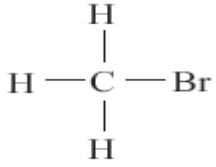
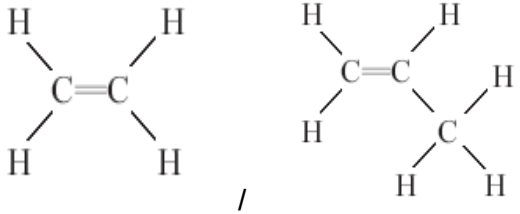
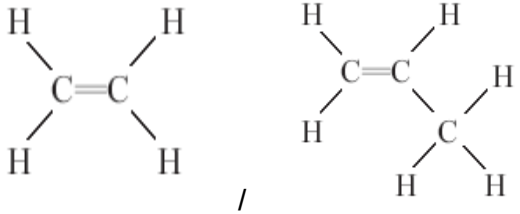
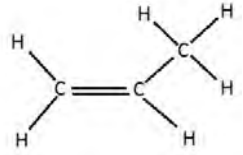
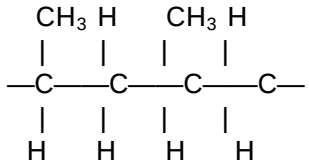
Question number				Answer	Notes	Marks
1	a	i		S	Accept diagram: 	1
		ii	M1	T / U	Accept diagrams: 	1
		iii	M1	T / U	Accept diagrams:  Do not penalise if both T and U are given Do not award the mark if either or both of T or U is given and any other letter is included	1

Question number				Answer	Notes	Marks
1	b		M1 M2	(add) bromine (water) decolourised / goes colourless	If bromide, then 0/2 Do not allow bromine in UV light, but M2 can be awarded Ignore starting colour of bromine Ignore clear / discolours Reject bleached	1 1
	c		M1	displayed formula of but-1-ene, but-2-ene or methylpropene	All atoms and bonds must be shown Allow dienes	1
	d	i	M1	C_nH_{2n+2}	Accept x and other letters in place of n Accept answers like $C_nH_{2n}+2$ Ignore brackets	1
		ii	M1 M2 M3 M4	same/similar chemical properties / reactions / behaviour / characteristics gradation /gradual change / trend / increase / decrease of physical properties (neighbouring members) differ by CH_2 same functional group	Ignore specific example such as react with oxygen Ignore similar (type of) reactivity Accept reference to specific property, eg boiling point Reject same / similar physical properties Any two for 1 each Accept two answers on one answer line	 2

Question number				Answer	Notes	Marks
1	e		M1 M2	(compounds / molecules with) same molecular formula / same number of each type of atom different structures / structural formulae / atoms arranged differently / different displayed formulae	Ignore same chemical formula Ignore hydrocarbons If atoms or elements instead of compounds or molecules, max 1 for Q	1 1

Total 11 marks

Question number			Answer	Notes	Marks
2	a	i	heated	Accept boiled / evaporated / vaporised Reject burn Ignore melts	1
		ii	(compounds containing) hydrogen and carbon only	Accept substances/molecules containing … Reject atoms/elements //mixture containing … Reject hydrogen and carbon molecules/ions Accept alternatives such as solely M2 needs a reference to hydrogen and carbon	1 1
		iii	(hydrocarbons/molecules in) D have: higher boiling point larger/bigger/heavier/longer molecules more viscous/thicker/less runny	Ignore melting point If no reference to D or F, then 0/3 Accept converse statements for F	1 1 1
2	b	i	silica / alumina (catalyst) 600 – 700 °C	Accept aluminosilicate / Al_2O_3 / SiO_2 / zeolite /broken ceramic/porous pot Accept any value or range within this range Units required Accept equivalent values in K	1 1
		ii	(alkene has) double bond (between C atoms) OR alkane has only single bonds / no double bonds / no multiple bonds	Assume it = alkenes Accept multiple bonds Reject triple bonds Reject references to ionic bonding Ignore references to intermolecular forces	1

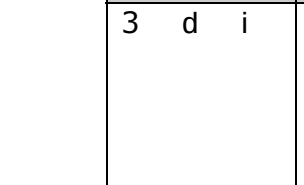
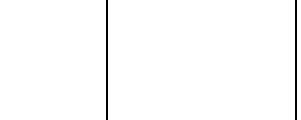
Question number			Answer	Notes	Marks
2		iii	C_2H_4	Accept structural and displayed formula Penalise incorrectly shown formulae eg eg C2H4 / C_2h_4 / C_2 + H_4	1
	c	i	propene	Accept propylene / prop-1-ene Reject incorrect spellings	1
		ii	general empirical 	Accept methyl group in any position Ignore shape and bond angles	1 1 1
		iii		M1 for <u>two</u> carbon atoms both with 2 H atoms M2 for <u>two</u> carbon atoms both with 1 H atom and 1 CH_3 group No M2 if methyl groups on 1st + 2nd, or 3rd + 4th carbons in chain Do not penalise bonds to H of CH_3 Max 1 if chain extended correctly 0/2 if any double bonds shown Ignore brackets and $_n$	2

(Total for Question 2 = 16 marks)

Question number	Answer	Notes	Marks
3 (a)	C	Accept formula of C	1
3 (b) i	(compound/molecule/substance containing) carbon and hydrogen (atoms/elements)	Reject atom/element in place of compound/molecule Reject compound/molecule in place of atoms/elements Reject mixture	1
	Only	M2 dependent on mention of carbon and hydrogen even if M1 not awarded Accept other terms with same meaning, e.g. solely / exclusively / just	1
	A	M3 independent Accept name/formula of A	1
ii	contains a (C=C) double bond	Accept multiple bond Ignore references to type of compound, eg hydrocarbon Reject double bond between C and H Do not penalise incorrect terms such as atom or element Ignore not all bonds are single Accept can undergo addition reactions Accept does not contain the maximum number of hydrogens/hydrogen atoms	1
	B	M2 independent Accept name/formula of B	1

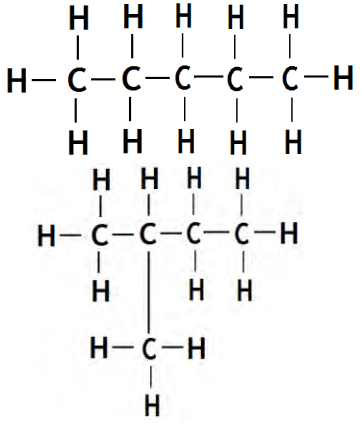
	Answer	Notes	Marks
3 b iii	(compounds / molecules / substances with) same molecular formula / same number of each type of atom	Ignore same (chemical) formula /same compound No penalty for reference to hydrocarbons Reject same empirical/general formula If atoms or elements instead of compounds or molecules, only 1 of M1 and M2 can be awarded	1
	different structures /different structural/displayed formulae OR atoms arranged differently	Ignore different molecular arrangement	1
	C and F	Accept in either order Accept formulae of C and F	1

Question number	Answer	Notes	Marks
3 c i	same/similar chemical properties/reactions/behaviour/characteristics	Ignore specific examples such as react with oxygen Ignore similar (type of) reactivity Do not penalise reference to trends	2
	gradation / gradual change / trend / increase / decrease of physical properties	Accept reference to specific property, eg boiling point Reject same / similar physical properties Ignore variable physical properties	
	same functional group	Ignore reference to specific group	
	same general formula	Accept alkanes have the (general) formula C_nH_{2n+2} Reject same empirical/molecular formula	
		Any two for 1 each Accept two answers on one answer line Ignore any reference to properties not specified as physical or chemical	
ii	D AND E	Reject any other combinations Accept correct formulae	1

Question number	Answer	Notes	Marks
3 d i		Ignore bond angles and positioning of Br (as long as one on each C)	1
ii			1
		Total	**14**

Question number	Answer	Notes	Marks
4 a	fractional distillation/fractionating column/tower (crude oil) heated/vaporised / boiled cooler at top/hotter at bottom/idea of temperature gradient fractions condense /separate at different heights/levels fractions have different boiling points/ranges	Reference to fractional / fractionating needed Ignore references to fracking Accept components / hydrocarbons / compounds / gases Accept separate at different temperatures Ignore references to melting point Any four for 1 mark each If any reference to cracking, MAX 2 M1 - M4 can be scored from suitably labelled diagram	4

Question number	Answer	Notes	Marks
4 b i	C_nH_{2n+2}	Do not penalise inappropriate spaces or failure to show 2 and n as subscripts	1
ii	same/similar chemical properties/reactions/behaviour/characteristics gradation / gradual change / trend / increase / decrease of physical properties same functional group (neighbouring) members differ by CH_2	Ignore specific examples such as react with oxygen Ignore similar (type of) reactivity Do not penalise reference to trends Accept reference to specific property, eg boiling point Reject same / similar physical properties Ignore variable physical properties Ignore reference to specific group Any two for 1 each Accept two answers on one answer line Ignore any reference to properties not specified as physical or chemical	2
c	(1) 5 3 4	Accept multiples and fractions	1
d i	carbon monoxide / CO		1
ii	reduces capacity of blood to carry oxygen / OWTTE	Accept correct explanation involving haemoglobin Ignore references to carbon monoxide reacting with blood / red blood cells	1
iii	nitrogen/N_2 AND oxygen/O_2	Accept in either order Ignore N and O	1

Question number	Answer	Notes	Marks
4 e		Penalise missing H atoms once only provided all bonds are correctly shown Penalise missing bonds in both structures	1 1

Question number	Answer	Notes	Marks
4 f i	setting out correct division of each % by A_r OR 4.4, 11.1 and 1.1	Award 0/3 if division by any atomic numbers / wrong way up / multiplication used / wrong atomic mass (eg 16 for C) Do not penalise roundings and minor misreads of % values, eg 11 for H and 36.5 for S If molecular mass used for H, no M1, but can award M2 and M3 but no CQ in ii Using 2 for H gives C_4H_5S Working required for this answer	1
	division by smallest /ratio of 4 : 10 : 1	M2 subsumes M1	1
	$C_4H_{10}S_{(1)}$	Accept elements in any order Award 3 for correct final answer with no working No ECF from M2 Accept use of 90 from ii, i.e. 90 × 0.533 = 48 etc scores M1 ratio scores M2, answer scores M3	1
ii	$C_4H_{10}S_{(1)}$	Accept elements in any order No other answer acceptable	1
			Total 17 marks