

## 8: Organic 1 – Topic questions

## Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
5	2016	June	42
6	2016	June	41
7	2016	March	42

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

5 (a) Hydrocarbons are compounds which contain hydrogen and carbon only.

- 10 cm<sup>3</sup> of a gaseous hydrocarbon, C<sub>x</sub>H<sub>y</sub>, are burned in 100 cm<sup>3</sup> of oxygen, which is an excess of oxygen.
- After cooling to room temperature and pressure, there is 25 cm<sup>3</sup> of unreacted oxygen, 50 cm<sup>3</sup> of carbon dioxide and some liquid water.

All volumes are measured under the same conditions of temperature and pressure.

(i) What is meant by an excess of oxygen?

..... [1]

(ii) What was the volume of oxygen that reacted with the hydrocarbon?

..... [1]

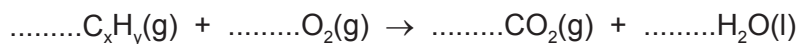
(iii) Complete the table below to express the smallest whole number ratio of

volume of hydrocarbon reacted : volume of oxygen reacted : volume of carbon dioxide produced

	volume of hydrocarbon reacted	volume of oxygen reacted	volume of carbon dioxide produced
<b>smallest</b> whole number ratio of volumes			

[1]

(iv) Use your answer to (a)(iii) to find the mole ratio in the equation below. Complete the equation and deduce the formula of the hydrocarbon.



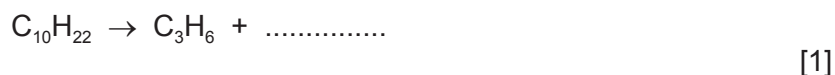
formula of hydrocarbon = .....

[2]

- (b) Cracking is used to convert long chain alkanes into shorter chain alkanes and alkenes. Alkenes are unsaturated compounds.

Decane,  $C_{10}H_{22}$ , can be cracked to give propene and one other product.

- (i) Complete the chemical equation.



- (ii) What is meant by the term *unsaturated*?

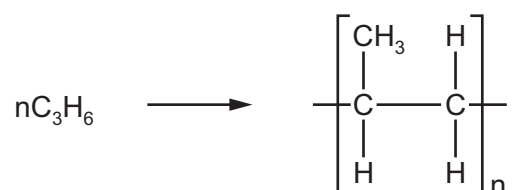
..... [1]

- (iii) Describe a test to show that propene is an unsaturated compound.

test .....

result ..... [2]

- (c) Propene can be polymerised. The only product is polypropene. The equation for the polymerisation is:



- (i) Name the type of polymerisation that occurs.

..... [1]

- (ii) Deduce the maximum mass of polypropene that could be produced from 1 kg of propene.

..... kg [1]

- (iii) Give the empirical formula of

propene, .....

polypropene. .... [2]

[Total: 13]

**6** Petroleum is a source of many important chemicals.

**(a)** Name **two** industrial processes which must take place to produce alkenes from petroleum.

.....  
..... [2]

**(b)** Ethene,  $\text{CH}_2=\text{CH}_2$ , and propene,  $\text{CH}_2=\text{CHCH}_3$ , can both be converted into polymers.

**(i)** What type of polymerisation takes place when ethene forms a polymer?

..... [1]

**(ii)** What is the empirical formula of the polymer formed from ethene?

..... [1]

**(iii)** Propene has the structural formula  $\text{CH}_2=\text{CHCH}_3$ .

Draw **two** repeat units of the polymer made from propene.

[2]

**(c)** Ethene will react with steam to form ethanol.

Propene will react with steam to form two isomers, both of which are alcohols.

Suggest the structures of these alcohols.

[2]

**(d)** Esters are organic chemicals noted for their characteristic smells. Ethanoic acid and methanol will react to form an ester.

**(i)** Name the catalyst needed to form an ester from ethanoic acid and methanol.

..... [1]

**(ii)** Name the ester formed when ethanoic acid reacts with methanol.

..... [1]

**(iii)** Draw the structure of the ester formed when ethanoic acid reacts with methanol. Show all bonds.

[2]

**(iv)** Give the name of a polyester.

..... [1]

[Total: 13]

**7 (a)** Alkanes and alkenes are examples of hydrocarbons.

**(i)** What is meant by the term *hydrocarbon*?

.....  
..... [1]

**(ii)** Give the general formula of straight-chain

alkanes, .....

alkenes. .... [2]

**(b)** A compound X contains carbon, hydrogen and oxygen only.

X contains 54.54% of carbon by mass, 9.09% of hydrogen by mass and 36.37% of oxygen by mass.

**(i)** Calculate the empirical formula of compound X.

[2]

**(ii)** Compound X has a relative molecular mass of 88.

Deduce the molecular formula of compound X.

[2]

(c) An ester has the molecular formula  $C_3H_6O_2$ .

Name and give the structural formulae of **two** esters with the molecular formula  $C_3H_6O_2$ .

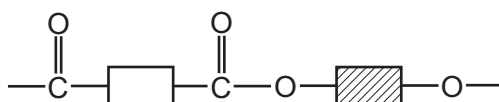
name of ester		
structural formula		

[4]

(d) Name the ester produced from the reaction of propanoic acid and methanol.

..... [1]

(e) A polyester is represented by the structure shown.



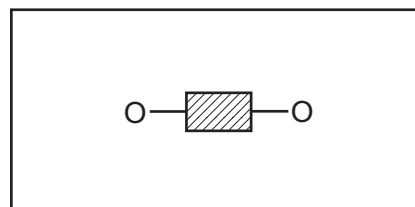
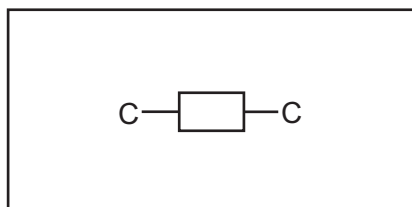
(i) What type of polymerisation is used for the production of polyesters?

..... [1]

(ii) Which simple molecule is removed when the polyester is formed?

..... [1]

(iii) Complete the diagrams below to show the structures of the monomers used to produce the polyester. Show all atoms and bonds.



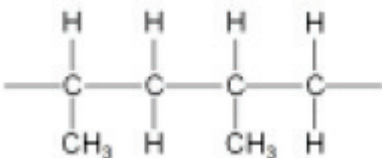
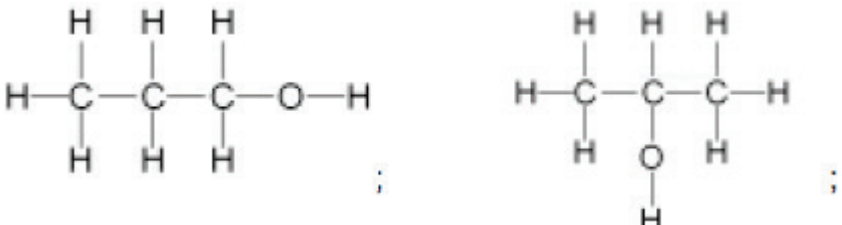
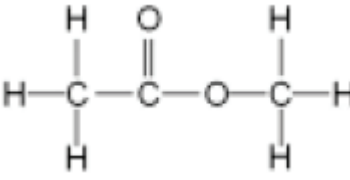
[2]

[Total: 16]

Question	Answer	Marks
5 (a) (i)	more than enough to react (with all the hydrocarbon); <b>OR</b> (some) oxygen remaining;	<b>1</b>
5 (a) (ii)	75 cm <sup>3</sup> ;	<b>1</b>
5 (a) (iii)	2 : 15 : 10;	<b>1</b>
5 (a) (iv)	2 : 15 : 10 : 10; C <sub>5</sub> H <sub>10</sub> ;	<b>2</b> 1 1
5 (b) (i)	C <sub>7</sub> H <sub>16</sub> ;	<b>1</b>
5 (b) (ii)	contains a double bond / triple bond / multiple bond; <b>OR</b> not all bonds are single bonds;	<b>1</b>
5 (b) (iii)	test: aqueous bromine / bromine (water) / Br <sub>2</sub> ; result: (orange / yellow / brown) to colourless / decolourised / colour disappears;	<b>2</b> 1 1
5 (c) (i)	addition;	<b>1</b>
5 (c) (ii)	1 (kg);	<b>1</b>
5 (c) (iii)	propene: CH <sub>2</sub> ; polypropene; CH <sub>2</sub> ;	<b>2</b> 1 1
		<b>Total: 13</b>

*Continues on next page ...*



Question	Answer	Marks
6 (a)	fractional distillation; cracking;	2 1 1
6 (b) (i)	addition;	1
6 (b) (ii)	CH <sub>2</sub> ;	1
6 (b) (iii)	 <p><b>M1</b> chain of 4 carbon atoms with single bonds and continuation bonds; <b>M2</b> correctly positioned CH<sub>3</sub> side chains;</p>	2
6 (c)		2
6 (d) (i)	(concentrated) sulfuric acid;	1
6 (d) (ii)	methyl ethanoate	1
6 (d) (iii)	 <p><b>M1</b> ester link; <b>M2</b> rest of molecule;</p>	2
6 (d) (iv)	terylene;	1
		Total: 13

Continues on next page ...

Question	Answer	Marks				
7 (a) (i)	compound containing carbon and hydrogen only;	1				
7 (a) (ii)	$C_nH_{2n+2}$ ; $C_nH_{2n}$ ;	2				
7 (b) (i)	mol C = 54.54 / 12 or 4.5(45) and mol H = 9.09 / 1 or 9.09 and mol O = 36.37 / 16 or 2.27; $C_2H_4O$	2				
7 (b) (ii)	$M_r$ of $C_2H_4O$ = 44; 88 / 44 = 2 therefore $C_4H_8O_2$ ;	2				
7 (c)	<table><tr><td>methyl ethanoate</td><td>ethyl methanoate</td></tr><tr><td><math>CH_3COOCH_3</math>;</td><td><math>HCOOC_2H_5</math>;</td></tr></table>	methyl ethanoate	ethyl methanoate	$CH_3COOCH_3$ ;	$HCOOC_2H_5$ ;	4
methyl ethanoate	ethyl methanoate					
$CH_3COOCH_3$ ;	$HCOOC_2H_5$ ;					
7 (d)	methyl propanoate;	1				
7 (e) (i)	condensation;	1				
7 (e) (ii)	water / $H_2O$	1				
7 (e) (iii)	dicarboxylic acid or diacyl chloride; diol;	2				
Total: 16						