Synthetic Polymers Mark Scheme 1

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

Time Allowed:			81 minutes	;				
Score:			/67					
Percentag	ge:		/100					
Grade Bo	undaries:							
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	H CH ₃ 	 M1 chain of two carbons joined by single bond AND both continuation bonds M2 one CH₃ group in any position AND three H atoms 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 	2
d	$rac{H}{H}$ $c = c$	Accept Cl in any position Ignore bond angles Ignore brackets / n	1

Question number	Answer	Notes	
1 e i	M1 (polymer) breaks down / decomposes / decays	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	2
	M2 by bacteria / microbes / microorganisms / decomposers /enzymes	Accept biologically / naturally M2 DEP on M1 or near miss	
ii	inert(ness) / unreactive / OWTTE	Ignore do not react with named chemical Ignore references to bond strengths / bond breaking	1
		Total 9	9 marks

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

(c)	M1 – (they) do not biodegrade	accept not broken down by bacteria / microbes / decomposers / microorganisms / enzymes	1
	M2 – (because) they are inert / do not react / are unreactive	ignore do not react with any named chemical ignore references to bond strengths / bond breaking Mark independently	1

Question number	Answer	Accept	Reject	Marks
Question number 3 (a)	M1 - $\begin{pmatrix} H & H \\ - H & - H $	Accept continuation bonds not going through brackets polypropene polypropylene methyl group attached to any carbon methyl group displayed	Reject just plastic	Marks 1 1 1 1

(b)	Any two from	OWTTE	
	M1 – (many) small molecules/monomers join up		
	M2 - double bond becomes single bond/ it becomes saturated	double bond breaks and single bond forms	
	M3 – increase in mass/chain length/size		
			2
(c) (i)	inert(ness) IGNORE strong bonds / long chains	unreactive/non-polar	1
(ii)	M1 – produces greenhouse gases/toxic gases/poisonous gases	carbon dioxide	1
	M2 – (landfill) uses up land / takes up space		1
	OR new sites hard to find		

(Total marks for Question 3 = 9 marks)

	uesti numbe		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} and C_2H_4	Ignore names of compounds	1
		(ii)	M1 600-700°C		2
			M2 silica / alumina (catalyst)	accept 'aluminium oxide / silicon dioxide / aluminosilicate / zeolite' accept correct formulae	
	(c)	(i)	M1 (they have) the same molecular 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 $H_{2}^{H} CH_{3}CH_{2}^{-}C = C_{H}^{H}$	accept CH_3 H_3 $C=C_4$ H_3 CH_3 ignore bond angles accept fully displayed formula	1

4 (d) (i)	poly(propene) / polypropene	accept 'polypropylene'	1
(ii)	CH₃ H	ignore brackets and 'n'	2
	M1 correct structure M2 extension bonds	M2 dep on M1 except award M2 if >1 repeat unit given	
(e)	$ \begin{array}{ccc} H & COOCH_3 \\ $	penalise incorrect use of upper / lower case letters and subscripts penalise bonds to incorrect atoms	1

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Question number	Answer	Notes	Marks
5 a	reference to line/curve/temperature /graph/it AND not reached minimum / not constant / not level /not horizontal /still falling /decreasing/changing	Ignore reference to correlation Ignore has not reached zero / x-axis Ignore does not become	1
b	(better) insulator (than glass) OR poor conductor (of heat)	Accept equivalents such as prevents heat from entering / keeps out heat better Allow stops heat escaping / traps heat Reject references to keeping temperature constant Ignore references to breaking glass	1
C i	effervescence / fizzing / bubbles OR colourless solution/liquid formed	Accept carbon dioxide <u>gas</u> Accept gas given off/evolved/formed Ignore identity of gas Accept solid disappears/dissolves Ignore hissing and other sounds	1
ii	Neutralisation	Accept acid-base / acid-alkali	1
	endothermic	M1 and M2 independent Accept answers in either order Do not penalise contradictions such as exothermic and endothermic – this answer is worth 1 mark	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	Answer	Notes	Marks
5 (e) i	temperature change = (-)5.5 (°C)	Award M1 for 5.5 anywhere	1
	heat change (= 100 × 4.2 × 5.5) = 2310/2300 (J)	CQ on candidate temperature change, provided other values correct Accept answer in kJ Ignore signs Correct final answer scores 2 2.31 (J) scores 1 mark if M1 not awarded	1
ii	concentration (of vinegar / (ethanoic) acid / CH ₃ COOH)	Ignore strength Ignore reference to <i>M</i> _r Accept concentration even if in an incorrect expression	1
		Total	10

	Question numbe	-	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)</u> / <u>molecules</u> / <u>monomers</u> join (together)			1
			OR			
			(many) <u>ethene(s)</u> / <u>molecules</u> / <u>monomers</u> form a chain			

	uestion umber	Expected Answer	Accept	Reject	Marks
6	(c)	Any 4 from:			
		 produces smaller / shorter (chain) molecules 			
		 smaller / shorter (chain) molecules more useful (as fuels) / have greater demand 	ORA low(er) demand products converted to high(er) demand products		
		 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 	ORA		
		 produces alkenes / any named alkene 			
		 alkenes used to make alcohol / polymers / plastics / chemical feedstock / any named addition polymer 			4

_	estion mber	Answer	Notes	Marks
7	а	hydrogen / H ₂	Ignore H	1
	b	only 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 İ	H H Br-C-C-Br H H	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}{cccccccccccccccccccccccccccccccccccc$	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	F = C = F	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	
ii	inert / unreactive / OWTTE	Ignore do not react with named chemical Ignore references to bond strengths / bond breaking	1	
		Total 10 marks		