Mark scheme

Petrochemicals and polymers

Chemistry 0620 · Questions from Paper 3 and Paper 4

Total marks

87

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
6	9	12	6	8	8	9	9	9	11	**87**

Question 1 [6]

1(a)	one mark each for any two of: • (substance containing) atoms / ions of two or more (different) elements • (atoms) bonded / chemically combined • cannot be separated (into its components by physical means)	**2**
1(b)(i)	X in lowest section of the column / X in the tube where bitumen collects	**1**
1(b)(ii)	diesel (oil) / gas oil	**1**
1(b)(iii)	refinery gas	**1**
1(b)(iv)	chemical feedstock / making chemicals	**1**

Question 2 [9]

2(a)	any 4 from: • petroleum vaporised / heated • petroleum enters the fractionating column at the bottom • vapours move up the fractionating column • column is hotter at the bottom / cooler at the top • idea of vapours condensing in different parts of the fractionating column • idea of different fractions having different boiling ranges • fractions (condensing) higher up have lower boiling points **ORA**	**4**
2(b)(i)	breaking down / decomposing / splitting hydrocarbons	**1**
	into smaller hydrocarbons / into alkanes and alkenes / by heating / using a high temperature	**1**
2(b)(ii)	hydrogen	**1**
2(c)	covalent	**1**
2(d)	polymer	**1**

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Question 3 [12]

3 **(a)** boiling point / first box down ticked [1]

(b) fuel oil: fuel for home heating;
kerosene: jet fuel;
lubricating fraction: waxes and polishes;
naphtha: making chemicals; [4]

(c) **(i)** high temperature; catalyst; [2]

(ii) $C_{12}H_{26}$ [1]

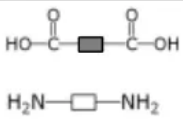
(iii) correct structure showing all atoms and bonds [1]

(d) poly(ethene) **allow:** polythene [1]

(e) **(i)** steam [1]

(ii) substance which speeds up rate / speed of reaction [1]

Question 4 [6]

4(a)(i)		1
4(a)(ii)		2
4(a)(iii)	water	1
4(b)	non-biodegradable / running out of space / toxic / leaching	1
4(c)	(complex) carbohydrate / protein	1

Question 5 [8]

5(a)(i)	monomer	1
5(a)(ii)	any **hydrocarbon** with one C=C bond (with both C atoms having 4 bonds) (1) structure of methylpropene (1)	2
5(b)	water is a product (when polymer is made)	1
5(c)(i)	any correct amide link between any two blocks showing all atoms and all bonds (1) correct orientation of 3 inter-block amide links (1) continuation bonds (1)	3
5(c)(ii)	nylon	1

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Question 6 [8]

6 **(a)** **(i)** does not decay **or** non-biodegradable **or** flexible **or** bendable **or** easily moulded **or** low density / light / lightweight **or** waterproof / insoluble in water **or** does not corrode **or** durable [1]

(ii) any two from: [2]
chlorine
hydrogen chloride
carbon monoxide

(b) **(i)** CH_3—$CH = CH_2$ [1]
note: can be fully or semi-displayed, C = C must be shown

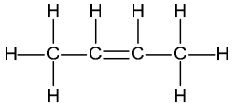
(ii) correct repeat unit [1]
–$CH(C_6H_5)$–CH_2–

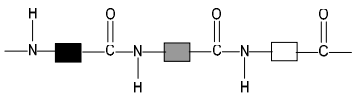
continuation shown [1]

(c) glucose two products (polymer and water) / condensation (polymerisation) / (small) molecules removed [1]

phenylethene one product (polymer) / addition (polymerisation) [1]

Question 7 [9]

7(a)	monomers	**1**
7(b)(i)	any **hydrocarbon** with one C=C bond (with both C atoms having 4 bonds) (1) structure of but-2-ene (1) 	**2**
7(b)(ii)	addition	**1**

7(c)(i)	protein	**1**
7(c)(ii)	 any correct amide link between any two blocks showing all atoms and all bonds (1) identical orientation of both inter-block amide links including terminal groups with correct orientation (if shown) (1) continuation bonds on polymer (1)	**3**
7(c)(iii)	hydrolysis (1)	**1**

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Question 8 [9]

8(a)	large / big molecule made from (many) monomers (joined together)	**1** **1**
8(b)(i)	amide / peptide	**1**
8(b)(ii)	(can be) broken down by microbes / bacteria	**1** **1**
8(b)(iii)	starch / cellulose / DNA / RNA / polysaccharides /	**1**

8(c)(i)	**M1** at least one correct ester linkage between boxes **M2** at least two boxes shown and sufficient correct C and O atoms to make **two correct** ester linkages **M3** continuation bond(s) **AND** if more than one repeat unit is shown, the repeat unit must be correctly identified	**1** **1** **1**

Question 9 [9]

9(a)(i)	3	**1**
9(a)(ii)	diagram of dioic acid showing two fully displayed carboxylic acid groups on unshaded block diagram of diol showing two fully displayed hydroxyl groups on shaded block	**2**
9(a)(iii)	polyester	**1**
9(b)	one	**1**
9(c)(i)	any hydrocarbon with one C=C bond (with both C atoms having 4 bonds) (1) structure of but-2-ene (1) but-2-ene	**3**
9(c)(ii)	cracking	**1**

Question 10 [11]

10(a)	petroleum	**1**
10(b)	**M1** high temperature **M2** catalyst	**2**
10(c)(i)	$C_{12}H_{26} \rightarrow 3C_4H_8 + H_2$ **M1** C_4H_8 **M2** correct equation	**2**
10(c)(ii)	thermal decomposition	**1**
10(d)(i)	poly(propene)	**1**
10(d)(ii)	**M1** chain of six C atoms joined by single bonds in a chain **M2** three correctly placed CH_3 groups **M3** correct structure **AND** continuation bonds	**3**
10(d)(iii)	addition	**1**

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