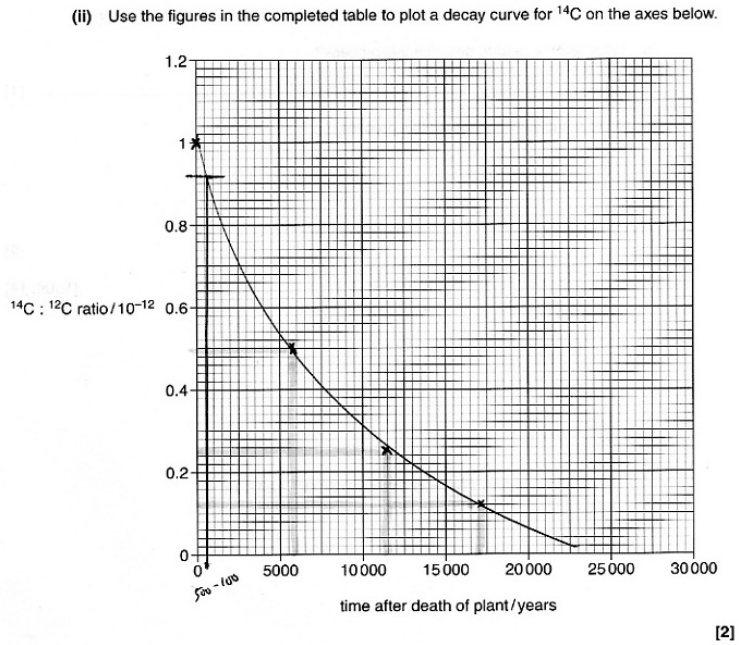
F331 Chemistry for Life

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th></th><th>protons</th><th>neutrons</th><th>electrons</th></tr>
<tr><td>^{14}C</td><td>6</td><td>8</td><td>6</td></tr>
<tr><td>^{12}C</td><td>6</td><td>6</td><td>6</td></tr>
</table>
one mark for each row</td><td>2</td><td>do not allow ecf for electrons based on proton number</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>$^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$
correct β particle (either symbol)(1) ;
rest correct (1) ;</td><td>2</td><td>must be <u>beta</u> decay to score
allow – β on LHS
numbers on wrong side scores maximum 1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>time taken for half(radioactive) isotope to decay / count rate to fall by half / mass / amount to decrease by half(1) ;</td><td>1</td><td>do not allow atom instead of isotope
allow ‘substance’ (to decay by half etc)</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Number of half lives</th><th>Time after death of organism/years</th><th>^{14}C: ^{12}C ratio/10^{-12}</th></tr>
<tr><td>0</td><td>0</td><td>1.000</td></tr>
<tr><td>1</td><td>5730</td><td>0.500</td></tr>
<tr><td>2</td><td>11460</td><td>0.25(0)</td></tr>
<tr><td>3</td><td>17190</td><td>0.125</td></tr>
</table>
</td><td>1</td><td>all correct as in table to left for mark</td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
		(ii)	correct plotting(1) ; smooth curve(1) ;  	2	plotting within the square curve does not need to go through all points but must be 'sensible!' not point to point straight lines line must not become horizontal / rise after the final point ecf on candidate values in table
		(iii)	between 500 and 1000 yrs(1) ;	1	check against graph if outside range (for ecf)
	(c)		**very short** not around in sufficient levels long enough to detect(AW) / burst of harmful radiation (1) ; **very long** possible harm to patient/too little radiation to detect(1) ;	2	**do not allow** isotope finished / stopped; must be about diagnosis / detection / tracing **allow** 'not around long enough to be useful as a tracer' / decays too fast / quickly for use(AW)
	(d)	(i)	(nuclear) fusion (1) ;	1	**allow** spelling errors

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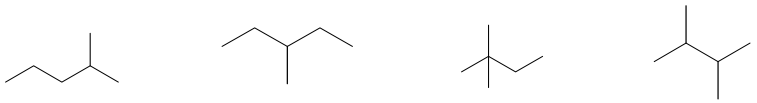
		(ii)	${}_{1}^{1}H + {}_{1}^{2}H \rightarrow {}_{2}^{3}He$ RHS(1) **;** LHS(1) **;**	**2**	**con** one mark for numbers on right **ignore** gamma radiation
			Total	**14**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	for elements yet to be discovered(1) **;**	1	**allow** AW **allow** "to line up elements with similar properties"
		(ii)	new elements(1) **;** showed properties fitting in with group(1) **;**	2	Showed properties / characteristics / chemistry predicted / fitted – for second mark **allow** specific reference to a "new" element
		(iii)	noble(inert) gases / group 0 / group 8 / VIII (1) **;**	1	wrongly named group **cons** correct group number
	(b)	(i)	Atomic / proton number(1) **;**	1	
		(ii)	properties of some of the elements did not match up in Newlands(1) **;**	1	**allow** "he didn't leave gaps"
	(c)	(i)	goes up(rises) then goes down(falls) (1) **;**	1	**allow** high to higher then drops / falls
		(ii)	**bonding:** *(one mark available)* metallic on left of period changing to covalent going right(1) **;** may be combined with later marks **structure:** *(three marks available)* (giant) metallic at start(1) **;** giant / large molecular / covalent or network / lattice in middle(1) **;** (simple) molecular on right(1) **;**	4	**allow** description using quoted elements eg Li, Be, (B) metallic. etc **allow** 'carbon / C' for middle marking point
	(d)		group 2 and period 4 (both needed)	1	
			Total	12	

Question			Expected Answers	Marks	Additional Guidance
3	(a)		fuel igniting too early / before or without spark/on compression(1) ; can damage engine / loss of power / efficiency(1) ;	2	**do not allow** tendency to auto ignite **do not allow** causes knocking
	(b)	(i)	any value between 0.218 and 0.300 inclusive(1) ;	1	
		(ii)	bond enthalpies decrease down group(1) ; longer bonds weaker(1) ; ORA	2	**allow** from left to right longer bonds give smaller bond enthalpies **scores 2**
	(c)	(i)	tetrahedral(1) ; 109º(1) ;	2	**allow** tetrahedron between 104 and 110^0
		(ii)	four sets / pairs of electrons / areas of negative charge / electron density(AW)(1) ; repel(1) ; as far as possible/minimise electronic energy(1) ; (need not refer to electrons)	3	**note** do not need around central atom (in stem) **do not allow** four sets / four pairs on own without qualification repel **must** refer to electrons not bonds or atoms etc **do not allow** repel as much as possible
	(d)	(i)	QWC – **heterogeneous** (1) ; spelling of word must be correct adsorption of reactants(1) ; bonds (in reactants) weaken and break(1) ; new bonds (in products) form(1) ; products diffuse off / desorbed / released from catalyst(1) ;	5	**do not allow** absorption but **allow** anything else which suggests "on the surface" bonds between reactants break **cons** 3rd mark **do not allow** forms an intermediate **do not allow** petrol as a named reactant
		(ii)	poison blocks / coats / reduces surface of catalyst (AW) (1) ; reactants / other molecules cannot bond to surface(1) ;	2	**allow** poison binds irreversibly for 1st mark
			Total	17	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	aliphatic(1) ; unsaturated(1) ;	2	
		(ii)	(cyclo)alkene / C=C / carbon-carbon double bond(1) ;	1	
		(iii)	process (+17,578 -23,524)(1) ; answer with sign ecf (1) ; -5946 scores 2	2	+5946 scores 1 5946 without a sign scores zero
		(iv)	**bond enthalpies** are for the gaseous state / not in standard state (1) ; bond enthalpy values are averages(1) ;	2	**no** other reference to standard states / conditions
		(v)	M_r limonene = 136(1) ; moles of limonene = 1/136 (= 0.007352)(1) ; 3 sf(1) ; (0.00735)/7.35 x 10^{-3} scores all three	3	**allow** any 3sf if a calculation present. Answer must be consistent with calculation
	(b)	(i)	ethanol(1) ; alkene(1) ; ether / alkoxyalkane(1) ;	3	**not** ethan-1-ol
		(ii)	correct **skeletal** formula for **branched six** carbon alkane	1	
		(iii)	correct name from above (ecf on incorrect skeletal / structural formula)	1	2-methylpentane 3-methylpentane 2,2-dimethylbutane 2,3-dimethylbutane **allow** methyl-2-pentane etc **ignore** dashes, commas etc

Question			Expected Answers	Marks	Additional Guidance
	(c)	(i)	more molecules in products(1) **;** more disorder/ways of arranging them(1) **;**	**2**	**allow** 'increase in number of moles' **allow** exothermic reaction giving more kinetic energy for 1st mark **not** more ways of arranging <u>atoms</u>
			Total	**17**	