

Synthetic Polymers

Mark Scheme 2

Level	IGCSE(9-1)
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2C)
Topic	Organic Chemistry
Sub-Topic	Synthetic Polymers
Booklet	Mark Scheme 2

Time Allowed: 63 minutes

Score: /52

Percentage: /100

Grade Boundaries:

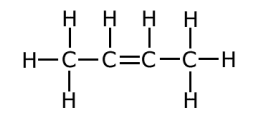
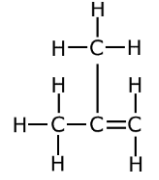
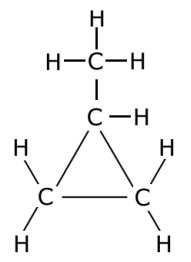
9	8	7	6	5	4	3	2	1
>90%	80%	70%	60%	50%	40%	30%	20%	10%

Question number	Answer	Accept	Reject	Marks
1 (a) (i)	poly(ethene)	polyethene / polythene / polyethylene		1
(ii)	cracking			1
(b) (i)	M1 - bar labelled 9 M2 - drawn to correct height			1 1
(ii)	(boiling point/it) increases as number of carbon atoms increases	ORA as one goes up, the other goes up positive correlation	(directly) proportional	1

Question number	Answer	Accept	Reject	Marks
1 (c)	<p><u>A/buried underground</u> because</p> <p>Any two from:</p> <ul style="list-style-type: none"> • M1 (plastics) do not produce carbon dioxide/carbon emissions / toxic / poisonous gases <p>IGNORE harmful/dangerous/polluting gases / sulfur dioxide</p> <ul style="list-style-type: none"> • M2 (plastics) do not contribute to global warming /climate change / greenhouse effect / acid rain • M3_Does not pollute the <u>soil</u> / cause damage to the <u>soil</u>. <p>IGNORE references to effect on wildlife/habitats / cost</p> <p>OR</p> <p><u>B/burned</u> because</p> <ul style="list-style-type: none"> • M1 (burning) space in landfill not taken up / does not cause landfill sites to get filled up / will not run out of space for landfills • M2 it provides heat / can be used to generate electricity <p>IGNORE just provides energy</p>	<p>ORA</p> <p>carbon monoxide / nitrogen dioxide / hydrogen chloride / chlorine / formulae</p>	<p>References to ozone layer for M2 only</p>	<p>1</p> <p>1</p> <p>OR</p> <p>1</p> <p>1</p> <p>7</p>
			Total	

Question number	Answer		Accept	Reject	Marks
2 (a)	M1 temperature after	27.1	one trailing zero	more than one trailing zero	3
M2 temperature before	18.8				
M3 temperature change	(+) 8.3				
Recorded temperatures correct but in wrong order scores 1 for M1 and M2 M3 csq on M1 and M2		water evaporates potassium hydroxide does not completely dissolve potassium hydroxide is impure less than 3 g of potassium hydroxide is used more than 50 cm ³ of water is used		2	
(b)	M1 heat (energy) /thermal energy lost (to the atmosphere) ignore just energy lost M2 potassium hydroxide dissolves (very/too) slowly				

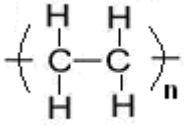
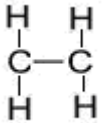
Total 5 marks

Question number	Answer	Notes	Marks
3 (a) (i)	<p>M1 (compounds/molecules with the) same molecular formula /same number of each type of atom</p> <p>M2 but different displayed formula / structural formula / structures / arrangement of atoms</p>	<p>Ignore references to chemical/general/empirical formula If use elements/atoms instead of compounds/molecules can score M2 only Allow reference to isomers in question ie have same number of carbon and hydrogen (atoms as each other)</p> <p>Ignore atoms in different order Ignore references to stereoisomerism</p>	2
(ii)	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p>Any one for 1 mark</p>	<p>Accept structure of trans but-2-ene Ignore bond angles</p>	1

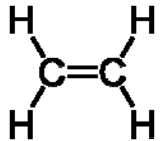
Question number	Answer	Notes	Marks
(iii)	<p>M1 (Reagent) – bromine (water)</p> <p>M2 (But-1-ene) – goes (from orange) to colourless</p> <p>M3 (cyclobutane) – no change (unless UV light present)</p>	<p>accept decolourised Ignore clear/discolours</p> <p>accept stays orange ignore no reaction</p> <p>If start with bromine (water) in presence of UV light then scores 0/3</p>	3

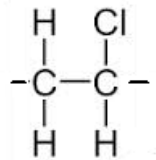
<p>(b) (i)</p>	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & \\ & \text{H} & \text{OH} & \text{H} & \text{H} \end{array} $ <p>OR</p> $ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & \\ & \text{OH} & \text{H} & \text{H} & \text{H} \end{array} $	<p>Allow -O-H and -OH but not -HO</p>	<p>1</p>
<p>(ii)</p>	$ \left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ - \text{C} & - \text{C} - \\ & \\ \text{C}_2\text{H}_5 & \text{H} \end{array} \right)_n $ <p>M1 correct formula of repeat unit (with carbon to carbon single bond)</p> <p>M2 brackets <u>and</u> continuation bonds <u>and</u> n</p>	<p>Accept displayed C₂H₅</p> <p>Accept C₂H₅ on either C Allow if more than one monomer correctly joined together</p> <p>Accept n anywhere after brackets but not before</p> <p>M2 dep on M1 or near miss</p>	<p>2</p>

Question number	Expected answer	Accept	Reject	Marks
4 (a) (i)	Contains a (carbon to carbon) double bond / contains C=C / multiple bond IGNORE references to 'free' bond / spare bond	Can undergo addition reactions / does not contain the maximum number of hydrogen (atoms)		1
	(ii) (add) bromine (water) / Br ₂ IGNORE references to any other solvent decolourised / turns (from orange/brown to) colourless IGNORE starting colour IGNORE clear IGNORE discolour 2 nd mark dependent on 1 st mark having been awarded, but for near miss on reagent, e.g. bromine in presence of uv, observation mark can be awarded Ignore references to any products, correctly named or otherwise	KMnO ₄ / potassium (per)manganate (VII) either an acid or an alkali (purple to) colourless (if acid used) (purple to) green (if alkali used)		1 1

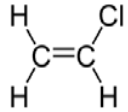
4 (b) (i)	H ₂ O			1
	(ii) Dehydration	Elimination		1
(c)	<p data-bbox="268 363 1041 487">  </p> <p data-bbox="268 503 1041 649"> 1 mark for  i.e. double to single </p> <p data-bbox="268 673 1041 755"> 1 mark for rest of formula, including extension lines, brackets and the 'n' </p>	<p data-bbox="1119 641 1390 673">CH₂ - CH₂</p> <p data-bbox="1119 706 1390 738">n as superscript</p> <p data-bbox="1119 779 1390 844">Max 1 for skeletal formula</p>	<p data-bbox="1425 357 1747 422">Any double-bonded product scores 0/2</p> <p data-bbox="1425 706 1747 738">n before the brackets</p>	2

Total 7 Marks

Question number		Answer	Notes	Marks
5	a	cross in box C (fractional distillation)		1
	b	M1 larger molecules in crude oil	Accept longer (chains)/ bigger M_r in place of larger Accept molecules in crude oil have wide range of sizes AND molecules in kerosene have similar sizes	4
		M2 more covalent bonds in crude oil (molecules) / bonds have different strengths	Accept no difference / same type of covalent bonding Reject references to double bonds in kerosene	
		M3 crude oil has higher viscosity	Accept less runny / less thick	
		M4 correct reference to other difference - eg crude oil darker colour crude oil harder to ignite crude oil burns with a smokier flame crude oil has a higher boiling point / wider range of boiling points		
			Any three points from four Accept converse statements for (molecules in) kerosene	
	c			
	i	C_9H_{20}	Accept $H_{20}C_9$	1
	ii	pentane		1
	iii		Ignore bond angles Ignore dot and cross diagram Ignore non-displayed formulae	1

Question number		Answer		Notes	Marks	
5	d	M1 M2		<p>M1 for 4 correct atoms joined to 2 C atoms (ignore C=C and extra atoms joined to C) Accept Cl in any position of four</p> <p>M2 for all 7 bonds correct provided that continuation bonds are shown but have no atoms attached Cl₂ in place of Cl but otherwise correct scores M2 but not M1 Ignore brackets and any subscript</p>	1 1	
	e	i	<p>(in condensation polymerisation) a small molecule/H₂O/HCl is (also) formed /lost/released OR two (different) monomers / more than one product</p>	<p>Accept converse statement for addition polymerisation eg (only) one product formed / no atoms are lost/gained</p>	1	
				If no reference to type of polymerisation, assume that condensation is referred to		
		ii	M1	breakdown / decomposition	Ignore wear away / rot	1
			M2	by bacteria/microbes/micro-organisms	Accept biologically / naturally M2 dep on M1 or near miss	1
		iii		inert(ness)	Accept unreactive / non-polar Ignore strong bonds / long chains	1
TOTAL						13

Question number	Answer	Accept	Reject	Marks
6 (a)	$C_{12}H_{22}O_{11} + H_2O \rightarrow 2C_6H_{12}O_6$ Ignore yeast		lower case symbols and numbers not given as subscripts	1
(b) (i)	no more bubbles/fizzing/effervescence IGNORE when no more ethanol is formed/all the glucose has reacted/all the yeast has reacted/references to mass/references to temperature	no more gas/carbon dioxide given off		1
(ii)	filtration/filtering IGNORE sieving	decant	evaporation/distillation	1
(c) (i)	(the elements of) water removed	H ₂ O removed 2 hydrogen (atoms) and 1 oxygen (atom) are removed		1
(ii)	aluminium oxide/Al ₂ O ₃	(concentrated) sulfuric acid (concentrated) phosphoric acid	dilute acid phosphorus/phosphorous	1
(iii)	chlorine (gas) / Cl ₂ If both name and formula given, both must be correct	correct name or formula as part of an equation	chloride / Cl ⁻	1
(iv)	CH ₂ ClCH ₂ Cl → CH ₂ (=)CHCl + HCl	C ₂ H ₄ Cl ₂ for CH ₂ ClCH ₂ Cl and C ₂ H ₃ Cl for CH ₂ =CHCl		1

Question Number	Answer	A	Reject	Marks
(d) (i)	 <p data-bbox="310 488 997 553">IGNORE bond angles and positions of H and Cl relative to each other</p>			1
(ii)	<p data-bbox="310 597 569 630">Any three from:</p> <p data-bbox="310 667 951 699">M1 - (one bond in the) double bond breaks</p> <p data-bbox="310 737 1010 802">M2 - small molecules/monomers/chloroethene molecules join together</p> <p data-bbox="310 839 951 872">M3 - to form a (long) chain/macromolecule</p> <p data-bbox="310 909 1037 941">M4 - product/polymer contains only single bonds</p>			3
			Total	11