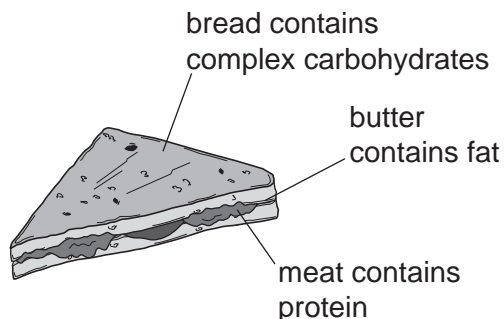


1 A sandwich contains three of the main constituents of food.



(a) These constituents of food can be hydrolysed by boiling with acid or alkali. Complete the table.

constituent of food	product of hydrolysis
protein	
fat	
complex carbohydrate	

[3]

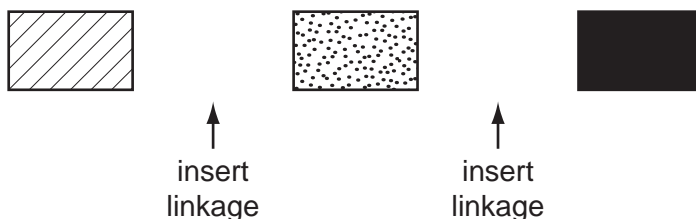
(ii) What type of synthetic polymer contains the same linkage as

fats,

proteins?

[2]

(b) An incomplete structural formula of a protein is given below. Complete this diagram by inserting the linkages.



[2]

(c) Butter contains mainly saturated fats. Fats based on vegetable oils, such as olive oil, contain mainly unsaturated fats.

A small amount of fat was dissolved in an organic solvent. Describe how you could determine if the fat was saturated or unsaturated.

.....

..... [3]

2 The alcohols form a homologous series. The first member of this series is methanol, CH_3OH .

(a) Give the general formula of the alcohols.

..... [1]

(ii) The mass of one mole of an alcohol is 116 g. What is its formula?
Show your reasoning.

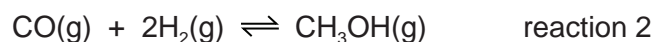
.....
..... [2]

(iii) Draw a diagram showing the arrangement of the outer (valency) electrons in one molecule of 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]

(b) Methanol is manufactured using the following method.



The conditions for reaction 2 are:

pressure 100 atmospheres
catalyst a mixture of copper, zinc oxide and aluminium oxide
temperature 250 °C

The forward reaction is exothermic.

(i) Why is high pressure used in reaction 2?

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

- (ii) Explain why using a catalyst at 250 °C is preferred to using a higher temperature of 350 °C and no catalyst.

.....
.....
..... [3]

(c) Methanol is oxidised by atmospheric oxygen. This reaction is catalysed by platinum.

- (i) The products of this reaction include a carboxylic acid. Give its name and structural formula.

name

structural formula showing all bonds

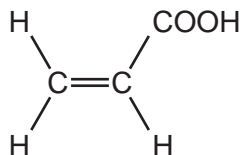
[2]

- (ii) Deduce the name of the ester formed by the reaction of methanol with the carboxylic acid named in (i).

..... [1]

[Total: 14]

- 3 Propenoic acid is an unsaturated carboxylic acid. The structural formula of propenoic acid is given below.



- (a) Describe how you could show that propenoic acid is an unsaturated compound.

test

result

..... [2]

- (ii) Without using an indicator, describe how you could show that a compound is an acid.

test

result

..... [2]

- (b) Propenoic acid reacts with ethanol to form an ester. Deduce the name of this ester. Draw its structural formula.

name of ester

structural formula showing all bonds

[3]

- (c) An organic compound has a molecular formula $C_6H_8O_4$. It is an unsaturated carboxylic acid. One mole of the compound reacts with two moles of sodium hydroxide.

- (i) Explain the phrase *molecular formula*.

.....

..... [2]

(ii) One mole of this carboxylic acid reacts with two moles of sodium hydroxide.
How many moles of -COOH groups are there in one mole of this compound?

..... [1]

(iii) What is the formula of another functional group in this compound?

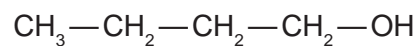
..... [1]

(iv) Deduce a structural formula of this compound.

[1]

[Total: 12]

4 The structural formula of a butanol is given below.



(a) Butanol can be made from petroleum and also by fermentation.

(i) Describe the chemistry of making butanol from petroleum by the following route.

petroleum → butene → butanol

.....
.....
..... [3]

(ii) Explain, in general terms, what is meant by *fermentation*.

.....
.....
.....
..... [3]

(b) Butanol can be oxidised to a carboxylic acid by heating with acidified potassium manganate(VII). Give the name and structural formula of the carboxylic acid.

name [1]

structural formula

[1]

(c) Butanol reacts with ethanoic acid to form a liquid, **X**, which has the sweet smell of bananas. Its empirical formula is C_3H_6O and its M_r is 116.

(i) What type of compound is liquid **X**?

..... [1]

(ii) Give the molecular formula of liquid **X**.

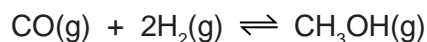
..... [1]

(iii) Draw the structural formula of **X**. Show all the individual bonds.

[2]

[Total: 12]

- 5 (a) Methanol can be made from a mixture of carbon monoxide and hydrogen.



The forward reaction is exothermic.

- (i) Explain why the concentration of methanol at equilibrium does not change.

.....
 [2]

- (ii) Suggest conditions, in terms of temperature and pressure, which would give a high yield of methanol.

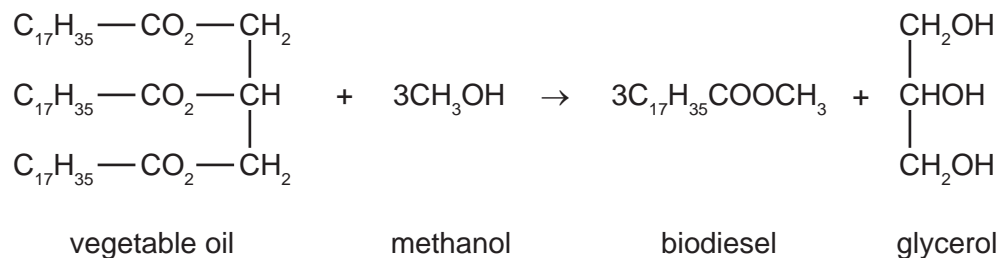
.....
 [2]

- (iii) How would the conditions used in practice compare with those given in (ii)? Give an explanation of any differences.

.....

 [2]

- (b) Biodiesel is made from a vegetable oil by the following reaction.



- (i) What type of compound are vegetable oil and biodiesel?

..... [1]

- (ii) What other useful product is made from vegetable oil by heating it with aqueous sodium hydroxide?

..... [1]

- (iii) Suggest an explanation why making and using biodiesel has a smaller effect on the percentage of carbon dioxide in the atmosphere than using petroleum-based diesel.

.....

(c) Petroleum-based diesel is a mixture of hydrocarbons, such as octane and octene.

(i) 'Oct' means eight carbon atoms per molecule. Draw a structural formula of an octene molecule.

[1]

(ii) Describe a test which would distinguish between octane and octene.

test

result with octane

result with octene [3]

[Total: 14]

6 Structural formulae are an essential part of Organic Chemistry.

(a) Draw the structural formula of each of the following. Show all the bonds in the structure.

(i) ethanoic acid

[1]

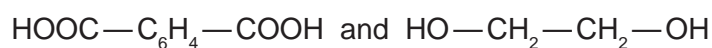
(ii) ethanol

[1]

(b) Ethanoic acid and ethanol react to form an ester.
What is the name of this ester?

..... [1]

(ii) The same linkage is found in polyesters. Draw the structure of the polyester which can be formed from the monomers shown below.

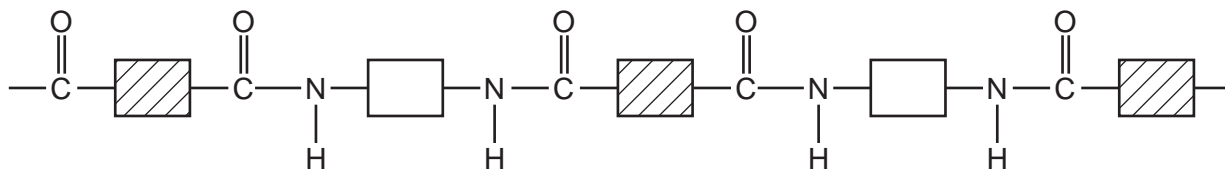


[3]

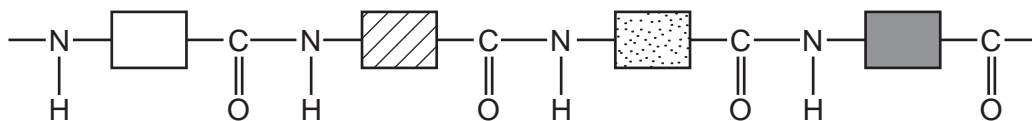
(iii) Describe the pollution problems caused by non-biodegradable polymers.

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

(c) Two macromolecules have the same amide linkage.
Nylon, a synthetic polymer, has the following structure.



Protein, a natural macromolecule, has the following structure.



How are they different?

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

[Total: 10]