OCR
Oxford Cambridge and RSA

GCSE

Chemistry B

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

General Certificate of Secondary Education

Mark Scheme for June 2017

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 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
	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 i	**D** (1) idea that absorbs then gives off light (1)	2	award 0 marks for the question with **incorrect** choice but second mark can be awarded if no choice given **allow** blue for **D** (1) **ignore** reference to any temperature change
ii	**C** (1) idea of changes colour with temperature (1)	2	award 0 marks for the question with **incorrect** choice but second mark can be awarded if no choice given **allow** pink or thermochromic for **C** (1) **allow** eg it changes to yellow if the food is too hot (1) **ignore** shows the temperature of the baby's food
b	solvent evaporates (1) oil is oxidised (by atmospheric oxygen) (1)	2	**allow** solvent becomes a gas or vapour (1) **ignore** just 'evaporation' **ignore** solvent dries **ignore** liquid evaporates **not** solvent reacts with oxygen **not** water evaporates **allow** oil reacts with oxygen (1) **allow** binding medium is oxidised (1) **ignore** paint is oxidised or reacts with oxygen (1)

Question	Answer	Marks	Guidance
c	**any two from:** idea that may harm or hurt the animal / testing is cruel (1) idea that results on animals not (necessarily) same with humans (1) idea that animals do not have a choice of being tested / animals have no control over what happens to them (1) idea that there are other ways of testing products (that are less damaging to living things) (1)	2	**assume unqualified answer refers to testing on animals** **allow** idea that animals have rights / morally wrong / unethical (1)
	Total	**8**	

Question	Answer	Marks	Guidance
2 a	acid + **alcohol** → ester + water (1)	1	**allow** a named alcohol eg ethanol (1) **allow** phonetic spelling
b	Water ….. ☐ The force …… ✓ There is ….. ☐ The force …… ✓ Water will ……. ☐ (2)	2	**one mark** for each tick in the correct box if **one incorrect** box ticked maximum of **one** mark if **two** or **more incorrect** boxes ticked **no** marks for the question
c	volatile or easily evaporates – so perfume particles can easily reach the **nose** (1) insoluble – so cannot be washed off easily (1)	2	**allow** volatile – so you can **smell** it (1) **allow** idea that sweat will not remove the perfume (1)
	Total	**5**	

Question	Answer	Marks	Guidance
3 a	**B** (1)	1	**allow** ethene / C_2H_4 , but letter takes precedence(1)
b	**A** (1)	1	**allow** methane / CH_4, but letter takes precedence (1)
c	**B** (1)	1	**allow** ethene / C_2H_4 , but letter takes precedence (1)
d	**C** (1)	1	**allow** poly(bromoethene) / $(C_2H_3Br)_n$, but letter takes precedence (1)
e	waterproof – (because holes in PTFE are too small) so do not allow (liquid) water to pass through (1) breathable – (holes are big enough to) allows (water) **vapour** through (1)	2	**allow** rain for (liquid) water **allow** water droplets **BUT ignore** water molecules or water particles **allow** big enough to let sweat or water **evaporate** (1) **BUT ignore** 'sweat' without reference to evaporation **not** water for water vapour **allow** the (liquid) water does not pass through but (water) **vapour** does (2)
	Total	**6**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>Level 3
Evaluates one advantage and one disadvantage of all three of the fuels
AND
chooses B with at least two correct reasons
Quality of written communication does not impede communication of the science at this level.
(5 – 6 marks)

Level 2
Evaluates one advantage and one disadvantage of two of the fuels
AND
chooses fuel B with a correct reason
Quality of written communication partly impedes communication of the science at this level.
(3 – 4 marks)

Level 1
Evaluates one advantage and one disadvantage of one of the fuels
OR
chooses fuel B with a correct reason
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. (0marks)</td><td>6</td><td>This question is targeted at grades up to grade A/A*
Indicative scientific points may include:
Evaluations
<table><tr><th colspan="2">Fuel A</th></tr><tr><th>Advantages</th><th>Disadvantages</th></tr><tr><td>• high(est) energy content
• reasonable projected supply
• does not produce SO_2 / only produces CO_2
• liquid can be stored in tanks and pipeline used</td><td>• limited availability
• medium cost
• makes carbon dioxide</td></tr><tr><th colspan="2">Fuel B</th></tr><tr><th>Advantages</th><th>Disadvantages</th></tr><tr><td>• good availability
• cheap(est)
• solid is easy to store
• many / most years of supply</td><td>• low(est) energy value
• makes the most pollution</td></tr><tr><th colspan="2">Fuel C</th></tr><tr><th>Advantages</th><th>Disadvantages</th></tr><tr><td>• does not produce SO_2 / only produces CO_2
• good availability</td><td>• (most) expensive
• gas is more difficult to store
• insufficient years of supply
• makes carbon dioxide</td></tr></table>Choices
• B because it is eg cheap and has more than 25 years supply

Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</td></tr>
</table>

		6	
Question	**Answer**	**Marks**	**Guidance**
5 a	crust **and** upper or outer part of the mantle (1)	1	**allow** cold, rigid outer part of the Earth (1) **ignore** between crust and mantle
b	**any two from:** to predict future eruptions (1) to minimise danger to life or keep people safe (1) to reveal information about the **structure** of the Earth (1) to understand how volcanoes are formed (1) idea of gathering (extra) data / get samples (1)	2	**ignore** to predict earthquakes **allow** to understand about the Earth or tectonic plates (1)
c	**any two from:** can evaluate ideas / check results / can compare results (1) can share ideas / have different views (1) can collect more evidence (in a shorter time) / more productive / can do more approaches / can work faster / more ideas can be tested (1) can share cost of research (1) to see if work can be replicated / so work does not need to be duplicated (1) so that further evidence can be collected (1) to provide information to other scientists or public or other organisations / AW (1)	2	**allow** peer-review (1) **allow** results would be more reliable (1) **ignore** results are more accurate **allow** small discoveries can be combined into a large one (1) **allow** help to make new predictions (1) **allow** work can be developed further (1)

	so they can get recognition for their work (1)		**allow** so other scientists cannot take credit (1)
	Total	**5**	

Question	Answer	Marks	Guidance
6 a	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ formulae (1) balancing - dependent on the correct formulae (1)	2	**allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & instead of '+' **allow** 1 mark for a balanced equation with a minor error in subscripts, superscripts and case e.g. $NH_3 + H2So_4 \rightarrow (Nh_4)_2SO_4$
b	potassium nitrate (1)	1	**allow** KNO_3 but name takes precedence (1)
c	H^+ (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank
	Total	**4**	

Question	Answer	Marks	Guidance
7 a	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ formulae (1) balancing - dependent on the correct formulae (1)	2	**allow** any correct multiple, including fractions **allow** = / $\rightarrow$ instead of $\rightleftharpoons$ **not** and / & instead of '+' **allow** one mark for a balanced equation with a minor error in subscripts, superscripts and case e.g. $N_2 + 3H2 \rightarrow 2Nh_3$
b i	idea of increases / ora (1)	1	**allow** percentage yield **decreases** when pressure **decreases** (1)
ii	idea of decreases / ora (1)	1	**allow** percentage yield **increases** when temperature **decreases** (1)
iii	**any three from:** idea that high(er) pressures are expensive (to generate or maintain) / ora (1) idea that higher pressures are (more) dangerous (1) high(er) pressures give a high(er) yield / ora (1) high(er) pressures give a high(er) rate / ora (1) idea that reaction is too slow at low(er) temperatures or rate is fast(er) at 450°C (1) but low(er) temperatures give high(er) yield / ora (1) catalyst increases rate of reaction (1) catalyst does not affect (percentage) yield (1)	3	**note** 450^{o}C is a high temperature and 200 atmospheres is a low pressure in the context of this question **allow** high(er) atmospheres for high(er) pressures **allow** correct higher level answers in terms of moving the position of equilibrium **allow** correct higher level answers in terms of moving the position of equilibrium

	Total	**7**	

Question	Answer	Marks	Guidance
8 a	(yes because)	2	**marks are for explanation BUT** just quoting numbers is insufficient **ignore** no
	idea that this alloy is a good conductor (of electricity) (1)		just 'conducts (electricity)' is not sufficient **not** it has the highest (electrical) conductivity
	and has good ductility / can easily be pulled into wires (1)		just 'it is ductile' / 'it is quite ductile' / 'it is fairly ductile' is not sufficient **ignore** comments about strength **ignore** comments about other brasses **BUT** **allow** no use **A** because it is the best conductor (of electricity) (1)
b	oxidation occurs at the anode because electrons are lost / copper loses electrons **AND** reduction occurs at the cathode because electrons are gained / copper ions gain electrons (1)	1	just oxidation is loss of electrons and reduction is gain is **not** sufficient **not** incorrect particle eg oxidation occurs at the anode because copper ions lose electrons **not** incorrect particle eg reduction occurs at the cathode because copper gains electrons

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>c</td><td>
Level 3
Applies knowledge and understanding to <u>evaluate</u> an advantage and disadvantage for each of aluminium and steel

AND

explains which metal (aluminium, steel or both) is suitable to make a helicopter body.
Quality of written communication does not impede communication of the science at this level.
(5–6 marks)
Level 2
Applies knowledge and understanding to give an advantage and disadvantage for each of aluminium and steel

OR

Applies knowledge and understanding to give two advantages, two disadvantages or an advantage and a disadvantage for either metal
AND
chooses a metal (aluminium, steel or both) with a reason.
Quality of written communication partly impedes communication of the science at this level.
(3–4 marks)
Level 1
Applies knowledge and understanding to give two advantages, two disadvantages or an advantage and a disadvantage for either metal

OR

chooses a metal (aluminium, steel or both) with a reason.

Quality of written communication impedes communication of the science at this level.
(1–2 marks)
Level 0
Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit.
(0 mark)
</td><td>6</td><td>
This question is targeted at grades up to A / A*

Relevant scientific points may include:

Comments for aluminium:
<table>
<tr><th>Advantage</th><th>Disadvantage</th><th>Evaluation</th></tr>
<tr><td>low density / lightweight</td><td></td><td>so better fuel economy / so can travel faster</td></tr>
<tr><td>does not corrode / does not rust</td><td></td><td>so will last longer</td></tr>
<tr><td>malleable</td><td></td><td>can be made into correct shape</td></tr>
<tr><td></td><td>not very strong</td><td>might get damaged (in a crash)</td></tr>
<tr><td></td><td>not very hard</td><td>scratched easily</td></tr>
<tr><td></td><td>(more) expensive</td><td>cost more to make</td></tr>
</table>
Comments for steel:
<table>
<tr><th>Advantage</th><th>Disadvantage</th><th>Evaluation</th></tr>
<tr><td>strong</td><td></td><td>so less damage (in a crash)</td></tr>
<tr><td>malleable</td><td></td><td>can be made into correct shape</td></tr>
<tr><td>hard</td><td></td><td>will not scratch easily</td></tr>
<tr><td>cheap(er)</td><td></td><td>cost less to make</td></tr>
<tr><td></td><td>high density</td><td>poor fuel economy / would travel slower</td></tr>
<tr><td></td><td>corrodes (slowly)</td><td>so will not last longer / have to spend money on rust protection</td></tr>
</table>
Use the L1, L2, L3 annotations in RM Assessor. Do not use ticks.
</td></tr>
</table>

	Total	9	
Question	**Answer**	**Marks**	**Guidance**
9 a	60% (2) **BUT if answer is incorrect then** atom economy = $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}}$ x 100 **or** atom economy = $\frac{48}{80}$ x 100 scores (1)	2	**allow** full marks for correct answer even if equation for atom economy not stated
b	84 (%) (2) **BUT if answer is incorrect then** $\frac{\text{actual yield}}{\text{predicted yield}}$ x100 **or** $\frac{81}{96}$ x 100 scores (1)	2	**note** final answer must be two significant figures look for correct answer first, 84(%) on own scores (2) unit not needed - **ignore** incorrect units **allow** $\frac{\text{am}}{\text{pm}}$ x 100 (1) **allow** 84.4 / 84.38 / 84.375 / 84.3 (%) on their own scores one mark i.e. the mark for the substitution into the equation.
c	**high atom economy**: to make the process more sustainable or 'greener' / (to make the process more efficient) by reducing the amount of waste product (made) / to reduce the processing of unwanted products (1) **high percentage yield**: to **reduce** cost / reducing the reactants wasted / reducing the need to recycle unreacted reactants (1)	2	**ignore** just 'less waste' **allow** idea of making the process more profitable (1) **ignore** conserve reactants / conserve raw materials

			ignore just 'less waste'
	Total	**6**	
Question	**Answer**	**Marks**	**Guidance**
10 a	75 (g) (2) **BUT if answer is incorrect then** mass = $\frac{6300}{4.2 \times 20}$ **or** mass = $\frac{6300}{84}$ **or** mass = $\frac{\text{energy}}{\text{specific heat capacity x temp change}}$ (1)	2	**look for correct answer first**, 75 (g) on own scores (2) despite any other working out **allow ecf** from incorrect temperature change for the final mass (1)
b	**no** because fuel **A** uses the most fuel or more fuel / **no** because all the other fuels use less fuel (1) **BUT** **no** because fuel **A** does not transfer the most energy **per gram** / does not have the highest temperature change **per gram** / evidence of correct calculation of energy **per gram** for each fuel / evidence of calculation of temperature change **per gram** for each fuel (2)	2	'yes' = 0 for question **ignore** no because fuel **A** transfers the **lowest** energy per gram (as this is incorrect) **allow** answer that refers to fuel **D** i.e. no, fuel **D** is best choice (1) **ignore** fuel **D** is the most efficient because fuel **D** transfers more energy **per gram** / fuel **D** has a higher temperature change **per gram** / evidence of calculation of energy **per gram** for each fuel (1) **NB** Energy per gram values are:

			A – 5775 J/g **B** – 7875 J/g **C** – 5250 J/g **D** - 9000 J/g

Question	Answer	Marks	Guidance
c	idea that bond breaking is endothermic (1) idea that bond making is exothermic (1) more energy is given out (in bond making) than is taken in (in bond breaking) (1)	3	**allow** bond breaking absorbs energy or heat (1) **allow** bond making releases energy or heat (1) **allow** more energy or heat released than absorbed (1) **ignore** references to different numbers of bonds, e.g. more bonds made than broken **not** references to intermolecular bonds **allow** exothermic reactions give out energy or heat (1) if no other mark awarded
d	$2C_3H_8O + 9O_2 \rightarrow 6CO_2 + 8H_2O$ formulae (1) balancing dependent on the correct formulae (1)	2	**allow** any correct multiple, including fractions eg $C_3H_8O + 4½O_2 \rightarrow 3CO_2 + 4H_2O$ **allow** = / ⇌ instead of → **not** and / & instead of '+' **allow** 1 mark for a balanced equation with a minor error in subscripts, superscripts or case e.g. $2C_3H_8O + 9O2 \rightarrow 6Co2 + 8h_2O$ **allow** C_3H_7OH for C_3H_8O
	Total	**9**	

Question	Answer	Marks	Guidance
11 a	calcium carbonate + hydrochloric acid $\rightarrow$ calcium chloride + carbon dioxide + water (1)	1	order of substances on either side of arrow is unimportant **allow** marble for calcium carbonate **allow** mixture of correct formulae and names but names take precedence **allow** correct formulae, i.e. $CaCO_3 + HCl \rightarrow CaCl_2 + CO_2 + H_2O$ balancing is **not** required **allow** = or $\rightleftharpoons$ for arrow **not** 'and' or & for +
b i	2.9 / 3.0 (minutes) (1)	1	**allow** just '3' (minutes) (1)
ii	curve for small chips is **steeper** / ora (1)	1	**assume unqualified answer refers to small marble chips** **allow** for a given time more gas with smaller chips (1) **allow** reaction finishes in shorter time / reaction finishes before the large chips / curve ends first / reaction stops sooner (1) **ignore** references to reaction finishes in a faster / quicker time **allow** numbers quoted from the graph but they must be correct to within ±½ square eg the curve for small chips finishes at 3 minutes but the curve for large chips finishes at 5 minutes
c	the number of (successful) collisions is doubled (1)	1	**ignore** frequency or chance of collisions is doubled

Question	Answer	Marks	Guidance
d	**Level 3** **Applies reacting particle model, including mention of collisions, to explain the effect of concentration** **AND** **temperature on the rate of reaction.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Applies reacting particle model, including mention of collisions, to explain the effect of concentration** **OR** **temperature on the rate of reaction** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Applies reacting particle model (without collisions) to explain the effect of concentration** **OR** **temperature on the rate of reaction.** 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** **Indicative scientific points may include:** • more collisions between marble chips and hydrochloric acid particles result in faster reaction **concentration of hydrochloric acid** increasing the concentration of the acid increases the rate of reaction because • idea of more crowded acid particles / more acid particles in same volume • idea of increased collisions (frequency) **ignore** references to 'more particles' **temperature of hydrochloric acid:** increasing the temperature of the acid increases the rate of reaction because • idea that acid particles move faster / particles have more energy / more (successful) collisions between acid and marble chips / collisions between marble chips and acid are more energetic • idea of increased collisions (frequency) between acid particles and marble chips **allow** reference to ions / atoms / molecules instead of particles **Use the L1, L2, L3 annotations in RM Assessor. Do not use ticks.**
	Total	**11**	

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

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553