

Synthetic Polymers

Mark Scheme 1

Level	IGCSE(9-1)
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1C)
Topic	Organic Chemistry
Sub-Topic	Synthetic Polymers
Booklet	Mark Scheme 1

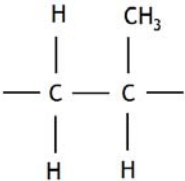
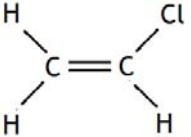
Time Allowed: 81 minutes

Score: /67

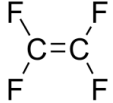
Percentage: /100

Grade Boundaries:

9	8	7	6	5	4	3	2	1
>90%	80%	70%	60%	50%	40%	30%	20%	10%

Question number	Answer	Notes	Marks
1 a	A (addition)		1
b	A (a molecule used to make a polymer)		1
c i	propene		1
ii		<p>M1 chain of two carbons joined by single bond AND both continuation bonds</p> <p>M2 one CH₃ group in any position AND three H atoms</p> <p>Do not penalise bond to H of CH₃ Reject any structure with double bond Allow multiple repeat units if correct Three or more CH₂ groups linked together scores 0/2 Ignore brackets and subscripted n</p>	2
d		<p>Accept Cl in any position Ignore bond angles Ignore brackets / n</p>	1

Question number	Answer	Notes	Marks
1 e i	<p>M1 (polymer) breaks down / decomposes / decays</p> <p>M2 by bacteria / microbes / microorganisms / decomposers /enzymes</p>	<p>Do not penalise compound / object / molecule / substance in place of polymer Reject element in place of polymer Ignore rots / degrades / digests / disintegrates If reference to <u>not</u> breaking down etc, only M2 can be awarded</p> <p>Accept biologically / naturally</p> <p>M2 DEP on M1 or near miss</p>	2
ii	inert(ness) / unreactive / OWTTE	<p>Ignore do not react with named chemical Ignore references to bond strengths / bond breaking</p>	1
Total 9 marks			

Question number	Answer	Notes	Marks
2 (a) (i)		<p>ignore bond angles Ignore brackets and n Do not penalise FI</p>	1
(ii)	<p>M1 – a long chain (molecule)</p> <p>M2 – formed when (many) small molecules/monomers join (together)</p>	<p>accept large molecule / macromolecule</p> <p>Accept react/bond/add/link for join</p>	1 1
(iii)	poly(tetrafluoroethene)/poly(tetrafluoroethylene)	<p>accept names without brackets Ignore minor spelling errors Ignore PTFE accept Teflon</p>	1
(b)	<p>M1 (name) – ethene</p> <p>M2 (formula) – C₂H₄</p>	<p>accept ethylene</p> <p>reject structural or displayed formula Penalise inappropriate use of upper and lower case letters or numbers No penalty for correct answers on wrong lines</p>	1 1

(c)	M1 – (they) do not biodegrade M2 – (because) they are inert / do not react / are unreactive	accept not broken down by bacteria / microbes / decomposers / microorganisms / enzymes ignore do not react with any named chemical ignore references to bond strengths / bond breaking Mark independently	1 1
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(b)	Any two from M1 – (many) small molecules/monomers join up M2 - double bond becomes single bond/ it becomes saturated M3 – increase in mass/chain length/size	OWTTE double bond breaks and single bond forms		2
(c) (i)	inert(ness) IGNORE strong bonds / long chains	unreactive/non-polar		1
(ii)	M1 – produces greenhouse gases/toxic gases/poisonous gases M2 – (landfill) uses up land / takes up space OR new sites hard to find	carbon dioxide		1

(Total marks for Question 3 = 9 marks)

Question number	Answer	Notes	Marks
4 (a)	(the molecule) contains a (carbon to carbon) double bond	accept 'multiple bond' ignore refs to single bonds	1
(b) (i)	C_8H_{18} <u>and</u> C_2H_4	Ignore names of compounds	1
(ii)	M1 600-700°C M2 silica / alumina (catalyst)	accept 'aluminium oxide / silicon dioxide / aluminosilicate / zeolite' accept correct formulae	2
(c) (i)	M1 (they have) the same <u>molecular</u> formula	allow 'both have same number of carbon and hydrogen (atoms as each other)' accept 'the atoms are arranged differently'	2
(ii)	M2 (but have) different structural formulae / displayed formulae / structures $ \begin{array}{c} \text{H} \\ \\ \text{CH}_3\text{CH}_2-\text{C}=\text{C} \\ \quad \quad \quad \quad \quad \quad \\ \quad \quad \quad \text{H} \quad \quad \quad \text{H} \end{array} $	accept $ \begin{array}{c} \text{CH}_3 \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{CH}_3 \end{array} $ ignore bond angles accept fully displayed formula	1

4 (d) (i)	poly(propene) / polypropene (ii) $ \begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ -\text{C} - \text{C}- \\ \quad \\ \text{H} \quad \text{H} \end{array} $ M1 correct structure M2 extension bonds	accept 'polypropylene' ignore brackets and 'n' M2 dep on M1 except award M2 if >1 repeat unit given	1 2
(e)	$ \begin{array}{c} \text{H} \quad \text{COOCH}_3 \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{CN} \end{array} $	penalise incorrect use of upper / lower case letters and subscripts penalise bonds to incorrect atoms	1

Question number	Answer	Notes	Marks
5 d i	product formulae or names / products (word) above reactants	Horizontal line not needed Ignore formula errors and one or two missing product(s) Ignore curves and intermediates	1
	ii (approximately) vertical line between reactants and products / between two levels AND labelled ΔH / energy change / heat change / enthalpy change	Ignore arrowheads on vertical line Ignore sign of ΔH Mark can be awarded for exothermic reaction Accept 2310 or any other number in place of ΔH	1

Question number	Expected Answer	Accept	Reject	Marks
6 (a) (i)	M1 contains carbon and hydrogen (atoms / elements / particles)	C and H for carbon and hydrogen	ions / carbon molecules / hydrogen molecules / H ₂ / mixture of C and H	1
	M2 only	other equivalent words, eg solely / entirely / completely		1
	M2 DEP on M1, but allow M2 if molecules / ions / mixture used in M1			
(ii)	C ₁₀ H ₂₂ IGNORE structural formula	H ₂₂ C ₁₀	Reject superscripts / lower case c or h / full size numbers	1
(b) (i)	addition	additional		1
(ii)	M1 one of the bonds in the double bond breaks	double bond breaks / double bond becomes single bond changes (from unsaturated) to saturated		1
	M2 (many) <u>ethene(s)/molecules/monomers</u> join (together) OR (many) <u>ethene(s)/molecules/monomers</u> form a chain			1

Question number	Expected Answer	Accept	Reject	Marks
6 (c)	<p>Any 4 from:</p> <ul style="list-style-type: none"> • produces smaller / shorter (chain) molecules • smaller / shorter (chain) molecules more useful (as fuels) / have greater demand • smaller / shorter (chain) molecules burn more cleanly / are used to make petrol/diesel/fuel for vehicles • crude oil richer in / has a surplus of long (chain) molecules • produces alkenes / any named alkene • alkenes used to make alcohol / polymers / plastics / chemical feedstock / any named addition polymer 	<p>ORA low(er) demand products converted to high(er) demand products</p> <p>ORA</p>		4

Question number	Answer	Notes	Marks
7 a	hydrogen / H ₂	Ignore H	1
b	<u>only</u> 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	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	Accept Br atoms in any position provided one on each carbon	1
ii	C (the product of the reaction is colourless)		1
d	$\begin{array}{cccc} \text{H} & \text{CH}_3 & \text{H} & \text{H} \\ & & & \\ \cdots & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & \cdots \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{CH}_3 \end{array}$	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	$\begin{array}{c} \text{F} \quad \quad \text{F} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{F} \quad \quad \text{F} \end{array}$	Reject any extension bonds Ignore bond angles Do not penalise more than one correct structure	1

Question number	Answer	Notes	Marks
7 f i	(polymer) breaks down / decomposes / decays by bacteria / microbes / microorganisms	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 Ignore naturally / enzymes	1 1
ii	inert / unreactive / OWTTE	Ignore do not react with named chemical Ignore references to bond strengths / bond breaking	1
Total 10 marks			