

Chemistry B (Salters)

Advanced Subsidiary GCE

Unit **F331**: Chemistry for Life

Mark Scheme for January 2011

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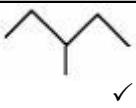
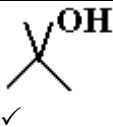
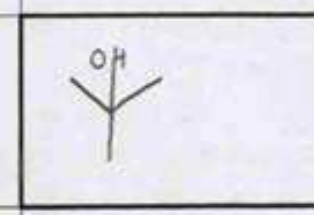

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MARK SCHEME

Question			Answer				Mark	Guidance
1	(a)	(i)	compound	molecular formula	skeletal formula	homologous series	7	one mark for each cell correct
							ALLOW 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' ALLOW recognisable spellings IGNORE commas, dashes and spaces	
						(cyclo)alkane ✓	ALLOW aromatic Do not allow benzene or cycloalkene	
						alkene ✓		
						arene ✓		
							ALLOW alternatives e.g. –OH sticking downwards Must show 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 ✓	 	Wrong bond touches H Ambiguous so okay
							ALLOW alkoxyalkane	

Question			Answer	Mark	Guidance
1	(a)	(ii)	fractional distillation ✓	1	DO NOT ALLOW just distillation
		(iii)	(structural) isomer(s) ✓	1	Functional group isomerism ALLOW mark
		(iv)	pent-2-ene ✓	1	ALLOW methylbenzene
	(b)		(tendency to) autoignite / pre-ignite / knock ✓ (more branching) increases octane number ✓	2	ALLOW just 'autoignition etc' If relationship of octane number to autoignition is given incorrectly then only second mark can score. Must link (could be by implication) branching to increase in octane number NOTE '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	ALLOW one mark if correct names or skeletal formulae used instead of formulae
		(ii)	$C_6H_{14} \rightarrow C_6H_{12} + H_2$ ✓	1	ALLOW if written as skeletal formulae (with H_2)
Total				15	

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

Question		Answer	Mark	Guidance
2	(b)	α particles not very penetrating / AW ✓	1	idea of stopped by skin, clothes, very small range etc. ALLOW has to be ingested/consumed ora / AW IGNORE 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	IGNORE possible extra lines which may have been drawn and removed because these may be detected by scanner DO NOT ALLOW 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	ALLOW half of parent/radioactive isotope decayed ✓ Assume 'its' mass refers to radioisotope ✓ NOT half <u>the</u> atom/nucleus decayed NOT half size DO NOT ALLOW second mark unless working shown on graph only one half life needs to be found ALLOW 1.9 ± 0.2 days
		(iii) 'Detection' mark Yes suitable/useful because long enough/not too short to detect OR No not suitable because large amount would be needed ✓ 'Time factor' mark short enough not to stay in body too long ✓	2	 ALLOW reverse argument for time factor i.e. too long because isotope still active/causes damage in body (first detection mark stands)
		Total	12	

Question			Answer	Mark	Guidance
3	(a)	(i)	$M_r = 309.1 \checkmark$ $\frac{195.1}{309.1} \times 100 = 63\% \checkmark$	2	<p>ALLOW ecf on M_r of PtF_6 e.g. $195.1 \div 290.1 \times 100 = 67.25$ scores 1</p> <p>ALLOW A_r values to nearest whole number</p> <p>ALLOW 2 or more sig figs</p> <p>Any of 63%/63.106/63.11/63.12 on answer line scores both marks</p> <p>ALLOW $\text{PtF}_6/\text{XePtF}_6 = 70.2$ ecf 1 mark</p>
		(ii)	$M_r \text{XePtF}_6 = 440.4 \checkmark$ moles = $10.0/440.4 (= 0.0227) \checkmark$ volume = $0.0227 \times 24000 = 545\text{cm}^3$ / ALLOW $540 \text{cm}^3 \checkmark$	3	<p>ALLOW A_r values to nearest whole number (gives M_r 440) (NOT other values eg 440.2)</p> <p>ALLOW ecf's on wrong M_r for marking points 2 and 3 evaluation must be correct if present to any number of sig. figs</p> <p>For 3rd mark don't allow rounding to 0.02 ALLOW 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>ALLOW inner shells full and outer empty (Hence group 0)</p> <p>ALLOW '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>NOTE 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"> • (Xe) can bond even with a full outer shell \checkmark • because only atoms without full outer shells (of electrons) were thought to react (v. good answer) \checkmark • because despite a full outer shell it reacted • when some atoms react they don't end up with

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"> • can form dative bonds ✓ • NOT general answers of the type 'no longer matched the evidence'; 'because the Xenon reacted'; clearly reacted therefore theory wrong
	(c)	(i)		
		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> $\text{Xe(g)} + 3 \text{F}_2\text{(g)} + \text{Pt(s)}$ </div> ✓✓	2	<p>Symbols (cases must be correct) with states ✓ (both needed for first mark)</p> <p>3 ✓</p>
		(ii)		
		$(\Delta H_r =) \Delta H_2 - \Delta H_1$ ✓	1	<p>ALLOW $-\Delta H_1 + \Delta H_2$ or $\Delta H_r + \Delta H_1 = \Delta H_2$</p> <p>Allow equations without Δ</p>
		(iii)		
		<u>only</u> /AW bonds made OR no bonds broken ✓	1	<p>ALLOW there are more bonds formed</p> <p>IGNORE answers in terms of magnitude of ΔH</p> <p>Any reference to bonds being broken scores zero unless candidate says no bonds broken</p>
3	(d)	<p>wedges show bond/molecule/elements/atoms/F</p> <p>in front/out of (plane of paper)/closer to us ✓</p> <p>dots show behind/into (plane of paper)/further from us ✓</p>	2	<p>ALLOW one mark for 'shows 3D (structure)' AW</p> <p>ALLOW one mark for wrong way round (essentially the 3D possibility)</p>
	(e)	<p>Group 0 and Period 5 ✓</p> <p>number of 'shells' gives period, outer electron structure gives group ✓ allow ecf on both numbers</p>	2	<p>ALLOW group 8/VIII/18/noble or inert gases</p> <p>IGNORE references to level of shell filling</p> <p>ALLOW specific description in terms of Xe i.e. 5 shells containing electrons therefore Period 5</p>
		Total	15	

Question			Answer	Mark	Guidance
4	(a)	(i)	2.8.8 ✓	1	ALLOW $1s^2 2s^2 2p^6 3s^2 3p^6$ (allow subscripts) Ignore any square brackets or charge e.g. [2 8 8] ⁺
		(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 (only scores if spelled correctly) ✓	2	spg NOT a separate mark emission and absorption is a CON – no mark

Question			Answer	Mark	Guidance
4	(b)	(ii)	<p>(a) energy absorbed/heating causes electrons 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 OR shown in diagram as discrete lines with energy levels labelled or implied OR energy on vertical axis ✓</p> <p>(e) therefore lines of specific/certain frequency/wavelength formed OR $E = hf / \lambda$ ✓</p> <p>(f) diagram ✓</p>	6	<p>Please annotate the marking points ✓</p> <p>Marking points (a), (b), (c) and (d) can be scored from a diagram</p> <p>References to <u>atoms</u> moving up/down energy levels penalise once only</p> <p>To score (d) from diagram: MUST have energy/energy levels (not shells), label on axis OR $n=1, n=2, n=3$ and etc.</p> <p>Diagram mark: 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>NOT hazardous/dangerous/harmful (to health) ALLOW specific danger e.g. binds to blood cells/causes respiratory problems but not breathing problems CON if greenhouse gas / photochemical smog</p>

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

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