IGCSE Edexcel Chemistry Revision

Revision Guide Section 6: Organic Chemistry

Paper 1 [All Pathways]

Please note, these questions may have parts related to **other** topics within the GCSE Chemistry course. However, all questions are related at least in part to Organic Chemistry

Questions taken from 2019 and 2020 January and June Papers (C and CR)

- 7 questions
- 75 marks
- Recommended time: 80 minutes (just over 1 minute per mark)

1. This question is about alkenes and polymers.

(a) (i) Ethene (C_2H_4) can be represented by different types of formula.
Complete the table by giving the missing information. (2)

Molecular formula	C_2H_4
Empirical formula	
General formula	

(ii) Ethene is a member of the homologous series of alkenes.
All members of the same homologous series have the same general formula.
Give two other characteristics of a homologous series.
(2)
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(b) Ethene is used to make poly(ethene).
(i) State the type of polymerisation used to form poly(ethene).
(1)

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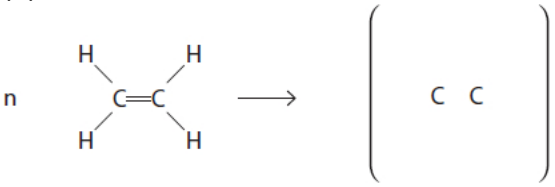
(ii) Complete the equation for the polymerisation of ethene.
(2)



(iii) Poly(ethene) is used to make plastic bags.
Corn starch from plants can also be used to make polymers for plastic bags.
The table gives some information about poly(ethene) and polymers made from corn starch.

	Poly(ethene)	Polymers from corn starch
Cost per tonne	£1500	£3700
Relative strength	100	50
Time to decompose	estimated 450 years	3–6 months

Use the information in the table and your knowledge to discuss the advantages and disadvantages of using poly(ethene) to make plastic bags.
(5)

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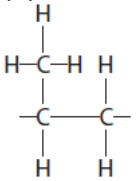
(c) The diagram shows the repeat unit of another polymer.



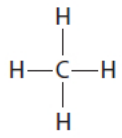
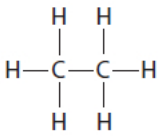
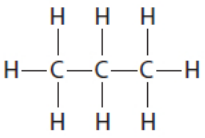
Draw the displayed formula of the monomer used to make this polymer.

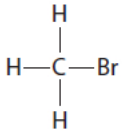
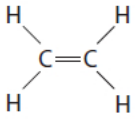
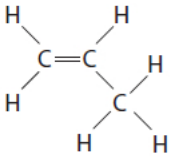
(1)

(Total for question = 13 marks)

Q2.

The boxes show the displayed formulae of six organic compounds, P, Q, R, S, T and U.

		
P	Q	R

		
S	T	U

(a) Use the letters P, Q, R, S, T and U to answer these questions.
Each letter may be used once, more than once or not at all.
(i) Give the letter of the compound that is not a hydrocarbon.
(1)

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(ii) Give the letters of the two compounds that have the same empirical formula.
(1)

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(iii) Give the letter of the compound that is used to manufacture poly(propene).
(1)

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(b) Describe a test that can be used to distinguish between compounds Q and T.
(3)
test

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result with compound Q

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result with compound T

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(c) Compounds P, Q and R are members of the same homologous series.
Give two characteristics of a homologous series.
(2)

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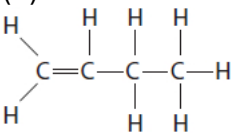
(d) This is the displayed formula of an alkene, V.



(i) Give the name of alkene V.
(1)

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(ii) Draw the displayed formula of another alkene that is an isomer of alkene V.
(1)

(e) An organic compound has the percentage composition by mass
C = 36.36% H = 6.06% F = 57.58%

(i) Show that the empirical formula of the compound is CH_2F
(2)

(ii) The relative molecular mass (M_r) of the compound is 66.
Determine the molecular formula of the compound.
(2)

molecular formula = ...

(Total for question = 14 marks)

Q3.

Ethene (C_2H_4) can be converted into chloroethene (C_2H_3Cl) in a two-stage process.
(a) The first stage is to convert ethene into 1,2-dichloroethane, $C_2H_4Cl_2$
Ethene is reacted with hydrogen chloride and oxygen.
Complete the chemical equation for this reaction.
(1)

..... C_2H_4 + ... HCl + ... O_2 → ..... $C_2H_4Cl_2$ + ... H_2O

(b) In the second stage, 1,2-dichloroethane is converted into chloroethene.

$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$

This is a thermal decomposition reaction.
State what is meant by the term thermal decomposition.
(1)

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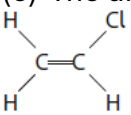
(c) The diagram shows the displayed formula of chloroethene.



(i) State why chloroethene is described as an unsaturated compound.

(1)

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(ii) Describe a test to show that chloroethene is unsaturated.

(2)

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(d) Name the polymer formed from chloroethene.

(1)

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(Total for question = 6 marks)

Q4.

This question is about hydrocarbons.

(a) State the meaning of the term hydrocarbon.

(2)

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(b) One homologous series of hydrocarbons is the alkanes.

Pentane (C_5H_{12}) is an alkane.

(i) When pentane burns completely in oxygen, carbon dioxide and water are produced.

Give a chemical equation for this combustion reaction.

(2)

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(ii) Incomplete combustion can occur when the oxygen supply is limited.

Give the names of two products of the incomplete combustion of pentane.

(2)

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(iii) One of the products of incomplete combustion is a poisonous gas.

State why this gas is poisonous to humans.

(1)

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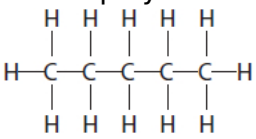
(iv) C_5H_{12} has three isomers.

The displayed formula for one of these isomers is



Draw the displayed formulae of the other two isomers.

(2)

(c) Another homologous series of hydrocarbons is the alkenes.

Alkenes are unsaturated hydrocarbons.

(i) Give the general formula for the alkenes.

(1)

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(ii) State the meaning of the term unsaturated.

(1)

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(iii) Describe a test to show that a hydrocarbon is unsaturated.

(2)

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(Total for question = 13 marks)

Q5.

Poly(chloroethene) is a polymer.

It is made from its monomer, chloroethene.

(a) Chloroethene has the percentage composition by mass

C = 38.4% H = 4.8% Cl = 56.8%

Show, by calculation, that the empirical formula of chloroethene is C_2H_3Cl

(3)

(b) The molecular formula of chloroethene is also C_2H_3Cl

Chloroethene can be prepared by a two-stage process.

In stage 1, ethene reacts with chlorine in the presence of an iron(III) chloride catalyst to form dichloroethane.

The reaction is exothermic.

$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$

(i) Give the formula of iron(III) chloride.

(1)

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(ii) State the purpose of using a catalyst.

(1)

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(iii) State the meaning of the term exothermic.

(1)

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(iv) What type of reaction occurs in stage 1 between ethene and chlorine?

(1)

☒ A addition

☒ B displacement

☒ C neutralisation

☒ D substitution

(v) In stage 2, dichloroethane decomposes into chloroethene and hydrogen chloride.

Give a chemical equation for this reaction.

(1)

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(c) (i) Draw the displayed formula of

· chloroethene

· the repeat unit of poly(chloroethene)

(3)

chloroethene	repeat unit of poly(chloroethene)

(ii) Draw a dot-and-cross diagram to represent a molecule of chloroethene.
Show only the outer electrons of each atom.
(2)

(Total for question = 13 marks)

Q6.

Crude oil is a mixture of hydrocarbons, most of which are alkanes.
(a) (i) State what is meant by the term hydrocarbon.
(2)

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(ii) Give the general formula for the alkanes.
(1)

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(b) Name the process used to separate crude oil into fractions.

(1)

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(c) One of the fractions obtained from crude oil is fuel oil.
Fuel oil is used to heat homes.
Explain why burning fuel oil in an insufficient supply of oxygen is dangerous.
(2)

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(d) Another fraction obtained from crude oil is gasoline.
Gasoline is used to make petrol for cars.
(i) Explain why it is dangerous to light a match even when standing several metres away from a petrol spillage.
(2)

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(ii) Suggest why a petrol spillage is more dangerous than a fuel oil spillage.
(1)

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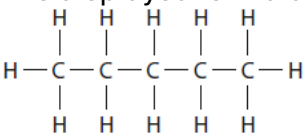
(Total for question = 9 marks)

Q7.

(a) There are three isomers with the molecular formula C_5H_{12}
One of these isomers is pentane.
The displayed formula for pentane is



(i) State what is meant by the term isomers.
(2)

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(ii) Draw the displayed formula for another isomer of C_5H_{12}
(2)

(b) Pentane reacts with bromine in the presence of ultraviolet radiation.
(i) Complete the equation for this reaction.
(2)

$C_5H_{12} + Br_2 \rightarrow$ ..... + ...

(ii) Give the name of this type of reaction.
(1)

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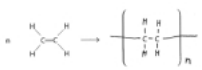
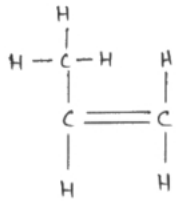
(Total for question = 7 marks)

Mark Scheme

Q1.

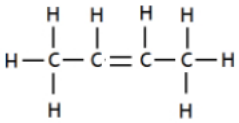
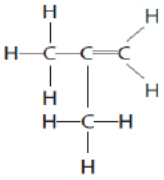
Question number		Answer	Notes	Marks
(a)	(i)	M1 (Empirical formula) CH_2 M2 (General formula) C_nH_{2n}	**ALLOW** sub and super script numbers for M1 and M2 **ALLOW** letters other than n **ALLOW** capital letters	2
	(ii)	Any two from: M1 each member differs from the next by a CH_2 group OWTTE M2 (each member has) same functional group M3 (each member has) similar/same chemical properties / similar/same (chemical) reactions M4 trend in physical properties (between successive members)	 **ACCEPT** react in similar/same way **ACCEPT** named physical property, e.g. boiling point **REJECT** similar/same physical properties	2
(b)	(i)	addition	**ALLOW** additional **REJECT** condensation	1
	(ii)	(ii) Complete the equation for the polymerisation of ethene. (2)  M1 Single bond between the two carbons, 4 hydrogens joined by single bonds M2 trailing bonds through the brackets and the n to the right	 **ALLOW** n in any position outside the bracket to the right of the structure. **ALLOW** capital N	2

(iii)	Any 5 points from: **M1** Poly(ethene) is cheaper than polymers from corn starch **M2** Poly(ethene) is stronger than polymers from corn starch **M3** Poly(ethene) frees up land to grow food crops **M4** Poly(ethene) comes from (cracking of certain fractions from) crude oil **M5** Poly(ethene) is non-renewable **OR** ethene is a finite source **M6** Poly(ethene) is inert **M7** poly(ethene) is non-biodegradable **M8** poly(ethene) takes longer to decompose **M9** Disposal of poly(ethene) is a problem (in landfill) **M10** Poly(ethene) causes problems with litter **M11** Burning poly(ethene) (could) create toxic fumes / greenhouse gases	If only advantages or disadvantages given, max 3 marks **IGNORE** durable	5
(c)		Must show every bond. **IGNORE** bond angles **IGNORE** n **IGNORE** brackets **REJECT** trailing bonds	1

(**Q09 4CH1/1CR, Jan 2020**)

Q2.

Question number	Answer	Notes	Marks
(a) (i)	S		1
(ii)	T and U		1
(iii)	U		1
(b)	A description that makes reference to the following three points **M1** (add) bromine water **M2** no change / stays orange **M3** (bromine water) decolourised / changes (from orange) to colourless	 **ACCEPT** Br_2 (aq) **ALLOW** no reaction If initial colour of bromine water is given in M2 or M3 it must be correct -ALLOW any combination of orange/yellow/brown - but penalise once only If bromine given for M1 then in M2 and M3 allow any combination of red/orange/brown/yellow **M2** and **M3** dep on bromine water/bromine in **M1** If no reagent and correct M2 and M3 - score 1 if incorrect reagent and correct M2 and M3 score 0 **IGNORE** clear **REJECT** discoloured **ALLOW M1** acidified potassium manganate(VII) **M2** no change/stays purple **M3** decolourised / goes colourless	3

Question number	Answer	Notes	Marks
(c)	Any **two** of the following points **M1** (can be represented by a) general formula **M2** each member differs from the next by a CH_2 group OWTTE **M3** (each member has) same functional group **M4** (each member has) similar/same chemical properties / similar/same (chemical) reactions **M5** trend in physical properties (between successive members)	**ACCEPT** react in similar/same way **ACCEPT** named physical property, e.g. boiling point **REJECT** similar/same physical properties	2
(d) (i)	but-1-ene	**ALLOW** 1-butene	1
(ii)	**Either**  **Or** 	**ACCEPT** cis or trans isomer **REJECT** displayed formulae of cyclic alkanes	1

Question number	Answer	Notes	Marks
(e) (i)	• Divide percentages by relative atomic masses • Divide results by smallest value to obtain ratio Example calculation **M1** C: $\frac{36.36}{12}$ H: $\frac{6.06}{1}$ F: $\frac{57.58}{19}$ **M2** $\frac{3.03}{3.03}$ $\frac{6.06}{3.03}$ $\frac{3.03}{3.03}$ **OR** 1 2 1	0 marks if division by atomic numbers or upside down calculation	2
(ii)	• divide relative molecular mass by empirical formula mass • correct molecular formula Example calculation **M1** $\frac{66}{12 + 2 + 19}$ **OR** $\frac{66}{33}$ OR 2 **M2** $C_2H_4F_2$	**ACCEPT** symbols in any order correct answer without working scores 2 marks. $2CH_2F$ scores 1	2
			Total 14

(**Q05 4CH1/1C, Jan 2020**)

Q3.

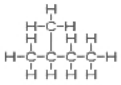
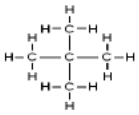
Question number	Answer	Notes	Marks
a	**2** C_2H_4 + **4** HCl + **(1)** O_2 → **2** $C_2H_4Cl_2$ + **2** H_2O	**ACCEPT** multiples and fractions	**1**
b	breaking down by heating OWTTE		**1**
c i	(it) contains a (carbon to carbon) double bond		**1**
ii	**M1** add bromine water/solution **M2** (bromine water/solution) is decolourised/ turns (from orange to) colourless	**ACCEPT** Br_2(aq) as long as the state symbol is present **IGNORE** clear **REJECT** discoloured If initial colour of bromine water given it must be correct- **ALLOW** any combination of orange/yellow/brown **M2** dep on **M1** or near miss **ALLOW** **M1** add acidified potassium manganate(VII) **M2** potassium manganate(VII) is decolourised/turns (from purple) to colourless **REJECT** any other initial colour	**2**
d	poly(chloroethene) /polychloroethene	**ACCEPT** polyvinyl chloride **ALLOW** PVC	**1**

(**Q08 4CH1/1C, June 2019**)

Q4.

Question number	Answer	Notes	Marks
a	**M1** (a compound containing the elements/atoms) hydrogen and carbon **M2** only	**ALLOW** molecule/substance for compound **REJECT** element/atom/ mixture for compound **REJECT** ions/molecules for elements/atoms **ACCEPT** other equivalent words eg solely **M2 DEP** on mention of hydrogen and carbon in **M1**	2
b (i)	$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ **M1** all formulae correct **M2** balancing of correct formulae	**ALLOW** fractions/multiples **IGNORE** state symbols	2

(ii)	Any two from **M1** carbon monoxide **M2** carbon **M3** water	**ACCEPT** correct formulae/symbol **ALLOW** soot for carbon	2
(iii)	reduces/limits capacity of blood to transport oxygen OWTTE M1	**ACCEPT** prevents blood from carrying oxygen OWTTE **ACCEPT** correct references to haemoglobin eg prevents haemoglobin from carrying oxygen	1 2

b(iv)			
	M2 	in either order	

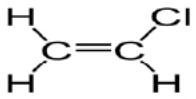
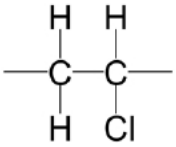
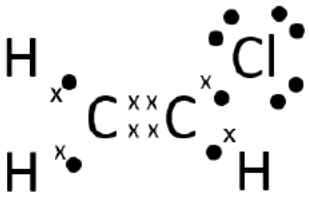
c (i)	C_nH_{2n}		1
(ii)	(contains a carbon to carbon) double bond	**ALLOW** (contains a carbon to carbon) multiple bond	1
(iii)	A description linking the following two points		2
	M1 add bromine water/solution	**ALLOW** $Br_2(aq)$	
	M2 (bromine water/solution) is decolourised / turns (from orange to) colourless	**IGNORE** clear **REJECT** discoloured If initial colour of bromine water given it must be correct- **ALLOW** any combination of orange/yellow/brown **M2** dep on **M1** or near miss **ALLOW** **M1** add acidified potassium manganate(VII) **M2** (potassium manganate(VII)) is decolourised/turns (from purple to) colourless **REJECT** any other initial colour	Total 13

(**Q04 4CH1/1CR, June 2019**)

Q5.

Question number	Answer	Notes	Marks
(a)	• Dividing percentages by atomic masses • Correct results of divisions • Obtaining ratio by dividing results by smallest value **M1** C H Cl $\frac{38.4}{12}$ $\frac{4.8}{1}$ $\frac{56.8}{35.5}$ **M2** 3.2 4.8 1.6 **M3** $\frac{3.2}{1.6}$ $\frac{4.8}{1.6}$ $\frac{1.6}{1.6}$ (= 2 3 1) Alternative method • Calculating Mr of C_2H_3Cl • Working for finding ratio of each element • Evaluation of correct percentages **M1** C_2H_3Cl (= 24 + 3 + 35.5) = 62.5 **M2** C H Cl $\frac{24}{62.5}$ $\frac{3}{62.5}$ $\frac{35.5}{62.5}$ **M3** all x 100 = 38.4(%) 4.8(%) 56.8(%)	0 marks if division by atomic numbers or calculation upside down	3

Question Number	Answer	Notes	Marks
(b) (i)	$FeCl_3$	**REJECT** incorrect use of upper and lower case letters, and superscript **ACCEPT** correct formula as ions $Fe^{3+}(Cl^-)_3$	1
(ii)	to increase the rate of the reaction/ to speed up the reaction	**ALLOW** references to (providing reaction pathway of) lower activation energy	1
(iii)	gives out heat (energy)	**ACCEPT** thermal energy **NOT** energy alone **IGNORE** reference to negative $\triangle H$	1
(iv)	A addition B is incorrect as this is not a displacement reaction C is incorrect as this is not a neutralisation reaction D is incorrect as this is not a substitution reaction		1
(v)	$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$	**IGNORE** incorrect use of lower/upper case and superscripts	1

Question number	Answer	Notes	Marks
(c) (i)	**M1** displayed formula of chloroethene 	**IGNORE** bond angles **IGNORE** brackets/n	3
	M2 correct displayed formula with single bond between C atoms 	If double bond in repeat unit no **M2** or **M3** **IGNORE** brackets/n	
	M3 extension bonds shown on C atoms	more than one correct repeat unit with extension bonds scores 1 mark out of M2/M3	
(ii)	**M1** 2 shared pairs between C atoms **M2** rest of structure fully correct 	**ACCEPT** any combination of dots and crosses. **IGNORE** inner shells even if incorrect **M2 DEP on M1**	2
			Total 13

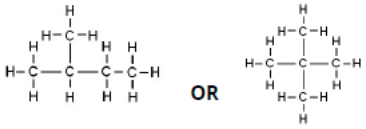
(**Q06 4CH1/1CR, June 2019**)

Q6.

Question number	Answer	Additional guidance	Marks
(a) (i)	**M1** (a compound) containing hydrogen/H and carbon/C (atoms) (1) **M2** only (1)	**ACCEPT** molecule/substance for compound **REJECT** element/mixture/atom for compound in **M1** only **ACCEPT** alternatives for only, eg just **M2** dep on mention of just H and C in **M1**	2
(ii)	C_nH_{2n+2}	**ALLOW** upper case N or x in place of n	1
(b)	fractional distillation	**ALLOW** fractionation /fractionating **REJECT** simple distillation **IGNORE** distillation on its own	1
(c)	An explanation that links together the following two points: **M1** carbon monoxide / CO **M2** reduces the capacity of the blood/haemoglobin to carry oxygen **/** is poisonous /is toxic	If both name and formula given, both must be correct **IGNORE** carbon oxide **ACCEPT** combines with haemoglobin in preference to oxygen	2
(d) (i)	An explanation that links together any two of the following points: **M1** (petrol) <u>vapour/gas/fumes</u> (produced) **M2** diffuses (through the air) **M3** (petrol) will ignite/catch fire/explode/ is flammable	**ALLOW** travels/moves/spreads for diffuses	2
(ii)	petrol is more volatile	**ACCEPT** petrol evaporates more easily/more readily **ACCEPT** petrol turns into a vapour/gas more easily/ more readily **ALLOW** petrol is more flammable/catches fire more easily **ACCEPT** reverse argument	1
		Total	**9**

(**Q04 4SS0/1C, June 2019**)

Q7.

Question number	Answer	Notes	Marks
ai	**M1** (compounds/molecules) with the same molecular formula **M2** but with different structural/displayed formula	**ACCEPT** same number **and** same type of atoms **REJECT** elements for compounds/molecules once only **ACCEPT** different structures **ACCEPT** atoms arranged differently **REJECT** contradicting statements, e.g. same displayed formula but different structures scores 0 out of 2	**2**
ii	 OR **M1** correct carbon skeleton **M2** all hydrogen atoms and all bonds shown	**M2** dep on **M1**	**2**

bi	$(C_5H_{12} + Br_2) \rightarrow \mathbf{C_5H_{11}Br + HBr}$ **M1** correct formula of organic product **M2** HBr as a product **and** correctly balanced	deduct 1 mark if cases or subscripts incorrect **ACCEPT** multiple substitutions of bromine $C_5H_{10}Br_2 + H_2$ scores **M1**	**2**
ii	substitution		**1**

(**Q10 4CH1/1C, June 2019**)