costs are not sufficient **allow** have to employ scientists expensive starting materials **not** sufficient **allow** need to do lots of marketing but **ignore** references to advertising
	(c)		**any two from** animal rights protesters may make scientists not use animal testing / people believe that testing of drugs on animals is cruel (1) government legislation has banned certain types of testing / testing on animals is now limited by laws (1) other scientists have invented testing regimes rather than to use animals (1) risk of bad publicity from accidents to human volunteers (1)	2	 **allow** people have a moral or religious objection to animal testing **allow** people think testing on people will ensure drug is safe **allow** computer modelling **allow** people do not trust animal testing / testing on animals may not have same effect as on people **allow** too dangerous to test on people (because it can have devastating effects)
			Total	**5**	

Question			Answer	Marks	Guidance
10	(a)		energy released = 100 × 4.2 × 20 **or** 8400 (1) energy per gram = 16800 (1)	2	**allow** 8400 on answer line (1) 16800 on its own scores **two** marks **allow** ecf from wrong energy released i.e. energy released ÷ 0.5 (1) e.g. 0.5 X 4.2 X 20 / 0.5 or 84 on answer line (1)
	(b)		Yes, because as the molecular size increases the temperature change increases (1) and result for decane is anomalous (1) **or** no, because although as the molecular size increases the temperature change increases (1) but result for decane does not fit the pattern / there is a bigger change in temperature for nonane than for decane / there is a bigger energy change for nonane than for decane (1)	2	no mark for yes or no, it is for the explanation answer must refer to the temperature change and not temperature at the end
			Total	**4**	

Question			Answer	Marks	Guidance
11	(a)		$\frac{34}{267}$ x 100 (1)	1	**allow** $\frac{34}{(233+34)}$ x100 **/** $\frac{34}{(98+169)}$ x 100 the mark is for the working out and not the answer
	(b)		$\frac{18}{20}\times 100$ / $\frac{18}{20}$ (1) 90 (1)	2	**allow** $\frac{am}{pm}\times 100$ for one mark if answer incorrect **allow** full marks for 90(%) with no working out
	(c)		because the atom economy is low / lots of atoms are wasted in the reaction (1)	1	**allow** lots of waste made / produces waste products / produces barium sulfate which is not used **not** reference to percentage yield
			Total	**4**	

Question			Answer	Marks	Guidance
12	(a)		has many strong bonds between atoms / has many covalent bonds between atoms (1) takes lots of energy to break bonds present (1) – this mark is dependent on the correct bond being broken	2	many bonds / it has covalent bonds is **not** sufficient **allow** each carbon atom is covalently bonded or strongly bonded to 4 other (carbon) atoms **not** has many ionic bonds **not** references to intermolecular bonding **allow** has a giant structure for one mark if no other marking point has been awarded
	(b)		does not contain free electrons / all electrons are in bonds (1)	1	**allow** does not have delocalised / spare electrons
			Total	**3**	

Question			Answer	Marks	Guidance
13	(a)		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ correct formulae (1) balancing marks – dependent on correct formulae (1)	2	**allow** one mark for balanced equation with formulae showing minor errors of case and subscript eg MG + 2HCL → MgCL2 + H2
	(b)	(i)	1.67×10^{-3} / 0.00167 (1)	1	answer must have **three** significant figures **allow** 16.7×10^{-4} **allow** 0.00166 / 1.66×10^{-3}

Question			Answer	Marks	Guidance
13	(b)	(ii)	**[Level 3]** **Applies knowledge and understanding of collision theory to explain <u>both</u> factors in detail although the reference to more collisions may only be made for one of the factors.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** **Applies knowledge and understanding of collision theory to explain one of the factors in detail <u>or</u> partially explain both factors** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** **Appreciation that the rate of any reaction depends on the number of collisions in whatever context it is used** Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to C** At all levels **ignore** reference to faster collisions and to more particles and **ignore** particles vibrate more **allow** answers that give ora but it must be very clear that this is what they have done **Indicative scientific points at levels 2 and 3 may include:** <u>rate increases with **temperature** because</u> • acid particles move faster / acid particles have more energy • more collisions between particles of acid and magnesium – this does not have to be qualified eg more (successful) collisions or more collisions (per second) **allow** – higher level answers for temperature that refer to more acid particles having sufficient energy to react or more acid particles having energy above that of the activation energy <u>rate increases with **powder** because</u> • magnesium has greater surface area / powder has more magnesium particles exposed • more collisions between particles of acid and magnesium – this does not have to be qualified eg more (successful) collisions or more collisions (per second) **Indicative scientific points at level 1 may include:** • more collisions gives a faster reaction even if referring to concentration or pressure • link between number of collisions and rate of reaction
			Total	**9**	

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
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553