

Question	Key	Marks	Guidance
1	C	1	

Question			Answer	Marks	Guidance
2	(a)		$\text{C}_7\text{H}_{16} + 7\frac{1}{2}\text{O}_2 \rightarrow 7\text{CO} + 8\text{H}_2\text{O}$ OR $\text{C}_7\text{H}_{16} + 4\text{O}_2 \rightarrow 7\text{C} + 8\text{H}_2\text{O} \checkmark$	1	ALLOW multiples IGNORE state symbols ALLOW equations for incomplete combustion that give CO and/or C with CO_2 e.g $\text{C}_7\text{H}_{16} + 9\text{O}_2 \rightarrow 4\text{CO} + 3\text{CO}_2 + 8\text{H}_2\text{O}$

Question	Answer	Marks	AO	Guidance
3	A	1	AO1.2	

Question	Answer	Marks	AO	Guidance
4	D	1	AO2.1	

Question			Answer	Marks	AO element	Guidance
5 (b)						
			urther substitution/s OR produces different termination products OR More than one termination step OR Mixture of products are formed ✓ substitution at different positions along chain ✓	2	1.1×2	ALLOW dibromo/multibromo compounds formed OR an example of a further substitution product OR an example of a different termination product ALLOW more than one hydrogen (atom) can be replaced ALLOW radicals react with each other to form other products IGNORE references to separation of products IGNORE references to atom economy or yield ALLOW a hydrogen (atom) on a different carbon (atom) can be replaced

Question	Answer	Marks	AO element	Guidance
6	C	1	AO2.1	ALLOW 4 (This is the number of structural isomers)

Question	Answer	Marks	AO	Guidance
7	D	1	AO1.2	

Question	Answer	Marks	AO	Guidance
8	D	1	AO1.1	

Question	Answer	Marks	AO element	Guidance
9	B	1	AO2.2	

SECTION B

Question	Answer	Marks	AO element	Guidance
10 (a)	Trend for all 3 hydrocarbons (1 mark): Boiling point increases with less branching OR less methyl/alkyl groups/side chains ✓ Explanation with comparison (3 marks): Branching and surface contact (Less branching gives) more (surface) contact / interaction (between molecules) ✓ Surface contact and London forces (More surface contact) gives more /stronger induced dipole(–dipole) interactions/ London forces ✓ Energy and intermolecular forces More energy to break induced dipole(–dipole) interactions/ London forces/intermolecular forces/intermolecular bonds (with less branching) ✓	4	AO1.1 AO1.2 X3	ANNOTATE WITH TICKS AND CROSSES Comparisons needed throughout ORA throughout Must have link between rank order of branching and boiling point for all 3. ALLOW Hexane is least branched/straight chain and has highest bp AND 2,2-dimethylbutane is most branched and has lowest bp. IGNORE Chain length Surface area alone is not sufficient, must have idea of contact. DO NOT ALLOW arguments comparing different numbers of electrons (as all have the same number). IGNORE van der Waals'/vdW forces OR IDID OR IDD ALLOW 'more energy to break intermolecular forces' if intermolecular forces are not identified or incorrect. IGNORE harder to overcome/break intermolecular forces (no reference to energy) IGNORE just 'bonds' intermolecular/London forces required

Question	Answer	Marks	Guidance
11 (a) (i)	Equation $ \begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & \\ \text{H} & \text{CH}_3 & \text{H} \end{array} + \text{Br}_2 \longrightarrow \begin{array}{c} \text{H} & \text{Br} & \text{H} \\ & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & \\ \text{H} & \text{CH}_3 & \text{H} \end{array} + \text{HBr} \quad \checkmark $ Name Radical substitution ✓ Bond fission homolytic (fission) ✓	3	ALLOW any combination of skeletal OR structural OR displayed formula as long as unambiguous IGNORE mechanism, need overall equation
11 (a) (ii)	Further substitution/s OR Different termination products OR More than one termination step Substitution at different positions along (carbon) chain ✓	2	ALLOW dibromo/multibromo compounds formed OR example of further substitution product e.g. $\text{CH}_2\text{BrCBr}(\text{CH}_3)_2$ / $\text{C}_4\text{H}_8\text{Br}_2$ / 1,2-dibromo-2-methylpropane OR example of different organic termination product e.g. C_8H_{18} ALLOW more than one H (atom) can be replaced ALLOW radicals react with each other to form other products ALLOW a hydrogen (atom) on a different carbon (atom) can be replaced ALLOW Substitutions can occur at other carbons (along the chain) ALLOW example of substitution at different position on chain e.g. $\text{CH}_2\text{BrCH}(\text{CH}_3)_2$ / 1-bromo-2-methylpropane IGNORE references to separation of products IGNORE references to atom economy or yield

Question			Answer	Mark	Guidance
12 (a)			$\text{C}_6\text{H}_{14} + 6\text{O}_2 \rightarrow 5\text{CO} + \text{C} + 7\text{H}_2\text{O} \checkmark$	1	DO NOT ALLOW any equations which show H_2 as a product ALLOW $\text{C}_6\text{H}_{14} + 6\text{O}_2 \rightarrow 2\text{CO}_2 + \text{CO} + 3\text{C} + 7\text{H}_2\text{O}$ ALLOW $\text{C}_6\text{H}_{14} + 6\text{O}_2 \rightarrow \text{CO}_2 + 3\text{CO} + 2\text{C} + 7\text{H}_2\text{O}$ ALLOW multiples that show a 1:6 ratio e.g. $2\text{C}_6\text{H}_{14} + 12\text{O}_2 \rightarrow 10\text{CO} + 2\text{C} + 14\text{H}_2\text{O}$ OR $2\text{C}_6\text{H}_{14} + 12\text{O}_2 \rightarrow 5\text{CO}_2 + 7\text{C} + 14\text{H}_2\text{O}$