1 **(a)** Alkanes and alkenes are examples of hydrocarbons.

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

.....

..... [1]

(ii) Give the general formula of straight-chain

alkanes, ...

alkenes. .....

[2]

(b) A compound X contains carbon, hydrogen and oxygen only.

X contains 54.54% of carbon by mass, 9.09% of hydrogen by mass and 36.37% of oxygen by mass.

(i) Calculate the empirical formula of compound X.

[2]

(ii) Compound X has a relative molecular mass of 88.

Deduce the molecular formula of compound X.

[2]

(c) An ester has the molecular formula $C_3H_6O_2$.

Name and give the structural formulae of **two** esters with the molecular formula $C_3H_6O_2$.

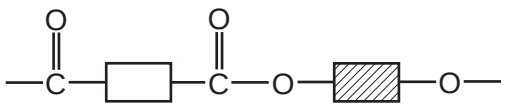
name of ester		
structural formula		

[4]

(d) Name the ester produced from the reaction of propanoic acid and methanol.

..... [1]

(e) A polyester is represented by the structure shown.



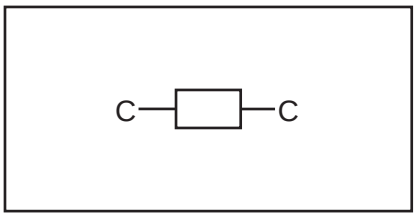
(i) What type of polymerisation is used for the production of polyesters?

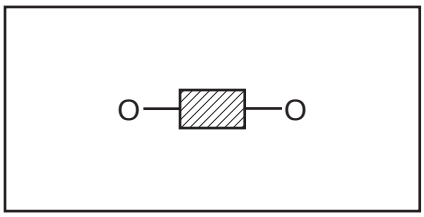
..... [1]

(ii) Which simple molecule is removed when the polyester is formed?

..... [1]

(iii) Complete the diagrams below to show the structures of the monomers used to produce the polyester. Show all atoms and bonds.





[2]

[Total: 16]

2 The rate of a photochemical reaction is affected by light.

(a) The decomposition of silver bromide is the basis of film photography. This is a redox reaction.

$$\underset{\text{cream}}{2AgBr} \rightarrow \underset{\text{black}}{2Ag} + Br_2$$

step 1 $2Br^- \rightarrow Br_2 + 2e^-$

step 2 $Ag^+ + e^- \rightarrow Ag$

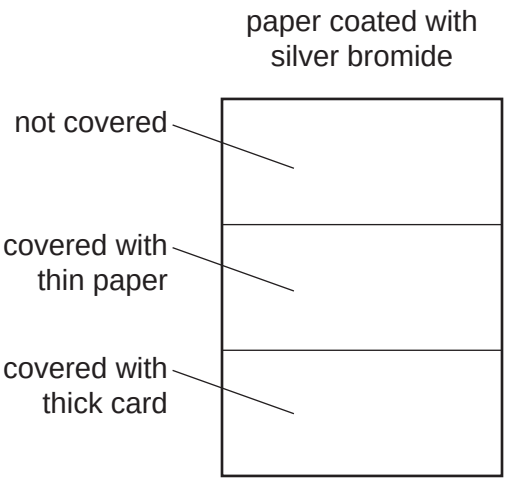
(i) Which step is reduction? Explain your answer.

..... [1]

(ii) Which ion is the oxidising agent? Explain your answer.

..... [1]

(b) A piece of white paper was coated with silver bromide and exposed to the light. Sections of the paper were covered as shown in the diagram.



Predict the appearance of the different sections of the paper after exposure to the light and the removal of the card. Explain your predictions.

.....

.....

.....

.....

.....

..... [4]

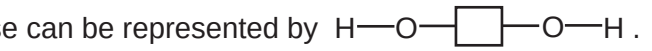
(c) Photosynthesis is another example of a photochemical reaction. Green plants can make simple carbohydrates, such as glucose. These can polymerise to make more complex carbohydrates, such as starch.

(i) Write a word equation for photosynthesis.

..... [2]

(ii) Name the substance which is responsible for the colour in green plants and is essential for photosynthesis.

..... [1]

(iii) The structural formula of glucose can be represented by  .

Draw part of the structural formula of starch which contains two glucose units.

[2]

(iv) Living organisms need carbohydrates for respiration.

What is meant by *respiration*?

..... [1]

[Total: 12]

3 **(a)** A compound **X** contains 82.76% of carbon by mass and 17.24% of hydrogen by mass.

(i) Calculate the empirical formula of compound **X**.

[2]

(ii) Compound **X** has a relative molecular mass of 58.

Deduce the molecular formula of compound **X**.

[2]

(b) Alkenes are unsaturated hydrocarbons.

(i) State the general formula of alkenes.

..... [1]

(ii) State the empirical formula of alkenes.

..... [1]

(c) What is meant by the term *unsaturated hydrocarbon*?

unsaturated .....

.....

hydrocarbon .....

.....

[2]

(d) Describe a test that would distinguish between saturated and unsaturated hydrocarbons.

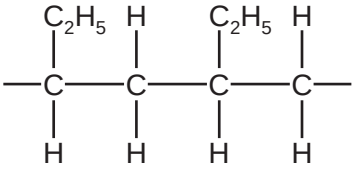
reagent .....

observation (saturated hydrocarbon) .....

observation (unsaturated hydrocarbon) .....

[3]

(e) Addition polymers can be made from alkenes. The diagram shows part of an addition polymer.



(i) Draw a circle on the diagram to show one repeat unit in this polymer. [1]

(ii) Give the structure and the name of the monomer used to make this polymer.

structure

name ..... [2]

(iii) Give the structure of an isomer of the alkene in **(e)(ii)**.

[1]

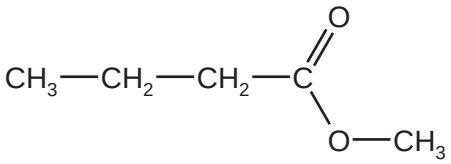
[Total: 15]

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

(a) Esters can be made from alcohols and carboxylic acids. For example, the ester ethyl ethanoate can be made by the following reaction.

$$CH_3COOH + CH_3CH_2OH \rightarrow CH_3COOCH_2CH_3 + H_2O$$

(i) Name the carboxylic acid and the alcohol from which the following ester could be made.



name of carboxylic acid .....

name of alcohol .....
[2]

(ii) 6.0 g of ethanoic acid, M_r = 60, was reacted with 5.5 g of ethanol, M_r = 46.
Determine which is the limiting reagent and the maximum yield of ethyl ethanoate, M_r = 88.

number of moles of ethanoic acid = ... [1]

number of moles of ethanol = ... [1]

the limiting reagent is ..... [1]

number of moles of ethyl ethanoate formed = ... [1]

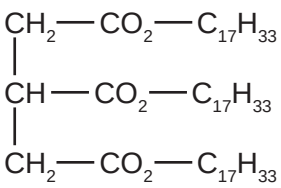
maximum yield of ethyl ethanoate = ... [1]

(b) The following two monomers can form a polyester.

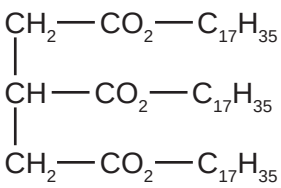
Draw the structural formula of this polyester. Include two ester linkages.

[3]

(c) Fats and vegetable oils are esters. The formulae of two examples of natural esters are given below.



ester 1



ester 2

(i) One ester is saturated, the other is unsaturated.
Describe a test to distinguish between them.

test .....

result with unsaturated ester .....

.....

result with saturated ester .....

.....
[3]

(ii) Deduce which one of the above esters is unsaturated. Give a reason for your choice.

.....

.....

..... [2]

(iii) Both esters are hydrolysed by boiling with aqueous sodium hydroxide.
What types of compound are formed?

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

[Total: 17]

5 **(a)** Biological catalysts produced by microbes cause food to deteriorate and decay.

(i) What is the name of these biological catalysts?

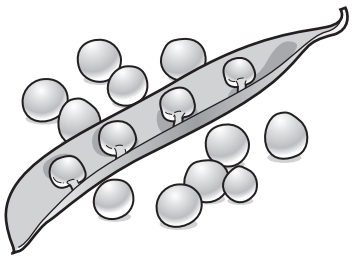
..... [1]

(ii) Freezing does not kill the microbes.
Suggest why freezing is still a very effective way of preserving food.

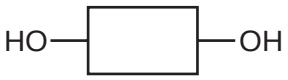
.....

..... [2]

(b) Pea seeds grow in pods on pea plants.



Freshly picked pea seeds contain a sugar. The sugar can form a polymer.
Give the structural formula of the polymer and name the other product of this polymerisation reaction.
You may represent the sugar by the formula:



structural formula of the polymer

other product ..... [3]

(c) Describe how the pea plant makes a sugar such as glucose.

.....

.....

.....

.....

..... [3]

[Total: 9]