

# **Chemistry B (Salters)**

Advanced Subsidiary GCE

Unit **F331**: Chemistry for Life

## **Mark Scheme for January 2011**

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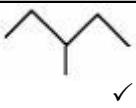
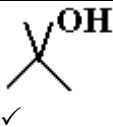
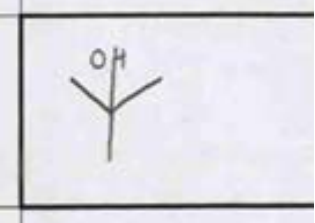

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## MARK SCHEME

Question			Answer				Mark	Guidance
1	(a)	(i)	compound	molecular formula	skeletal formula	homologous series	7	one mark for each cell correct
							<b>ALLOW</b> structures either way up or branch between adjacent sections of chain. Allow dots at junctions between C – C bonds	
			2,3-dimethylbutane ✓				Must be 'di' <b>ALLOW</b> recognisable spellings <b>IGNORE</b> commas, dashes and spaces	
						(cyclo)alkane ✓	<b>ALLOW</b> aromatic <b>Do not allow</b> benzene or cycloalkene	
						alkene ✓		
						arene ✓		
							<b>ALLOW</b> alternatives e.g. –OH sticking downwards <b>Must show</b> H atom on alcohol group but can be displayed Bond should be to O atom but only penalise if bond <u>clearly</u> to H atom i.e. only penalise if –HO	
						ether ✓	 <b>Wrong</b> bond touches H	
							 Ambiguous so <b>okay</b>	
							<b>ALLOW</b> alkoxyalkane	

Question			Answer	Mark	Guidance
1	(a)	(ii)	fractional distillation ✓	1	<b>DO NOT ALLOW</b> just distillation
		(iii)	(structural) isomer(s) ✓	1	Functional group isomerism <b>ALLOW</b> mark
		(iv)	pent-2-ene ✓	1	<b>ALLOW</b> methylbenzene
	(b)		(tendency to) autoignite / pre-ignite / knock ✓ (more branching) increases octane number ✓	2	<b>ALLOW</b> just 'autoignition etc' If relationship of octane number to autoignition is given incorrectly then only second mark can score.  Must <b>link</b> (could be by implication) branching to increase in octane number  <b>NOTE</b> 'a higher octane number means a lower tendency to autoignite' on its own, does not score second mark because it is not linked to branching.
	(c)	(i)	$C_{11}H_{24} \rightarrow C_5H_{10} + C_6H_{14}$ ✓✓	2	<b>ALLOW one</b> mark if correct names or skeletal formulae used instead of formulae
		(ii)	$C_6H_{14} \rightarrow C_6H_{12} + H_2$ ✓	1	<b>ALLOW</b> if written as skeletal formulae (with H <sub>2</sub> )
<b>Total</b>				<b>15</b>	

Question			Answer	Mark	Guidance
2	(a)	(i)	${}_{84}^{210}\text{Po} \rightarrow {}_2^4\text{He} \checkmark + {}_{82}^{206}\text{Pb} \checkmark$ $\checkmark$ for products  (max 1 if <b>any</b> symbol <u>clearly</u> incorrect e.g. HE, he, PA, pA )	2	<p><b>ALLOW</b> <math>\alpha</math> symbol instead of He  <b>ALLOW</b> – (minus) <math>{}_2^4\text{He}</math> on LHS  <b>ALLOW</b> an arrow, <math>\rightarrow</math> instead of +  <b>MAX one mark</b> if any number on right  <b>DO NOT ALLOW</b> He on top of arrow  <b>DO NOT ALLOW</b> charges on He or Pb</p> <p>If equation written as a fusion reaction with + <math>{}_2^4\text{He}</math> (giving Rn-214) scores <b>zero</b>, <b>however</b> if written as a fusion <b>but</b> producing <math>{}_{82}^{206}\text{Pb}</math> allow one mark</p> <p><b>IGNORE</b> gamma ray</p>
		(ii)	$\frac{10^{-6}}{210} = 4.76 \times 10^{-9} \checkmark$  sig. figs. $4.8 \times 10^{-9} \checkmark$ 2 marks if on answer line	2	<p>First mark for <b>process with correct evaluation</b>;</p> <p><b>Some examples:</b></p> <p><math>1.0 \times 10^{-6} \div 84 = 1.2 \times 10^{-8}</math> scores zero for first point (wrong process) but scores second sf mark</p> <p><b>However:</b></p> <p><math>1.0 \times 10^{-6} \div 210 = 4.7619</math> scores zero for first point (wrong evaluation) but one for 4.8 on answer line (sf mark)</p> <p><b>And:</b></p> <p><math>1.0 \times 10^{-6} \times 84 = 8.4</math> scores zero for first point (wrong process) <b>and</b> zero for sf mark because evaluation also wrong (should be <math>8.4 \times 10^{-5}</math>)</p> <p><b>i.e. sig fig ecf is not</b> scored if both process and evaluation are wrong</p>

Question		Answer	Mark	Guidance
2	(b)	$\alpha$ particles not very penetrating / AW ✓	1	idea of stopped by skin, clothes, very small range etc.  <b>ALLOW</b> has to be ingested/consumed ora / AW  <b>IGNORE</b> references to 'not very much, or half life i.e. no mark if only answer
	(c)	(i) correct plots (within a square) ✓  curve through or close to points ✓  line taken to 10 days and does not meet x axis or start to go up by more than one square ✓	3	<b>IGNORE</b> possible extra lines which may have been drawn and removed because these may be detected by scanner  <b>DO NOT ALLOW</b> straight line
		(ii) time taken for count rate / amount / mass of radioisotope/substance to drop by half ✓  half life from graph 1.9 days some working must be shown ✓	2	<b>ALLOW</b> half of parent/radioactive isotope decayed ✓ Assume 'its' mass refers to radioisotope ✓ <b>NOT</b> half <u>the</u> atom/nucleus decayed <b>NOT</b> half size  <b>DO NOT ALLOW</b> second mark unless working shown on graph only one half life needs to be found  <b>ALLOW</b> $1.9 \pm 0.2$ days
		(iii) <b>'Detection' mark</b> Yes suitable/useful because long enough/not too short to detect <b>OR</b> No not suitable because large amount would be needed ✓  <b>'Time factor' mark</b> short enough not to stay in body too long ✓	2	        <b>ALLOW</b> reverse argument for time factor i.e. too long because isotope still active/causes damage in body (first detection mark stands)
		<b>Total</b>	<b>12</b>	

Question			Answer	Mark	Guidance
3	(a)	(i)	$M_r = 309.1 \checkmark$  $\frac{195.1}{309.1} \times 100 = 63\% \checkmark$	2	<p><b>ALLOW</b> ecf on <math>M_r</math> of <math>\text{PtF}_6</math> e.g. <math>195.1 \div 290.1 \times 100 = 67.25</math> scores 1</p> <p><b>ALLOW</b> <math>A_r</math> values to nearest whole number</p> <p><b>ALLOW</b> 2 or more sig figs</p> <p>Any of 63%/63.106/63.11/63.12 on answer line scores both marks</p> <p><b>ALLOW</b> <math>\text{PtF}_6/\text{XePtF}_6 = 70.2</math> ecf 1 mark</p>
		(ii)	$M_r \text{XePtF}_6 = 440.4 \checkmark$  moles = $10.0/440.4 (= 0.0227) \checkmark$  volume = $0.0227 \times 24000 = 545\text{cm}^3$ / <b>ALLOW</b> $540 \text{cm}^3 \checkmark$	3	<p><b>ALLOW</b> <math>A_r</math> values to nearest whole number (gives <math>M_r</math> 440) <b>(NOT</b> other values eg 440.2)</p> <p><b>ALLOW ecf's</b> on wrong <math>M_r</math> for marking points 2 and 3 evaluation must be correct if present to any number of sig. figs</p> <p>For 3<sup>rd</sup> mark don't allow rounding to 0.02 <b>ALLOW</b> rounding i.e. 0.023 (gives 550/552)</p>
	(b)	(i)	Noble gas has <u>full / complete</u> outer shell of electrons (this is very stable) $\checkmark$	1	<p><b>ALLOW</b> inner shells full and outer empty (Hence group 0)</p> <p><b>ALLOW</b> 'has eight electrons in outer shell'</p>
3	(b)	(ii)	reactions occur in order to attain Noble gas configuration; in the 'Bartlett' reaction this configuration is lost / broken / AW $\checkmark$	1	<p><b>NOTE</b> to score this mark candidate must answer in terms of the idea that full/complete shells are stable and would not be expected to react.</p> <p>Some examples may help:</p> <ul style="list-style-type: none"> <li>• (Xe) can bond even with a full outer shell <math>\checkmark</math></li> <li>• because only atoms without full outer shells (of electrons) were thought to react (v. good answer) <math>\checkmark</math></li> <li>• because despite a full outer shell it reacted</li> <li>• when some atoms react they don't end up with</li> </ul>

Question		Answer	Mark	Guidance
				<p>complete outer electron shells (although not directly related to Xe this deserves credit) ✓</p> <ul style="list-style-type: none"> <li>• can form dative bonds ✓</li> <li>• <b>NOT general answers of the type 'no longer matched the evidence'; 'because the Xenon reacted'; clearly reacted therefore theory wrong</b></li> </ul>
	(c)	(i)		
		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <math>\text{Xe(g)} + 3 \text{F}_2\text{(g)} + \text{Pt(s)}</math> </div> ✓✓	2	Symbols (cases must be correct) with states ✓ (both needed for first mark)  3 ✓
		(ii)		
		$(\Delta H_r =) \Delta H_2 - \Delta H_1$ ✓	1	<b>ALLOW</b> $-\Delta H_1 + \Delta H_2$ or $\Delta H_r + \Delta H_1 = \Delta H_2$ Allow equations without $\Delta$
		(iii)		
		<u>only</u> /AW bonds made <b>OR</b> no bonds broken ✓	1	<b>ALLOW</b> there are more bonds formed  <b>IGNORE</b> answers in terms of magnitude of $\Delta H$  Any reference to <b>bonds</b> being <b>broken</b> scores zero unless candidate says no bonds broken
3	(d)	wedges show bond/molecule/elements/atoms/F  in front/out of (plane of paper)/closer to us ✓  dots show behind/into (plane of paper)/further from us ✓	2	<b>ALLOW one</b> mark for 'shows 3D (structure)' AW  <b>ALLOW one</b> mark for wrong way round (essentially the 3D possibility)
	(e)	Group 0 and Period 5 ✓  number of 'shells' gives period, outer electron structure gives group ✓ allow ecf on both numbers	2	<b>ALLOW</b> group 8/VIII/18/noble or inert gases  <b>IGNORE</b> references to level of shell filling  <b>ALLOW</b> specific description in terms of Xe i.e. 5 shells containing electrons therefore Period 5
		<b>Total</b>	<b>15</b>	



Question			Answer	Mark	Guidance
4	(a)	(i)	2.8.8 ✓	1	<b>ALLOW</b> $1s^2 2s^2 2p^6 3s^2 3p^6$ (allow subscripts) Ignore any square brackets or charge e.g. [2 8 8] <sup>+</sup>
		(ii)	$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ correct equation ✓ state symbols ✓	2	State symbols mark dependent on correct equation No ecf's
	(b)	(i)	atomic ✓ emission ( <b>only scores if spelled correctly</b> ) ✓	2	spg <b>NOT</b> a separate mark emission and absorption is a CON – no mark

Question			Answer	Mark	Guidance
4	(b)	(ii)	<p>(a) energy absorbed/heating causes <b>electrons</b> to be excited ✓</p> <p>(b) promotion to higher energy levels (electron shells allowed here – see diagram mark) ✓</p> <p>(c) drop back emitting photon/light/em radiation/visible spectrum (ASSUME wave means light) ✓</p> <p>(d) energy levels quantised/specific  <b>OR</b> shown in diagram as discrete lines with energy levels labelled or implied  <b>OR</b> energy on vertical axis ✓</p> <p>(e) therefore lines of specific/certain frequency/wavelength formed <b>OR</b> <math>E = hf / \lambda</math> ✓</p> <p>(f) diagram ✓</p>	6	<p>Please annotate the marking points ✓</p> <p><b>Marking points (a), (b), (c) and (d) can be scored from a diagram</b></p> <p>References to <u>atoms</u> moving up/down energy levels penalise <b>once</b> only</p> <p>To score (d) from diagram:  <b>MUST</b> have energy/energy levels (<b>not shells</b>), label on axis <b>OR</b> <math>n=1, n=2, n=3</math> and etc.</p> <p><b>Diagram mark:</b> at least three levels upper gap smaller than lower but need not have energy label or transitions shown. Circles or horizontal lines.</p>
	(c)	(i)	toxic / poisonous ✓	1	<p><b>NOT</b> hazardous/dangerous/harmful (to health)  <b>ALLOW</b> specific danger e.g. binds to blood cells/causes respiratory problems <b>but</b> not breathing problems  <b>CON</b> if greenhouse gas / photochemical smog</p>

Question			Answer	Mark	Guidance
4	(c)	(ii)	reaction of N <sub>2</sub> and O <sub>2</sub> (either) <u>in air/atmosphere</u> Reference to either coming from exhaust or fuel is a CON ✓  at high temp (of fire) ✓	2	<b>ALLOW</b> words nitrogen/oxygen ( <b>NOT</b> N and O) and alternatives to 'react' i.e. combine / combust (oxygen does not need to be mentioned) / form bonds / burns  <b>ALLOW</b> temperature/heat of fire ( <b>NOT</b> high energy/engine)  <b>ALLOW</b> partial combustion
		(iii)	2CO + 2NO → N <sub>2</sub> + 2CO <sub>2</sub> ✓ Doubles/halves/multiples	1	<b>DO NOT ALLOW</b> N <sub>2</sub> O instead of NO, however see below (iv)
		(iv)	(measure) of degree of disorder/chaos <b>OR</b> ways of arranging ✓  entropy decreases/randomness ✓  fewer molecules on right ✓ ORA	3	<b>DO NOT ALLOW</b> arrangement of <u>atoms/electron</u> <b>OR</b> within a molecule or molecular size (penalise once only)  <b>ALLOW ecf</b> from above e.g.: CO + N <sub>2</sub> O → N <sub>2</sub> + CO <sub>2</sub> No/little change in entropy ✓ Same number of molecules on either side ✓
			<b>Total</b>	<b>18</b>	

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