Organic Chemistry – 2021 IGCSE 0620

1. June/2021/Paper_11/No.33

Some information about compound L is listed.

1 L is an organic compound which contains four hydrogen atoms.

2 L is soluble in water.

3 An aqueous solution of L reacts with copper(II) carbonate to produce a gas.

What is L?

A methane

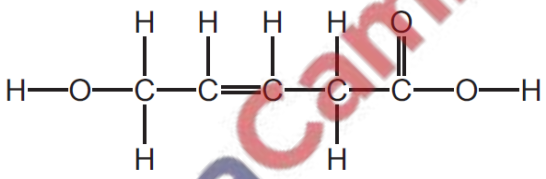
B ethene

C ethanoic acid

D ethanol

2. June/2021/Paper_11/No.34

The structure of an organic molecule is shown.



Which functional groups does this molecule contain?

	alcohol	alkene	carboxylic acid
A	no	no	no
B	no	yes	yes
C	yes	no	yes
D	yes	yes	yes

3. June/2021/Paper_11,12&13/No.35

Which compounds belong to the same homologous series?

A ethane and propane

B ethanoic acid and ethanol

C methane and ethene

D propene and ethanoic acid

4. June/2021/Paper_11&13/No.36

Which statement about alkanes is correct?

A They burn in oxygen.

B They contain carbon, hydrogen and oxygen atoms.

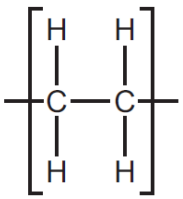
C They contain double bonds.

D They contain ionic bonds.

5. June/2021/Paper_11/No.37

Which structure represents poly(ethene)?

A



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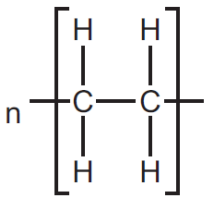

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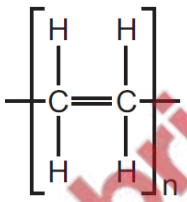

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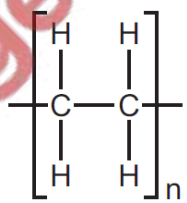


6. June/2021/Paper_11/No.38

P, Q, R and S are four organic compounds.

P is an unsaturated hydrocarbon.

Q burns but otherwise is unreactive.

R contains a C–C single bond and a C=C double bond.

S undergoes addition polymerisation.

Which compounds are alkenes?

A P and R only **B** P, R and S **C** P, Q and S **D** Q, R and S

7. June/2021/Paper_11/No.39

Which statement about petroleum fractions is correct?

A All petroleum fractions are used as fuels.

B Gas oil is used to make bottled gas for heating.

C Hydrocarbons in diesel have higher boiling points than hydrocarbons in gasoline.

D Molecules in kerosene are larger than molecules in fuel oil.

8. June/2021/Paper_12/No.34

Which gas is the main constituent of natural gas?

A ethane

B ethene

C methane

D propane

9. June/2021/Paper_12,21&23/No.36

Which statement about alkanes is correct?

A They burn in oxygen.

B They contain carbon, hydrogen and oxygen atoms.

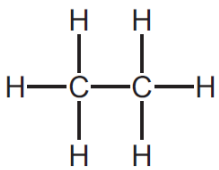
C They contain double bonds.

D They contain ionic bonds.

10. June/2021/Paper_12/No.37

Which compound decolourises aqueous bromine?

A



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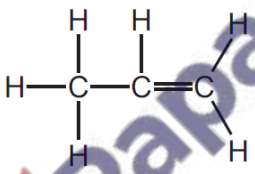

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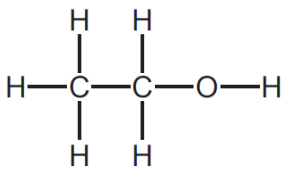

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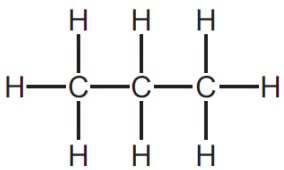


11. June/2021/Paper_12/No.38

What is the chemical equation for the process of fermentation?

A $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

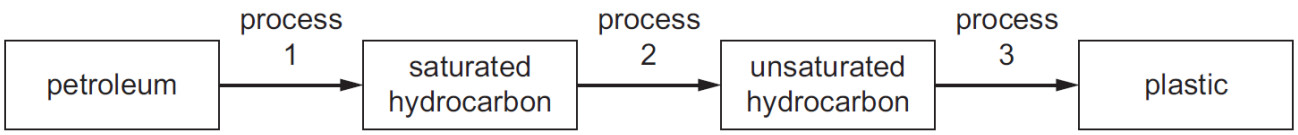
B $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

C $C_6H_{12}O_6 + 3H_2O \rightarrow 3C_2H_5OH + 3O_2$

D $C_6H_{12}O_6 + 3O_2 \rightarrow 6CO + 6H_2O$

12. June/2021/Paper_12/No.39

The flow chart shows how petroleum may be turned into a plastic.



What are processes 1, 2 and 3?

	process 1	process 2	process 3
A	cracking	fractional distillation	polymerisation
B	cracking	polymerisation	fractional distillation
C	fractional distillation	cracking	polymerisation
D	fractional distillation	polymerisation	cracking

13. June/2021/Paper_12,13,21,22&23/No.40

Which substance is a natural polymer?

A ethene

B *Terylene*

C nylon

D protein

14. June/2021/Paper_13/No.37

P, Q, R and S are organic compounds.

P is formed by reacting ethene with steam.

Q decolourises bromine water.

R is a hydrocarbon; all of its bonds are single covalent bonds.

S is a waste product from digestion in animals.

Which compounds are alkanes?

A P and Q **B** P and S **C** Q and R **D** R and S

15. June/2021/Paper_13/No.38

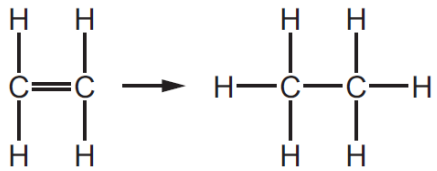
Which row describes how ethanol is used?

	fuel	solvent
A	no	no
B	no	yes
C	yes	no
D	yes	yes

16. June/2021/Paper_13/No.39

Which diagram shows the conversion of ethene into ethanol?

A



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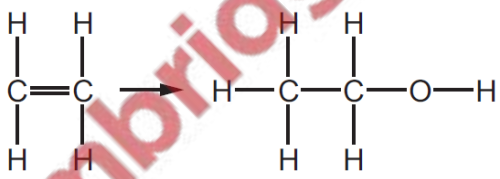

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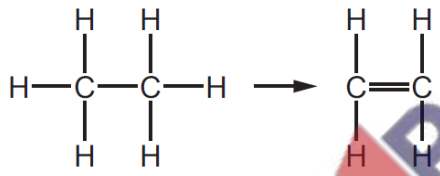

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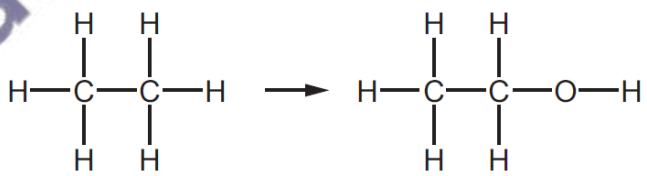


17. June/2021/Paper_21/No.33

What is the structure of butanoic acid?

A $CH_3CH_2CO_2H$

B $CH_3CH_2CH_2CO_2H$

C $CH_3CH_2CH_2CH_2CO_2H$

D $CH_3CH_2CH_2CO_2CH_3$

18. June/2021/Paper_21/No.34

Compound Z contains carbon, hydrogen and oxygen.

Molecules of compound Z have four hydrogen atoms and two carbon atoms.

Compound Z can be made by oxidation of an alcohol.

What is compound Z?

A ethene

B ethanol

C ethanoic acid

D methyl methanoate

19. June/2021/Paper_21/No.35

Which statement about homologous series and isomerism is correct?

A Butane and butene are structural isomers.

B Compounds in the same homologous series have the same general formula.

C Compounds in the same homologous series have the same molecular formula.

D Structural isomers have different molecular formulae.

20. June/2021/Paper_21/No.37

What is an advantage of manufacturing ethanol by fermentation?

A The process is very fast.

B The ethanol requires no separation.

C The raw materials used are renewable.

D There are no other products formed.

21. June/2021/Paper_21/No.38

P, Q, R and S are four organic compounds.

P is an unsaturated hydrocarbon.

Q burns but otherwise is unreactive.

R contains a C–C single bond and a C=C double bond.

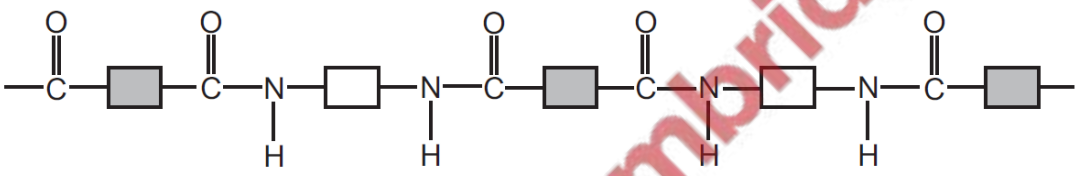
S undergoes addition polymerisation.

Which compounds are alkenes?

A P and R only **B** P, R and S **C** P, Q and S **D** Q, R and S

22. June/2021/Paper_21,22&23/No.39

The structure of a synthetic polymer is shown.



The structure shows that it is a .....1..... . It is formed by .....2..... polymerisation.

Which words complete gaps 1 and 2?

	1	2
A	polyamide	addition
B	polyamide	condensation
C	polyester	addition
D	polyester	condensation

23. June/2021/Paper_22/No.34

Which statement about ethanol is **not** correct?

A Ethanol can be made by fermentation.

B Ethanol is oxidised to make ethanoic acid.

C Ethanol reacts with oxygen exothermically, making it a good fuel.

D Ethanol reacts with propanoic acid to make propyl ethanoate.

24. June/2021/Paper_22/No.35

Which pair of formulae represents two alkanes?

A CH_4 and C_8H_{18}

B C_2H_6 and C_5H_8

C C_3H_6 and C_5H_{12}

D $C_{10}H_8$ and C_4H_8

25. June/2021/Paper_22/No.36

Which statement about alkanes is correct?

A They burn in oxygen.

B They contain carbon, hydrogen and oxygen atoms.

C They contain double bonds.

D They contain ionic bonds.

26. June/2021/Paper_22/No.37

Which statements about ethanoic acid are correct?

1 It is a strong acid.

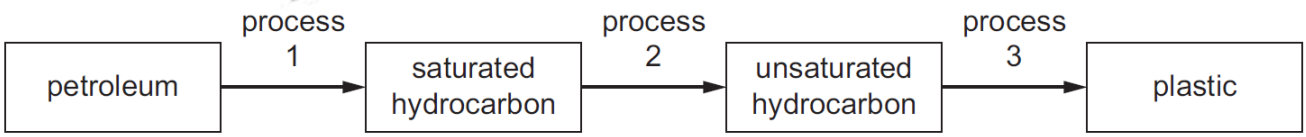
2 It reacts with ethanol to form an ester.

3 It has the formula CH_3COOH.

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

27. June/2021/Paper_22/No.38

The flow chart shows how petroleum may be turned into a plastic.



What are processes 1, 2 and 3?

	process 1	process 2	process 3
A	cracking	fractional distillation	polymerisation
B	cracking	polymerisation	fractional distillation
C	fractional distillation	cracking	polymerisation
D	fractional distillation	polymerisation	cracking

28. June/2021/Paper_23/No.34

Ethanol is reacted with acidified potassium manganate(VII).

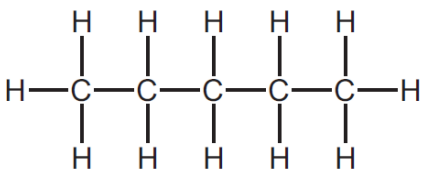
Which row describes the type of reaction and the type of organic compound formed?

	type of reaction	organic compound
A	oxidation	carboxylic acid
B	oxidation	alkene
C	dehydration	carboxylic acid
D	dehydration	alkene

29. June/2021/Paper_23/No.35

The diagrams show the structural formulae of four compounds.

1



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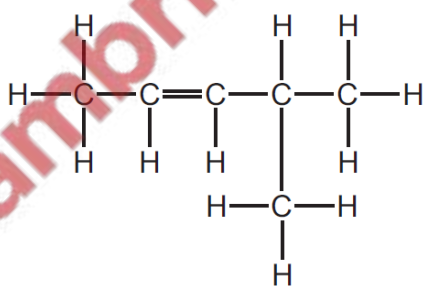

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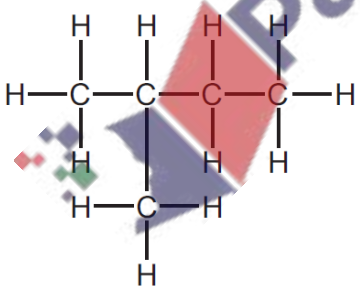

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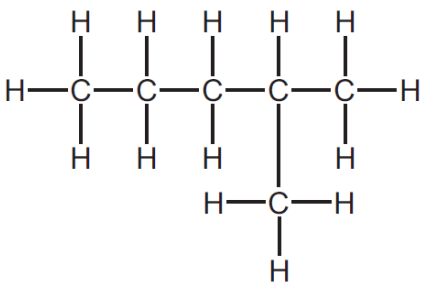


Which two compounds are structural isomers?

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

30. June/2021/Paper_23/No.38

What is an advantage of the fermentation process for producing ethanol compared with the catalytic addition of steam to ethene?

A Fermentation requires less heat energy.

B Ethanol from fermentation needs to be distilled.

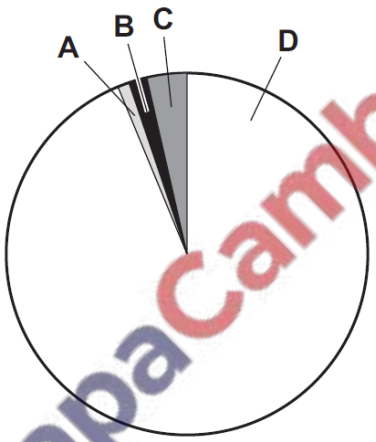
C Raw materials for fermentation are non-renewable.

D The fermentation process is carried out in batches rather than continuously.

31. March/2021/Paper_12&22/No.35

The pie chart represents the composition of natural gas.

Which sector represents methane?



32. March/2021/Paper_12/No.36

Which fraction, obtained from petroleum, is used for jet fuel?

A bitumen

B gasoline

C kerosene

D naphtha

33. March/2021/Paper_12&22/No.37

The formula of a hydrocarbon is C_xH_y.

The equation for its complete combustion is shown.

$$C_xH_y + 8O_2 \rightarrow 5CO_2 + 6H_2O$$

What are the values of x and y?

	x	y
A	5	6
B	5	12
C	6	5
D	12	5

34. March/2021/Paper_12/No.38

Pentane is an alkane and pentene is an alkene.

What is observed when bromine water is added to a sample of each compound?

	pentane	pentene
A	becomes colourless	becomes colourless
B	becomes colourless	remains unchanged
C	remains unchanged	becomes colourless
D	remains unchanged	remains unchanged

35. March/2021/Paper_12/No.39

Molecule 1 undergoes a process to make molecule 2.

$$\text{molecule 1} \xrightarrow{\text{process}} \text{molecule 2}$$

Which row describes the molecules and the process?

	molecule 1	process	molecule 2
A	monomer	cracking	polymer
B	monomer	polymerisation	polymer
C	small molecule	polymerisation	monomer
D	small molecule	cracking	monomer

36. March/2021/Paper_12/No.40

Which substance has long-chain molecules and is a constituent of food?

A carbohydrate

B nylon

C poly(ethene)

D *Terylene*

37. March/2021/Paper_22/No.34

Propane reacts with chlorine.

Which row shows a condition required for this reaction and identifies the type of reaction?

	condition	type of reaction
A	phosphoric acid catalyst	addition
B	phosphoric acid catalyst	substitution
C	ultraviolet light	addition
D	ultraviolet light	substitution

38. March/2021/Paper_22/No.36

Which statement describes the reaction between ethene and steam?

A a cracking reaction which produces ethane and hydrogen gas as products

B an addition reaction which produces ethanol as the only product

C an oxidation reaction which produces ethanoic acid as the only product

D a slow reaction producing ethanol and carbon dioxide

39. March/2021/Paper_22/No.38

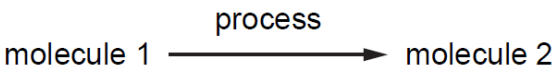
The formula of an ester is $CH_3CH_2CH_2COOCH_2CH_2CH_3$.

Which acid and alcohol react together to make the ester?

	acid	alcohol
A	butanoic acid	butanol
B	butanoic acid	propanol
C	propanoic acid	butanol
D	propanoic acid	propanol

40. March/2021/Paper_22/No.39

Molecule 1 undergoes a process to make molecule 2.



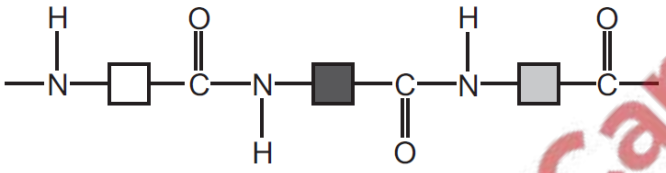
Which row describes the molecules and the process?

	molecule 1	process	molecule 2
A	monomer	cracking	polymer
B	monomer	polymerisation	polymer
C	small molecule	polymerisation	monomer
D	small molecule	cracking	monomer

41. March/2021/Paper_22/No.40

Which structure represents a protein?

A



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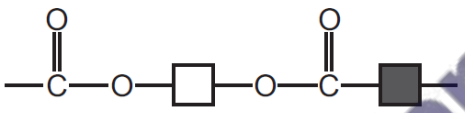

C

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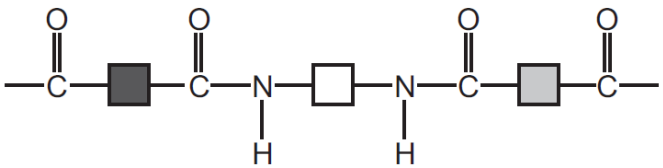
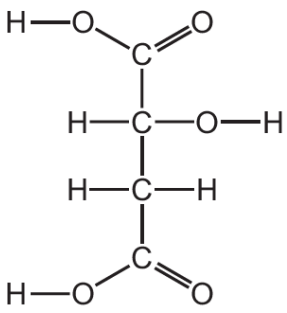


42. June/2021/Paper_31/No.4

The structure of malic acid is shown.



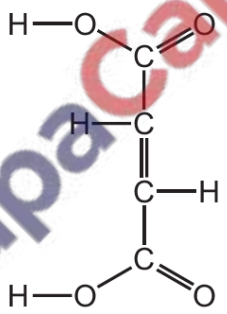
(a) (i) On the structure draw a circle around the alcohol functional group. [1]

(ii) Deduce the formula of malic acid to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

(b) When malic acid is heated it forms compound **F**.

The structure of compound **F** is shown.



Explain why compound **F** is described as unsaturated.

..... [1]

(c) Compound **F** can form polymers.

(i) State the meaning of the term *polymer*.

.....

..... [2]

(ii) State the name of the polymer formed when ethene is polymerised.

..... [1]

(d) Ethanoic acid is a carboxylic acid.

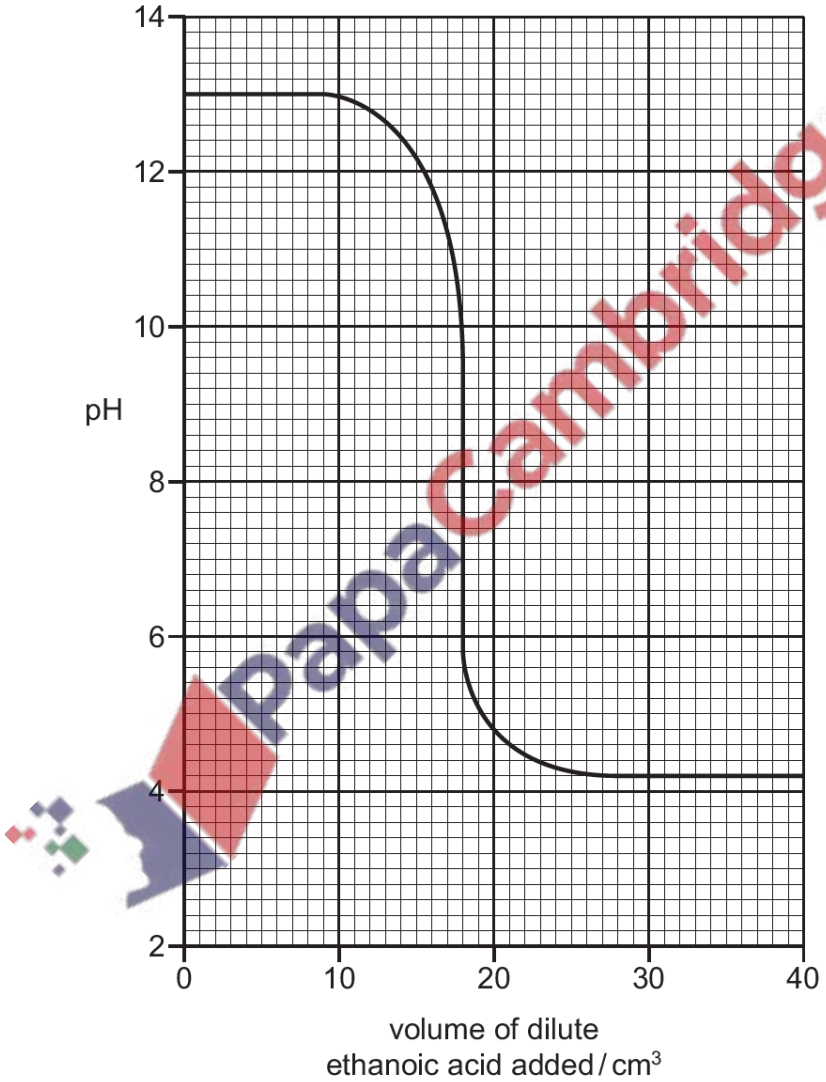
Describe the observations made when dilute ethanoic acid reacts with:

magnesium .....

litmus solution. .....

[2]

(e) The graph shows how the pH changes when dilute ethanoic acid is added slowly to aqueous sodium hydroxide.



(i) Deduce the pH of the aqueous sodium hydroxide before the addition of dilute ethanoic acid.

pH = ... [1]

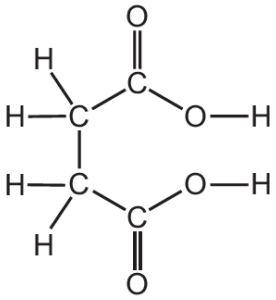
(ii) Deduce the volume of dilute ethanoic acid added when the pH is neutral.

..... cm^3 [1]

[Total: 10]

43. June/2021/Paper_32/No.4

The structure of succinic acid is shown.



(a) (i) On the structure draw a circle around one carboxylic acid functional group. [1]

(ii) Deduce the formula of succinic acid to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

(b) When succinic acid is heated it undergoes sublimation.

State the meaning of the term *sublimation*.

.....

..... [1]

(c) Succinic acid is heated with compound **F**.

Compound **F** has the formula $HOCH_2CH_2OH$.

(i) State the name of the –OH functional group in compound **F**.

..... [1]

(ii) A polymer is formed when succinic acid is heated with compound **F**.

Choose **one** word from the list that best describes the small molecules that react together to form a polymer.

Draw a circle around the correct answer.

bases **ceramics** **monomers** **plastics** [1]

(d) Ethanoic acid is also a carboxylic acid.

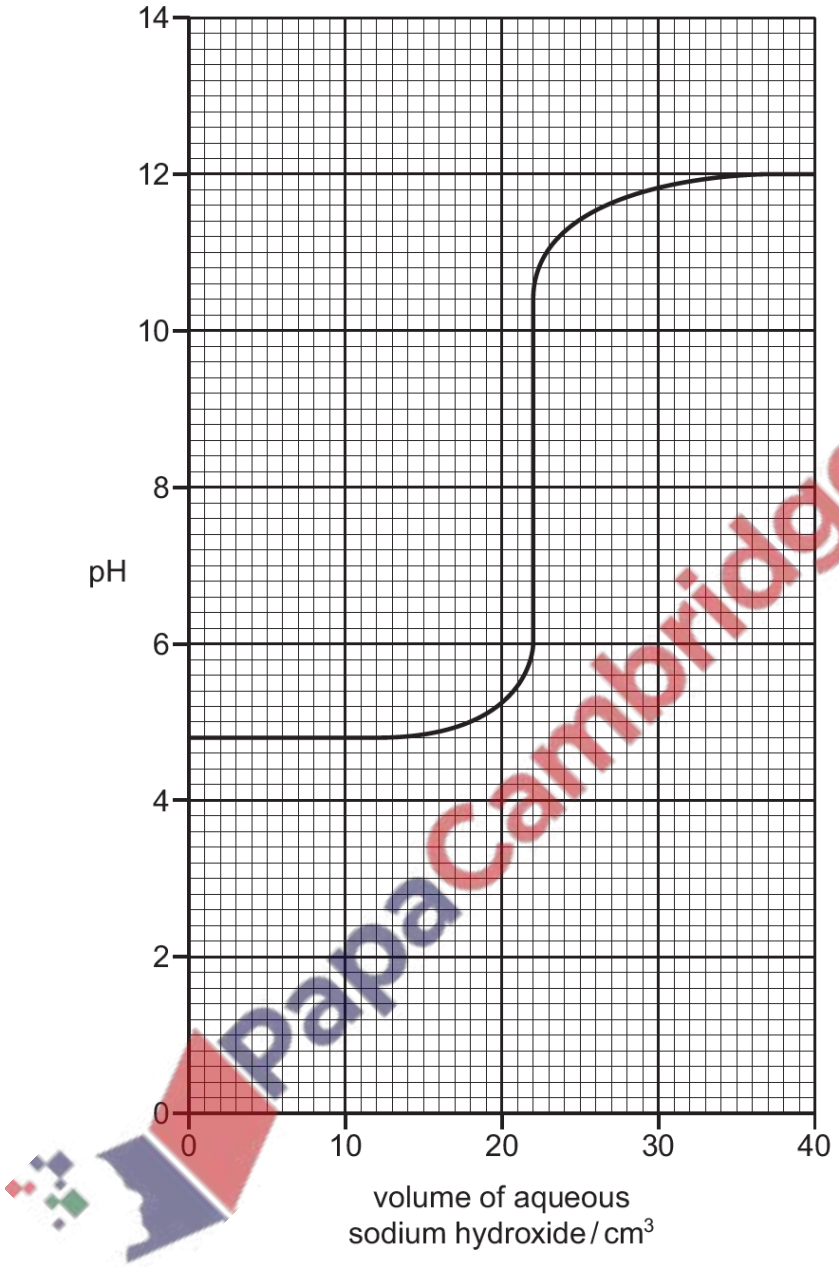
Describe the observations made when ethanoic acid reacts with:

blue litmus paper .....

calcium carbonate. .....

[2]

(e) A student's graph of how the pH changes when aqueous sodium hydroxide is added slowly to dilute ethanoic acid is shown.



(i) Deduce the pH of the dilute ethanoic acid before the addition of aqueous sodium hydroxide.

pH = ... [1]

(ii) Deduce the volume of aqueous sodium hydroxide added when the pH is neutral.

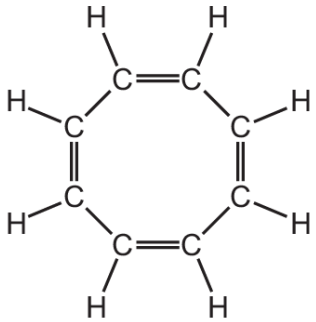
..... cm^3 [1]

[Total: 9]

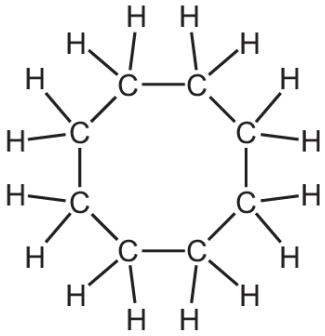
44. June/2021/Paper_33/No.4

(a) The structure of two organic compounds, **F** and **G**, are shown.

F



G



(i) Compound **F** is an unsaturated compound.

Describe a chemical test for an unsaturated compound.

test .....

observations .....

[2]

(ii) Compound **F** is reduced to compound **G** using hydrogen and a catalyst.

State what is meant by the term *catalyst*.

.....

..... [1]

(iii) Compound **G** is a saturated hydrocarbon.

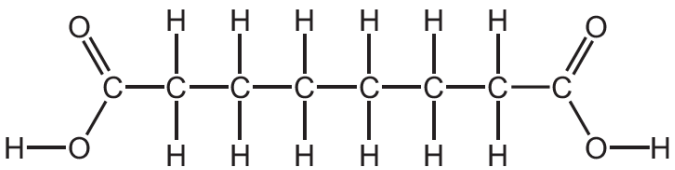
Name the saturated hydrocarbon which contains two carbon atoms.

..... [1]

(b) Compound **G** is oxidised by nitric acid to compound **H**.

The structure of compound **H** is shown.

H



(i) Deduce the formula of compound **H** to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

(ii) Compound **H** contains two carboxylic acid functional groups.
Ethanoic acid also contains a carboxylic acid functional group.

Draw the structure of ethanoic acid. Show all of the atoms and all of the bonds.

[1]

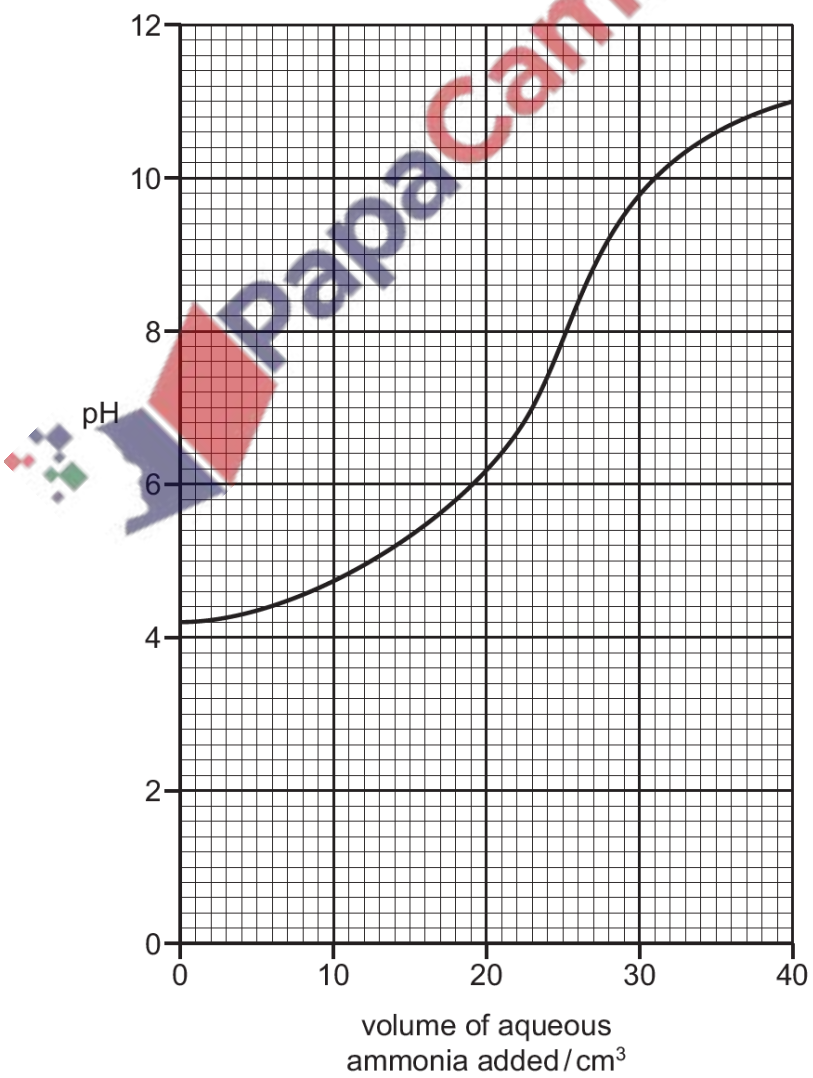
(iii) Describe the observations made when ethanoic acid reacts with:

universal indicator solution .....

sodium. .....

[2]

(c) A student's graph of how the pH changes when aqueous ammonia is added slowly to dilute ethanoic acid is shown.



(i) Deduce the pH of the dilute ethanoic acid before the addition of aqueous ammonia.

pH = ... [1]

(ii) Deduce the volume of aqueous ammonia added when the pH is neutral.

..... cm^3 [1]

(d) Compound **H** reacts with compound **J** to form a polymer.

Compound **J** has the formula $HOCH_2CH_2OH$.

(i) State the name of the –OH functional group in compound **J**.

..... [1]

(ii) Ethene polymerises to form poly(ethene).

Choose **one** word from the list that best describes the type of reaction that occurs.

Draw a circle around the correct answer.

addition **combustion** **cracking** **reduction** [1]

[Total: 12]

45. June/2021/Paper_41/No.7

Many organic compounds contain carbon, hydrogen and oxygen only.

(a) An organic compound **V** has the following composition by mass.

C, 48.65%; H, 8.11%; O, 43.24%

Calculate the empirical formula of compound **V**.

empirical formula = ... [3]

(b) Compound **W** has the empirical formula CH_4O and a relative molecular mass of 32.

Calculate the molecular formula of compound **W**.

molecular formula = ... [1]

(c) Compounds **X** and **Y** have the same general formula.

X and **Y** are both carboxylic acids.

Compound **X** has the molecular formula $C_2H_4O_2$.

Compound **Y** has the molecular formula $C_4H_8O_2$.

(i) Deduce the general formula of compounds **X** and **Y**.

..... [1]

(ii) Draw the structure of compound **Y**. Show all of the atoms and all of the bonds.

Name compound **Y**.

name .....
[3]

(iii) Give the name used to describe a 'family' of similar compounds with the same general formula, similar chemical properties and the same functional group.

..... [1]

(d) Propene is an unsaturated hydrocarbon. The formula of propene is shown.

$CH_3CH=CH_2$

(i) State the colour change observed when propene is added to aqueous bromine.

from ..... to ..... [1]

(ii) Propene can be produced by cracking long chain alkanes.

Pentadecane, $C_{15}H_{32}$, is cracked to produce an alkane and propene in a 1 : 2 molar ratio.

Complete the chemical equation for this reaction.

$C_{15}H_{32} \rightarrow$ ..... + ... [2]

(iii) Propene can be converted into poly(propene).

Name the type of polymerisation that occurs when propene is converted into poly(propene).

..... [1]

(iv) Complete the diagram to show a section of poly(propene).

[2]

[Total: 15]

46. June/2021/Paper_42/No.6

Molecules **A** and **B** can form condensation polymers.

A

B

(a) Each molecule has two identical functional groups.

(i) Name the functional group in **B**.

..... [1]

(ii) Draw the part of the structure of the synthetic polymer that would form when two molecules of **A** and two molecules of **B** combine. Show all of the bonds in the linkages.

[3]

(iii) Name the other product formed when molecules of **A** and **B** undergo polymerisation.

..... [1]

(b) Molecule **A** is a simple sugar unit which can be made by hydrolysis of complex carbohydrates.

(i) Draw part of the complex carbohydrate that could be hydrolysed to make molecules of **A**.

Include **one** linkage and show all of the bonds in the linkage.

[1]

(ii) State **two** sets of conditions which could be used to hydrolyse the complex carbohydrate to form **A**.

1 .....

2 .....

[2]

(iii) Name the technique used to identify the individual sugar units made by the hydrolysis of a complex carbohydrate.

..... [1]

(c) Ethanol can be made from the simple sugar glucose, $C_6H_{12}O_6$.

(i) State the name of this process.

..... [1]

(ii) Complete the chemical equation for this reaction.

$C_6H_{12}O_6 \rightarrow$ [2]

[Total: 12]

47. June/2021/Paper_43/No.7

Many organic compounds contain carbon, hydrogen and oxygen only.

(a) An organic compound **R** has the following composition by mass.

C, 69.77%; H, 11.63%; O, 18.60%

Calculate the empirical formula of compound **R**.

empirical formula = ... [2]

(b) Compound **S** has the empirical formula CH_2O and a relative molecular mass of 60.

Calculate the molecular formula of compound **S**.

molecular formula = ... [2]

(c) Compounds **T** and **V** have the same molecular formula, $C_3H_6O_2$.

- Compound **T** is an ester.
- Compound **V** contains a –COOH functional group.

(i) State the name given to compounds with the same molecular formula but different structures.

..... [1]

(ii) Name the homologous series that **V** is a member of.

..... [1]

(iii) Draw a structure of compound **T**. Show all of the atoms and all of the bonds.

Name compound **T**.

name .....

[3]

(iv) Draw the structure of compound **V**. Show all of the atoms and all of the bonds.

Name compound **V**.

name .....

[2]

(d) Ethanol can be produced from long chain alkanes such as decane, $C_{10}H_{22}$, in a two-step process.

$$\text{decane} \xrightarrow{\textbf{step 1}} \text{ethene} \xrightarrow{\textbf{step 2}} \text{ethanol}$$

For each of the two steps:

- name the type of chemical reaction that occurs
- write a chemical equation.

step 1: decane to ethene

type of reaction .....

chemical equation .....

step 2: ethene to ethanol

type of reaction .....

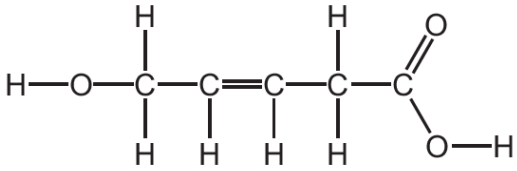
chemical equation .....

[4]

[Total: 15]

48. March/2021/Paper_32/No.6

The structure of compound **A** is shown.



(a) (i) On the structure of compound **A**, draw a circle around the carboxylic acid functional group.

[1]

(ii) State the name of the carboxylic acid that has only two carbon atoms.

..... [1]

(iii) Deduce the molecular formula of compound **A** to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

(iv) Explain, by referring to its structure, why compound **A** is described as unsaturated.

..... [1]

(b) Ethene is an unsaturated hydrocarbon.

Draw the structure of ethene to show all of the atoms and all of the bonds.

[2]

(c) Ethene can be produced by cracking hydrocarbons.

(i) State the meaning of the term *cracking*.

.....

..... [1]

(ii) Give the conditions required for cracking.

1 .....

2 .....

[2]

(d) Ethene can be polymerised.

Complete these sentences about the polymerisation of ethene using words from the list.

addition **decomposition** **neutralisation** **poly(ethene)**

poly(ethane) **reduction** ***Terylene***

When ethene polymerises, it produces a molecule called ..... .

The type of reaction which occurs is ..... .

[2]

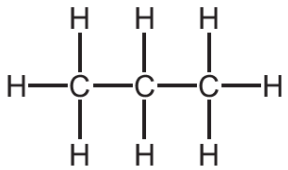
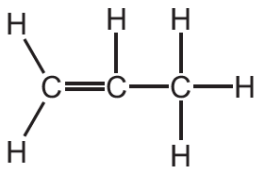
(e) Describe **one** pollution problem caused by non-biodegradable plastics.

..... [1]

[Total: 12]

49. March/2021/Paper_42/No.5

The table shows the names or structures of organic compounds **P** to **U**.

P	**Q**	**R**
	propanoic acid	but-1-ene
S	**T**	**U**
propan-1-ol	methyl butanoate	

(a) Give the letters of the organic compounds, **P** to **U**, that are unsaturated hydrocarbons.

..... [2]

(b) Describe the test for an unsaturated hydrocarbon.

test .....

observations .....

[2]

(c) But-1-ene is an unbranched molecule.

(i) Name the unbranched isomer of but-1-ene.

..... [1]

(ii) Draw the structure of a branched isomer of but-1-ene. Show all of the atoms and all of the bonds.

[1]

(d) Dodecane is an alkane with 12 carbon atoms. Dodecane can be cracked.

(i) Write the formula of dodecane.

..... [1]

(ii) Give the letters of all the organic compounds, **P** to **U**, that can be formed when dodecane is cracked.

..... [2]

(e) Name the reagent and suggest the conditions needed to convert organic compound **U** into organic compound **S**.

reagent .....

conditions .....

[3]

(f) Organic compound **S** can be converted to organic compound **Q** by reaction with an acidified reagent.

(i) Name the type of chemical change that happens to organic compound **S**.

..... [1]

(ii) Name the acidified reagent added to organic compound **S**.

..... [1]

(g) Organic compound **T** is made by reacting two compounds together.

(i) Name the homologous series that organic compound **T** belongs to.

..... [1]

(ii) Name the **two** compounds which react together to make organic compound **T**.

Draw the structures of each compound you have named. Show all of the atoms and all of the bonds.

name .....

structure

name .....

structure

[4]

(iii) Deduce the molecular formula of organic compound **T**.

..... [1]

[Total: 20]

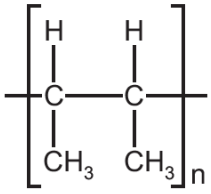
50. March/2021/Paper_42/No.6

Polymers are large molecules built up from small molecules.

(a) State the name given to the small molecules from which polymers are made.

..... [1]

(b) The formula of a polymer is shown.



(i) Draw the structure of the small molecule from which this polymer is made. Show all of the atoms and all of the bonds.

[2]

(ii) State the type of polymerisation used to make this polymer.

..... [1]

(c) Three amino acids are shown. They combine to form part of a natural polymer.

(i) Name the type of natural polymer formed when amino acids combine.

..... [1]

(ii) Complete the diagram to show part of the structure of the natural polymer that forms when these three amino acids combine. Show all of the bonds in the linkages.

[3]

(iii) Name the type of chemical reaction that takes place when this natural polymer is converted back to amino acids.

..... [1]

[Total: 9]