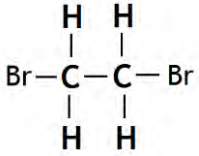
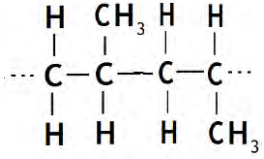
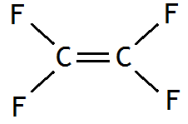
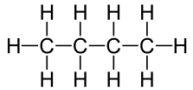
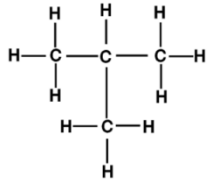
Question number	Answer	Notes	Marks
1 (a)	nitrogen / N_2	accept N	1
(b)	oxygen AND water	accept steam	1
(c)	incomplete combustion (of the octane / fuel)	accept '(burns in a) limited supply / shortage of oxygen/air' reject 'no oxygen'	1
(d) (i)	$N_2 + 2O_2 \rightarrow 2 NO_2$	accept halves and multiples accept as two correct equations via NO	1
(ii)	(It produces) acid rain OR (it causes) breathing problems / asthma	accept 'photochemical smog' ignore refs to greenhouse gas / global warming / climate change ignore refs to pollution	1

Question number	Answer	Notes	Marks
2 a	hydrogen / H_2	Ignore H	1
b	only single bonds (between carbon atoms) /single bond(s) between carbon atoms	ignore between C and H Accept no double bond(s) / no multiple bond(s) Ignore answers that refer to numbers of hydrogens	1
c i		Accept Br atoms in any position provided one on each carbon	1
ii	C (the product of the reaction is colourless)		1
d		M1 for 4 × C AND 6 × H and 2 × CH_3 M2 for extension bonds and two CH_3 groups on alternate carbon atoms (can be both above or both below carbon chain) M2 DEP on M1 Do not penalise bonds to H of CH_3 Ignore brackets and subscripted n If any double bond shown, then 0/2	2
e		Reject any extension bonds Ignore bond angles Do not penalise more than one correct structure	1

Question number	Answer	Notes	Marks
2 f i	(polymer) breaks down / decomposes / decays	Do not penalise compound / object / molecule / substance in place of polymer Reject element in place of polymer Ignore rots / degrades / digests / disintegrate If reference to <u>not</u> breaking down etc, only M2 can be awarded	1
	by bacteria / microbes / microorganisms	Ignore naturally / enzymes	1
ii	inert / unreactive / OWTTE	Ignore do not react with named chemical Ignore references to bond strengths / bond breaking	1
			Total 10 marks

Question number	Answer	Accept	Reject	Marks
3 (a)	**M1** C_6H_{14} **M2** 58 **M3** any value in the range 25 to 45			1 1 1
(b)	boiling point/it <u>increases</u> as M_r <u>increases</u>	reverse argument positive correlation as one increases the other increases	directly proportional	1
(c)	different <u>general</u> formulae / **OR** (general) formula of ethene is <u>not</u> C_nH_{2n+2} / (general) formula of ethane is <u>not</u> C_nH_{2n} **OR** use of/ mention of displayed formulae to show/indicate double (C to C) bond in ethene <u>and</u> single (C to C) bond in ethane	same number of carbon atoms but different number of hydrogen atoms	just different number of hydrogen atoms	1
(d) (i)	 **M1**  **M2** penailse one missng H or one missing bond once only accept answers in either order			1 1
(ii)	(structural) isomer(s)	isomerism		1

3 (e) (i)	$C_2H_6 + Br_2 \rightarrow C_2H_5Br + HBr$ **M1** – C_2H_5Br **M2** – rest of equation correct **M2** dep on **M1** **IGNORE** state symbols	further substituted formula structural or displayed formulae		2
(ii)	substitution	bromination/halogenation		1
(iii)	ultraviolet/uv (radiation)	uv light sunlight	light on its own	1
			Total	**12**

Question number		Answer	Notes	Marks
4 a	M1	(compound/molecule/substance containing) carbon and hydrogen (atoms)	Reject atoms/elements in place of compounds Reject molecules in place of atoms Reject mixture Accept C and H in place of carbon and hydrogen	1
	M2	only	M2 dependent on M1 or near miss, eg mixture of C and H Accept equivalent wording such as alone / purely / solely	1
b		contains (C=C) double bonds	Accept multiple bonds Reject implied C=H	1

Question number				Answer	Notes	Marks
4	c	i		alkene(s)		1
		ii		C_nH_{2n}	Accept other symbols such as x Accept $H_{2n}C_n$	1
		iii	M1	same/similar chemical properties	Accept same/similar reactions Do not accept a specific reaction, eg they all burn Ignore similar reactivities	2
			M2	trend/gradation in physical properties	Accept named trend eg boiling point Accept correct trend eg smaller molecules have lower boiling points, but not incorrect trend such as smaller molecules have higher boiling points	
			M3	same functional group		
			M4	(neighbouring) members differ by CH_2		
					Any two for 1 each	

Question number				Answer	Notes	Marks
4	d	i		but-1-ene	Accept butene Ignore mention of cis or trans	1
		ii		C_4H_8		1
		iii	M1	(compounds/molecules with) same molecular formula / same number of each type of atom	Do not penalise specific compound types, eg hydrocarbons / alkenes If elements/atoms in place of compounds, max 1 for Q Ignore references to chemical/general/empirical formula	1
			M2	different structure(s) / different structural formula(e) / different displayed formula(e)	Ignore atoms in a different order	1
		iv		displayed formula of but-2-ene or methylpropene	Accept cyclobutane or methylcyclopropane Ignore but-1-ene structure	1
	e	i		colourless / decolorised	Ignore clear	1
		ii		$C_2H_4Br_2$	Insist on correct use of subscripts and cases of letters Do not penalise elements in different order Accept correct structural/displayed formula	1
					Total	**14**