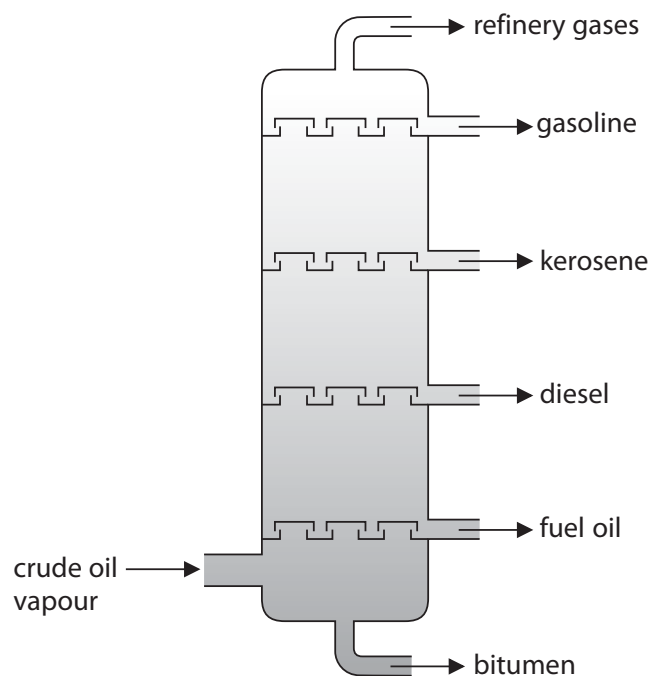


- 1 Crude oil is a complex mixture of organic compounds called hydrocarbons. It is separated into fractions using a fractionating tower.



(a) Which fraction has the lowest boiling point?

(1)

gasoline

(b) Which fraction is the most viscous?

(1)

bitumen

- (c) (i) Some fractions containing long-chain hydrocarbons are cracked. The cracking of octadecane, ($C_{18}H_{38}$), produces octane, (C_8H_{18}), and one other product.

Write a chemical equation for this cracking reaction.

(1)

$C_{18}H_{38} \rightarrow C_8H_{18} + C_{10}H_{20}$

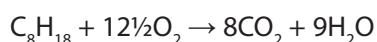
- (ii) Explain why it is important to crack long-chain hydrocarbon fractions.

(2)

**to turn them into shorter more useful hydrocarbons
which condense at a lower temperature.**

- (d) Octane is one of the hydrocarbons in the petrol used in cars.

The equation for the complete combustion of octane is



The incomplete combustion of octane produces a poisonous gas that reduces the capacity of blood to carry oxygen.

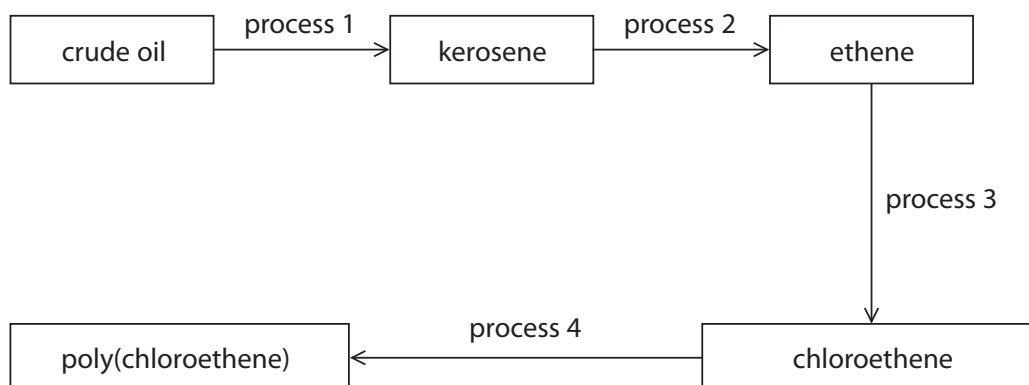
Write a chemical equation for this incomplete combustion of octane.

(2)

$C_8H_{18} + 11O_2 \rightarrow CO + 6CO_2 + C + 9H_2O$

(Total for Question 1 = 7 marks)

2 The diagram shows some important conversion processes used in the oil industry.



(a) Process 1 is called

(1)

- ☐ A catalytic cracking
- ☐ B condensation polymerisation
- ☒ C fractional distillation
- ☐ D thermal decomposition

(b) Describe the differences between crude oil and kerosene. In your answer you should refer to

- the average size of the molecules in the two liquids
- the covalent bonding in the molecules
- the viscosities of the two liquids

(3)

kerosene comprises of hydrocarbon chains of the same, short length, whereas crude oil has chains of varying length from very short to very long. Kerosene is an Alkene and has the general formula of $(C_n H_{2n})$ whereas crude oil is a mixture of alkanes and alkenes. Crude oil is very viscous whereas kerosene is not.

(e) Poly(chloroethene) is formed by addition polymerisation.

Nylon is formed by condensation polymerisation.

(i) How does condensation polymerisation differ from addition polymerisation?

(1)

condensation polymerisation produces water as a by-product.

(ii) Poly(chloroethene) and nylon do not biodegrade easily.

What is meant by the term **biodegrade**?

(2)

biodegrade means that they can be decomposed by living things like bacteria and fungi and turned into smaller simpler molecules.

(iii) What feature of addition polymers makes it difficult for them to biodegrade?

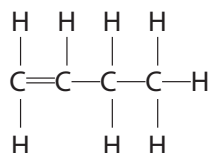
(1)

they are unreactive

(Total for Question 2 = 13 marks)

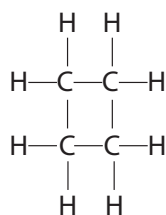
- 1 But-1-ene is a member of the homologous series of alkenes.

The displayed formula of but-1-ene is



The saturated compound cyclobutane is an isomer of but-1-ene.

The displayed formula of cyclobutane is



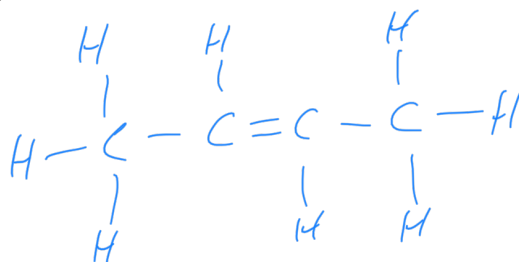
- (a) (i) State what is meant by the term **isomers**.

(2)

same chemical formula but different displayed formula

- (ii) Draw the displayed formula of another isomer of but-1-ene.

(1)



- (iii) Describe a test that would distinguish between but-1-ene and cyclobutane.

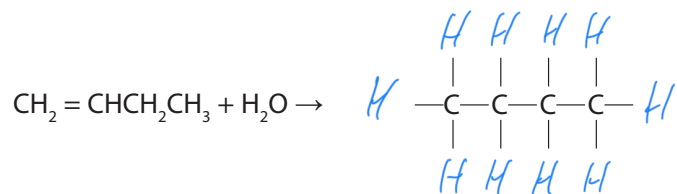
(3)

but-1-ene will turn bromine water colourless because the bromine reacts with the c=c double bond in but-1-ene.

(b) Using your knowledge of the reactions of ethene, complete the two chemical equations to show the formula of the organic product.

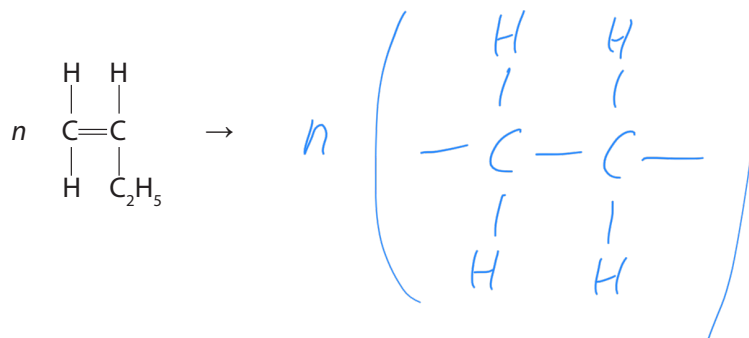
(i) The reaction between but-1-ene and steam.

(1)



(ii) The polymerisation of but-1-ene.

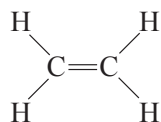
(2)



(Total for Question 1 = 9 marks)

2 Here are some statements about the compound ethene.

- ethene has the displayed formula



- ethene is a gas at room temperature
- ethene burns with a smoky flame
- ethene is unsaturated
- ethene is insoluble in water
- ethene can be prepared from ethanol
- ethene is used to make the polymer poly(ethene)

(a) (i) State why ethene is described as **unsaturated**.

(1)

it has a double bond

(ii) Describe a chemical test to show that ethene is an alkene.

(2)

Test

bubble through bromine water

Result

bromine water turns colourless

- (b) (i) Complete the following equation that represents the preparation of ethene from ethanol.



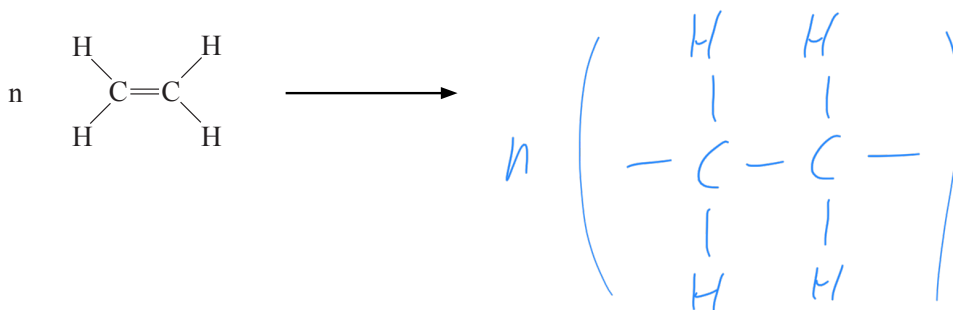
- (ii) What is the name given to this type of reaction?

(1)

dehydration

- (c) Complete the equation to show the formation of poly(ethene) from ethene.

(2)



(Total for Question 2 = 7 marks)