

Answers to worksheet questions

Chapter 11

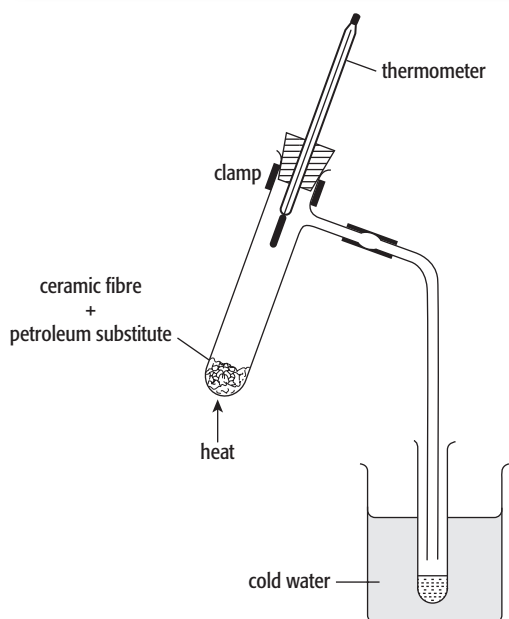
Worksheet 11.1

- 1 a because their boiling points are low (below ambient temperature) so they do not condense in the tower
b because the boiling points of the fractions are different and they condense at different heights in the column
c naphtha
d The boiling point of bitumen is too high – it does not vaporise.

e

Fraction	Use
petrol (gasoline)	fuel for cars
naphtha	source of chemicals
kerosene (paraffin)	aircraft fuel, heating oil
lubricating oil	lubricating engines / moving parts
bitumen	road surfacing

f

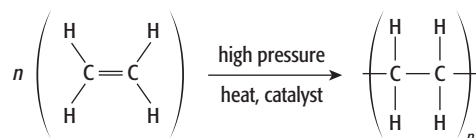
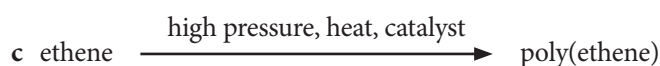


- g This method uses normal lab glassware and apparatus, and so it is inexpensive.
h The process is continuous and collects all the fractions at the same time.
i The experiment does not reach the boiling point of the lubricating oil fraction.
j petrol (gasoline)

- 2 The hydrocarbons in petroleum are called *alkanes*. Their carbon atoms are joined by *single* bonds. They cannot form any extra bonds so they are said to be *saturated*. When long-chain hydrocarbons from petroleum are cracked, *alkenes* such as ethene are formed. Ethene has a carbon–carbon *double* bond. This can open up to add more atoms, so ethene is said to be *unsaturated*.

Worksheet 11.2

- 1 a Addition polymerisation is a type of polymerisation in which unsaturated molecules (monomers) containing a C=C double bond join together to make long-chain molecules.
b There is no small molecule released when the monomers join together in addition to polymerisation.



- 2 a $n =$ a large number

b

	Name of monomer	Name of polymer	Use of polymer
A	propene	poly(propene)	crates and boxes, plastic rope
B	chloroethene	poly(chloroethene)/PVC	pipes, guttering
C	tetrafluoroethene	poly(tetrafluoroethene)/PTFE	non-stick pans, non-stick joints

Worksheet 11.3

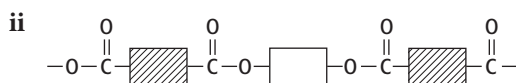
- 1 a In addition polymerisation, monomers join together without any small molecule being released / double bond opens and monomers join together.

In condensation polymerisation, a small molecule (usually water) is released when each monomer is added to the chain.



- c This is a protein chain because there are more than two different monomers involved / protein chains are built from 20 different amino acids.

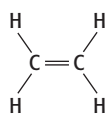
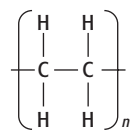
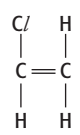
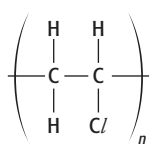
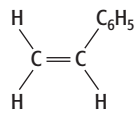
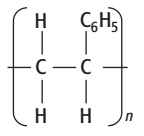
- d i *Terylene*



- 2 a amino acids
b by heating overnight with concentrated hydrochloric acid
c (acid) hydrolysis
d chromatography

Worksheet 11.4

1

Name and structure of monomer	Name and structure of polymer
Ethene 	Poly(ethene) 
Chloroethene 	Poly(chloroethene) 
Phenylethene 	Poly(phenylethene) 

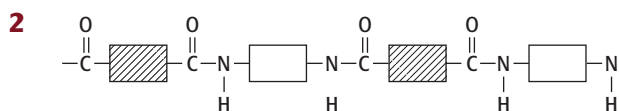
- 2 A monomer is the simple molecule that then is joined together into a long-chain polymer / the individual unit from which a polymer is built.
- 3 They have a carbon-carbon double bond (C=C).
- 4 It does not corrode / it is lighter.
- 5 a It is flexible and an electrical insulator.
b It does not perish / poly(chloroethene) is fire resistant / it can be made in a variety of colours.
- 6 tetrafluoroethene poly(tetrafluoroethene), PTFE



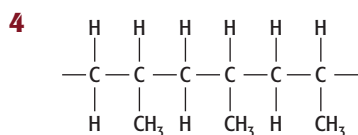
- 7 These addition polymers are non-biodegradable and therefore do not rot. They give off toxic fumes when incinerated (burnt).

Worksheet 11.5

- 1 Nylon is similar in structure to proteins; a polyester is not a direct mimic of a biological molecule.



- 3 A protein chain is made from many different amino acid monomers.



- 5 a nylon: condensation polymerisation
 b poly(propene): addition polymerisation
- 6 a nylon: water
 b poly(propene): no other product

Worksheet 11.6

- 1 High temperatures remove colour from fabrics and can damage the fibres of the fabric.
- 2 Food and grease have biological components and so can be degraded by enzymes.
- 3 The enzymes are denatured at higher temperatures.
- 4 These washing powders contain enzymes and these are biological catalysts / enzymes are proteins.
- 5 glucose \rightarrow ethanol + carbon dioxide
 $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$
- 6 The ethanol evaporates in the oven as the bread is baked.
- 7 Assess the presentation in class discussion.

Worksheet 11.7

Assess the presentation in class discussion.