1 Large areas of the Amazon rain forest are cleared each year to grow soya beans. The trees are cut down and burnt.

(a) Why do these activities increase the percentage of carbon dioxide in the atmosphere?

.....

..... [2]

(b) Soya beans contain all three main food groups. Two of which are protein and carbohydrate.

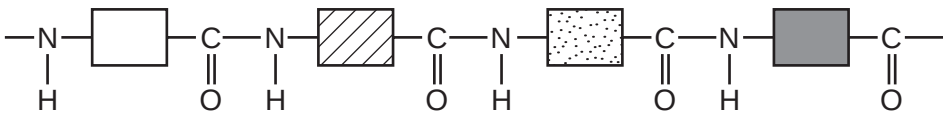
(i) What is the third group?

..... [1]

(ii) Draw the structural formula of a complex carbohydrate such as starch.

[3]

(iii) Compare the structure of a protein with that of a synthetic polyamide. The structure of a typical protein is given below.



How are they similar?

.....

How are they different?

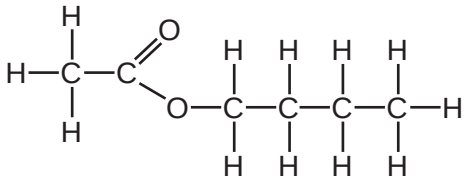
.....

..... [3]

[Total: 9]

2 Esters, fats and polyesters all contain the ester linkage.

(a) The structural formula of an ester is given below.



Name **two** chemicals that could be used to make this ester and draw their structural formulae. Show all bonds.

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

structural formulae

[2]

(b) **(i)** Draw the structural formula of a polyester such as *Terylene*.

[2]

(ii) Suggest a use for this polymer.

..... [1]

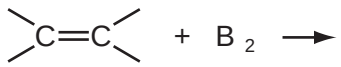
(c) Cooking products, fats and vegetable oils, are mixtures of saturated and unsaturated esters.

The degree of unsaturation can be estimated by the following experiment. 4 drops of the oil are dissolved in 5 cm^3 of ethanol. Dilute bromine water is added a drop at a time until the brown colour no longer disappears. Enough bromine has been added to the sample to react with all the double bonds.

cooking product	mass of saturated fat in 100 g of product / g	mass of unsaturated fat in 100 g of product / g	number of drops of bromine water
margarine		35	5
butter		28	4
corn oil	10	84	12
soya oil	15	70	10
lard		56	.....

(i) Complete the one blank space in the table. [1]

(ii) Complete the equation for bromine reacting with a double bond.



[2]

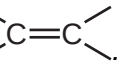
(iii) Using saturated fats in the diet is thought to be a major cause of heart disease. Which of the products is the least likely to cause heart disease?

..... [1]

(d) A better way of measuring the degree of unsaturation is to find the iodine number of the unsaturated compound. This is the mass of iodine that reacts with all the double bonds in 100 g of the fat.

Use the following information to calculate the number of double bonds in one molecule of the fat.

Mass of one mole of the fat is 884 g.

One mole of I_2 reacts with one mole 

The iodine number of the fat is 86.2 g.

Complete the following calculation.

100 g of fat reacts with 86.2 g of iodine.

884 g of fat reacts with ..... g of iodine.

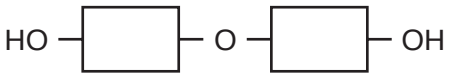
One mole of fat reacts with ..... moles of iodine molecules.

Number of double bonds in one molecule of fat is ..... [3]

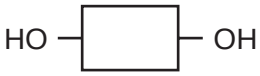
[Total:14]

3 The three types of food are carbohydrates, proteins and fats.

(a) Aqueous starch is hydrolysed to maltose by the enzyme amylase.
The formula of maltose is:



Starch is hydrolysed by dilute sulphuric acid to glucose.



(i) What is an enzyme?

.....

[1]

(ii) Draw the structure of starch.

[1]

(iii) Name the technique that would show that the products of these two hydrolyses are different.

.....

[1]

(b) Proteins have the same linkage as nylon but there is more than one monomer in the macromolecule.

(i) Draw the structure of a protein.

[2]

(ii) What class of compound is formed by the hydrolysis of proteins?

.....

[1]

(c) Fats are esters. Some fats are saturated, others are unsaturated.

(i) Write the word equation for the preparation of the ester, propyl ethanoate.

..... [2]

(ii) Deduce the structural formula of this ester showing each individual bond.

[2]

(iii) How could you distinguish between these two fats?
Fat 1 has the formula

$CH_2 - CO_2 - C_{17}H_{33}$
|
$CH - CO_2 - C_{17}H_{33}$
|
$CH_2 - CO_2 - C_{17}H_{33}$

Fat 2 has the formula

$CH_2 - CO_2 - C_{17}H_{35}$
|
$CH - CO_2 - C_{17}H_{35}$
|
$CH_2 - CO_2 - C_{17}H_{35}$

test .....

result with fat 1 .....

result with fat 2 ..... [3]

(iv) Both of these fats are hydrolysed by boiling with aqueous sodium hydroxide. What type of compounds are formed?

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

4 A South Korean chemist has discovered a cure for smelly socks. Small particles of silver are attached to a polymer, poly(propene), and this is woven into the socks.

(a) Give the structural formula of the monomer.

[1]

(ii) Draw the structural formula of the polymer.

[2]

(iii) Suggest which one, monomer or polymer, will react with aqueous bromine and why?

.....

..... [2]

(b) To show that the polymer contains silver the following test was carried out.

The polymer fibres were chopped into small pieces and warmed with nitric acid. The silver atoms were oxidised to silver(I) ions. The mixture was filtered. Aqueous sodium chloride was added to the filtrate and a white precipitate formed.

(i) Why was the mixture filtered?

..... [1]

(ii) Explain why the change of silver atoms to silver ions is oxidation.

..... [1]

(iii) Give the name of the white precipitate.

..... [1]

(c) The unpleasant smell is caused by carboxylic acids. Bacteria cause the fats on the skin to be hydrolysed to these acids. Silver kills the bacteria and prevents the hydrolysis of the fats.

(i) Fats are esters. Give the name and structural formula of an ester.

name ..... [1]

structural formula

[1]

(ii) Complete the word equation.

Ester + water ⟶ carboxylic acid + ... [1]

(d) Propanoic acid is a weak acid.

(i) The following equation represents its reaction with ammonia.

$CH_3-CH_2-COOH + NH_3 \longrightarrow CH_3-CH_2-COO^- + NH_4^+$

Explain why propanoic acid behaves as an acid and ammonia as a base.

.....

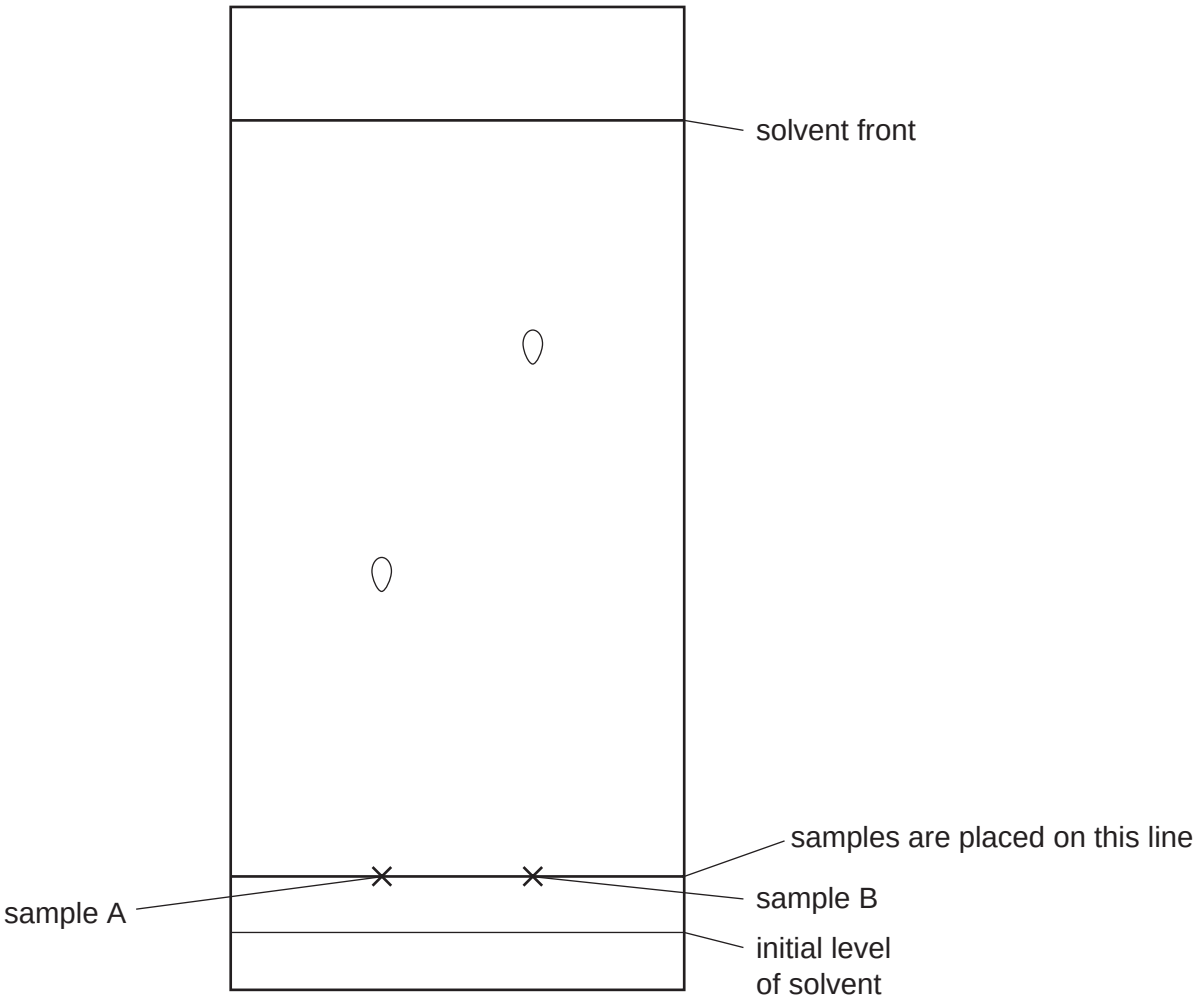
..... [3]

(ii) Explain the expression *weak acid.*

..... [1]

5 Enzymes are biological catalysts. They are used both in research laboratories and in industry.

(a) Enzymes called proteases can hydrolyse proteins to amino acids. The amino acids can be separated and identified by chromatography. The diagram below shows a typical chromatogram.



(i) The R_f value of a sample = $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent front}}$

Some R_f values for amino acids are:

glutamic acid = 0.4 glycine = 0.5 alanine = 0.7 leucine = 0.9

Identify the two amino acids on the chromatogram.

A is ..... B is ..... [2]

(ii) Explain why the chromatogram must be exposed to a locating agent before R_f values can be measured.

..... [1]

(iii) Measuring R_f values is one way of identifying amino acids on a chromatogram. Suggest another.

.....

[1]

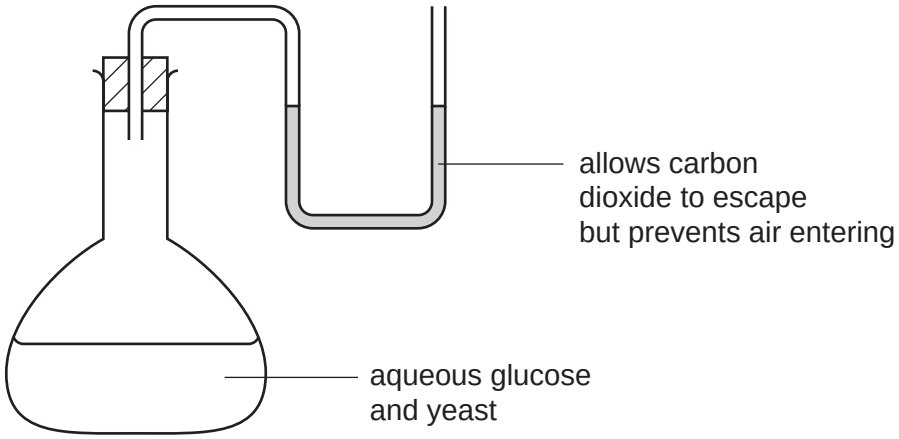
(iv) The synthetic polymer, nylon, has the same linkage as proteins. Draw the structural formula of nylon.

[3]

(b) Enzymes called carbohydrases can hydrolyse complex carbohydrates to simple sugars which can be represented as HO — [ ] — OH. Draw the structure of a complex carbohydrate.

[2]

(c) Fermentation can be carried out in the apparatus drawn below. After a few days the reaction stops. It has produced a 12% aqueous solution of ethanol.



(i) Complete the equation.

$C_6H_{12}O_6 \rightarrow$ ..... + ...

glucose ethanol carbon dioxide [2]

(ii) Zymase catalyses the anaerobic respiration of glucose. Define the term *respiration*.

.....

..... [2]

(iii) Suggest a reason why the reaction stops after a few days.

..... [1]

(iv) Why is it essential that there is no oxygen in the flask?

..... [1]

(v) What technique is used to concentrate the aqueous ethanol?

..... [1]