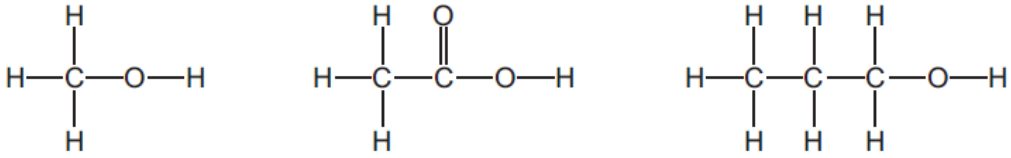
Organic Chemistry – 2023 IGCSE Chemistry 0620

1. Nov/2023/Paper_0620/11/No.32

The structures of three organic molecules are shown.



Which description of the three molecules is correct?

	they all have the same general formula, $C_nH_{2n+1}OH$	they all belong to the same homologous series
A	no	no
B	no	yes
C	yes	no
D	yes	yes

2. Nov/2023/Paper_0620/11/No.33

Petroleum is separated into fractions by fractional distillation.

Which row describes a use of the named fraction?

	fraction	use
A	bitumen	fuel for ships
B	refinery gas	jet fuel
C	fuel oil	road making
D	gasoline	fuel for cars

3. Nov/2023/Paper_0620/11/No.34

Which statement about alkanes is correct?

A They are saturated.

B They are very reactive.

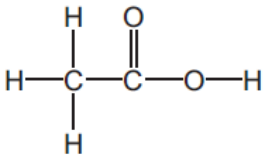
C They contain carbon, hydrogen and oxygen only.

D They contain double bonds.

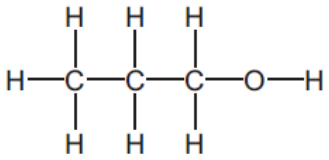
4. Nov/2023/Paper_0620/11/No.37

Which diagram shows the displayed formula of ethanol?

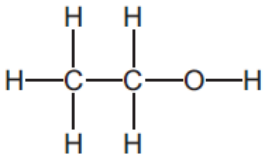
A



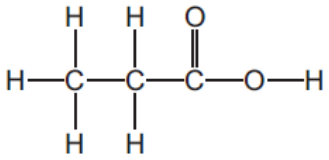
B



C



D



5. Nov/2023/Paper_0620/11/No.38

Ethane is used as a fuel.

Which equation shows the complete combustion of ethane?

A $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

B $2C_2H_6 + 5O_2 \rightarrow 4CO + 6H_2O$

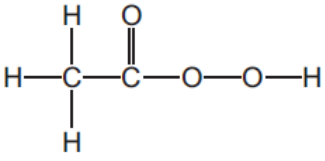
C $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

D $C_2H_4 + 2O_2 \rightarrow 2CO + 2H_2O$

6. Nov/2023/Paper_0620/12/No.34

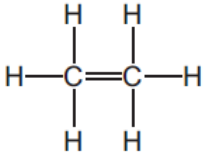
Which diagram shows the displayed formula for the named organic compound?

A



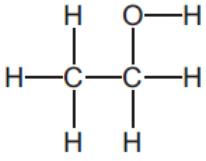
ethanoic acid

B



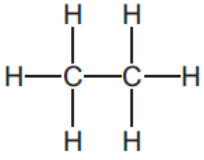
ethene

C



ethanol

D



methane

7. Nov/2023/Paper_0620/12/No.35

Poly(ethene) is formed from petroleum using three separate processes.

In which order are the processes used?

A cracking → fractional distillation → polymerisation

B cracking → polymerisation → fractional distillation

C fractional distillation → cracking → polymerisation

D fractional distillation → polymerisation → cracking

8. Nov/2023/Paper_0620/12/No.36

Gas oil and naphtha are two fractions obtained from petroleum.

What are uses of gas oil and naphtha?

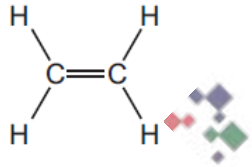
	gas oil	naphtha
A	jet fuel	making chemicals
B	jet fuel	making roads
C	diesel engine fuel	making chemicals
D	diesel engine fuel	making roads

9. Nov/2023/Paper_0620/12/No.37

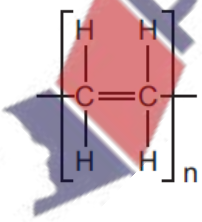
Ethene can be polymerised.

Which diagram represents the structure of the product formed?

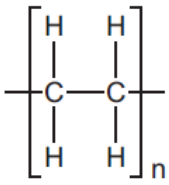
A



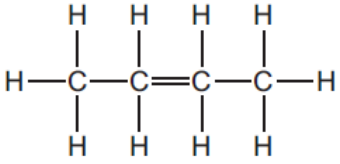
B



C



D



10. Nov/2023/Paper_0620/13/No.35

Ethene reacts with steam and with bromine in two separate reactions.

What are the products of these two reactions?

A ethanoic acid and bromoethane

B ethanoic acid and dibromoethane

C ethanol and bromoethane

D ethanol and dibromoethane

11. Nov/2023/Paper_0620/13/No.36

Four types of reactions are listed.

1 substitution

2 combustion

3 polymerisation

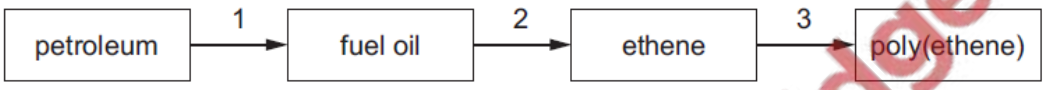
4 addition

Which reactions will ethane undergo?

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

12. Nov/2023/Paper_0620/13/No.37

The flow diagram shows how poly(ethene) may be made from petroleum.



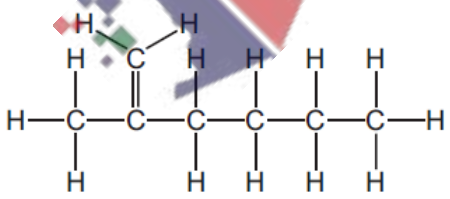
What are stages 1, 2 and 3?

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

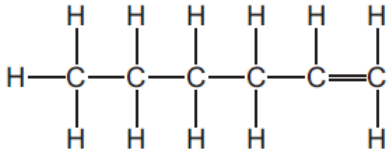
13. Nov/2023/Paper_0620/21/No.31

The structures of two molecules, X and Y, are shown.

X



Y



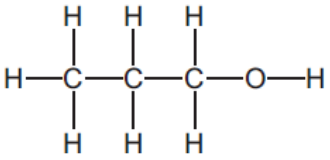
Which row describes X and Y?

	structural isomers	belong to same homologous series
A	no	no
B	no	yes
C	yes	no
D	yes	yes

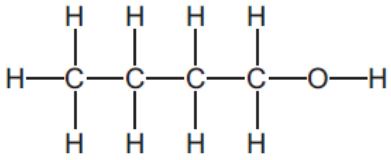
14. Nov/2023/Paper_0620/21/No.32

What is the structure of butanoic acid?

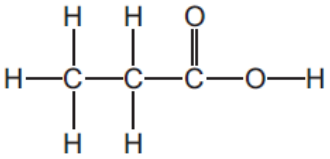
A



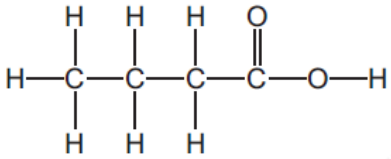
B



C



D



15. Nov/2023/Paper_0620/21/No.33

When a mixture of methane and chlorine is exposed to ultraviolet light, a reaction takes place.

Which statements about this reaction are correct?

1 It is an addition reaction.

2 The ultraviolet light provides the activation energy.

3 An equation for the reaction is $CH_4 + Cl_2 \rightarrow CH_2Cl_2 + H_2$.

4 CH_3Cl is made in the reaction.

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

16. Nov/2023/Paper_0620/21/No.34

Esters are formed when a carboxylic acid reacts with an alcohol.

What is the catalyst for this reaction?

A aqueous potassium manganate(VII)

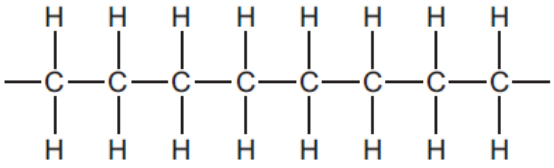
B iron

C sulfuric acid

D vanadium(V) oxide

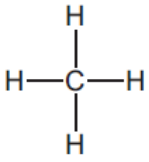
17. Nov/2023/Paper_0620/21/No.35

The diagram shows part of a polymer.

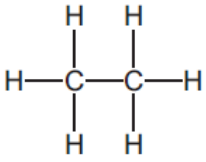


Which diagram shows the monomer from which this polymer is made?

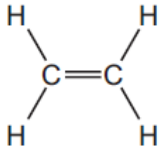
A



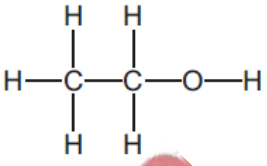
B



C



D



18. Nov/2023/Paper_0620/21/No.36

Nylon and PET are polymers.

Which statements about these polymers are correct?

1 They are both condensation polymers.

2 $HOCH_2CH_2CH_2OH$ could be a monomer for both polymers.

3 The complete combustion of both polymers gives two products only.

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

19. Nov/2023/Paper_0620/21/No.37

Ethane is used as a fuel.

Which equation shows the complete combustion of ethane?

A $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

B $2C_2H_6 + 5O_2 \rightarrow 4CO + 6H_2O$

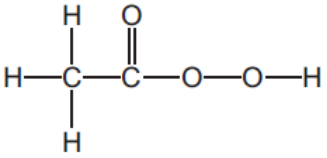
C $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

D $C_2H_4 + 2O_2 \rightarrow 2CO + 2H_2O$

20. Nov/2023/Paper_0620/22/No.33

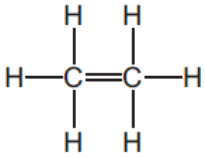
Which diagram shows the displayed formula for the named organic compound?

A



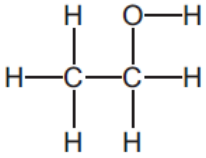
ethanoic acid

B



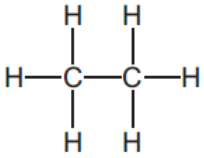
ethene

C



ethanol

D



methane

21. Nov/2023/Paper_0620/22/No.34

What is the total number of covalent bonds in a molecule of butane, C_4H_{10}?

A 3 **B** 10 **C** 13 **D** 14

22. Nov/2023/Paper_0620/22/No.35

Propane reacts with chlorine in a substitution reaction.

Which reaction condition is required for the reaction to occur?

A acid catalyst

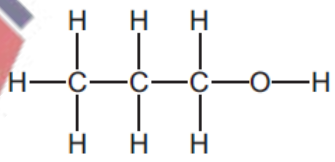
B iron catalyst

C temperature of 400 °C

D ultraviolet light

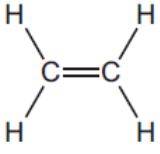
23. Nov/2023/Paper_0620/22/No.36

The structure of an organic compound is shown.

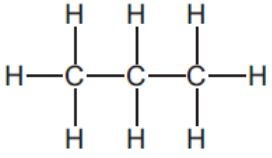


Which structure represents a molecule that reacts with steam to produce this product?

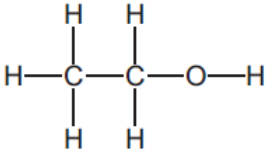
A



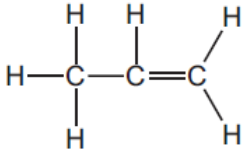
B



C



D



24. Nov/2023/Paper_0620/22/No.37

Which term describes nylon?

A addition polymer

B natural polymer

C polyamide

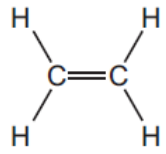
D polyester

25. Nov/2023/Paper_0620/22/No.38

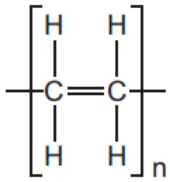
Ethene can be polymerised.

Which diagram represents the structure of the product formed?

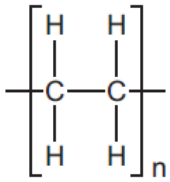
A



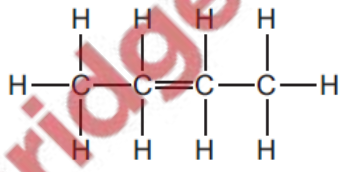
B



C



D



26. Nov/2023/Paper_0620/23/No.33

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 $CH_3COOCH_2CH_3$

27. Nov/2023/Paper_0620/23/No.34

Methane reacts with chlorine in sunlight.

$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

Which statements about this reaction are correct?

1 It is a substitution reaction.

2 It is an addition reaction.

3 It is a photochemical reaction.

4 It is catalysed by nickel.

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

28. Nov/2023/Paper_0620/23/No.35

Propene reacts with bromine to give one product only.

What is the formula of the product?

A $CH_3CH_2CHBr_2$

B $CH_2BrCH_2CH_2Br$

C $CH_3CHBrCH_2Br$

D $CH_3CH_2CH_2Br$

29. Nov/2023/Paper_0620/23/No.36

Ethanol can be manufactured by fermentation or by the catalytic addition of steam to ethene.

Which statements describe an advantage of manufacturing ethanol by fermentation?

1 The yield of ethanol is low.

2 The method uses a batch process.

3 The process takes place at a lower temperature.

4 The ethanol is made from a renewable source.

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

30. Nov/2023/Paper_0620/23/No.37

A compound with the formula $CH_3COOC_2H_5$ is formed from ethanol in two separate reactions.

reaction 1 Ethanol reacts to form ethanoic acid.

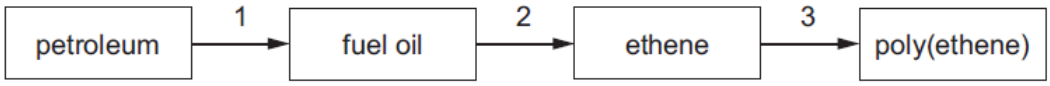
reaction 2 Ethanoic acid and ethanol react together to form $CH_3COOC_2H_5$.

Which row describes reaction 1 and reaction 2?

	reaction 1	reaction 2
A	oxidation	ester formation
B	oxidation	addition
C	reduction	ester formation
D	reduction	addition

31. Nov/2023/Paper_0620/23/No.38

The flow diagram shows how poly(ethene) may be made from petroleum.



What are stages 1, 2 and 3?

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

32. Nov/2023/Paper_0620/31/No.1(e)

A list of substances is shown.

ammonium nitrate
carbon monoxide
copper(II) chloride
ethane
ethene
litmus
methane
methyl orange
sodium chloride
sodium sulfate
sulfur dioxide
thymolphthalein

Answer the following questions using only the substances from the list.
Each substance may be used once, more than once or not at all.

Give the name of the substance that:

(e) is a hydrocarbon with a total of five atoms in a molecule

..... [1]

33. Nov/2023/Paper_0620/31/No.2(b)

(b) Fig. 2.2 shows a fractionating column for separating petroleum into different hydrocarbon fractions.

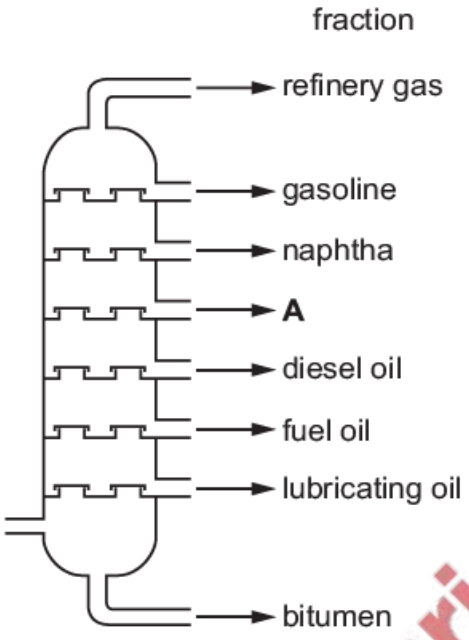


Fig. 2.2

(i) On Fig. 2.2, draw an **X** inside the column to show where the hydrocarbon with the highest viscosity collects. [1]

(ii) Name the fraction labelled **A** in Fig. 2.2.

..... [1]

(iii) State the name of the fraction in Fig. 2.2 which has the lowest boiling point.

..... [1]

(iv) State **one** use of the bitumen fraction.

..... [1]

34. Nov/2023/Paper_0620/31/No.7

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

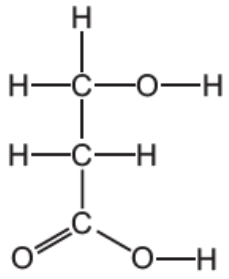


Fig. 7.1

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

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

..... [1]

(b) Compound **S** can be converted to acrylic acid.
The molecular formula of acrylic acid is $C_3H_4O_2$.

(i) Complete Table 7.1 to calculate the relative molecular mass of acrylic acid.

Table 7.1

atom	number of atoms	relative atomic mass	
carbon	3	12	$3 \times 12 = 36$
hydrogen		1	
oxygen		16	

relative molecular mass = ... [2]

(ii) Acrylic acid is an unsaturated compound.

Describe a test for an unsaturated compound.

test .....

observations .....

[2]

(iii) When left in the air, acrylic acid forms a polymer.

State the meaning of the term polymer.

.....

..... [2]

(iv) Poly(ethene) is also a polymer.

Choose from the list the type of polymerisation that occurs when poly(ethene) is made.

Draw a circle around your chosen answer.

substitution **oxidation** **neutralisation** **addition** [1]

(c) Ethanoic acid is a carboxylic acid.

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

ethanoic acid	+	sodium hydroxide	→	....	+	.....

[2]

(d) Ethanoic acid can be converted to ethanol.

Name the **two** products formed when ethanol undergoes complete combustion.

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

[Total: 13]

35. Nov/2023/Paper_0620/32/No.1(a, d)

A list of compounds is shown.

ammonia
carbon dioxide
carbon monoxide
cobalt(II) chloride
ethane
ethene
glucose
methane
potassium sulfate
sodium phosphate
sulfur dioxide

Answer the following questions using only the compounds from the list.
Each compound may be used once, more than once or not at all.

Give the name of the compound that:

(a) is an unsaturated hydrocarbon

..... [1]

(d) is the main constituent of natural gas

..... [1]

36. Nov/2023/Paper_0620/32/No.2(b)

(b) Fig. 2.1 shows a fractionating column for separating petroleum into different hydrocarbon fractions.

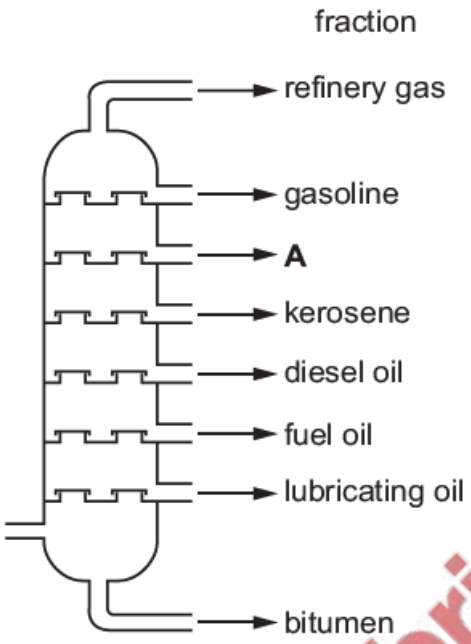


Fig. 2.1

(i) On Fig. 2.1, draw an **X** inside the column to show where the hydrocarbon with the lowest volatility collects. [1]

(ii) Name the fraction labelled **A** in Fig. 2.1.

..... [1]

(iii) State the name of the fraction which has hydrocarbons with the longest chain length.

..... [1]

(iv) State one use of the fuel oil fraction.

..... [1]

37. Nov/2023/Paper_0620/32/No.7

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

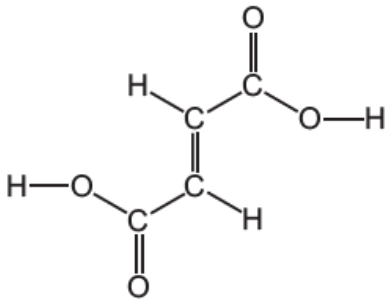


Fig. 7.1

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

(ii) Deduce the molecular formula of fumaric acid.

..... [1]

(iii) Fumaric acid is a colourless compound.

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

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

(b) Fumaric acid can be oxidised to produce a compound with the molecular formula $C_4H_6O_6$.

Complete Table 7.1 to calculate the relative molecular mass of $C_4H_6O_6$.

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]

(c) Ethanoic acid is a carboxylic acid.

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

ethanoic acid	+	sodium carbonate	→	....	+	....	+	.....

[3]

(d) Ethanoic acid can be produced by the oxidation of ethanol.

(i) State **one** use of ethanol.

..... [1]

(ii) Ethanol, C_2H_5OH, is an alcohol.

Choose from the list the general formula for the alcohol homologous series.

Draw a circle around your chosen answer.

C_nH_nOH $C_nH_{2n+1}OH$ $C_nH_{2n+2}OH$ $C_{2n}H_{2n}OH$ [1]

(iii) Ethanol can be manufactured by the addition of steam to ethene.

State **two** conditions for this reaction.

1 .....

2 .....

[2]

[Total: 13]

38. Nov/2023/Paper_0620/33/No.1(b)

A list of substances is shown.

ammonia
calcium oxide
carbon monoxide
cobalt(II) chloride
ethane
ethanol
ethene
oxygen
potassium oxide
sodium sulfate
sulfuric acid
water

Answer the following questions using only the substances from the list.
Each substance may be used once, more than once or not at all.

Give the name of the substance that:

(b) is a member of the alkene homologous series

..... [1]

39. Nov/2023/Paper_0620/33/No.2

Hydrocarbons are compounds of carbon and hydrogen.

(a) State the meaning of the term compound.

.....

..... [2]

(b) Fig. 2.1 shows a fractionating column for separating petroleum into different hydrocarbon fractions.

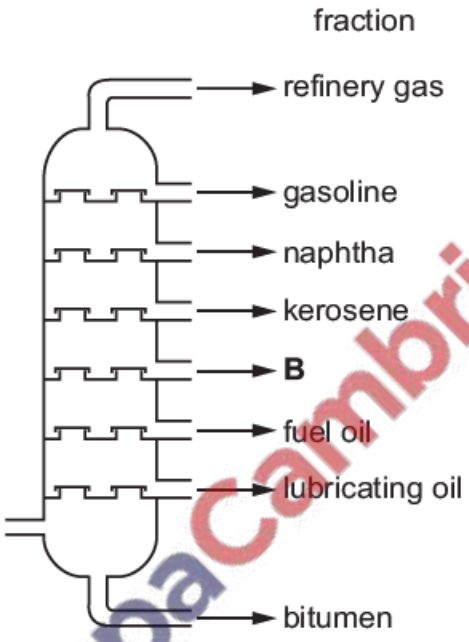


Fig. 2.1

(i) On Fig. 2.1, draw an **X** inside the column to show where the hydrocarbon with the highest boiling point collects. [1]

(ii) Name the fraction labelled **B** in Fig. 2.1.

..... [1]

(iii) State the name of the fraction which has hydrocarbons with the shortest chain length.

..... [1]

(iv) State **one** use of the naphtha fraction.

..... [1]

[Total: 6]

40. Nov/2023/Paper_0620/41/No.1(e)

A list of gases is shown.

ammonia
carbon dioxide
carbon monoxide
ethene
fluorine
oxygen
sulfur dioxide
xenon

Answer the following questions using only the gases from the list.
Each gas may be used once, more than once or not at all.

Give the name of the gas that:

(e) can form a polymer

..... [1]

41. Nov/2023/Paper_0620/41/No.6

Ethanol is manufactured by **two** methods:

method 1 fermentation of aqueous glucose

method 2 catalytic addition of steam to an alkene.

(a) Method 1 takes place at room temperature and pressure.

State **two** other conditions needed in method 1.

1 .....

2 .....

[2]

(b) (i) State the typical temperature and pressure used in method 2.

temperature ..... °C

pressure ..... kPa

[2]

(ii) Name the alkene used in method 2.

..... [1]

(iii) State why the reaction in method 2 is referred to as an addition reaction.

..... [1]

(c) The catalyst in method 2 is phosphoric acid, H_3PO_4. Dilute phosphoric acid is a weak acid which contains phosphate ions, PO_4^{3-}.

(i) State what is meant by the term acid.

..... [1]

(ii) State the meaning of weak in the term weak acid.

..... [1]

(iii) Determine the oxidation number of phosphorus in the PO_4^{3-} ion.

Show your working.

oxidation number = ... [2]

(d) Give **one** advantage of each method of production of ethanol.

method 1 .....

method 2 .....

[2]

(e) Ethanol can be converted to ethanoic acid by reacting it with an acidified oxidising agent.

(i) Name the acidified oxidising agent.

..... [1]

(ii) State, in terms of redox, what type of reagent ethanol is in this reaction.

..... [1]

(f) Ethanoic acid reacts with calcium to form a salt and one other product.

(i) Name the salt.

..... [1]

(ii) Write the formula of the salt.

..... [1]

(iii) Identify the other product.

..... [1]

[Total: 17]

42. Nov/2023/Paper_0620/42/No.6

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]

(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.

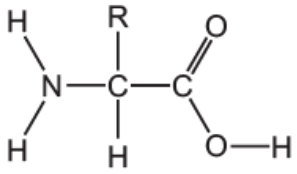


Fig. 6.1

(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]

43. Nov/2023/Paper_0620/43/No.1(d)

A list of substances is shown.

barium nitrate
carbon monoxide
hydrated cobalt(II) chloride
copper(II) oxide
anhydrous copper(II) sulfate
ethane
potassium iodide
propene
sodium bromide
sulfur dioxide
zinc oxide

Answer the following questions using only the substances from the list.
Each substance may be used once, more than once or not at all.

Give the name of the substance that:

(d) is an unsaturated hydrocarbon

..... [1]

44. Nov/2023/Paper_0620/43/No.6

(a) Esters are members of a homologous series of organic compounds.

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

1 .....

2 .....

[2]

(b) Ester **X** has the structure shown in Fig. 6.1.

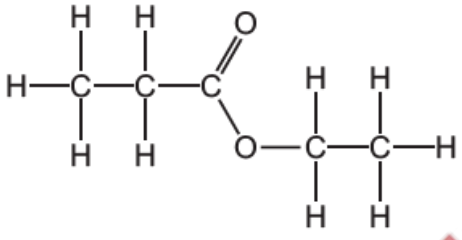


Fig. 6.1

Name ester **X**.

..... [1]

(c) **(i)** Ester **Y** has the structural formula $HCOOCH_2CH_2CH_3$.

Name the alcohol and the carboxylic acid used to make ester **Y**.

alcohol .....

carboxylic acid .....

[2]

(ii) State the molecular formula of ester **Y**.

..... [1]

(d) Ester **Z** has the molecular formula $C_4H_8O_2$.

State the empirical formula of ester **Z**.

..... [1]

(e) Polymers containing ester linkages are known as polyesters.

Polyamides are another type of polymer. Nylon is a polyamide.

The structure of nylon is shown in Fig. 6.2.

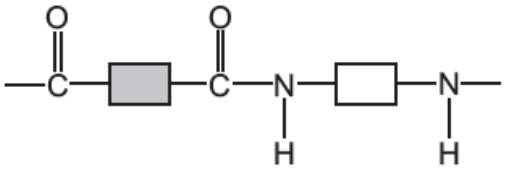


Fig. 6.2

(i) State the term used to describe the type of polymerisation used to produce polyesters and polyamides.

..... [1]

(ii) Complete Fig. 6.3 to show the structures of the monomers used to produce nylon. Show all of the atoms and all of the bonds.

Fig. 6.3

[2]

(f) Naturally occurring polyamides are found in food.

(i) State the name given to naturally occurring polyamides.

..... [1]

(ii) Name the type of monomer which forms naturally occurring polyamides.

..... [1]

[Total: 12]