F331 Chemistry for Life

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	skeletal ✓	1	**ALLOW** recognisable spellings
		(ii)	2,2,4-trimethylpentane ✓✓	2	**IGNORE** gaps, dashes, hyphens, commas pentane✓ rest ✓
		(iii)	ring structure / arene / cyclic **OR** short(er) molecule ✓	1	**ALLOW** small
	(b)	(i)	burn measured mass / amount of fuel / octane ✓ measure temp rise ✓ of a fixed volume / mass / amount of water ✓ use - energy transferred = mass of water x specific heat capacity (of water) x temp rise ✓ scale up to one mole of fuel / octane used / AW ✓	5	**ALLOW** measure starting and finishing temperature / mass of octane / fuel **DO NOT ALLOW** just 'final' temp. recorded **IGNORE** reference to solution **ALLOW** q / energy = mcΔT or mcθ allow 'm' as mass of water unless conned eg **ALLOW** answer **divided by** moles burnt

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		(ii)	*any **two** from 4:* heat loss to surroundings / air / effect of draughts; etc ✓ heat losses to calorimeter / apparatus; ✓ incomplete combustion of fuel / lack of (enough) oxygen; ✓ evaporation of fuel (from wick); ✓	2	**DO NOT ALLOW** 'not standard conditions' / reference to data book values / AW **DO NOT ALLOW** 'enthalpy may escape' **IGNORE** evaporation of water / measurement error / human error
	(c)	(i)	ΔH_1 = enthalpy *(change)* of formation (of octane) ✓ ΔH_2 = enthalpy *(change)* of combustion of *eight moles of* carbon / (*enthalpy (change) of formation of eight moles of carbon dioxide)* ✓ ΔH_3 = enthalpy *(change)* of combustion of *nine moles of* hydrogen / (*enthalpy (change) of formation of nine moles of water)* ✓ ΔH_4 = enthalpy *(change)* of combustion of octane ✓	4	**ALLOW** omission of the words 'enthalpy change of…' **IGNORE** references to oxygen **ALLOW** appropriate symbols eg ΔH_f **ALLOW** ΔH_2 and ΔH_3 in either order. Score one out of two if numbers of moles not mentioned **ALLOW** ΔH_2 / ΔH_3 in terms of enthalpy changed of formation of 8 moles CO_2 and 9 moles of H_2O. **DO NOT ALLOW** any rearrangement of ΔH_1 etc
		(ii)	answer = –248 ✓	1	
			Total	16	

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th rowspan="2">property</th><th colspan="3">type of emission</th></tr>
<tr><th>α</th><th>β</th><th>γ</th></tr>
<tr><td>relative charge</td><td>+2</td><td>-1</td><td>0</td></tr>
<tr><td>relative mass</td><td>4</td><td>0.00055</td><td>0</td></tr>
<tr><td>nature</td><td>helium nucleus</td><td>(nuclear) <u>electron /</u> correct symbol</td><td>very high frequency electromagnetic radiation</td></tr>
<tr><td>range in air</td><td>(few) cms / mm</td><td>few metres</td><td>very long</td></tr>
<tr><td>stopped by</td><td>tissue paper</td><td>metal foil</td><td>Lead / aluminium / thick metal (sheet) / concrete</td></tr>
<tr><td>deflection by an electric field</td><td>low</td><td>High / big / large</td><td>none</td></tr>
</table>
✓ ✓ ✓</td><td>3</td><td>One mark for each column:

ALLOW none / dashes for 0’s

ALLOW ‘short’ for ‘few cms’
DO NOT ALLOW ‘Not very far’ / AW (too vague)

DO NOT ALLOW medium for β deflection
DO NOT ALLOW neutral for γ deflection</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>$^{99}_{42}Mo \rightarrow {}^{0}_{-1}\beta + {}^{99}_{43}Tc$ ✓✓</td><td>2</td><td>top line ✓

bottom line ✓

ALLOW one mark for completely correct beta or Tc if other is wrong</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>same atomic number ✓

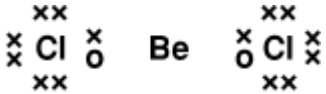
different mass number ✓</td><td>2</td><td>OR

atoms of the same element ✓

with different numbers / more / less of neutrons ✓</td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
	(c)	(i)	difficult to detect very small amounts of Ar-40 formed K-40 decayed / dating errors very large when so little decay has taken place / AW ✓	1	**DO NOT ALLOW** answers that talk only in terms of 'not even finished one half life'
		(ii)	Ar^{+} (allow Ar^{2+}) ✓	1	**ALLOW** with <u>correct</u> mass / atomic numbers **DO NOT ALLOW** wrong symbol
		(iii)	peak / bar / line at (mass numbers) 36, 38 and 40 ✓ size / height of peak related to abundance ✓	2	mass numbers **needed** to score
		(iv)	(energy lost as) electrons go from higher to lower levels ✓ relationship of energy to frequency / wavelength ✓ gives a (specific) line(s) ✓ energy gaps / levels different for different elements ✓ **QWC –** wavelength / frequency / frequencies must be spelled correctly	4	 eg E = hf or in words mention of lines scores a mark **CON** one mark if spelling incorrect
			Total	15	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	(hydrocarbon) contains no <u>benzene</u> rings / not an arene ✓	1	**DO NOT ALLOW** contains no rings
		(ii)	<u>fractional</u> distillation ✓	1	
		(iii)	$C_{25}H_{52}$ + **38**O_2 → 25CO_2 + 26H_2O ✓	1	
	(b)	(i)	unburnt hydrocarbon / $C_{25}H_{52}$ ✓	1	**ALLOW** paraffin wax **ALLOW** CO **ALLOW** smaller hydrocarbon
		(ii)	carbon monoxide ✓ carbon / soot ✓	2	**ALLOW** water **IGNORE** oxides of nitrogen
	(c)	(i)	C_3H_6 ✓	1	order of elements immaterial
		(ii)	110-130º ✓ 3 areas of electron density ✓ around **central** C ✓ areas of electron density / pairs repel as far apart as possible / minimize energy ✓	4	 **DO NOT ALLOW** 3 'atoms' or 'electron pairs' **ALLOW** names or descriptions of electron groups eg double bond **ALLOW** clear diagram or description **DO NOT ALLOW** repel **as much** as possible **TAKE CARE** repel and 'as far apart' run together for only one mark **ALLOW** bonds (but not atoms) repel
		(iii)	catalysts **and** reactants in different (physical) states ✓	1	
		(iv)	contain hole(s) / channels / porous / gaps / rings ✓ can trap branched / let through straight isomers ✓	2	
			Total	14	

Question			Expected Answers	Marks	Additional Guidance
4	(a)		mass number = 1 ✓ atomic number = 0 ✓	2	
	(b)	(i)	moles of Be = 1.75/9 (0.19) ✓ moles of Cu = 98.25/63.5 (1.55) ✓	2	all usual ecf's apply (allow working to more / less sig. figs.) Max 1 if unit other than moles put in
		(ii)	**11 scores all three ✓✓✓** total no. of moles = 1.74 ✓ %Be = 0.19/1.74 x 100 ✓ (=10.919) Sig. figs. separate mark based on a followable calculation ✓	3	**ALLOW** ecf's from **(b)(i)** **ALLOW** sig. figs. mark for a (wrong) calculation based on some given figures
	(c)		Delocalised electrons ✓ Regular array of cations / positive ions / residues ✓ Labels but any used must be correct✓	3	*First two points can be on diagram or labels* *minimum of five cations shown (can touch)* **ALLOW** positive atoms **DO NOT ALLOW** positive nucleus or positive metal
	(d)		 'correct' pairs on Be ✓ 3 <u>pairs</u> on Cl ✓	2	**DO NOT ALLOW** ionic structure

Question			Expected Answers	Marks	Additional Guidance
	(e)		melting point (is different) ✓ (melting point) is higher in ionic compounds ✓ **AND** *Any **one** of:* ionic compounds conduct electricity when in solution / molten ✓ **OR** ionic compounds (generally) water soluble / ora / AW ✓	3	**ALLOW** ORA throughout **DO NOT ALLOW** references to ionic solids / covalent gases liquids **ALLOW** boiling point Must be a comparison for 2nd mark Incorrect chemical explanation **CON** 2nd mark eg reference to bond strengths **DO NOT ALLOW** just 'conduct electricity'
			Total	**15**	