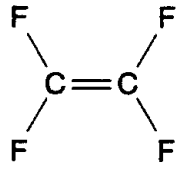
Core 1

(a) The structure of tetrafluoroethene is shown below.

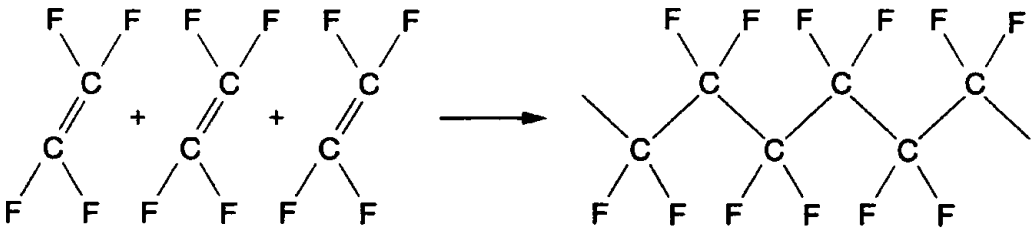


(i) Use the Periodic Table to help you calculate the relative molecular mass of tetrafluoroethene.

[2]

(ii) Teflon is used to make non-stick coatings for saucepans.

Teflon is made when many molecules of tetrafluoroethene join together.



What type of chemical reaction is shown in this equation?

.....[2]

Extension 1

Nantucket is an island twenty five miles off the coast of the USA. Some of the different fuels and sources of energy that have been used on the island over the years are listed below.

wood	earliest
whale oil	↓
coal and coal gas	
petroleum products	at present
electricity by cable from mainland	future

(a) Wood was the first carbon-based fuel used. Explain why the cycle of cutting down trees, burning the wood and the regrowth of the forest does not cause any long term changes in the amount of carbon dioxide in the atmosphere.

.....

.....

.....[3]

(b) Whale oil contains unsaturated esters. As well as being used as a fuel, a number of valuable products can be made from this oil.

(i) Describe how you could show that whale oil contains compounds that have carbon-carbon double bonds.

.....

.....

.....[3]

(ii) How could a soap be made from the oil?

.....

.....[2]

(iii) Margarine used to be made from the oil by changing the unsaturated hydrocarbon chains into saturated hydrocarbon chains. Complete the word equation for this reaction.

unsaturated hydrocarbon + ... ⟶ saturated hydrocarbon [1]

(c) Coal gas was made on the island by heating coal. It is a mixture of hydrogen, methane, carbon monoxide, nitrogen etc. Explain how the percentage of hydrogen in the mixture is increased by diffusion through a porous barrier.

.....

.....

.....[3]

Extension 1

(d) A typical electricity cable would have a copper core surrounded by a polymer as an outer casing.

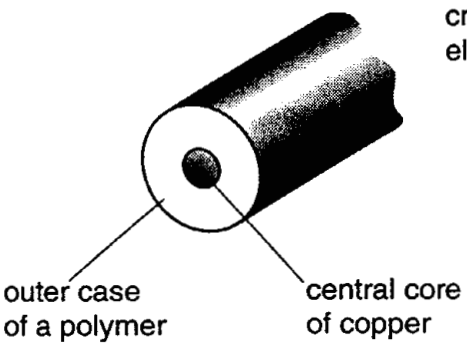


Fig. 1

(i) Give **two** reasons why the core is made from copper.

.....

.....[2]

(ii) Give **two** reasons why a polymer might be a suitable material for the outer casing.

.....

.....[2]

Extension 2

(a) The structure of the synthetic polymer *Terylene* is given below.

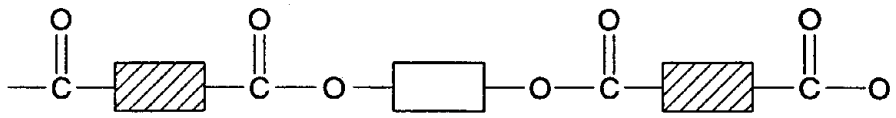


Fig. 2

(i) Name the type of linkage in this polymer.

.....[1]

(ii) What naturally occurring substance contains the same linkage?

.....[1]

(b) Another synthetic polymer is nylon. Draw the structure of a nylon.

[3]

(c) Complex carbohydrates such as starch are natural polymers.

(i) Name the **three** elements present in carbohydrates.

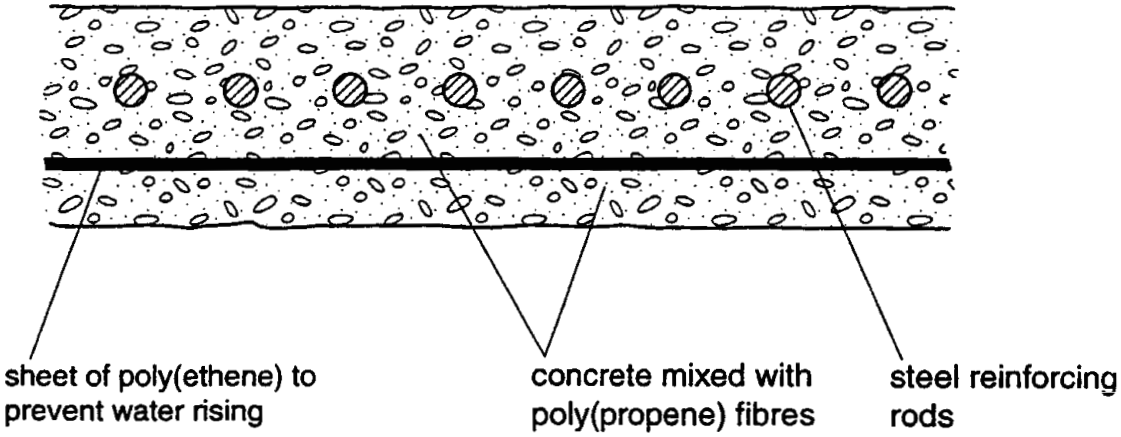
.....[1]

(ii) Draw the structure of a complex carbohydrate.

[2]

Extension 3

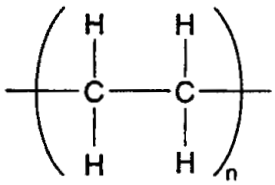
The diagram below shows a correctly constructed concrete floor.



(a) (i) What type of reaction is used to make both of the polymers, poly(ethene) and poly(propene)?

.....

(ii) A diagram of the structure of poly(ethene) is given below.



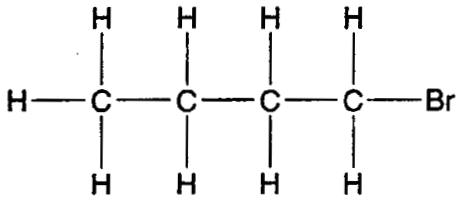
Draw a similar diagram to show the structure of poly(propene).

[3]

Extension 4

Organic compounds that contain the halogens can have chloro, bromo or iodo in their names.

(a) The following diagram shows the structure of 1-bromobutane.



(i) Draw the structure of an isomer of this compound.

(ii) Draw a possible structure of a dibromobutane.

(iii) Name two chemicals that react together to make only one product – dibromobutane.

..... and .....

[4]

(b) Draw a diagram to show the arrangement of the valency electrons in the covalent compound chloromethane.
Use o to represent an electron from carbon
Use x to represent an electron from hydrogen
Use ⊗ to represent an electron from chlorine

[3]

Extension 4

(c) Organic halides react with water to form an alcohol and a halide ion.
The halogen present in an organic compound can be determined by identifying the halide ion.

$$\underset{\text{bromoethane}}{CH_3CH_2Br} + \underset{\text{water}}{H_2O} \longrightarrow \underset{\text{ethanol}}{CH_3CH_2OH} + H^+ + \underset{\text{bromide ion}}{Br^-}$$

(i) Name the alcohol formed when 1-bromobutane reacts with water.

.....

(ii) Describe how you could test for the bromide ion.

reagent used .....

result of test .....

(iii) Suggest an explanation for the following observations.
Bromine was bubbled through a solution containing a halide ion. The solution turned dark brown.

.....

.....

[5]

(d) The rate of reaction between an organic halide and water can be studied in the following experiment.

A mixture of $10\,cm^3$ of aqueous silver nitrate and $10\,cm^3$ of ethanol are warmed to 60 °C. Drops of the organic halide are added and the time taken for a precipitate to form is measured.

The reaction produces halide ions which react with the silver nitrate to give a precipitate of a silver halide. The results are given in the table.

experiment	organic halide	number of drops	time/min
A	bromobutane	4	5
B	bromobutane	8	2
C	chlorobutane	4	100
D	iodobutane	4	0.1

(i) Write the three organic halides in order of reactivity with water.

..... most reactive

.....

.....

..... least reactive

(ii) Explain why it takes longer to produce the precipitate in experiment A than in B.

.....

.....

[3]

Extension 5

(a) Ethanol can be made from starch. Starch is a complex carbohydrate with a structure of the type shown.

Extension 5

This can be broken down by enzymes to simple sugars with formulae of the type shown.

(i) What other method changes starch into simple sugars?

.....[2]

(ii) Give a brief description of how sugars are changed into ethanol.

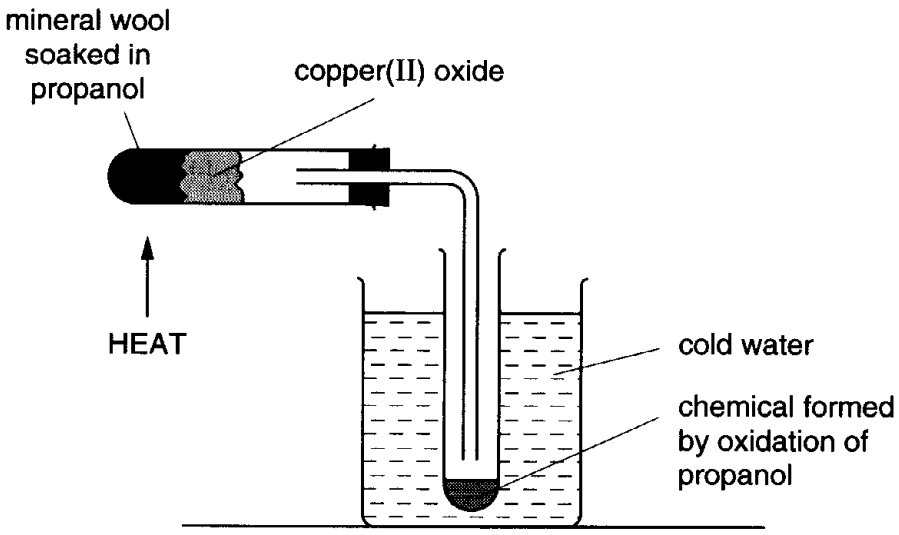
.....

.....

.....

.....[3]

(b) Some alcohols are easily oxidised.



The chemical formed has a pH of 2. Give the name and structural formula of the chemical formed.

name .....[1]

structural formula

[1]

Core 1

(i) 100

(ii) addition or polymerisation

Extension 1

a burning forms carbon dioxide
photosynthesis uses up the gas or plant (growth) uses up gas
the two balance or are in equilibrium

b(i) bromine(water)
brown / orange / yellow
turns to colourless

or

potassium manganate
purple / pink
turns to colourless or green for alkaline reagent

(ii) hydrolyse or saponification or heat (for correct reagent)
sodium hydroxide or alkali

(iii) hydrogen

c any two of these
hydrogen has lowest M*r*
lowest density
highest molecular speeds
lightest molecules

it is lightest gas

d(i) good conductor
ductile or malleable

(i) one of
insulator or poor conductor

one of
easily shaped or flexible or not biodegradable or unreactive or durable

Extension 2

a(i) ester or polyester

(ii) fats or vegetable oils or lipids

b -NHCO$(CH_2)_4$CONH$(CH_2)_6$NHCO-

or -NHCO-■-CONH-○-NHCO-

or -NHCO-■-NHCO-■-NHCO-

c(i) carbon, hydrogen and oxygen

(ii) -■-●-■-●-■-●-■-●

Extension 3

(i) addition or addition polymerisation

(ii) correct repeat unit showing branched CH_3

Extension 4

a(i) correct formula of an isomer

$CH_3.CH_2.CHBr.CH_3$
or $CH_3.CH(CH_3).CH_2Br$
or $(CH_3)_3CBr$

(ii) any correct formula for a dibromomethane

(iii) butene

bromine

b correct formula CH_3Cl showing 8e around C and Cl and 2e around hydrogen

c(i) butanol or butan-1-ol

(iii) correct reagent and result

silver nitrate	cream or off-white precipitate
lead nitrate	yellow precipitate
chlorine	goes brown / orange / yellow
manganate (VII)	purple to colourless / green / brown
dichromate (VI)	orange to green

(iv) halide was iodide
colour due to iodine

d(i) iodo
bromo
chloro

(ii) any two of
slower rate
smaller concentration
fewer particles
frequency of collision

Extension 5

a(i) acid
hydrolysis

(ii) any three of these
- yeast or enzymes such as zymase
- fermentation
- aqueous solution
- word equation
- symbol equation

b propanoic acid
CH_3CH_2COOH