

Chemistry B (Salters)

Advanced Subsidiary GCE

Unit **F331**: Chemistry for Life

Mark Scheme for January 2012

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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.

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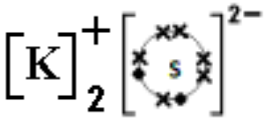
Annotations

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
<u> </u>	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
bod	benefit of the doubt
nbod	benefit of the doubt not given
ECF	error carried forward
^	information omitted
I	Ignore
R	Reject
CON	Contradiction

Question		Answer	Marks	Guidance
1	(a)	Allows food crops to be used for food / doesn't compete / production of food not affected ORA ✓	1	ALLOW otherwise is waste(d) / waste product DO NOT ALLOW: idea of sustainable / recyclable / no extra land/space needed / large amounts not eaten
	(b) (i)	Alkene ✓ ether ✓	2	ALLOW alkoxyalkane for ether NOT alkoxy on own ALLOW furan for 1 mark; Not C double bond C NOT cycloalkene
	(ii)	$C_5H_4O_2 + 5O_2 \rightarrow 5CO_2 + 2H_2O$ formulae ✓ balancing ✓	2	ALLOW ecf on incorrect formula ALLOW doubled (or multiple or halved) equation If balanced using CO one mark only
	(c) (i)	Any three of the following: Ar of elements / Mr furfural (Specific) heat capacity of water Mass/volume of water (Specific) heat capacity of calorimeter Mass of calorimeter ✓✓✓	3	Atomic mass of furfural is a CON NOT mass of fuel before and after NOT number of moles burnt NOT just '(specific) heat capacity' – must be qualified NOT how much/amount of water
	(ii)	- 2385 ✓	1	ONLY one mark (both sign and value needed)
	(iii)	Any three of the following: Incomplete combustion / some fuel produces CO or C Evaporation/release/loss of fuel (from wick) Bond enthalpies for vapour phase Bond enthalpies in furfural are not the same as average bond enthalpies Non-standard conditions in the experiment ✓✓✓	3	ALLOW 'bond energies' for 'bond enthalpies' A general comment "not all fuel combusted" does not score NOT energy lost as light NOT vapours lost to environment/loss of fuel (alone) but OK if 'from wick' NOT elements not in their standard states NOT evaporation of water Must say bond enthalpies are for vapour or gaseous state not experiment DO NOT ALLOW any reference to experimental/operator errors AW eg experiment not conducted at standard state
Total			12	

Question			Answer	Marks	Guidance
2	(a)	(i)	0.74(18) ✓	1	ALLOW 2 or more correct sig figs IGNORE units if given Note earlier rounding gives 0.74(26) e.g. 0.741 does NOT score (because of rounding error)
		(ii)	One mole contains Avogadro constant/certain number of particles <i>AW</i> ✓ Note guidance Ar/mass of C atoms less than S atoms <i>ORA</i> ✓ Therefore more atoms of C in a given/particular/specific mass <i>ORA</i> ✓	3	The idea that a mole of anything contains a fixed number of 'particles' (Avogadro's constant) is needed. Specific e.g.'s could be given. If a number is quoted it must be the correct one i.e. $6(.02) \times 10^{23}$ ALLOW number of atoms in a mole of an element, but not atoms in mole of a compound/molecule/substance ALLOW C has a lower <u>molar</u> mass References to larger/smaller <u>atoms</u> does not score mark Need to say more C atoms in a specific mass or amount (e.g. per mole)
	(b)	(i)	$2\text{KNO}_3(\text{s}) + 3\text{C}(\text{s}) + \text{S}(\text{s}) \rightarrow \text{K}_2\text{S}(\text{s}) + 3\text{CO}_2(\text{g}) + \text{N}_2(\text{g})$ ✓✓	2	One mark for CO_2 and N_2 One mark for balancing ALLOW multiples/half Second mark depends on the first 2N scores one
		(ii)	One mark each for:  $[\text{K}]_2^+ [\text{S}]^{2-}$ Correct K^+ structure, including + sign ✓ Correct S^{2-} structure, including 2- sign ✓ Two K^+ shown ✓ may be scored even if first mark isn't, third does not depend on first	3	Structures do NOT have to have 'shells' drawn Watch out for covalent structures - score zero. S^{2-} must show 2 electrons different ALLOW eight electrons shown for K^+ ion IGNORE inner shell electrons ALLOW cation drawn twice or '2' in front of the cation drawn once

Question		Answer	Marks	Guidance
	(c) (i)	Entropy is a measure of the 'number of ways' particles can be arranged AW ✓	1	ALLOW references to disorder / unordered / randomness / chaos of system OR no. of ways a substance can organize itself or is disorganized ALLOW molecules/atoms ALLOW no. of ways energy can be distributed
	(ii)	(Three) solids produce (one solid and two) gases ✓ Gases have higher entropy/disorder (etc.) than solids ORA ✓	2	Only allow this mark if a <u>comparison</u> made e.g. solids on one side (some) gases on other OR more gases on right; but do not penalize twice i.e. if first mark no comparison but second answer says gases have high entropy/disorder allow second mark
	(d) (i)	Melting point which is higher in carbon ORA ✓	1	Melting point and difference both needed for mark ALLOW boiling point or density higher in carbon
	(ii)	109° ✓ 4 pairs/sets/regions of electrons/areas of negative density (around each S atom) ✓ Electrons (pairs) repel ✓ to get as far apart as possible/to minimise electronic energy ✓	4	<i>Use annotations</i> ALLOW 104 – 110° IGNORE references to tetrahedral shape DO NOT ALLOW bonds ALLOW diagram to show 4 areas of charge/electrons DO NOT ALLOW repel 'as much as possible' DO NOT ALLOW bonds (unless it is clear elsewhere that they contain electrons) repel/or electrons 'push' Mark independently DO NOT ALLOW 3 bonding pairs 1 lone 3 sets can only score last two marks must have electrons repel ALLOW 'furthest they can repel'
Total			17	

Question			Answer	Marks	Guidance
3	(a)	(i)	Skeletal ✓	1	ALLOW recognisable spelling
		(ii)	C ₂₁ H ₄₄ ✓	1	
		(iii)	A / C ₂₂ H ₄₄ ✓	1	
		(iv)	B and C ✓	1	
		(v)	C ✓	1	
(b)	(i)	Any two of: Short(er) hydrocarbons/have less carbons ✓ Unsaturated/alkenes ✓ Branched/cyclic ✓	2	DO NOT ALLOW answers in terms of octane number and auto-ignition ALLOW (physically) smaller ALLOW (carbon-carbon) double bond	
	(ii)	(Catalyst) speeds up a reaction and can be recovered unchanged/not used up OR provides a path/route/mechanism of lower activation enthalpy/energy ✓ Heterogeneous (catalysis) (QWC mark) ✓ (Heterogeneous catalysis) occurs on surface OR 'adsorbed' ✓ large surface area ✓	4	<i>Use annotations</i> DO NOT ALLOW just 'lowers/reduces activation energy' DO NOT ALLOW 'speeds up reaction' without qualification Second mark only scored if 'heterogeneous' spelled correctly, <i>annotate with ✓ or x on pencil</i> IGNORE references to molecules fitting through holes IGNORE detailed mechanisms NB: 'Large surface for reaction (to occur)' scores both last marks	
(c)		Isomerisation ✓	1	NOT isomerism	

Question		Answer	Marks	Guidance
	(d)	Incomplete/partial combustion/breakdown of the oil ✓ Caused by insufficient supply/not enough of oxygen/air OR therefore C produced instead of CO/CO ₂ AW ✓	2	ALLOW not a favourable oxygen to fuel ratio
		Total	14	

Question		Answer	Marks	Guidance
4	(a)	0.003/200.6 ✓ 1.496 x 10 ⁻⁵ (ecf) x 24,000 ✓ or x 24 followed by x 1000 = 0.36 (answer to 2sf) ✓	3	3.0 x 10 ⁻³ fine ALLOW third mark for any 2 sig fig answer derived from a calculation
	(b) (i)	Line (spectra) ✓ (Coloured/bright lines on) black/dark background ✓ Lines converge at <u>higher frequency</u> ✓	3	A diagram could score all three ALLOW bands for lines Diagram would need frequency labelled to score last mark
	(ii)	Either: Black/dark lines ✓ OR coloured/bright/spectrum/rainbow background ✓	1	ALLOW bands No ecf from 4b(i)
	(c) (i)	3900–4100 ✓ sensible drawing of trend/best fit lines shown on graph ✓	2	ALLOW only straight-ruled/hand drawn extension (but IGNORE slight curve at end) for 2 nd mark
	(ii)	<u>Rises/increase</u> (to a maximum/peak) then <u>falls/decreases</u> ✓	1	IGNORE references to specific elements (e.g. tungsten)
	(d)	<i>LHS</i> : Delocalised ✓ electrons ✓ <i>RHS</i> : Cations / positive ions / positive residues ✓	3	NOT free flowing for delocalised NOT nuclei or positive atoms
	(e)	outer/valence electronic structure OR number of outer shell electrons ✓	1	ALLOW reference to d-shell
	(f) (i)	atomic weight/mass ✓	1	ALLOW relative atomic mass NOT molecular mass
	(ii)	Reversed the order / swapped over some pairs of elements ✓ OR Left gaps ✓ OR Put elements with similar properties in the same group ✓	1	NOT moved/changed NOT shared spaces ALLOW specific examples
	(ii)	Number of protons (in the nucleus) ✓	1	Give BOD for 'number of proton and electrons'
Total			17	

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