

Question number	Answer	Notes	Marks
1 (a) (i)	Q R S P M1 Q and P correct M2 R and S correct		2
(ii)	M1 magnesium chloride M2 hydrogen M1 and M2 can be in either order	ACCEPT correct formulae IGNORE incorrect formulae	2
(b)	M1 (add) (aqueous) silver nitrate / AgNO_3 M2 white precipitate (forms)	IGNORE refs to nitric acid do not award M1 if hydrochloric acid also added M2 dep on mention of silver nitrate in M1	2

Question number	Answer	Notes	Marks
2 a	<p>M1 (they/all) contain hydrogen and carbon (atoms)</p> <p>M2 only</p>	<p>Accept H and C</p> <p>Accept particles/elements in place of atoms</p> <p>Reject ions/molecules/compounds in place of atoms</p> <p>Reject element instead of they/all</p> <p>Reject H₂</p> <p>Reject mixture</p> <p>Accept words with other meaning (eg solely/ exclusively)</p> <p>M2 DEP on reference to hydrogen and carbon even if M1 not awarded</p>	2
b	double bond	<p>Accept multiple in place of double</p> <p>Accept contain C=C</p> <p>Ignore references to single bonds</p>	1
c	A		1
d	B and E and F	<p>All three correct scores 2 marks</p> <p>Two correct scores 1 mark</p> <p>If more than three answers given lose one mark for each error eg BCEF scores 1 mark</p>	2
e	because it has no double bond(s) / has only single bonds / is saturated	<p>Accept because only unsaturated compounds decolourise bromine water</p> <p>Accept because only alkenes decolourise bromine water</p> <p>Accept because it's not an alkene</p> <p>Accept because it's not unsaturated</p> <p>Accept because it's a (cyclo)alkane</p>	1

Question number	Answer	Notes	Marks														
2 f i	<p>M1 for setting out calculation</p> <table><tr><td>C</td><td>H</td><td>Br</td></tr><tr><td>$\frac{22.2}{12}$</td><td>$\frac{3.7}{1}$</td><td>$\frac{74.1}{80}$</td></tr></table> <p>If division upside down or division by one or more atomic numbers, then 0/3</p> <p>M2 for obtaining ratio</p> <table><tr><td>1.85</td><td>3.7</td><td>0.93</td></tr></table> <p>Accept any number of sig figs except one Allow 0.92</p> <p>M3 for whole number ratio</p> <table><tr><td>2</td><td>:</td><td>4</td><td>:</td><td>1</td></tr></table> <p>M3 DEP on M2</p> <p>allow alternative method:</p> <p>M1 calculation of $M_r \text{ C}_2\text{H}_4\text{Br} = 108$</p> <p>M2 expression for % of <u>each</u> element eg C: $24/108 \times 100$</p> <p>M3 evaluation to show these equal 22.2%, 3.7%, 74.1%</p>	C	H	Br	$\frac{22.2}{12}$	$\frac{3.7}{1}$	$\frac{74.1}{80}$	1.85	3.7	0.93	2	:	4	:	1		3
C	H	Br															
$\frac{22.2}{12}$	$\frac{3.7}{1}$	$\frac{74.1}{80}$															
1.85	3.7	0.93															
2	:	4	:	1													
ii	<p>M1 $((2 \times 12) + (4 \times 1) + (1 \times 80) =) 108$</p> <p>M2 $(216 \div 108 = 2)$ (so molecular formula is) $\text{C}_4\text{H}_8\text{Br}_2$</p>	correct answer with no working scores 2	2														

Question number	Answer	Notes	Marks
3	a i	fuel oil	1
	ii	fuel oil	1
	iii	gasoline	1
b	i	alumina / silica Accept aluminosilicates/zeolites Accept aluminium oxide/silicon dioxide/silicon oxide/silicon (IV) oxide Accept correct formulae	1
	ii	M1 for correct formula - C_4H_8 M2 for correct coefficient - 2 Accept C_4H_8 + C_4H_8 for 2 marks Award 1 mark for $4C_2H_4$ Award 1 mark for C_8H_{16} Award 1 mark for two alkenes which have a total of 8C and 16H eg C_3H_6 + C_5H_{10}	2

iii	M1	over/greater supply of long-chain hydrocarbons/molecules/ heavy/heavier fractions / OWTTE	Accept long chain hydrocarbons/molecules heavy/heavier fractions are of less use (as fuels)	3
	M2	high demand/more use for short-chain/small hydrocarbons/ light/lighter fractions / OWTTE	Accept answers in terms of petrol / fuel (for cars) Short chain hydrocarbon molecules are more useful/in greater demand than long chain hydrocarbons/molecules scores M1 and M2	
	M3	Alkenes used to make polymers	Accept specific alkene and product eg ethene to make poly(ethene)/ethanol/alcohol	
c	M1	forms sulfur dioxide (when burned)		2
	M2	which causes specified problem for environment OR specified problem for humans	eg acid rain / damages trees / kills fish eg toxic / respiratory irritant / triggers asthma attacks Ignore harmful gas	

Question number	Answer	Notes	Marks
3 d	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{CH}_3 & \text{H} & \text{CH}_3 \end{array} $	<p>M1 for only <u>two</u> (of the four) carbon atoms both with two H eg $-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-$ scores 0</p> <p>M2 for (the other) <u>two</u> carbon atoms each with one H and one CH_3 No M2 if methyl groups on 1st + 2nd, or on 3rd + 4th carbons in chain</p> <p>Do not penalise bonds to H of CH_3</p> <p>Max 1 if chain extended correctly</p> <p>Ignore brackets and n</p> <p>each carbon must have four bonds eg $-\text{CH}_2-\text{CH}-\text{CH}-\text{CH}_2-$ scores 0</p> <p>if terminal Hs added max 1</p> <p>0/2 if any double bonds shown</p>	2

Question number	Answer	Notes	Marks
4 a	i C_5H_{12}	Accept $H_{12}C_5$ Ignore gap between C_5 and H_{12} Ignore names Ignore C_nH_{2n+2}	1
	ii CH_2Br	Accept elements in any order Ignore molecular formula Ignore $2CH_2Br$ Penalise inappropriate use of upper or lower case letters or numbers(eg $CH2Br$ / CH_2BR / CH^2Br)	1
b	i R <u>and</u> U	Accept in either order	1
	ii D (C_nH_{2n})		1
c	C (compound R \rightarrow compound Q)		1

Question number	Answer	Notes	Marks
4 d	<p>M1</p> <pre> Br Br H — C — C — H H H </pre> <p>M2 (1,2-)dibromoethane</p>	<p>Mark M1 and M2 independently</p> <p>Accept Br atoms in any positions so long as on different carbon atoms</p> <p>Ignore any numbers</p> <p>Accept ethylene dibromide</p>	2
e i	<pre> Br H — C — H H </pre>	<p>Ignore balancing in equation</p> <p>Ignore molecular formula</p>	1
ii	bromomethane		1
iii	UV or ultraviolet (light/radiation)	<p>Accept sunlight</p> <p>Ignore all references to heat and temperature</p> <p>Ignore references to pressure</p>	1
iv	D (substitution)		1

Question number	Answer	Notes	Marks												
4 f i	<div>M1 setting out division of each % by A_r OR evaluation</div> <div><table><tr><td>C</td><td>H</td><td>F</td></tr><tr><td><u>36.4</u></td><td><u>6.0</u></td><td><u>57.6</u></td></tr><tr><td>12</td><td>1</td><td>19</td></tr></table></div> <div>OR</div> <div><table><tr><td>3</td><td>6</td><td>3</td></tr></table></div> <div>M2 simplest whole number ratio (1:2:1 or ratio shown in notes for M1)</div> <div>M3 CH₂F</div>	C	H	F	<u>36.4</u>	<u>6.0</u>	<u>57.6</u>	12	1	19	3	6	3	<div>Award 0/3 if division by any atomic numbers / wrong way up / multiplication used</div> <div>Do not penalise roundings or minor misreads of % values (eg 56.7 for fluorine)</div> <div>Do not penalise use of FI in (i)</div> <div>If molecular masses used for H and/or F, lose M1 but M2 and M3 can be awarded: using 2 and 38 gives C₂H₂F using 2 and 19 gives CHF Using 1 and 38 gives C₂H₄F Working required for these answers</div> <div>M2 subsumes M1</div> <div>Accept elements in any order</div> <div>Award 3 marks for correct final answer with no working</div>	3
C	H	F													
<u>36.4</u>	<u>6.0</u>	<u>57.6</u>													
12	1	19													
3	6	3													
ii	C ₂ H ₄ F ₂	<div>Accept elements in any order</div> <div>Do not accept C₂H₄FI₂</div>	1												
		Total 15 marks													