

Chemistry B (Salters)

Advanced Subsidiary GCE

Unit **F331**: Chemistry for Life

Mark Scheme for January 2013

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.

© OCR 2013

Annotations

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	separates marking points
not	answers which are not worthy of credit and which will CON a correct answer
ignore	statements which are irrelevant and will NOT 'CON' a correct answer
allow	answers that can be accepted
()	words which are not essential to gain credit
—	underlined words must be present in answer to score a mark
ecf	error carried forward
AW	alternative wording (replaces the old 'or words to that effect')
ora	or reverse argument

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

Question			Answer	Marks	Guidance
1	(a)	(i)	measures tendency to auto-ignite/pre-ignite/knock/pink ✓ More efficient combustion OR reduces risk of/stops damage to engine OR higher octane number means less knocking/pinking/autoignition and etc ✓	2	Need to see likelihood of autoignition Ignore references to two sparks/explosions ALLOW improves engine performance ALLOW higher octane number means less knocking ALLOW knocking less likely but NOT <u>no</u> knocking NB prevents knocking does not CON another correct answer
		(ii)	cyclic / cycloalkane / cycloalkene / ring / arene / branched alkene ✓	1	ALLOW aromatic/benzene NOT branched alkane
	(b)	(i)	heterogeneous – catalyst and reactant(s)/hydrocarbons in different phase/state ✓ catalyst <u>speeds up reaction</u> by providing a <u>route/pathway/mechanism</u> of lower activation enthalpy/energy OR speeds up a reaction but can be recovered unchanged <u>at the end</u> /can be regenerated/is not used up ✓	2	ALLOW catalyst solid, reactants gases/liquids DO NOT ALLOW 'substance instead of reactants' DO NOT ALLOW 'chemical state' DO NOT ALLOW 'speeds up reaction' without qualification IGNORE reduces activation energy NOT 'not involved' NOT 'not changed' on own or remaining unchanged
		(ii)	Poison/lead (very) <u>strongly/irreversibly</u> adsorbed OR won't come off OR stays on ✓ reactions cannot happen/prevents reactants getting to surface/blocks surface/other molecules can't attach ✓	2	DO NOT ALLOW other suggested poisons eg S DO NOT ALLOW absorbed Vague comments e.g. 'catalyst prevented from working' do not score Mark independently
		(iii)	only produces water (on combustion/burning) OR does not produce CO ₂ / CO / no particulates / C / SO ₂ ✓	1	NOT just a general comment about pollution/harmful gases CON references to NO _x DO NOT ALLOW less/little pollutants IGNORE references to renewable/plentiful/energy density


Question		Answer	Marks	Guidance
	(iv)	energy in / endothermic to break bonds ✓ energy released / given out / exothermic when bonds form ✓ less energy given out than taken in ✓	3	statement 'more energy needed to break bonds than make' only scores one (first) mark Has to be bond formation NOT product formation NOT ecf on first two statements References to <u>fewer/more</u> bonds CONs final mark
	(c)	First marking point: idea of splitting or breaking (larger) hydrocarbon/molecule break/split AW ✓ Remaining two marking points for possible types of molecules formed, but <u>to score both points smaller/shorter must be mentioned at least once</u> Any <u>two</u> from: ✓ ✓ smaller/shorter } alkane/saturated (compound) } alkene/alkyne/unsaturated (compound) } cycloalkane	3	Reference to between molecules is a CON on first mark IGNORE references to branching DO NOT ALLOW arene/aromatic molecule ALLOW references to C=C etc. DO NOT ALLOW simply (shorter) hydrocarbon/molecule
		Total	14	

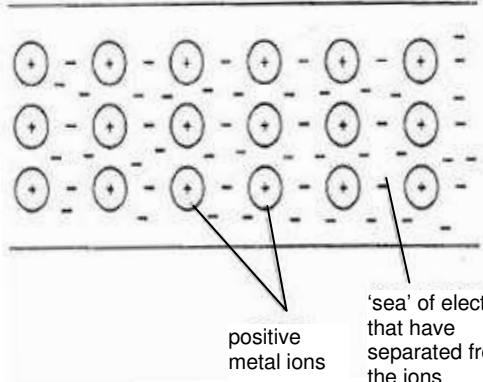
Question			Answer				Marks	Guidance
2	(a)	(i)	Isotope	Number of protons	Number of neutrons	Number of electrons	1	All must be correct
			Helium-3	2	1	2		
			Helium-4	2	2	2		
		(ii)	Beta/ β decay ✓ proton/atomic number (in daughter product) goes up (by one) OR neutron converted to proton ✓				2	DO NOT ALLOW no change in mass number (of daughter product) (this would be the case with just gamma emission) If alpha decay score 0 DO NOT ALLOW no change to A_r DO NOT ALLOW un-annotated equation as explanation IGNORE references to electrons
	(b)	(i)	${}^1_1\text{H} + {}^2_1\text{H} \rightarrow {}^3_2\text{He}$ ✓				1	<u>Any</u> of numbers on right of symbol scores zero IGNORE any reference (symbol) to gamma decay ALLOW '=' instead of '→'
		(ii)	Overcome repulsion ✓ between (positively charged) <u>nuclei</u> OR to join the two nuclei ✓				2	Mark separately IGNORE references to electrons NOT ions
	(c)	(i)	black/dark lines/bands ✓ bright/coloured/solar/ <u>visible</u> spectrum background ✓				2	IGNORE references to lines getting closer Description of emission spectra scores zero i.e. no ecf If word spectrum is used it must be qualified
		(ii)	Radiation/light/energy absorbed causes <u>electron(s)</u> to move <u>up</u> (electronic energy levels) ✓ energy levels unique/specific/different (to element) ✓ energy absorbed related to frequency (of line produced) OR (Δ) $E = hf$ OR $\Delta E = hv$ ✓				3	arrow up on a diagram scores first marking point ALLOW shells ALLOW 'each element has its own/different levels'

Question		Answer	Marks	Guidance
	(d)	<p>sample ionised ✓</p> <p>all ions are accelerated (in electric field/plates) ✓</p> <p>to the <u>same kinetic energy</u> ✓</p> <p>move into drift/flight region ✓</p> <p>heavier ions/isotopes move more slowly (across to detector) (ora) AW ✓</p>	5	<p>ALLOW 'ions are made', negative ions CON</p> <p>DO NOT ALLOW 'accelerated by magnetic/electromagnetic field' for this mark CON</p> <p>This statement scores 2nd and 3rd marking points i.e. a statement 'ions are given the <u>same kinetic energy</u>' scores both 2nd and 3rd marking points</p> <p>SPG (kinetic) must be spelt correctly to score this marking point, but not a separate mark; if not scored X on pencil</p> <p>At correct point in sequence, eg ionised > drift region scores this mark BUT ionised>drift region>accelerated does not score</p> <p>IGNORE references to molecules/atoms for last marking point</p> <p>IGNORE references to how detector measures abundance</p> <p>References to larger/smaller ions should be ignored</p>
Total			16	

Question		Answer	Marks	Guidance	
3	(a)	<p>Any one of: increases octane number/rating less knocking/auto ignition/pre-ignition reduces CO ✓</p>	1	<p>ALLOW combustion more complete / less incomplete ALLOW complete combustion ALLOW 'less oxygen to burn' / 'completely combust' / no CO</p>	
	(b)	(i)	C_8H_{16} ✓	1	<p>Accept $H_{16}C_8$ NOT "h"</p>
		(ii)	<p>M_r of $C_8H_{16} = 112$ ✓</p> <p>Moles in one kg = $1000/112 = 8.93$ kJ per kg = $8.93 \times 5300 = 47329$ ✓ (depending on rounding)</p> <p>two sf's ($47000/4.7 \times 10^4$) ✓</p> <p>correct answer is 3 marks</p>	3	<p>ecf on wrong formula in (i) ecf on wrong M_r above</p> <p>ALLOW sig fig mark from any correct calculation NB a different approach to solving the problem is: energy per gram = $5300/112$ then kJ per kg = $5300/112 \times 1000$</p> <p>IGNORE sign of answer</p>
	(c)	(i)	(molecules with) same molecular formula/same number and type of atoms but different structural formulae/arrangement of atoms AW ✓	1	DO NOT ALLOW 'different shape'
		(ii)	<p>Bond angle between 115–125 ✓</p> <p>3 areas of <u>electron</u> density/sets or groups (bonding) <u>electrons</u> ✓</p> <p>electrons <u>repel</u> ✓</p> <p>as far as possible/minimise electron repulsion ✓</p>	4	<p>IGNORE references to central carbon/shape/angle 3 bonding pairs/areas CON's the second mark</p> <p>NOT 'as much as possible' unless qualified with minimise etc. NOT 'bonds repel' but 'bonds made of electrons and repel is fine' NOT atoms repel</p> <p>As far as possible to minimise (electron) repulsion will score 3rd and 4th mark</p>

Question		Answer	Marks	Guidance
	(iii)	smaller OR a given angle of range 104–112 ✓ because 4/more areas (repel and gives 109.5°) ✓	2	No ecf from last question Do not penalise failure to mention 'of electrons' <i>Mark separately</i>
(d)	(i)	200 x 4.18 x 25 = 20900 ✓	1	ALLOW 21000
	(ii)	mass of <u>fuel/hydrocarbon/it</u> (burnt) ✓	1	ALLOW volume <u>and</u> density Assume 'it' refers to the fuel DO NOT ALLOW moles/amount
	(iii)	Same number of bonds broken and formed/made ✓ Same type of bonds broken and formed/made ✓	2	DO NOT ALLOW similar ALLOW 'same bonds broken and formed' for this mark same number and type of bonds broken scores 1 same number and type of bonds formed scores 1
	(iv)	One of: incomplete combustion evaporation of fuel/loss of fuel vapour non-standard conditions ✓	1	IGNORE heat loss to container NOT average bond enthalpies
		Total	17	

Question			Answer	Marks	Guidance
4	(a)	(i)	$4\text{Ce} + 3\text{O}_2 \rightarrow 2\text{Ce}_2\text{O}_3$ ✓	1	ALLOW 2:1½:1 or multiples IGNORE state symbols NOT 2Ce_2
		(ii)	moles Ce = $81.4 \div 140.1 = 0.58$ moles O = $18.6 \div 16.0 = 1.16$ ✓ gives CeO_2 ✓	2	ALLOW one mark for a correct whole number ratio based on wrong calculation e.g. using atomic number (this would give Ce_3O_5) CeO_2 alone scores 1 mark – “ show your working ” Not just any wrong calculation
	(b)	(i)	covalent network OR giant covalent (molecule) ✓	1	ALLOW covalent lattice
		(ii)	 ✓	1	All outer electrons must be shown Bonding electrons can be in any order or horizontal ‘Pairing’ not essential for lone pairs IGNORE shape Check for dot cross conformity
		(iii)	no double bonds in SiO_2 OR silicon forms four/more than two/single bonds to oxygen ✓	1	NOT carbon dioxide contains a double bond Look out for CON in any structure suggested e.g. lone pairs on Si e.g. no lone pairs on oxygen e.g. more lone pairs on each atom ALLOW each oxygen bonded to two Si atoms

Question		Answer	Marks	Guidance
	(c)	 <p>cations/positive ions ✓</p> <p>sea of /delocalised/ electrons ✓</p> <p>regular array (at least six ions) ✓</p> <p>positive metal ions</p> <p>'sea' of electrons that have separated from the ions</p>	3	<p>maximum 2 marks if no diagram drawn</p> <p>protons/nuclei/positive metal atoms/particles CONS first mp</p> <p>IGNORE free/pool/cloud/moving of electrons. ALLOW ring around all the ions labelled 'delocalised/sea of electrons'</p> <p>CON if first two marking points are labelled to incorrect parts of diagram If metal given ignore type</p> <p>3rd marking point from diagram (need not have label) structure = at least two rows; need not be 'close packed', circles may touch</p>
(d)	(i)	<p><i>First mark for <u>idea</u> that gaps left because without them some known elements did not fit in groups (without the gap) properties of known elements did not fit ✓</i></p> <p><i>Second mark for new elements discovered which did fit in gaps (with appropriate props) element/scandium discovered fitting in gap (with appropriate properties) ✓</i></p>	2	<p>ALLOW to place elements with similar properties in the correct column/group</p> <p>ALLOW 'he suggested there were elements yet to be discovered'</p> <p>DO NOT ALLOW 'elements were discovered' on own</p>

Question		Answer	Marks	Guidance
	(ii)	atomic/proton number/number of protons ✓	1	DO NOT ALLOW electronic structure
	(iii)	electron structure/configuration/arrangement ✓	1	ALLOW number of electrons in outer shell ALLOW number of electron shells / electron shells IGNORE any references to protons / energy shells ALLOW reference to electron shells e.g. number e.g. number of shells is period number
		Total	13	

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

© OCR 2013

