

Paper 3

Questions are applicable for both core and extended candidates

1 Alkenes are a homologous series of hydrocarbons which are made by cracking larger alkane molecules.

(a) (i) Write the general formula for alkenes.

..... [1]

(ii) Explain the need for cracking larger alkane molecules.

.....
 [1]

(iii) Describe **two** conditions needed for cracking.

1

2 [2]

(b) Alkenes are unsaturated compounds.

State the meaning of the term unsaturated.

.....
 [1]

(c) Table 4.1 shows the boiling points of some alkenes.

Table 4.1

alkene	boiling point / °C
ethene	-104
propene	
butene	-6
pentene	30
hexene	63

(i) Predict the boiling point of propene.

..... °C [1]

- (ii) The melting point of butene is -185°C .

Deduce the physical state of butene at -100°C .

Give a reason for your answer.

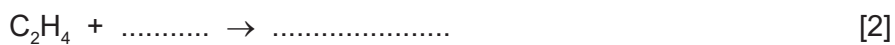
physical state

reason

.....
[2]

- (f) Ethene reacts with steam to produce ethanol.

- (i) Complete the symbol equation for this reaction. **(extended only)**



- (ii) Choose the word which describes the type of catalyst used in this reaction.

Draw a circle around your chosen answer. **(extended only)**

acid alkali metal salt [1]

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

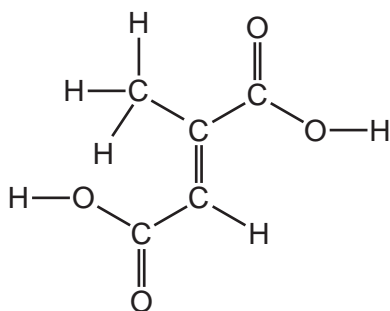


Fig. 7.1

- (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]

- 3 Fig. 7.1 shows the displayed formula of compound **S**.

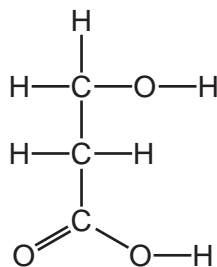


Fig. 7.1

- (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]

- 4 Hydrogen is a fuel which can be obtained from water by electrolysis.

Refinery gas and petrol are fuels obtained by the fractional distillation of petroleum.

- (e) More petrol can be made by cracking less useful petroleum fractions.

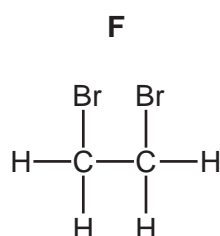
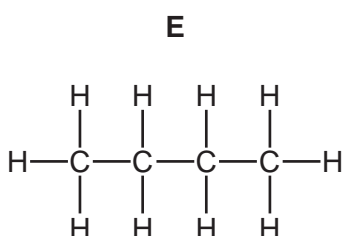
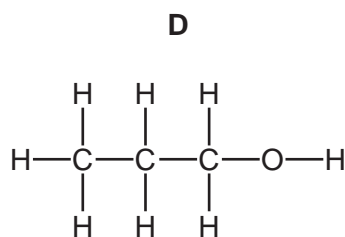
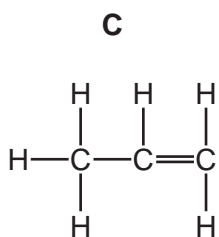
- (i) Define the term cracking.

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

- (ii) Complete the equation for the cracking of dodecane, $C_{12}H_{26}$, to form ethene and one other hydrocarbon.



- 5 (a) The structures of four organic compounds, **C**, **D**, **E** and **F**, are shown.



Answer the following questions about these compounds.
Each compound may be used once, more than once or not at all.

State which compound, **C**, **D**, **E** or **F**:

- (i) decolourises aqueous bromine [1]
- (ii) is an alcohol [1]
- (iii) is unsaturated [1]
- (iv) is in the same homologous series as ethane. [1]

- (d) Some hydrocarbons are formed by the process of cracking.

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

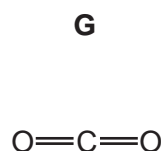
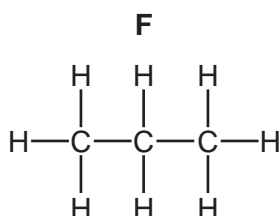
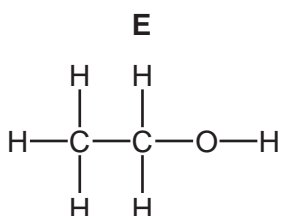
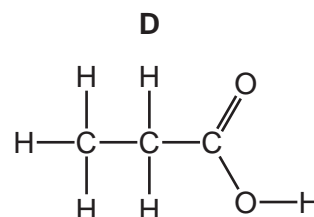
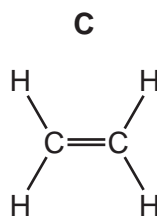
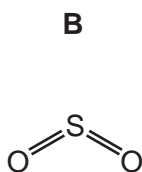
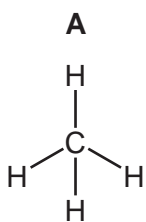
.....

 [2]

- (ii) Describe the conditions needed for cracking.

.....
 [2]

6 The structures of seven compounds, **A**, **B**, **C**, **D**, **E**, **F** and **G**, are shown.



Answer the following questions about these structures.

Each structure may be used once, more than once or not at all.

(a) State which structure, **A**, **B**, **C**, **D**, **E**, **F** or **G**, represents:

(i) a compound that contributes to acid rain

..... [1]

(ii) a product of respiration

..... [1]

(iii) a hydrocarbon that decolourises aqueous bromine

..... [1]

(iv) a carboxylic acid

..... [1]

(v) a compound that is the main constituent of natural gas.

..... [1]

(b) Compound **C** can be produced by cracking the kerosene fraction of petroleum.

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

.....
 [2]

(ii) Complete the chemical equation for the cracking of $C_{13}H_{28}$ to form C_8H_{18} and one other hydrocarbon.



[Total: 8]

Paper 4

**Questions are applicable for both core and extended candidates
unless indicated in the question**

7 Butane and but-1-ene are colourless gases at room temperature and pressure.

(a) Suggest why but-1-ene diffuses quicker than butane.

..... [1]

(b) Identify the products formed when butane undergoes complete combustion.

..... [1]

(d) When but-1-ene reacts with steam, **two** possible products form.

(i) Identify the type of catalyst which is used in this reaction. **(extended only)**

..... [1]

(ii) Name and draw the displayed formulae of the **two** possible products. **(extended only)**

product 1	product 2
name	name
displayed formula	displayed formula

[4]

8 This question is about organic compounds.

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

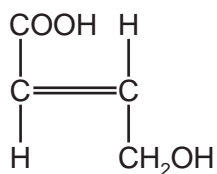


Fig. 7.1

(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]

9 This question is about alkanes and alkenes.

(a) Short-chain alkanes and alkenes can be formed from long-chain alkanes in a chemical reaction.

(i) Name the type of chemical reaction which forms short-chain alkanes and alkenes from long-chain alkanes.

..... [1]

(ii) Decane has 10 carbon atoms. It forms ethane and ethene as the only products in this type of chemical reaction.

Write the chemical equation for this reaction.

..... [3]

(b) Ethane reacts with chlorine at room temperature to form chloroethane, C_2H_5Cl , and one other product.

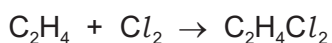
(i) Name the other product formed.

..... [1]

(ii) State the condition needed for this reaction to take place.

..... [1]

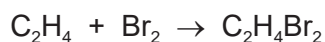
(c) Ethene reacts with chlorine at room temperature to form dichloroethane, $C_2H_4Cl_2$.



(i) State why this is an addition reaction. **(extended only)**

..... [1]

10 Ethene is an alkene which reacts with bromine as shown in the equation.



(a) Write the general formula of alkenes.

..... [1]

(b) Describe the colour change seen when ethene is bubbled through aqueous bromine.

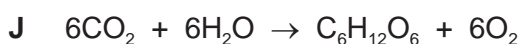
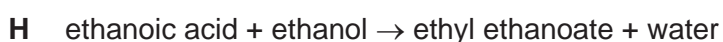
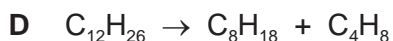
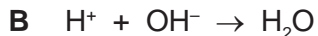
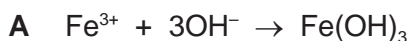
from to [1]

(c) In this reaction only one product is formed from two reactants.

Name this type of organic reaction. **(extended only)**

..... [1]

11 Some symbol equations and word equations, **A** to **J**, are shown.



Use the equations to answer the questions that follow.

Each equation may be used once, more than once, or not at all.

Give the letter, **A** to **J**, for the equation that represents:

(f) cracking. [1]