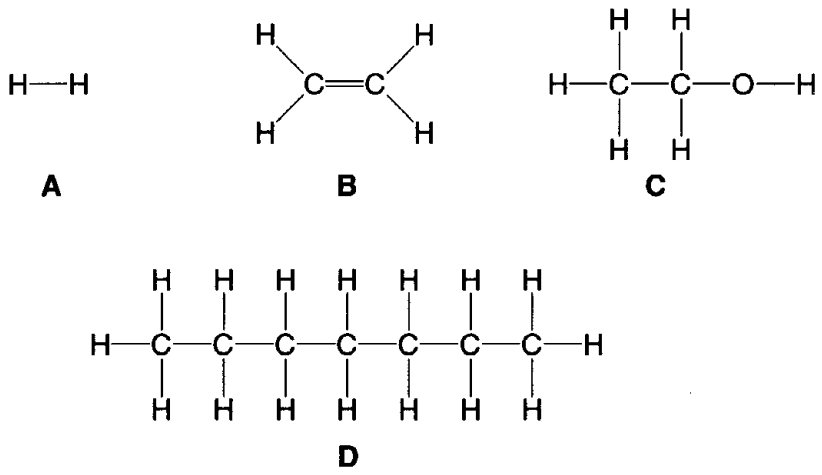
Core 1

Petroleum is a mixture of many different hydrocarbons.

(a) Which **two** of the structures **A**, **B**, **C** and **D** are hydrocarbons?



A **B** **C**

D

structure 1 .....

structure 2 .....

[1]

(b) The mixture of hydrocarbons in petroleum is separated into different fractions.

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

.....

.....[1]

(ii) What is the name of the process used to separate these fractions?

.....[1]

(iii) During this process, the mixture of hydrocarbons is vaporised and then condensed. Explain what is meant by

vaporised, ...

condensed. .....

[2]

(iv) The separation of the fractions depends on one physical property of the hydrocarbons.

State this property.

.....[1]

(c) Octane is a hydrocarbon which can be cracked to produce two different hydrocarbons, hexane and ethene.

$$\underset{\text{octane}}{C_8H_{18}} \rightarrow \underset{\text{hexane}}{C_6H_{14}} + \underset{\text{ethene}}{C_2H_4}$$

(i) State two conditions which are used to crack octane.

1. .....

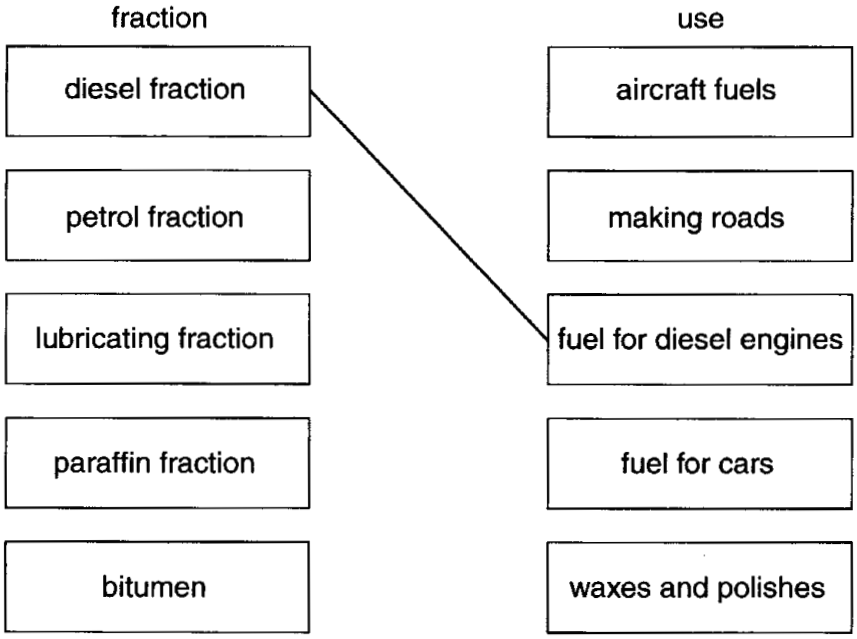
2. .....

[2]

(ii) Which of the three hydrocarbons in the equation above is used to make a polymer?

.....[1]

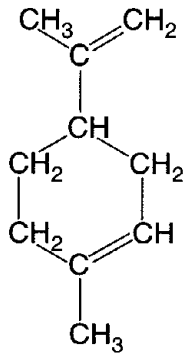
(d) In the diagram below, the boxes on the left give the names of some petroleum fractions. The boxes on the right show some uses of these fractions.
Draw lines between the boxes to link the fractions to their correct uses.
The first one has been done for you.



[4]

Core 2

(a) The structure of limonene is shown below.



(i) What is the molecular formula of limonene?

.....[1]

(ii) Some limonene was added to a few drops of aqueous bromine.
What colour change would you see in the aqueous bromine?

.....[2]

(iii) What feature of a limonene molecule is responsible for this colour change?

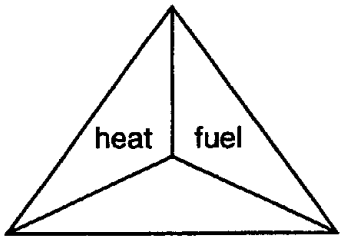
.....[1]

(iv) Name the two substances formed when limonene is burnt in an excess of oxygen.

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

Core 3

A fire triangle shows the three things that are needed for burning.



(a) Write the missing word in the empty triangle. [1]

(b) When fuels burn, energy is given out. State the name given to a reaction which releases energy.

.....[1]

(c) Fire-fighters recognise four classes of fire. These are shown in the table below.

class of fire	*type of substance burning*
A	solids such as wood, coal and paper
B	flammable liquids
C	flammable gases
D	metals

To which class of fire does each of the following belong?
Write either **A**, **B**, **C** or **D** in the boxes provided.

(i) burning petrol ☐

(ii) burning aluminium ☐

(iii) burning hydrogen ☐

[3]

(d) Water can be used to put out class **A** fires.

(i) Suggest a reason why water is able to extinguish these fires.

.....

(ii) Water reacts with some hot metals. For example:

aluminium + steam → aluminium oxide + hydrogen

Complete the following equation for the reaction of aluminium with steam.

..... Al + $3H_2O$ → Al_2O_3 + ... H_2

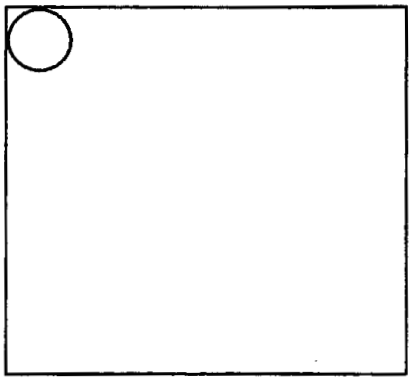
(iii) Suggest why it is particularly dangerous to add water to burning aluminium.

.....

.....[5]

(e) Some fire extinguishers are filled with liquid carbon dioxide. The carbon dioxide vaporises when it leaves the cylinder and stops air getting to the fire.

(i) In the box below, draw a picture to show the arrangement of molecules in liquid carbon dioxide.
Show each molecule as a circle.
One molecule has been drawn for you.

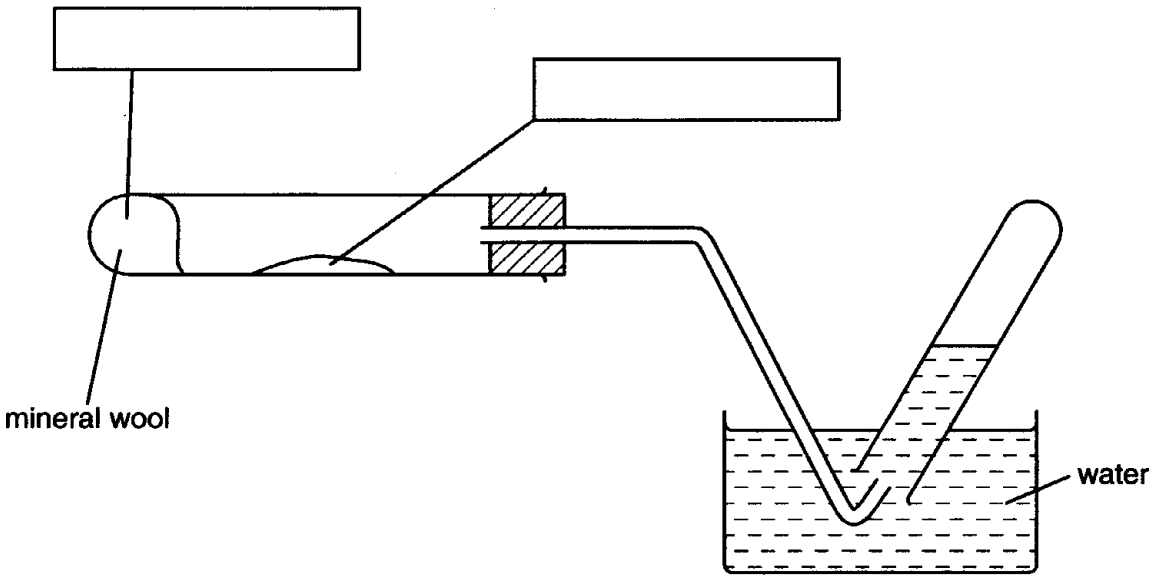


(ii) Suggest why carbon dioxide is **not** very successful in putting out fires in open areas.

.....[3]

Alternative to Practical 1

Ethene is made when ethanol is passed over hot aluminium oxide.



(a) Complete the boxes to show the chemicals used. [2]

(b) Show on the diagram with an arrow where the heat is applied. [1]

(c) Label on the diagram where the ethene is collected. [1]

(d) Why must the delivery tube be removed from the water before the heating is stopped?

.....

.....

.....[2]

(e) When ethene is shaken with aqueous bromine, the colour changes from ..... to ..... . [2]

Extension 1

In both Europe and the USA, scientists are investigating the use of hydrogen as a fuel for aeroplanes and cars. It is more efficient and produces less pollution than the existing petroleum-based fuels.

(a) **(i)** Name the fuel obtained from petroleum that is used for jet aircraft.

.....[1]

(ii) Name **two** pollutants formed by the combustion of petroleum fuels and then explain why the combustion of hydrogen would produce less pollution.

.....

.....

.....

.....[3]

(b) Describe a method of manufacturing hydrogen.

raw material .....

brief description of process .....

.....

.....

[2]

(c) Hydrogen could be transported in heavy cylinders as a gas under pressure or as a liquid at low temperatures.

(i) The pressure exerted by a gas is caused by the molecules of the gas colliding with the walls of the container. Why would the pressure inside a cylinder increase if the temperature was increased?

.....

.....[2]

(ii) Explain what happens to the molecules in gaseous hydrogen as it changes into a liquid at –253 °C.

.....

.....[3]

Extension 2

(a) The alcohols form a homologous series. Their names, formulae and heats of combustion are given below. The heat of combustion is the quantity of heat energy given out when one mole of the alcohol is burned in an excess of oxygen.

name	formula	mass of one mole / g	heat of combustion / kJ per mole
methanol	CH_3OH	32	−720
ethanol	CH_3CH_2OH	46	−1370
propanol	$CH_3CH_2CH_2OH$	60	−2020
butanol			

(i) Complete the last line in the table by writing the formula for butanol, calculating the mass of one mole and by predicting the heat of combustion. [3]

(ii) It is possible to predict physical properties of the members of a homologous series. Describe **two** other characteristics of a homologous series.

.....

.....[2]

(iii) The alcohol $CH_3CH(OH)CH_3$ is a structural isomer of the propanol in the table. Explain the term *structural isomer*.

.....

.....[2]

(b) Give a diagram to show the arrangement of the valency electrons in one molecule of the covalent compound methanol.

Use x to represent an electron from a carbon atom.
Use o to represent an electron from a hydrogen atom.
Use ⊗ to represent an electron from an oxygen atom. [3]

Core 1

a B and D

b(i) substance or group of substances with a specific boiling range or condensed at a similar temperature

(ii) distillation / fractional distillation / fractionation

(iii) vaporised change of state to gas / vapour state

condensed change of state from gas / vapour to liquid

(iii) boiling point

c(i) high temperature and catalyst

(ii) ethene / C_2H_4

d petrol → fuel for cars

lubricating fraction → waxes and polishes

paraffin → aircraft fuels

bitumen → making roads

Core 2

(i) $C_{10}H_{16}$

(ii) brown / orange / red

to colourless

(iii) C = C bond / carbon – carbon double bond

(iv) carbon dioxide and water

Core 3

a air / oxygen

b exothermic

c(i) B

(ii) D

(iii) C

d(i) cools the fire / prevents air getting to the fire

(ii) 2 (Al) $3(H_2)$

(iii) hydrogen produced

hydrogen very flammable / burns easily / explodes

e(i) reasonable number of molecules packed close together with the majority touching

most molecules randomly arranged

(ii) blows away / disperses very easily / escapes into air`

Alternative to Practical 1

a left hand box – ethanol

right hand box – aluminium oxide

b  underneath aluminium oxide

c ethene label to test-tube

d water sucked back

cracks / breaks tube

e brown / red / orange / yellow to colourless

Extension 1

a(i) paraffin or kerosine

(ii) any two of these
carbon monoxide
carbon dioxide
nitrogen oxide

hydrogen forms only water

b hydrocarbons mix with steam

or steam heated with carbon

or hydrocarbon cracking or heat with catalyst

or electrolysis of acid or water or sodium chloride solution

c(i) more energy or move faster
hit harder or more often

(ii) they are closer
forces hold them together
movement becomes slower

Extension 2

a(i) $CH_3CH_2CH_2CH_2OH$ 74 - 2670

(ii) any two from
- general molecular formula
- similar chemistry
- consecutive members differ by CH_2
- similar methods of preparation
- same functional group

(iii) same molecular formula or M*r*

different structural formulae or structure