OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry B

General Certificate of Secondary Education

Unit **B741/02:** Modules C1, C2, C3 (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.

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

Annotations

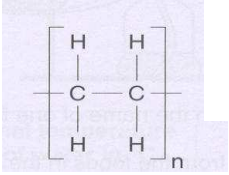
Annotation	Meaning
	correct response
	incorrect response
BOD	benefit of the doubt
NBOD	benefit of the doubt **not** given
ECF	error carried forward
^	information omitted
I	ignore
L1	Level 1
L2	Level 2
L3	Level 3
R	reject
CON	contradiction

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)		**any two from:** all the readily extractable resources will be used up in the future (1) will have to find replacements / AW (1) idea of not enough fuel to power vehicles or homes / make electricity / make chemicals (1) conflict between making petrochemicals and fuels (1) UK dependent on oil and gas from politically unstable countries / AW (1)	2	**allow** (all) it / oil / coal / fossil fuels will run out / be used up (1) **allow** crude oil will have to be extracted from more inaccessible areas (1) **allow** crude oil will become very expensive / may lead to rationing / may lead to conflicts (1)
	(b)		bitumen (1)	1	**allow** phonetic spelling
	(c)	(i)	C_4H_{10} (1)	1	**not** C4H10 / C^4H^{10} **allow** $H_{10}C_4$
		(ii)	propane and butane contain carbon and hydrogen (atoms) (1) only (1) has (carbon to carbon) single bonds **only** / contains single (covalent) bonds **only** (1)	3	**not** is a mixture of carbon and hydrogen (only) **not** contains carbon and hydrogen molecules Only must be linked to first marking point and is not independent **allow** has no (carbon to carbon) double bonds (1) **allow** they are saturated compounds (1) **allow** has general formula C_nH_{2n+2} (1) **ignore** has the maximum amount of hydrogen atoms
			Total	**7**	

Question			Answer	Marks	Guidance
2			**C** because it is flexible, waterproof and breathable (2)	2	marks are for evaluation, not for the choice of **C** but for two marks properties must relate to correct choice of **C** for two marks **all three** properties must be listed **allow** one mark for choice of **C** with **two** properties listed **allow** one mark for **E** and because it is flexible and waterproof ignore reference to not breathable if **E** mentioned.
			Total	**2**	

Question			Answer	Marks	Guidance
3	(a)	(i)	contains a double bond (between carbon atoms) (1)	1	**not** double bond between carbon molecules **ignore** does not have the maximum amount of hydrogen atoms
	(b)	(i)	addition reaction (1)	1	**allow** bromination
		(ii)	a dibromocompound (1)	1	**allow** saturated / halogenocompound
	(c)		 correct repeat unit drawn with open bonds at both ends (1) correct use of brackets and n (1)	2	**second mark is dependent on first mark** **allow** multiples of this structure eg $-(CH_2CH_2CH_2CH_2-)_n-$ for two marks **allow** one mark for a section of the polymer that has at least two repeat units with open ends at both ends
			Total	**5**	

Question			Answer	Marks	Guidance
4			**[Level 3]** Answer describes how an ester is made in a laboratory, including that the reactants must be mixed or heated together **AND** applies knowledge of safety and risk assessment to give at least two safety precautions used in the preparation of an ester, one involving the problems of heating a flammable liquid. Quality of written communication does not impede communication of science at this level. **(5–6 marks)** **[Level 2]** Candidates recall the names of <u>both</u> reactants **AND** applies knowledge of safety and risk assessment to give two safety precautions used in the preparation of an ester. Quality of written communication partly impedes communication of science at this level. **(3–4 marks)** **[Level 1]** Candidates recall the name of <u>one</u> reactant used to make an ester **OR** applies knowledge of safety and risk assessment to give at least one safety precaution used in the preparation of an ester. Quality of written communication impedes communication of science at this level. **(1–2 marks)** **[Level 0]** Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit. **(0 marks)**	6	**This question is targeted up to grade C** **Indicative scientific points may include:** • safety precautions include use of safety glasses, gloves, safety screen, fire extinguisher, water bath, laboratory coats etc • reagents are heated together in a beaker or in a test tube in a water bath • reagents are heated together • the reagents are mixed together • alcohols react with acids to make ester • higher level answers may refer to methods that use refluxing and distillation • sulfuric acid added as a catalyst to the reaction mixture • reaction mixture is added to sodium carbonate solution **Use the L1, L2, L3 annotations in scoris. Do not use ticks.**
			Total	**6**	

Question			Answer	Marks	Guidance
5	(a)		hydrophilic end bonds to water molecule (1) hydrophobic end bonds to oil molecule (1)	2	**allow** attracted to / sticks into / joins to or forms intermolecular forces with as alternative to bonding **allow** head bonds to water molecule and tail bonds to oil molecule for two marks **allow** one mark for water molecules surround the hydrophilic end **and** oil molecules surround the hydrophobic end **allow** one mark for one end is bonded to water **and** the other to oil **allow** one mark for hydrophilic end stays in or likes water **and** hydrophobic stays in or likes oil **not** hydrophobic is bonded to water and hydrophilic is bonded to oil
	(b)		shape of protein (molecules permanently) changes (1)	1	**allow** protein (molecule) is denatured **allow** protein (molecule) is destroyed **ignore** enzyme is denatured
	(c)		$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ formulae correct (1) balancing (1)	2	balancing mark is dependent on correct formulae **allow** = instead of → **allow** any correct multiples of this equation **allow** one mark for correct balanced equation with minor errors of superscripts, subscript or case. eg $2NAHCO_3 \rightarrow Na_2CO_3 + CO^2 + H2O$
			Total	**5**	

Question			Answer	Marks	Guidance
6	(a)		**any two from:** lithosphere includes the crust (1) lithosphere includes **outer part** / **upper part** of the mantle (1) lithosphere is (relatively) cold (1) lithosphere is rigid (1) lithosphere is made up of tectonic plates or correctly named plates continental / oceanic (1)	2	**not** lithosphere includes the core **not** lithosphere includes the atmosphere
	(b)		to forecast future eruptions (1) to reveal information about the structure of the Earth (1)	2	**allow** to forecast the magnitude of the eruption **ignore** to forecast earthquakes **allow** to find out how volcanoes work / to find out how lava moves
			Total	**4**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>
<table>
<tr><th>acid</th><th>base</th><th>salt</th></tr>
<tr><td>sulfuric acid</td><td>copper oxide</td><td>copper sulfate</td></tr>
<tr><td>nitric acid</td><td>sodium carbonate</td><td>sodium nitrate (1)</td></tr>
<tr><td>hydrochloric acid (1)</td><td>zinc oxide</td><td>zinc chloride</td></tr>
<tr><td>sulfuric acid</td><td>magnesium oxide / magnesium hydroxide / magnesium carbonate (1)</td><td>magnesium sulfate</td></tr>
</table>
</td><td>3</td><td>allow correct formulae i.e.
$NaNO_3$ (1)

HCl (1)

MgO / $Mg(OH)_2$ / $MgCO_3$ (1)</td></tr>
<tr><td></td><td>(b)</td><td></td><td>$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

formulae correct (1)
balancing (1)</td><td>2</td><td>balancing mark is dependent on correct formulae
but
allow one mark for balanced equation with minor errors of subscripts, superscripts, etc eg
$CACO_3 + 2HCl \rightarrow CaCl^2 + CO_2 + H2O$

not and or & for +
allow = instead of →
allow correct multiples eg
$2CaCO_3 + 4HCl \rightarrow 2CaCl_2 + 2CO_2 + 2H_2O$</td></tr>
<tr><td></td><td>(c)</td><td></td><td>$H^+ + OH^- \rightarrow H_2O$ (1)</td><td>1</td><td>order of reactants unimportant
allow OH_2 / HOH
allow correct multiples
subscripts and superscripts must be correct eg H^2O scores 0</td></tr>
</table>

Question	Answer	Marks	Guidance
(d)		3	**Use ticks in this question** **Mark scheme is hierarchical** – level 1 is required before level 2 can be awarded and levels 1 & 2 required before level 3 can be awarded
	Level 1 (1 mark) idea that fertiliser or nitrates increase the growth of water plants **or** that the outcome is that living organisms in the water die. idea that fertilisers cause water to become toxic limits mark to a maximum of 1		**allow** algal bloom for increased growth of water plants idea that **fertiliser** kills or poisons fish (0)
	Level 2 (2 marks) idea that (algal bloom) / plant growth blocks off sunlight (from other plants which then die).		**allow** idea that plants below surface cannot photosynthesis for level 2
	Level 3 (3 marks) idea that in addition to level 2, (aerobic) bacteria use up the oxygen in the water.		**allow** decomposers or microbes or micro organisms for bacteria
	Total	**9**	

Question			Answer	Marks	Guidance
8			**[Level 3]** All three metals are comprehensively evaluated **AND** metal A is chosen and justified. Quality of written communication does not impede communication of science at this level. **(5–6 marks)** **[Level 2]** An attempt is made to evaluate the strengths and weaknesses of at least two metals **AND** metal A or C is chosen with an attempt at a justification. Quality of written communication partly impedes communication of science at this level. **(3–4 marks)** **[Level 1]** An attempt is made to evaluate both the strengths or weaknesses of one metal. Quality of written communication impedes communication of 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*.** **Indicative scientific points may include:** • metal **A** has the lowest density and a high strength but is expensive • metal **B** has a high density, reasonable strength but is cheap • metal **C** has a high density but is cheap and is the strongest • metal **A** is the best choice • because it has the lowest density and good strength • metal **A** is expensive but not many aircraft will be made. • metal **B** has a low melting point as a disadvantage **Use the L1, L2, L3 annotations in scoris. Do not use ticks.**
			Total	**6**	

Question			Answer	Marks	Guidance
9	(a)	(i)	increases / gets bigger / AW (1)	1	
		(ii)	decreases / gets less / AW (1)	1	
	(b)		idea of catalyst used to speed up the reaction or increase the rate of reaction (1) 70 atm used as is cheaper to generate than higher pressures (1) 300 ^{o}C is used to increase the rate of reaction but sacrifice percentage yield / it is a compromise or optimum temperature (1)	3	**allow** catalyst does not affect percentage yield (1) **allow** answer relating to the risks associated with high pressure (1)
	(c)		idea of **reduction** of wage bill / idea of **reduction** of number of workers (1)	1	**ignore** rule out human error **ignore** to make the process work faster **ignore** references to safety **ignore** it is a continuous process **not** no labour costs
			Total	**6**	

Question			Answer	Marks	Guidance
10	(a)		32 (g) of methanol makes 60 (g) of ethanoic acid / 10 moles of methanol is used / 32 x 10 = 320 (1) So 320 (g) makes 600 (g) of ethanoic acid (1)	2	**allow** two marks for the correct answer of 600g even if no working out
	(b)		atom economy = $\frac{60}{60+18}$ / $\frac{60}{46+32}$ / $\frac{60}{78}$ (1) **but** atom economy = $\frac{60}{60+18} \times 100$ / $\frac{60}{46+32} \times 100$ / $\frac{60}{78} \times 100$ (2)	2	**allow** atom economy formula in words for one mark i.e. atom economy = total Mr of desired products x 100 (1) total Mr of all products
	(c)		percentage yield = $\frac{9.5}{9.8}$ (1) **but** percentage yield = $\frac{9.5}{9.8} \times 100$ (2)	2	**allow** percentage yield formula in words for one mark e.g. percentage yield = actual yield x 100 predicted yield or percentage yield = am x 100 pm
	(d)	(i)	more sustainable / makes less or no **waste** products (1)	1	makes less waste is **not** sufficient **ignore** makes less products **ignore** it wastes less resources
		(ii)	less waste of reactants (1)	1	**allow** no need to recycle unreacted reactants **ignore** less waste / waste products **ignore** able to make more / more products made
			Total	**8**	

Question			Answer	Marks	Guidance
11	(a)		bond breaking is endothermic / bond breaking takes in energy / bond breaking absorbs energy (1) 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)	3	**allow** heat instead of energy **ignore** more bonds are broken than are made

Question	Answer	Marks	Guidance
(b)	**[Level 3]** Applies reacting particle model, including mention of collisions frequency and / or successful collisions, to explain the effect of temperature **AND** pressure on the rate of reaction. Quality of written communication does not impede communication of science at this level. **(5-6 marks)** **[Level 2]** Applies reacting particle theory, including mention of collisions, to explain the effect of temperature **OR** pressure on the rate of reaction. Quality of written communication partly impedes communication of science at this level. **(3–4 marks)** **[Level 1]** Applies reacting particle theory to explain the effect of temperature **OR** pressure on the rate of reaction. Quality of written communication impedes communication of science at this level. **(1–2 marks)** **[Level 0]** Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit. **(0 marks)**	6	**This question is targeted at grades up to A.** **Indicative scientific points may include:** • Increasing pressure gives more crowded nitrogen and oxygen molecules / molecules are closer together / more nitrogen and oxygen molecules in the same volume so there is an increased number of collisions per second / collisions more often • Increasing temperature has nitrogen or oxygen molecules moving faster / molecules have more energy so more successful collisions per second / more energetic collisions. **Use the L1, L2, L3 annotations in scoris. Do not use ticks.**
	Total	**9**	

Question			Answer	Marks	Guidance
12	(a)		weak forces between the layers (1) which are easy to break (so layers can slide over each other) (1)	2	**allow** van der Waals' forces between layers / weak intermolecular forces **not** weak covalent bonds between layers
	(b)		large number of strong (covalent) bonds (1) needs lots of energy to break / AW (1)	2	**allow** giant molecular structure or giant covalent structure / large number of strong bonds (between atoms) **allow** heat for energy but **ignore** high temperature **any mention of intermolecular bonds / forces scores 0**
			Total	**4**	

Question			Answer	Marks	Guidance
13	(a)		energy = 100 × 4.2 × 9 (1) energy = 3780 (J) (1)	2	**allow** full marks for correct answer with no working out
	(b)		no energy released calculated for other value(s) / idea that temperature increase relates to the energy released (1) because the one with most atoms or pentanol the temperature increase is not the highest / with most atoms does not release the most energy (1)	2	**allow** yes with energy calculated for the other value(s) / idea that the temperature increase is related to the energy released (1) and the last result is an anomaly (1) **allow** energy calculations based on using the mass of fuel (1.0g)
			Total	**4**	

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