Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Introduction to organic chemistry

Time allowed: 50 minutes

Subject code **0620**

Chemistry

Questions from Paper 1, Paper 2, Paper 3 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 50

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 50 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

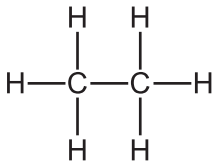
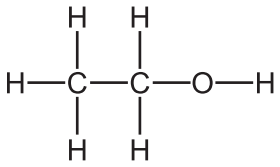
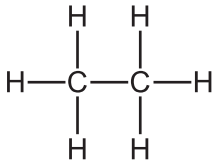
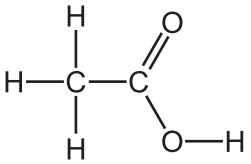
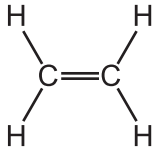
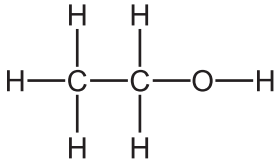
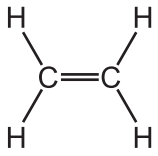
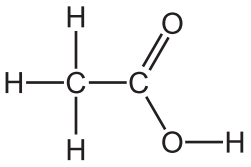
1 Which row identifies compounds in the same homologous series?

	chemical properties	functional group
A	different	different
B	different	same
C	similar	different
D	similar	same

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Answer D

2 Which structures represent ethene and ethanol?

	ethene	ethanol
A		
B		
C		
D		

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Answer C

3 Methane, ethane and propane belong to a family of hydrocarbons called alkanes.

What is the general formula of an alkane?

A C_nH_{2n} **B** C_nH_{2n+1} **C** C_nH_{2n-1} **D** C_nH_{2n+2}

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Answer D

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4 The molecular formulae of four compounds are shown.

C_2H_2 C_3H_8 C_4H_8 C_5H_{10}

How many of these compounds are in the alkane homologous series?

A 1 **B** 2 **C** 3 **D** 4

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Answer A

5 Which pair of compounds are structural isomers of each other?

A $CH_3CH_2CH_3$ and $CH_3CH_2CH_2CH_3$

B $CH_2{=}CHCH_3$ and $CH_3CH{=}CH_2$

C $CH_2(OH)CH_2CH_3$ and $CH_3CH_2CH_2OH$

D $CH_3CH_2CH_2COOH$ and $CH_3COOCH_2CH_3$

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Answer D

6 The structures of two compounds are shown.



Which statements about these compounds are correct?

1 They have the same molecular formula.

2 They have similar chemical properties.

3 They are structural isomers.

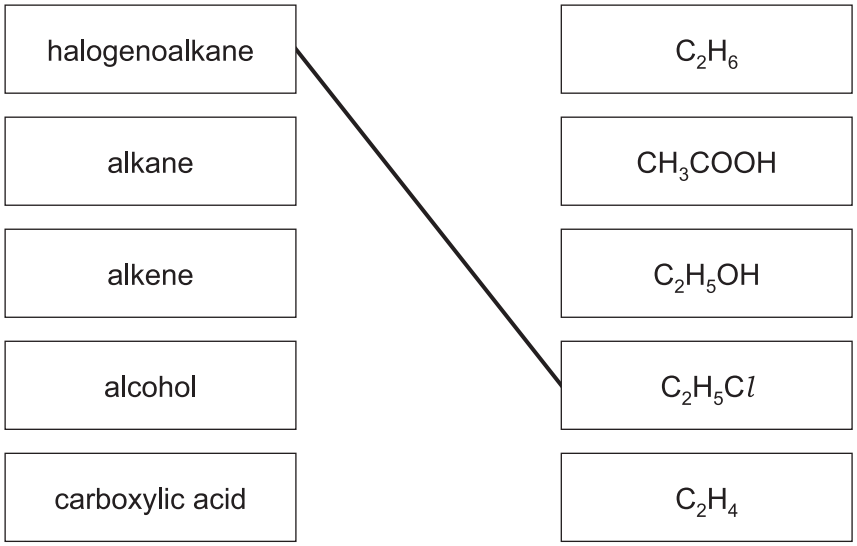
A 1 only **B** 1 and 2 **C** 2 and 3 **D** 1 and 3

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Answer D

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7 **(a)** Match the name of the homologous series on the left with its formula on the right. The first one has been done for you.



[4]

(b) Draw the full structural formula of the compound, C_2H_6, showing all atoms and bonds.

[1]

(c) The compound with the formula C_2H_4 is an unsaturated hydrocarbon.
Describe the difference between a saturated and an unsaturated hydrocarbon in terms of the bonds they contain.

.....

..... [2]

(d) Describe a test to distinguish between a saturated and unsaturated hydrocarbon.

test .....

result with saturated hydrocarbon .....

.....

result with unsaturated hydrocarbon .....

..... [3]

[Total: 10]

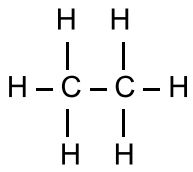
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7 **(a)** 1 mark for each correct line / indication

alkane → C_2H_6
alkene → C_2H_4
alcohol → C_2H_5OH
carboxylic acid → CH_3COOH [4]

(b) Full structural formula shown i.e.



[1]

ALLOW: correct dot and cross diagram

(c) saturated has only single bonds / no double bonds; [1]

unsaturated has double bond(s) [1]
IGNORE: one has single bonds and the other has double bonds

(d) bromine water / aqueous bromine / bromine / **ALLOW**: correct formula; [1]
IGNORE: Br

(saturated hydrocarbon) no reaction / stays the same colour / remains orange / remains orange-brown [1]
ALLOW: remains brown
ALLOW: remains yellow (if aqueous bromine used) / remains red (if bromine used)
IGNORE: remains yellow (if bromine used)
REJECT: incorrect colour, e.g. stays same blue colour, does not score

(unsaturated hydrocarbon) decolourises / goes colourless [1]
IGNORE: goes clear
IGNORE: initial incorrect colour of bromine

(acidified) potassium permanganate / potassium manganate(VII) (1 mark)
goes colourless / purple to colourless (1 mark)

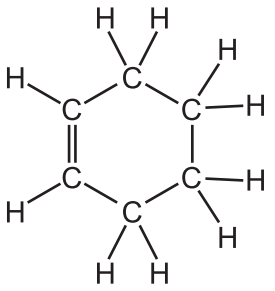
IF: incorrect reagent 0 for this question

[Total: 10]

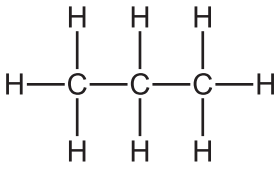
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8 The structures of some organic compounds are shown.

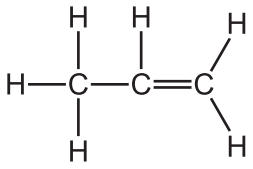
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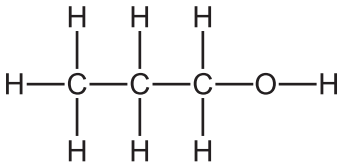
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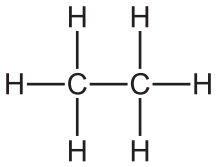
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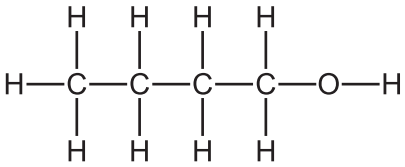
S



T



U



(a) **(i)** Which **two** of these compounds are alcohols?

Explain your answer.

.....

..... [2]

(ii) Which **two** of these compounds are saturated hydrocarbons?

..... [1]

(b) Methanol and ethanol are alcohols in the same homologous series.

Complete the following sentence about a homologous series using words from the list.

alcohols	**chemical**	**compounds**	**elements**
functional	**mixtures**	**physical**	

A homologous series is a family of similar ..... with similar

..... properties due to the same ..... group. [3]

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(c) Ethene is an alkene.

(i) Draw the structure of ethene showing all atoms and all bonds.

[1]

(ii) Describe how aqueous bromine is used to show that ethene is an unsaturated compound.

.....

..... [2]

(iii) Ethene is manufactured by cracking.

State the conditions needed for cracking.

..... [1]

(iv) Complete the chemical equation for the cracking of hexadecane, $C_{16}H_{34}$, to form propene and one other hydrocarbon.

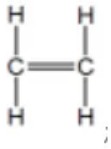
$$C_{16}H_{34} \rightarrow C_3H_6 + ...$$

[1]

[Total: 11]

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8(a)(i)	S and U; both have OH (group);	2 1 1
8(a)(ii)	Q and T;	1
8(b)	compounds; chemical; functional;	3 1 1 1
8(c)(i)		1
8(c)(ii)	aqueous bromine is added to (test tube of) ethene / aqueous bromine is orange; aqueous bromine turns colourless / solution turns colourless;	2 1 1
8(c)(iii)	high temperature / heat;	1
8(c)(iv)	$C_{13}H_{28}$;	1

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9 A homologous series is a family of organic compounds whose members have similar chemical properties.

(a) Give **two** characteristics that are the **same** for all members of a homologous series.

1 .....

2 .....

[2]

(b) In terms of structure, state how one member of a homologous series differs from the next member of that homologous series.

..... [1]

(c) **A**, **B** and **C** are organic compounds.

A has the molecular formula $C_{12}H_{24}$.

B has the name tetradecane.

C has three carbon atoms and is in the homologous series with the general formula $C_nH_{2n+1}COOH$.

(i) Name the homologous series each organic compound belongs to.

A .....

B .....

C .....

[3]

(ii) Name **C** and draw its displayed formula.

name .....

displayed formula

[2]

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(d) Amino acids are a homologous series where each member has the general structure shown in Fig. 6.1.

The R side chain contains carbon and hydrogen atoms only.

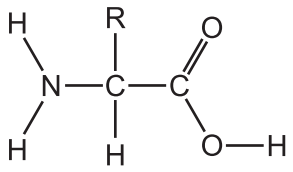


Fig. 6.1

(i) An amino acid has a relative molecular mass of 103.

Deduce the formula of the R side chain in this amino acid.

Show your working.

..... [2]

(ii) State the name given to the natural polyamides formed from amino acid monomers.

..... [1]

[Total: 11]

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9(a)	**M1** (same) general formula (1) **M2** (contain the same) functional group (1)	**2**
9(b)	-CH_2- unit	**1**
9(c)(i)	**M1** alkenes (1) **M2** alkanes (1) **M3** carboxylic acids (1)	**3**
9(c)(ii)	**M1** propanoic acid (1) **M2** displayed formula of propanoic acid (1)	**2**
9(d)(i)	**M1** *working to give the mass of atoms shown in Fig 6.1* 103 – 14 – (2 × 12) – (2 × 16) – (4 × 1) (= 29) **M2** 'R' = C_2H_5	**2**
9(d)(ii)	proteins	**1**

10 This question is about the homologous series of alkanes.

Three general characteristics of alkanes are:

- they are generally unreactive because they do **not** have a functional group
- they show trends in their physical properties, such as melting points and boiling points
- they have similar chemical properties.

(a) Describe **two other** general characteristics of the homologous series of alkanes.

1.....

2.....

[2]

(b) **(i)** State the trend in the boiling points of the alkanes as the carbon chain length increases.

..... [1]

(ii) Name **one other** physical property of alkanes that shows a trend, other than melting points and boiling points.

Describe this trend as the carbon chain length of alkanes increases.

name .....

description.....

[2]

(c) State why alkanes are described as saturated.

..... [1]

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(d) Propane has the structural formula $CH_3CH_2CH_3$.

When propane undergoes a monosubstitution reaction with chlorine at room temperature, **two** organic products can be formed.

(i) State **one** condition needed for this substitution reaction to take place.

..... [1]

(ii) Give the structural formula and state the name of each organic product formed.

- structural formula of product 1

name of product 1.....

- structural formula of product 2

name of product 2.....

[4]

(iii) The two products formed are structural isomers of each other.

Define the term structural isomers.

.....

..... [1]

[Total: 12]

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10(a)	**M1** (have a) general formula of C_nH_{2n+2} **M2** differ from one member to the next by a $–CH_2–$ unit	**2**
10(b)(i)	increases	**1**
10(b)(ii)	**M1** physical property **M2** change as chain length increases	**2**
10(c)	all carbon–carbon bonds are single (bonds)	**1**
10(d)(i)	ultraviolet light	**1**
10(d)(ii)	**M1** $CH_3CH_2CH_2Cl$ **M3** 1-chloropropane **M2** $CH_3CHClCH_3$ **M4** 2-chloropropane	**4**
10(d)(iii)	(compounds with) the same molecular formula but different structural formulae or structure	**1**

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