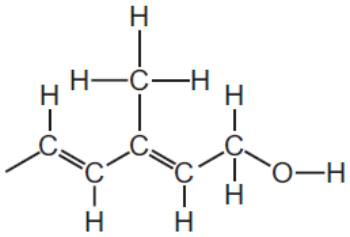
Organic Chemistry – 2023 June IGCSE Chemistry 0620

1. June/2023/Paper_ 0620/11/No.32

Part of the structure of a molecule of vitamin A is shown.



Which statements about this part of the structure are correct?

1 It is saturated.

2 There are two alkene groups.

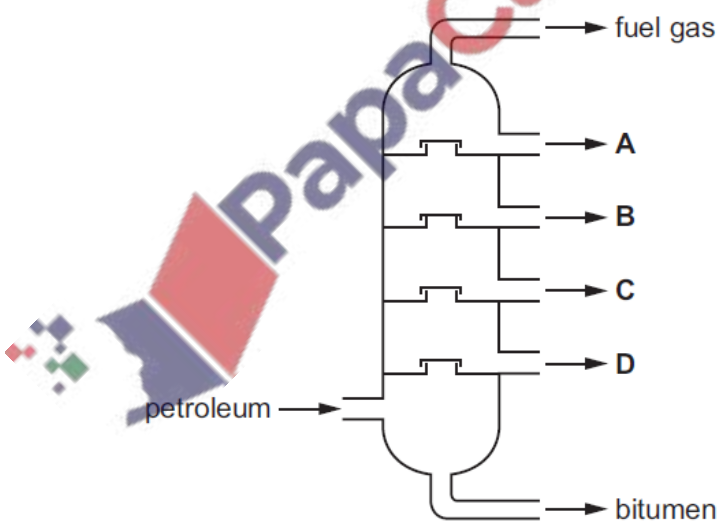
3 The structure shows a carboxylic acid.

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

2. June/2023/Paper_ 0620/11/No.33

The fractional distillation of petroleum is shown.

Which fraction contains hydrocarbons with the longest chain length?



3. June/2023/Paper_ 0620/11/No.34

Which equation represents the cracking of an alkane?

A $3C_2H_4 \rightarrow C_6H_{12}$

B $C_6H_{12} + H_2 \rightarrow C_6H_{14}$

C $C_6H_{14} \rightarrow 6C + 7H_2$

D $C_6H_{14} \rightarrow C_2H_4 + C_4H_{10}$

4. June/2023/Paper_ 0620/11/No.35

Which statements about ethanol are correct?

1 Ethanol is made by reacting steam with ethene at 300 °C.

2 Ethanol is made by fermentation at 55 °C.

3 Ethanol burns to produce carbon dioxide and water.

4 Ethanol contains a carbon–carbon double bond.

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

5. June/2023/Paper_ 0620/11/No.36

Which substances react with aqueous ethanoic acid to form a gas?

1 magnesium

2 magnesium carbonate

3 magnesium oxide

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

6. June/2023/Paper_ 0620/11/No.37

In reaction R, 2000 molecules of $CH_2=CH_2$ react to form a single molecule X only.

$$2000\ CH_2=CH_2 \rightarrow X$$

Which terms describe reaction R, $CH_2=CH_2$ and X?

	reaction R	$CH_2=CH_2$	X
A	addition	monomer	polymer
B	addition	polymer	monomer
C	substitution	monomer	polymer
D	substitution	polymer	monomer

7. June/2023/Paper_ 0620/12/No.32

Which row shows the general formula for alkenes and for alcohols?

	alkenes	alcohols
A	C_nH_{2n}	$C_nH_{2n+1}COOH$
B	C_nH_{2n}	$C_nH_{2n+1}OH$
C	C_nH_{2n+2}	$C_nH_{2n+1}COOH$
D	C_nH_{2n+2}	$C_nH_{2n+1}OH$

8. June/2023/Paper_ 0620/12/No.33

A molecule has the formula C_2H_5Cl.

What is its chemical name?

A chloroethane

B chloroethanol

C chloroethene

D chloromethanol

9. June/2023/Paper_ 0620/12/No.34

Which compound rapidly decolourises aqueous bromine?

A ethane

B ethanoic acid

C ethanol

D ethene

10. June/2023/Paper_ 0620/12/No.35

Compound Z has the molecular formula C_2H_6O.

Which statement about compound Z is correct?

A Z is unsaturated.

B Z is a carboxylic acid.

C Z is formed by the reaction of ethane with steam.

D Z is used as a fuel.

11. June/2023/Paper_ 0620/12/No.36

What is the formula of the salt formed when aqueous ethanoic acid reacts with calcium carbonate?

A $Ca(CH_3COOH)_2$

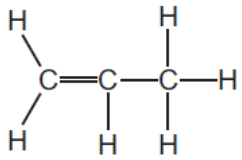
B $Ca(CH_3COO)_2$

C Ca_2CH_3COOH

D Ca_2CH_3COO

12. June/2023/Paper_ 0620/13/No.32

The displayed formula of an organic compound is shown.



To which homologous series does this compound belong?

A alcohols

B alkanes

C alkenes

D carboxylic acids

13. June/2023/Paper_ 0620/13/No.33

Kerosene is one of the fractions of petroleum.

What is kerosene used for?

A jet fuel

B petrol

C road making

D waxes

14. June/2023/Paper_ 0620/13/No.34

A hydrocarbon P is cracked to make compound Q and hydrogen.

Compound R is formed by the addition polymerisation of compound Q.

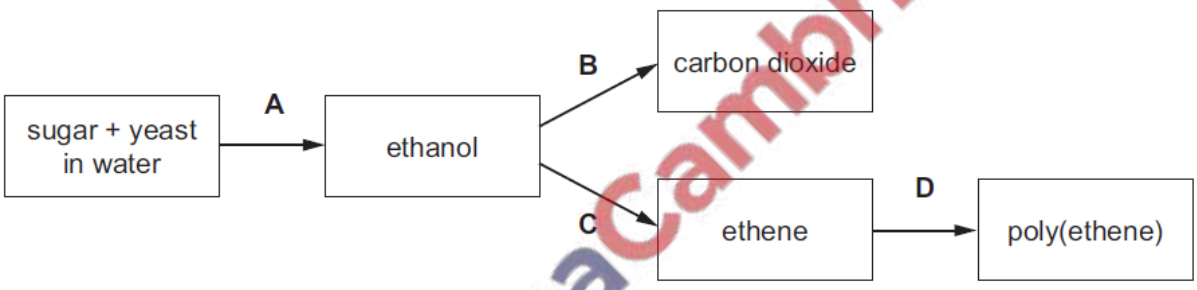
To which homologous series do P, Q and R belong?

	alkene	alkane
A	P only	Q and R
B	Q only	P and R
C	P and Q	R only
D	P and R	Q only

15. June/2023/Paper_ 0620/13/No.35

Which process involves combustion?

(Some of the reaction products are **not** shown on the diagram.)



16. June/2023/Paper_ 0620/13/No.36

What are the products when ethanoic acid reacts with aqueous sodium hydroxide?

A carbon dioxide and water

B carbon dioxide and sodium ethanoate

C sodium ethanoate and hydrogen

D sodium ethanoate and water

17. June/2023/Paper_ 0620/13/No.37

Which statements are correct?

1 The polymer of ethene is poly(ethane).

2 Monomers are small molecules.

3 Monomers join together to form polymers.

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

18. June/2023/Paper_ 0620/21/No.32

The structural formulae of two hydrocarbons are shown.

$CH_3CH_2CH_2CH_3$ $CH_3CH(CH_3)CH_3$

Which statement about the hydrocarbons is correct?

A They are both alkenes.

B They decolourise aqueous bromine.

C They are structural isomers.

D They undergo addition reactions.

19. June/2023/Paper_ 0620/21/No.33

The structural formula of compound Q is given.

$CH_3CH_2CH_2COOCH_2CH_2CH_3$

What is compound Q?

A butyl butanoate

B butyl propanoate

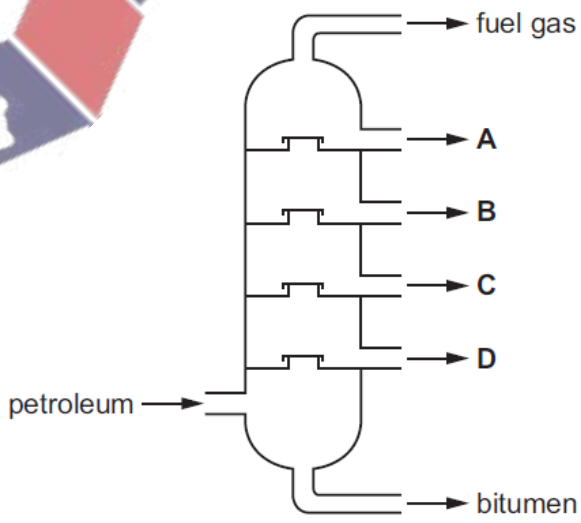
C propyl butanoate

D propyl propanoate

20. June/2023/Paper_ 0620/21/No.34

The fractional distillation of petroleum is shown.

Which fraction contains hydrocarbons with the longest chain length?



21. June/2023/Paper_ 0620/21/No.35

Which equation represents the cracking of an alkane?

A $3C_2H_4 \rightarrow C_6H_{12}$

B $C_6H_{12} + H_2 \rightarrow C_6H_{14}$

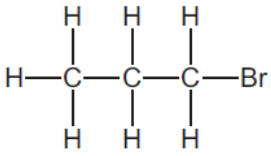
C $C_6H_{14} \rightarrow 6C + 7H_2$

D $C_6H_{14} \rightarrow C_2H_4 + C_4H_{10}$

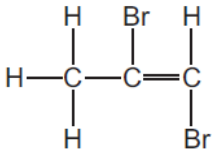
22. June/2023/Paper_ 0620/21/No.36

What is the structure of the product of the reaction of propene with bromine?

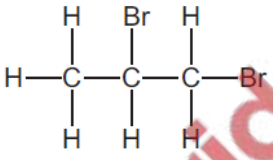
A



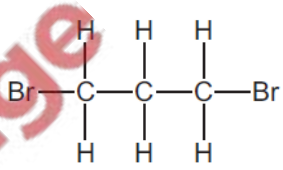
B



C



D



23. June/2023/Paper_ 0620/21/No.37

In reaction R, 2000 molecules of $CH_2=CH_2$ react to form a single molecule X only.

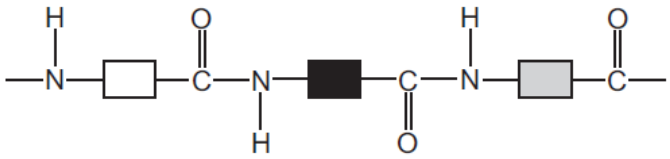
$$2000\ CH_2=CH_2 \rightarrow X$$

Which terms describe reaction R, $CH_2=CH_2$ and X?

	reaction R	$CH_2=CH_2$	X
A	addition	monomer	polymer
B	addition	polymer	monomer
C	substitution	monomer	polymer
D	substitution	polymer	monomer

24. June/2023/Paper_ 0620/21/No.38

Part of the structure of a polymer is shown.



Which statements about the polymer are correct?

1 The polymer is nylon.

2 The polymer is formed by condensation polymerisation.

3 There are ester linkages between the monomers.

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

25. June/2023/Paper_ 0620/22/No.30

The hydrocarbon C_4H_8 has two structural isomers, but-1-ene and but-2-ene.

Which statement is correct?

A But-2-ene has the structural formula $CH_3CH{=}CHCH_3$ and the same general formula as butane.

B But-2-ene has the structural formula $CH_3CH{=}CHCH_3$ and the same empirical formula as ethene.

C But-1-ene has the structural formula $CH_3CH_2CH{=}CH_2$ and the same general formula as butane.

D But-1-ene has the structural formula $CH_3CHCH_2{=}CH$ and the same empirical formula as ethene.

26. June/2023/Paper_ 0620/22/No.31

Which compound rapidly decolourises aqueous bromine?

A propane

B propanoic acid

C propanol

D propene

27. June/2023/Paper_ 0620/22/No.32

What are the products of the addition reactions of ethene with bromine and hydrogen?

	bromine	hydrogen
A	CH_2BrCH_2Br	CH_3CH_3
B	CH_2BrCH_2Br	CH_2CH_2
C	CH_3CH_2Br	CH_3CH_3
D	CH_3CH_2Br	CH_2CH_2

28. June/2023/Paper_ 0620/22/No.33

Ethanol is manufactured by fermentation and the catalytic addition of steam to ethene.

Which row describes an advantage of both methods?

	from sugar by fermentation	from ethene and steam
A	ethanol needs to be purified	the process is continuous
B	it is a batch process	ethene comes from petroleum
C	the process is slow	the process is rapid
D	renewable resources are used	the ethanol produced is pure

29. June/2023/Paper_ 0620/22/No.34

Methanoic acid and propan-1-ol react to form an ester.

What is the structural formula of the ester?

A $HCOOCH_2CH_2CH_3$

B $CH_3CH_2COOCH_3$

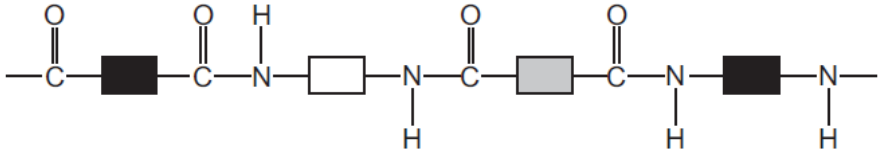
C $CH_3COOCH_2CH_3$

D $CH_3CH_2CH_2COOH$

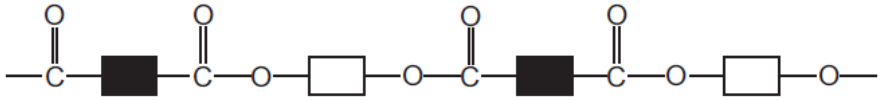
30. June/2023/Paper_ 0620/22/No.35

What is the correct structure of PET?

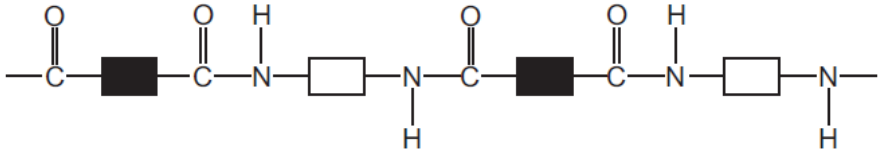
A



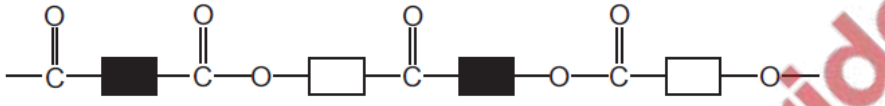
B



C



D



31. June/2023/Paper_ 0620/22/No.36

Alkanes undergo substitution reactions in the presence of UV light.

Which equation represents a substitution reaction of ethane?

A $C_2H_6 + Cl_2 \rightarrow C_2H_4 + 2HCl$

B $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$

C $C_2H_6 + Cl_2 \rightarrow C_2H_4Cl_2 + H_2$

D $C_2H_6 + HCl \rightarrow C_2H_5Cl + H_2$

32. June/2023/Paper_ 0620/22/No.37

Methane reacts with chlorine in substitution reactions.

How many different products, containing a single carbon atom, can be made during the reactions?

A 2 **B** 3 **C** 4 **D** 5

33. June/2023/Paper_ 0620/23/No.31

An alkene is represented by the formula $CH_3CH{=}CH_2$.

Which name is given to this type of formula?

A displayed

B empirical

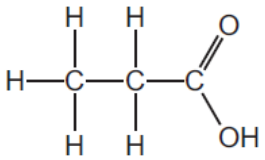
C general

D structural

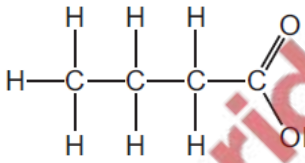
34. June/2023/Paper_ 0620/23/No.32

What is the structure of propanoic acid?

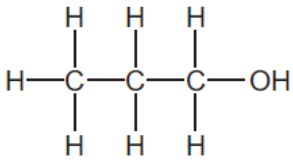
A



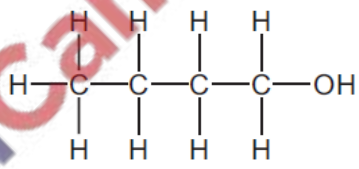
B



C



D



35. June/2023/Paper_ 0620/23/No.33

Butane reacts with chlorine in the presence of ultraviolet radiation.

What is the equation for this reaction?

A $C_4H_{10} + Cl_2 \rightarrow C_4H_8Cl_2 + H_2$

B $C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$

C $C_4H_{10} + Cl_2 \rightarrow 2C_2H_5Cl + H_2$

D $C_4H_{10} + Cl_2 \rightarrow C_2H_4 + C_2H_5Cl + HCl$

36. June/2023/Paper_ 0620/23/No.34

A hydrocarbon P is cracked to make compound Q and hydrogen.

Compound R is formed by the addition polymerisation of compound Q.

To which homologous series do P, Q and R belong?

	alkene	alkane
A	P only	Q and R
B	Q only	P and R
C	P and Q	R only
D	P and R	Q only

37. June/2023/Paper_ 0620/23/No.35

Which substances are structural isomers?

A but-2-ene and propene

B ethyl ethanoate and butanoic acid

C methyl methanoate and ethanol

D propan-1-ol and butan-1-ol

38. June/2023/Paper_ 0620/23/No.36

Ethanol is produced by:

1 the catalytic addition of steam to ethene

2 fermentation.

Which statement is correct?

A Both processes use similar amounts of energy.

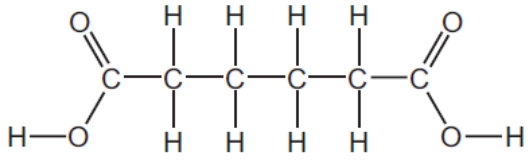
B Both processes use a catalyst.

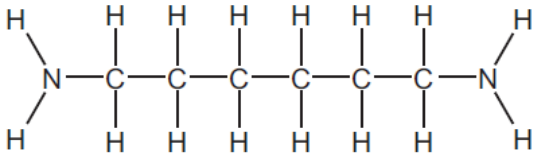
C Process 1 uses a temperature of 25–35 °C.

D Process 2 uses a pressure of 60 atm.

39. June/2023/Paper_ 0620/23/No.37

The two monomers shown can be used to form a condensation polymer.





Which small molecule is released during this reaction?

A H_2O **B** NH_3 **C** CO_2 **D** $CONH_2$

(a) Fig. 7.1 shows the displayed formula of mesaconic acid.

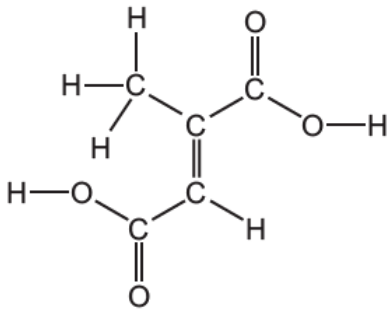


Fig. 7.1

(i) On Fig. 7.1 draw a circle around **one** carboxylic acid functional group. [1]

(ii) Deduce the molecular formula of mesaconic acid.

..... [1]

(iii) Mesaconic acid is a colourless compound.

Describe the colour change when excess mesaconic acid is added to aqueous bromine.

from ..... to ..... [2]

(b) Ethanoic acid belongs to the homologous series of carboxylic acids.

Define the term homologous series.

.....

..... [2]

(c) Complete the word equation for the reaction of ethanoic acid with magnesium.

ethanoic acid	+	magnesium	→	....	+	.....

[2]

(d) Ethanoic acid reacts with ethanol.
The organic product has the molecular formula $C_4H_8O_2$.

Complete Table 7.1 to calculate the relative molecular mass of $C_4H_8O_2$.

Table 7.1

atom	number of atoms	relative atomic mass	
carbon	4	12	$4 \times 12 = 48$
hydrogen		1	
oxygen		16	

relative molecular mass = ... [2]

(e) Ethanol can be manufactured by fermentation.

Complete the word equation for one **other** method of manufacturing ethanol.

..... + ... → ethanol [2]

[Total: 12]

41. June/2023/Paper_ 0620/32/No.7

(a) Fig. 7.1 shows the displayed formula of compound **D**.

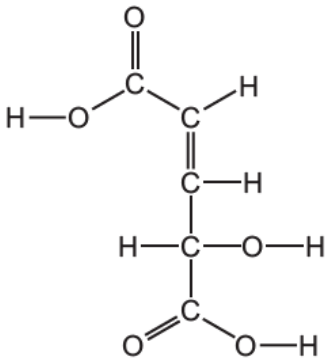


Fig. 7.1

(i) On Fig. 7.1 draw a circle around the alcohol functional group. [1]

(ii) Deduce the molecular formula of compound **D**.

..... [1]

(iii) Explain, by referring to the structure in Fig. 7.1, why compound **D** is unsaturated.

..... [1]

(b) Ethene is also an unsaturated compound.

(i) Draw the displayed formula of ethene.

[1]

(ii) Describe a test for unsaturated compounds.

test .....

observations .....

[2]

(c) Ethene can be manufactured by cracking larger alkane molecules.

(i) State **two** conditions for cracking.

1 .....

2 .....

[2]

(ii) Complete the symbol equation for the cracking of decane, $C_{10}H_{22}$, to produce ethene and one other hydrocarbon.

$$C_{10}H_{22} \rightarrow C_2H_4 + ...$$ [1]

(d) Ethanol can be manufactured by the reaction of ethene with steam.

Name one **other** method of manufacturing ethanol.

..... [1]

(e) Ethanol can be oxidised to ethanoic acid.

Ethanoic acid reacts with sodium.

Name the salt formed when ethanoic acid reacts with sodium.

..... [1]

(f) Ethanoic acid reacts with propanol.
The organic product has the molecular formula $C_5H_{10}O_2$.

Complete Table 7.1 to calculate the relative molecular mass of $C_5H_{10}O_2$.

Table 7.1

atom	number of atoms	relative atomic mass	
carbon		12	
hydrogen		1	
oxygen	2	16	2 × 16 = 32

relative molecular mass = ... [2]

[Total: 13]

42. June/2023/Paper_ 0620/32/No.8(b)

This question is about non-metals and compounds of non-metals.

(b) Methane is a compound of carbon and hydrogen.

(i) Complete Fig. 8.1 to show the dot-and-cross diagram for a molecule of methane.

Show outer shell electrons only.

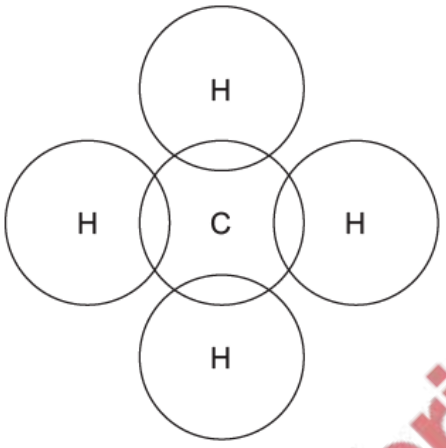


Fig. 8.1

[1]

(ii) Methane is an alkane.

Write the general formula for alkanes.

..... [1]

(iii) Methane is an air pollutant.

State **one** source of methane in the air.

..... [1]

(iv) State **one** adverse effect of methane in the air.

..... [1]

(v) Carbon particulates and water are two of the products of the incomplete combustion of methane.

Name one **other** compound formed during the incomplete combustion of methane.

..... [1]

43. June/2023/Paper_ 0620/33/No.7

(a) Fig. 7.1 shows the displayed formula of compound **E**.

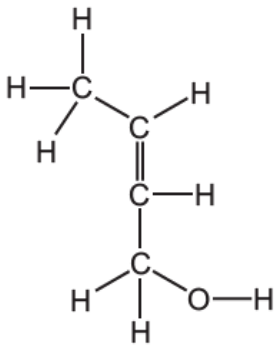


Fig. 7.1

(i) On Fig. 7.1 draw a circle around the functional group that makes compound **E** unsaturated. [1]

(ii) Deduce the molecular formula of compound **E**.

..... [1]

(iii) Describe a chemical test to distinguish between a saturated and an unsaturated compound.

test .....

observations with saturated compound .....

.....

observations with unsaturated compound .....

.....

[3]

(b) Alcohols have an –OH functional group.

(i) Write the general formula for the alcohol homologous series.

..... [1]

(ii) Ethanol is an alcohol with two carbon atoms in each molecule.

Draw the displayed formula of ethanol.

[1]

(c) Ethanol reacts to form a compound with the formula $C_6H_{12}O_2$.

Complete Table 7.1 to calculate the relative molecular mass of $C_6H_{12}O_2$.

Table 7.1

atom	number of atoms	relative atomic mass	
carbon	6	12	$6 \times 12 = 72$
hydrogen		1	
oxygen		16	

relative molecular mass = ... [2]

(d) Ethanol can be manufactured by the fermentation of aqueous glucose.

State **two** conditions for fermentation.

1 .....

2 .....

[2]

(e) Ethanol can be oxidised to ethanoic acid.

Complete the word equation for the reaction of ethanoic acid with sodium.

ethanoic acid	+	sodium	→	....	+	.....

[2]

[Total: 13]

44. June/2023/Paper_ 0620/41/No.7

This question is about organic compounds.

(a) Butane reacts with chlorine in a photochemical reaction.

$$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$$

(i) State the meaning of the term photochemical.

..... [1]

(ii) An organic compound with the formula C_4H_9Cl is formed when one molecule of butane reacts with one molecule of chlorine.

Draw the displayed formulae of **two** possible structural isomers with the formula C_4H_9Cl formed in this reaction.

[2]

(b) The structure of compound **A** is shown in Fig. 7.1.

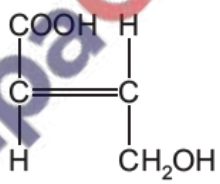


Fig. 7.1

(i) Deduce the molecular formula of compound **A**.

..... [1]

(ii) There are three functional groups in compound **A**.

Name the homologous series of compounds that contain the following functional groups:

–C=C– .....

–OH .....

–COOH. .....

[3]

(iii) State what is observed when compound **A** is added to:

aqueous bromine .....

aqueous sodium carbonate. .....

[2]

(iv) Compound **A** can be used as a single monomer to produce two different polymers.

Draw **one** repeat unit of the addition polymer formed from compound **A**.

[2]

(v) Compound **A** can be converted into a dicarboxylic acid.

Name the type of condensation polymer formed from a dicarboxylic acid and a diol.

..... [1]

[Total: 12]

45. June/2023/Paper_ 0620/42/No.5

Propane and propene both react with chlorine.

(a) When a molecule of propane, C_3H_8, reacts with chlorine in the presence of ultraviolet light, one atom of hydrogen is replaced by one atom of chlorine.

(i) State the term given to reactions in which one atom in an alkane is replaced by another atom.

..... [1]

(ii) State the purpose of ultraviolet light in this reaction.

..... [1]

(iii) State the term given to any reaction which requires ultraviolet light.

..... [1]

(iv) Write the symbol equation for the reaction between propane and chlorine.

..... [2]

(b) A molecule of propene, C_3H_6, is unsaturated and will react with chlorine at room temperature.

(i) State why propene is an unsaturated molecule.

..... [1]

(ii) Give the structural formula of the product of this reaction.

..... [1]

(c) Propene undergoes addition reactions with steam.
There are two possible products, **A** and **B**.

Draw the displayed formula and name each product.

displayed formula of product **A**

name of product **A** .....

displayed formula of product **B**

name of product **B** .....

[4]

[Total: 11]

46. June/2023/Paper_ 0620/42/No.6

Carboxylic acids can be converted to esters.

(a) Name the ester formed when butanoic acid, $CH_3CH_2CH_2COOH$, reacts with ethanol, CH_3CH_2OH.

..... [1]

(b) Identify the other product formed in this reaction.

..... [1]

(c) Deduce the empirical formula of the ester formed.

..... [1]

(d) PET is a polyester. Part of the structure of PET is shown in Fig. 6.1.

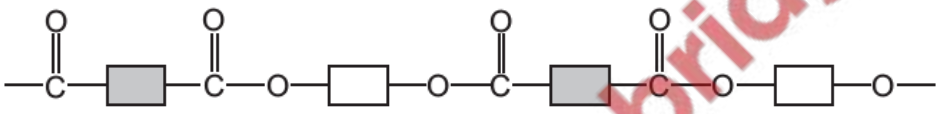


Fig. 6.1

(i) Circle **one** repeat unit of this polymer. [1]

(ii) Draw the structures of the monomers which make up PET. Draw the functional groups using displayed formulae.

[2]

(iii) State the type of polymerisation used in making PET.

..... [1]

[Total: 7]

47. June/2023/Paper_ 0620/43/No.7

This question is about organic compounds.

(a) Propane and chlorine react at room temperature. An equation for the reaction is shown.

$$C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$$

(i) State the condition required for this reaction.

..... [1]

(ii) Draw the displayed formulae of **two** structural isomers with the formula C_3H_7Cl.

[2]

(b) Alkenes are a homologous series of hydrocarbons.

(i) State **two** characteristics that all members of the same homologous series have in common.

1 .....

2 .....

[2]

(ii) Addition polymers are made from alkenes.

Complete Fig. 7.1 to show one repeat unit of the addition polymer formed from but-2-ene.

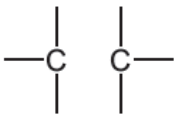


Fig. 7.1

[2]

(c) A repeat unit of a condensation polymer is shown in Fig. 7.2.
The polymer is made from two monomers.

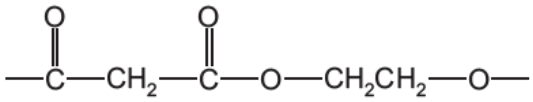


Fig. 7.2

(i) Draw the structures of the monomers used to produce the polymer in Fig. 7.2.

[2]

(ii) Name the **type** of condensation polymer in Fig. 7.2.

..... [1]

(iii) Name the **two** homologous series to which the monomers in **(i)** belong.

1 .....

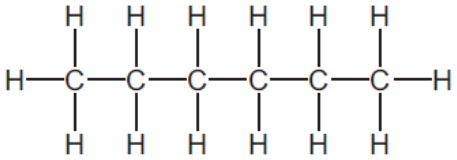
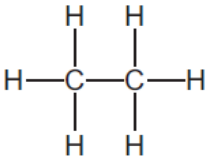
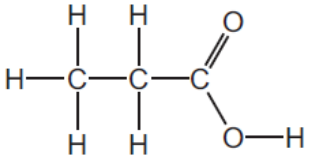
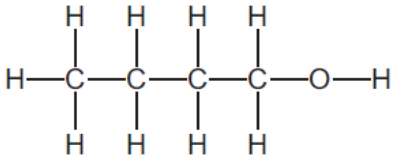
2 .....

[2]

[Total: 12]

48. March/2023/Paper_ 0620/12/No.32

Which row identifies the homologous series to which the molecular structure belongs?

	molecular structure	homologous series
A		alkane
B		alkene
C		alcohol
D		carboxylic acid

49. March/2023/Paper_ 0620/12/No.33

Petroleum is fractionally distilled at an oil refinery.

The table shows some fractions and uses.

	fraction	use
1	gasoline	fuel for ships
2	refinery gas	lubrication
3	naphtha	making chemicals
4	kerosene	jet fuel

Which rows identify a use for the fraction listed?

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

50. March/2023/Paper_ 0620/12/No.34

What is the word equation for the preparation of ethanol?

A glucose → ethanol + carbon dioxide

B glucose + yeast → ethanol + water

C ethane + water → ethanol

D ethene + water → ethanol + carbon dioxide

51. March/2023/Paper_ 0620/12/No.35

Which row describes properties of aqueous ethanoic acid?

	pH	effect of adding magnesium	effect of adding sodium carbonate
A	1	reacts to form hydrogen	reacts to form carbon dioxide and water only
B	4	reacts to form hydrogen	reacts to form a salt, carbon dioxide and water
C	5	no reaction	reacts to form a salt, carbon dioxide and water
D	8	no reaction	reacts to form carbon dioxide and water only

52. March/2023/Paper_ 0620/12/No.36

Which row describes the relative sizes of monomer and polymer molecules?

	monomer	polymer
A	large	large
B	large	small
C	small	large
D	small	small

53. March/2023/Paper_ 0620/22/No.30

One mole of alkane Y produces 72 dm^3 of carbon dioxide when burned in excess oxygen, measured at room temperature and pressure.

What is Y?

A butane

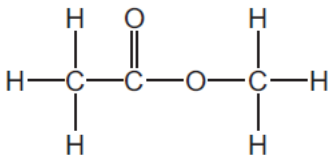
B ethane

C methane

D propane

54. March/2023/Paper_ 0620/22/No.31

The structure of organic compound X is shown.



What is X?

A ethyl ethanoate

B ethyl methanoate

C methyl ethanoate

D methyl methanoate

55. March/2023/Paper_ 0620/22/No.32

What is the structural formula of the compound formed in the addition reaction of propene with bromine?

A $CH_3CHBrCH_2Br$

B $CH_2BrCH_2CH_2Br$

C $CHBr_2CH_2CH_3$

D $CH_3CBr_2CH_3$

56. March/2023/Paper_ 0620/22/No.33

Ethanol is produced industrially by fermentation and also by a catalysed addition reaction involving steam.

Which row describes one advantage of each process?

	fermentation	catalysed addition reaction involving steam
A	the reactant used is renewable	it is a continuous process
B	the reactant used is renewable	it requires little energy
C	it is a very rapid reaction	it is a continuous process
D	it is a very rapid reaction	it requires little energy

57. March/2023/Paper_ 0620/22/No.34

Carboxylic acids react with alcohols when warmed with an acid catalyst.

Which type of substance is formed in this reaction?

A an alkene

B an ester

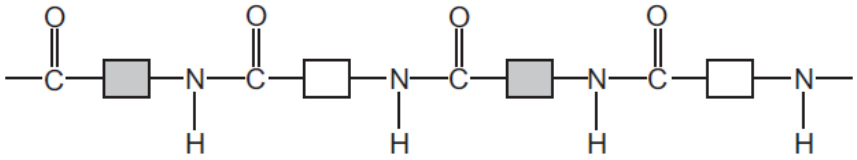
C a salt

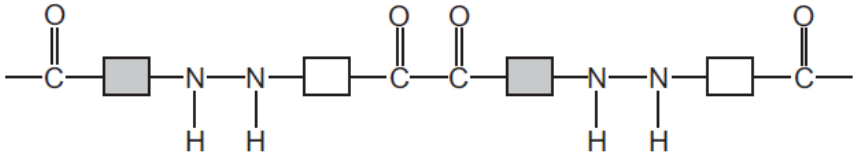
D a polymer

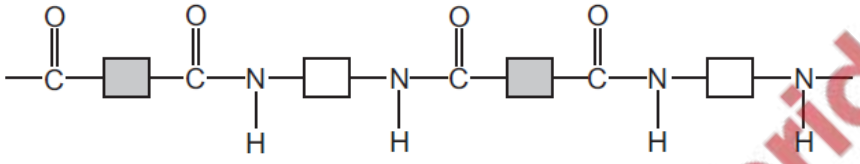
58. March/2023/Paper_ 0620/22/No.35

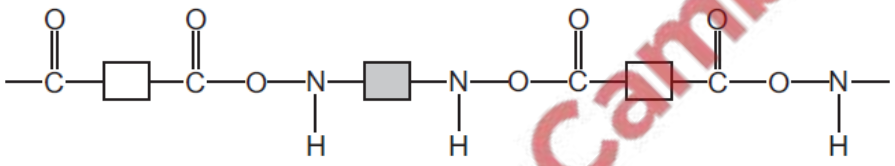
Nylon is formed by condensation polymerisation.

Which structure represents nylon?

A 

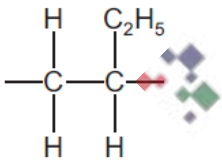
B 

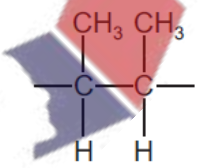
C 

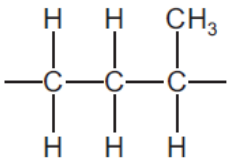
D 

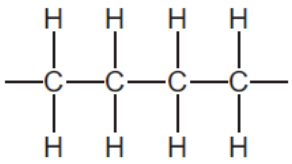
59. March/2023/Paper_ 0620/22/No.36

Which structure represents the repeat unit of the addition polymer formed from but-1-ene?

A 

B 

C 

D 

60. March/2023/Paper_ 0620/32/No.6

(a) Fig. 6.1 shows the displayed formula of a molecule of crotyl alcohol.

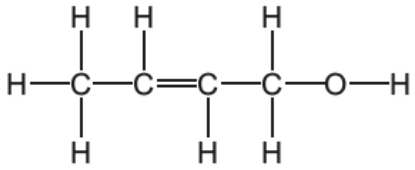


Fig. 6.1

(i) On Fig. 6.1 draw a circle around the alcohol functional group. [1]

(ii) Describe the feature of crotyl alcohol that shows it is an unsaturated compound.

..... [1]

(iii) Deduce the molecular formula of crotyl alcohol.

..... [1]

(iv) Crotyl alcohol is soluble in water.

The boiling point of crotyl alcohol is 121 °C.
The boiling point of water is 100 °C.

Suggest how fractional distillation can be used to separate a mixture of crotyl alcohol and water.

.....

.....

..... [2]

(b) Ethanol is also an alcohol.

Describe **two** conditions for the manufacture of ethanol by the fermentation of aqueous glucose.

1 .....

2 .....

[2]

(c) Ethanol can be converted to ethene.

Choose from the list the general formula for the homologous series to which ethene belongs.

Draw a circle around your chosen answer.

C_nH_n C_nH_{2n} C_nH_{2n+2} $C_{2n}H_n$ [1]

(d) Ethene can be converted to ethane.

(i) Ethane is an alkane.

Name the type of bonding in alkanes.

..... [1]

(ii) Draw the displayed formula of a molecule of ethane.

[1]

(iii) Complete this sentence.

Alkanes are unreactive except in terms of combustion and substitution by

..... . [1]

(iv) Complete the symbol equation for the complete combustion of methane.

$CH_4 + ...O_2 \rightarrow ..... + 2H_2O$ [2]

[Total: 13]

61. March/2023/Paper_ 0620/42/No.5

Propane, propene, propan-1-ol and propanoic acid are members of different homologous series. Molecules of these substances contain three carbon atoms.

(a) Explain why members of a homologous series have similar chemical properties.

..... [1]

(b) Name the homologous series to which propanoic acid belongs.

..... [1]

(c) State the general formula of the homologous series to which propanoic acid belongs.

..... [1]

(d) Propan-1-ol has an unbranched isomer.

- Name this isomer.

.....

- Draw the displayed formula of this isomer.

[2]

(e) Propane and propene can be manufactured by heating decane, $C_{10}H_{22}$, in the presence of a catalyst. One other product is formed.

(i) Complete the equation for this reaction.

$C_{10}H_{22} \rightarrow$ ..... + ... + ... [2]

(ii) Name this manufacturing process.

..... [1]

(f) Propene forms a polymer named poly(propene).

(i) Draw the displayed formula of a section of poly(propene) showing **three** repeat units.

[2]

(ii) State the type of polymerisation that occurs when propene forms poly(propene).

..... [1]

(g) Propanoic acid reacts with aqueous sodium carbonate to form a salt.

(i) Suggest the name of the salt formed.

..... [1]

(ii) Suggest the formula of the anion in this salt.

..... [1]

(h) Propanoic acid forms an ester when it reacts with ethanol in the presence of a catalyst.

(i) Suggest a suitable catalyst.

..... [1]

(ii) Name the ester formed.

..... [1]

(iii) Draw the displayed formula of this ester.

[2]

[Total: 17]