1. 0620/31/M/J/19/No.5

Coal gas is made by heating coal in the absence of air.
The list shows the main gases present in coal gas.

carbon dioxide
carbon monoxide
ethene
hydrogen
methane
nitrogen

(a) (i) Which **one** of these gases is an alkane?

..... [1]

(ii) Draw the structure of a molecule of ethene. Show all of the atoms and all of the bonds.

[1]

(iii) Describe how aqueous bromine can be used to tell the difference between methane and ethene.

.....

.....

..... [2]

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(b) Ethene molecules react with each other to form poly(ethene).

(i) What is the name given to this type of chemical reaction?

..... [1]

(ii) Which **one** of the following words describes the ethene molecules in this reaction? Draw a circle around the correct answer.

elements **mixtures** **monomers** **polymers**

[1]

(iii) Poly(ethene) is a non-biodegradable plastic.

What is meant by the term *non-biodegradable*?

.....

..... [1]

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

.....

..... [1]

(c) Ethanol can be made from ethene and one other reactant.

- Name the other reactant.

.....

- State the conditions needed to make ethanol from ethene.

.....

.....

[3]

[Total: 11]

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2. 0620/32/M/J/19/No.5

Methane, ethane and ethene are hydrocarbons.

(a) Draw the structure of a molecule of ethane. Show all of the atoms and all of the bonds.

[1]

(b) Which **one** of these compounds belongs to the same homologous series as methane?
Draw a circle around the correct answer.

butane **methanoic acid** **methanol** **propene**

[1]

(c) Ethene can be manufactured by cracking.

(i) Complete the sentence about cracking using words from the list.

atoms **ions** **larger** **molecules** **reactive** **smaller**

Cracking is the process of breaking down …… alkane …….. into …….. alkanes and alkenes.

[2]

(ii) State **two** conditions needed for cracking.

1 .....

2 .....

[2]

(d) Poly(ethene) is made by the polymerisation of ethene.

Which **one** of the structures represents part of a poly(ethene) molecule?
Tick **one** box.

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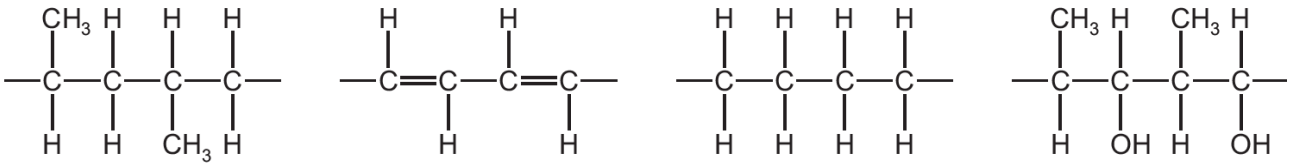


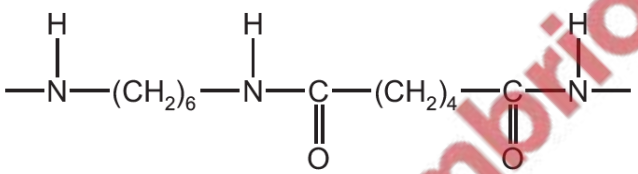
[1]

(e) Nylon is also a polymer.

(i) Give **one** common use of nylon.

..... [1]

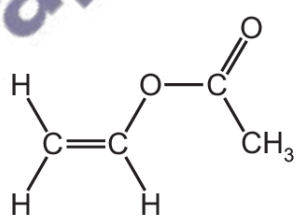
(ii) Part of the structure of nylon is shown.



How many different **types** of atom are shown in this structure?

..... [1]

(f) The structure of a monomer used to make a polymer is shown.



(i) What structural feature of this molecule shows that it is unsaturated?

..... [1]

(ii) Describe a test to show that this compound is unsaturated.

test .....

observations .....

[2]

[Total: 12]

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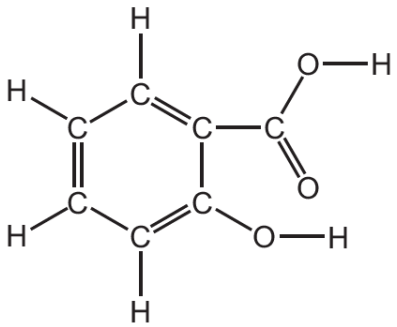
3. 0620/33/M/J/19/No.5

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



(a) (i) Draw a circle around the carboxylic acid functional group in this structure. [1]

(ii) How many different **types** of atom are shown in this structure?

..... [1]

(b) The melting point of pure **S** is 159 °C.
The boiling point of pure **S** is 200 °C.

(i) What is the physical state of pure **S** at 100 °C?
Explain your answer.

.....

..... [2]

(ii) Which **one** of these statements about an impure sample of compound **S** is correct?
Tick **one** box.

The melting point of impure **S** is 159 °C and the boiling point is above 200 °C. ☐

The melting point of impure **S** is below 159 °C and the boiling point is 200 °C. ☐

The melting point of impure **S** is 159 °C and the boiling point is 200 °C. ☐

The melting point of impure **S** is below 159 °C and the boiling point is above 200 °C. ☐

[1]

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(c) Aqueous ethanoic acid has chemical properties which are typical of acids.

Describe **two** chemical properties of aqueous ethanoic acid.

1 .....

.....

2 .....

.....

[2]

(d) Ethanol can be converted into ethene by passing ethanol vapour over a catalyst of aluminium oxide.

$$C_2H_5OH \rightarrow C_2H_4 + \mathbf{X}$$

(i) Identify compound **X**.

..... [1]

(ii) Explain why a catalyst is used.

..... [1]

(iii) Draw the structure of a molecule of ethanol. Show all of the atoms and all of the bonds.

[1]

(e) Ethene can be polymerised.

(i) State the name of the polymer formed from ethene.

..... [1]

(ii) *Terylene* is also a polymer.

State **one** use of *Terylene*.

..... [1]

[Total: 12]

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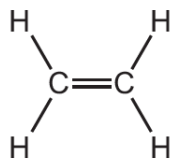
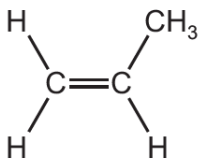
4. 0620/41/M/J/19/No.5

The structures of five alkenes, **A**, **B**, **C**, **D** and **E**, are shown.

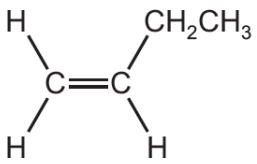
A



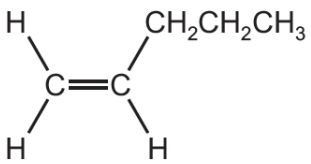
B



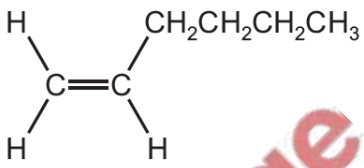
C



D



E



(a) What is the general formula of alkenes?

..... [1]

(b) What is the molecular formula of alkene **D**?

..... [1]

(c) Predict which alkene, **A**, **B**, **C**, **D** or **E**, has the highest boiling point.
Explain your answer.

alkene .....

explanation .....

.....

[2]

(d) Which alkene, **A**, **B**, **C**, **D** or **E**, diffuses most quickly?
Explain your answer.

alkene .....

explanation .....

.....

[2]

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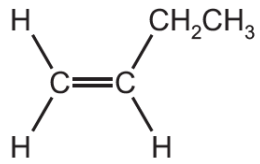
(e) A student added aqueous bromine to alkene **C**.

C



Describe the colour change seen and draw the structure of the product. Show all of the atoms and all of the bonds.

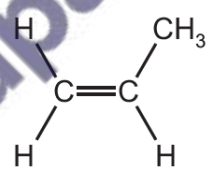
colour change from ..... to .....

structure

[2]

(f) Two different alcohols can be produced from alkene **B** by an addition reaction.

B



(i) Draw the structures of the **two** alcohols. Show all of the atoms and all of the bonds.

[2]

(ii) State the reagent and conditions needed to produce an alcohol from alkene **B**.

reagent .....

conditions .....

.....

[3]

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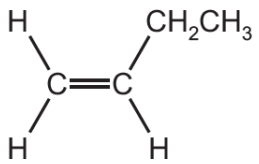
(g) Alkene **C** can be converted into a polymer.

C



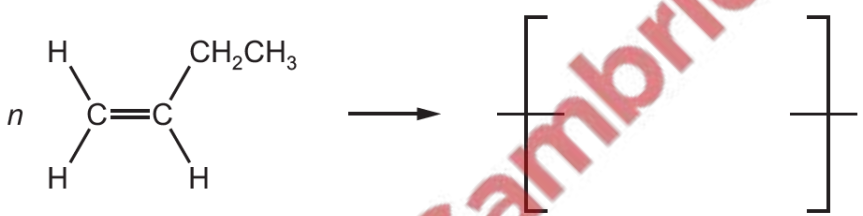
(i) What type of polymerisation occurs?

..... [1]

(ii) Suggest the name of the polymer formed.

..... [1]

(iii) Complete the chemical equation to show this polymerisation.



[3]

(iv) State the empirical formula of the polymer formed.

..... [1]

[Total: 19]

5. 0620/42/M/J/19/No.4

Methanol is made industrially by reacting carbon monoxide with hydrogen. The gases react at a temperature of 250 °C and a pressure of 75 atmospheres.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The forward reaction is exothermic.

(a) Suggest a source of hydrogen for this industrial process.

..... [1]

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(b) Complete the table using only the words *increases*, *decreases* or *no change*.

	effect on the rate of the reverse reaction	effect on the equilibrium yield of $CH_3OH(g)$
adding a catalyst		no change
increasing the temperature	increases	
decreasing the pressure		

[4]

(c) Methanol is a member of the homologous series of alcohols.

(i) State **two** general characteristics of a homologous series.

1 .....

2 .....

[2]

(ii) Draw the structures of **two** different alcohols, each containing **three** carbon atoms. Show all of the atoms and all of the bonds.

Name these **two** alcohols.

name .....

name .....

[4]

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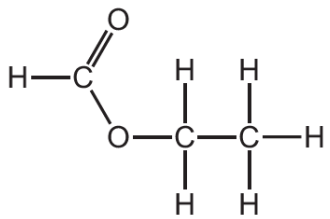
(iii) What term is used to describe compounds with the same molecular formula but different structural formulae?

..... [1]

(d) Alcohols react with carboxylic acids to produce esters.

(i) The structure of ester **X** is shown.



Name ester **X**.

..... [1]

(ii) Give the name of the carboxylic acid and the alcohol that react together to produce ester **X**.

carboxylic acid .....

alcohol .....

[2]

(iii) Ester **Y** is different from ester **X** but also has the formula $C_3H_6O_2$.

Draw the structure of ester **Y**. Show all of the atoms and all of the bonds.

.....

[2]

[Total: 17]

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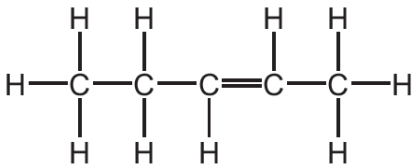
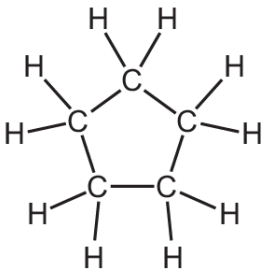
6. **(a)** Two hydrocarbons have the structures shown.

hydrocarbon **A**



hydrocarbon **B**



(i) Why are these **two** compounds *hydrocarbons*?

.....

..... [2]

(ii) Hydrocarbon **B** reacts in the same way as a typical alkane.

Describe a chemical test to tell the difference between hydrocarbon **A** and hydrocarbon **B**.

State the name of the reagent you would use and the result you would obtain with hydrocarbon **A** and hydrocarbon **B**.

reagent .....

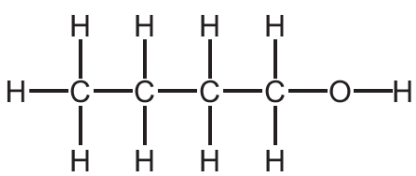
result with hydrocarbon **A** .....

result with hydrocarbon **B** .....

[3]

(b) Alkenes react with steam to form alcohols.
Compound **C** is an alcohol.

compound **C**



Draw the structure of the alkene which could be reacted with steam to make compound **C**.
Show all of the atoms and all of the bonds.

[1]

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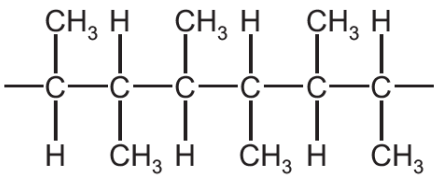
(c) Alkenes can form polymers.

(i) What type of polymerisation occurs when alkenes form polymers?

..... [1]

(ii) Part of the structure of a polymer is shown.

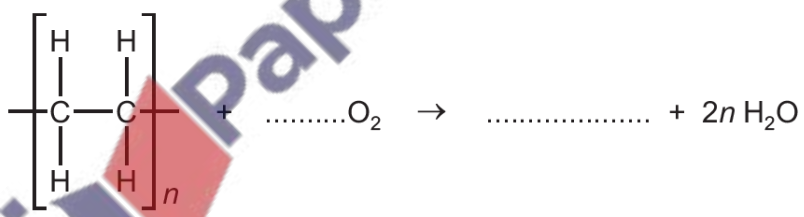


Draw the structure of the alkene from which this polymer can be made. Show all of the atoms and all of the bonds.

[1]

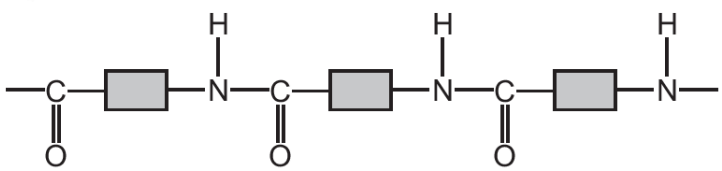
(iii) Polymers can undergo incomplete combustion to form carbon monoxide.

Complete the chemical equation for the incomplete combustion of poly(ethene). The only carbon-containing product is carbon monoxide.



[2]

(d) Part of the structure of a polyamide is shown.



This polyamide is formed from identical monomers. Complete the diagram to show the structure of **one** monomer. Show all of the atoms and all of the bonds.

[2]

[Total: 12]

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7. 0620/32/F/M/19/No.7

This question is about alkanes and petroleum fractions.

(a) The table gives some information about alkanes.

alkane	number of carbon atoms in each molecule	melting point in °C	boiling point in °C
methane	1	–182	–164
ethane	2	–183	–88
propane	3	–190	–42
butane	4	–135	0

Answer these questions using only information from the table.

(i) Describe how the boiling points of the alkanes vary with the number of carbon atoms in each molecule.

.....

..... [1]

(ii) Which alkane has the lowest melting point?

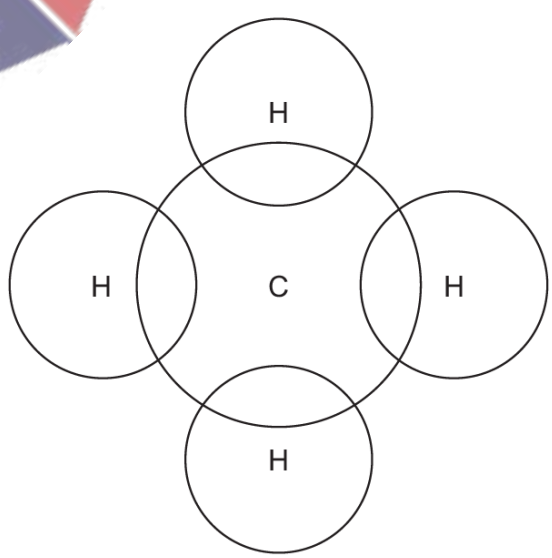
..... [1]

(iii) Deduce the physical state of butane at –50 °C.
Explain your answer.

.....

..... [1]

(b) **(i)** Complete the dot-and-cross diagram to show the electron arrangement in a molecule of methane. Show outer shell electrons only.



[1]

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(ii) Complete the word equation for the complete combustion of methane.

methane + oxygen → ..... + ...

.....

[2]

(c) Complete the sentences about homologous series using words from the list.

acidic	**alkenes**	**alcohol**	**carbohydrates**
chemical	**functional**	**hydrocarbons**	**physical**

Methane and ethane are ..... which belong to the same homologous series.

Members of the alkane homologous series have similar ..... properties due to the presence of the same ..... group.

[3]

(d) Petroleum is separated into useful fractions by fractional distillation.

Match the fractions on the left with the uses on the right.
The first one has been done for you.

fraction	**use**
refinery gas	fuel for aircraft
bitumen	bottled gas for heating
kerosene fraction	making chemicals
naphtha fraction	making roads

[2]

[Total: 11]

PapaCambridge

8. 0620/42/F/M/19/No.4

This question is about ethanoic acid, CH_3COOH.

(a) Ethanoic acid is manufactured from methanol and carbon monoxide.

$$CH_3OH(g) + CO(g) \rightleftharpoons CH_3COOH(g)$$

The process is done at 200 °C and 30 atmospheres pressure.
The forward reaction is exothermic.

Complete the table using only the words *increases*, *decreases* or *no change*.

	effect on the rate of the forward reaction	effect on the equilibrium yield of $CH_3COOH(g)$
adding a catalyst		no change
increasing the temperature		
decreasing the pressure	decreases	

[4]

(b) How would you show that an aqueous solution of ethanoic acid is an acid **without** using an indicator or measuring the pH?

State the reagent you would use and give the expected observations. Write a chemical equation for the reaction that you describe.

- reagent

.....

- expected observations

.....

.....

- chemical equation

.....

[3]

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(c) Ethanoic acid is a weak acid.

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

.....

..... [1]

(ii) Why is ethanoic acid described as *weak*?

.....

..... [1]

(d) Ethanoic acid reacts with methanol to form an ester.

(i) State **two** conditions required for this reaction.

1 .....

2 .....

[2]

(ii) Draw the structure of the ester formed when ethanoic acid reacts with methanol. Show all of the atoms and all of the bonds. Name the ester.

structure

name .....

[3]

(iii) Name an ester which is a structural isomer of the ester in **(d)(ii)**.

..... [1]

[Total: 15]

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