1 The hydrolysis of complex carbohydrates to simple sugars is catalysed by enzymes called carbohydrases and also by dilute acids.

(a) (i) They are both catalysts. How do enzymes differ from catalysts such as dilute acids?

.... [1]

(ii) Explain why ethanol, C_2H_6O, is not a carbohydrate but glucose, $C_6H_{12}O_6$, is a carbohydrate.

....

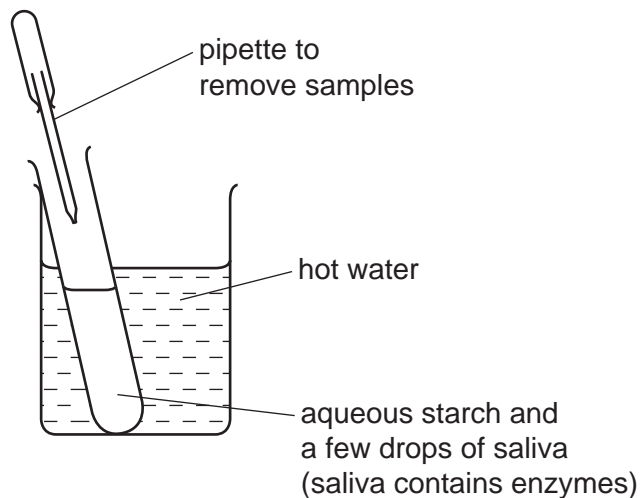... [2]

(b) Draw the structure of a complex carbohydrate, such as starch. The formula of a simple sugar can be represented by $HO \!-\!\boxed{}\!-\! OH$.

(c) Iodine reacts with starch to form a deep blue colour.

(i) In the experiment illustrated below, samples are removed at intervals and tested with iodine in potassium iodide solution.

pipette to remove samples

hot water

aqueous starch and a few drops of saliva (saliva contains enzymes)

Typical results of this experiment are shown in the table.

time / min	colour of sample tested with iodine in potassium iodide solution
0	deep blue
10	pale blue
30	colourless

Explain these results.

....

....

.... [3]
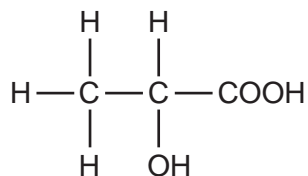
(ii) If the experiment was repeated at a higher temperature, 60 °C, all the samples stayed blue. Suggest an explanation.

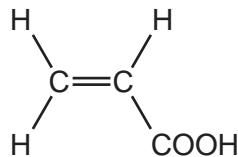.. [1]

[Total: 10]

2 Lactic acid can be made from corn starch.

$$CH_3 - CH - COOH$$
$$| $$
$$OH$$

lactic acid

It polymerises to form the polymer, polylactic acid (PLA) which is biodegradable.

(a) Suggest **two** advantages that PLA has compared with a polymer made from petroleum.

....

....

....

.... [2]

(b) The structure of PLA is given below.

$$-O-CH-C-O-CH-$$

(i) What type of compound contains the group that is circled?

.... [1]

(ii) Complete the following sentence.

Lactic acid molecules can form this group because they contain both an

.... group and an .... group.   [2]

(iii) Is the formation of PLA, an addition or condensation polymerisation? Give a reason for your choice.

....

....

.... [2]

(c) When lactic acid is heated, acrylic acid is formed.

lactic acid   acrylic acid

(i) Complete the word equation for the action of heat on lactic acid.

lactic acid → .... + ... [1]

(ii) Describe a test that would distinguish between lactic acid and acrylic acid.

test ....

result for lactic acid ....

result for acrylic acid .... [3]

(iii) Describe a test, other than using an indicator, which would show that both chemicals contain an acid group.

test ....

result ....

.... [2]

[Total: 13]

3   Three of the factors that can influence the rate of a chemical reaction are:

- physical state of the reactants
- light
- the presence of a catalyst

(a) The first recorded dust explosion was in a flour mill in Italy in 1785. Flour contains carbohydrates. Explosions are very fast exothermic reactions.
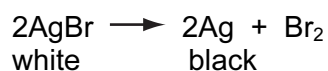
(i) Use the collision theory to explain why the reaction between the particles of flour and the oxygen in the air is very fast.

....

.... [2]

(ii) Write a word equation for this exothermic reaction.

.... [1]

The decomposition of silver(I) bromide is the basis of film photography. The equation for this decomposition is:

$$2AgBr \longrightarrow 2Ag + Br_2$$
white   black

This reaction is photochemical.
A piece of white paper was coated with silver(I) bromide and the following experiment was carried out.

initially   some time later with the
                                   card and paper removed

not covered ⎯

covered with
thin paper ⎯   exposure
                         to light   ⟶

covered with
thick card ⎯

                                   black

                                   grey

                                   white

paper coated with
silver(I) bromide

(b) Explain the results.

....

....

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.... [3]
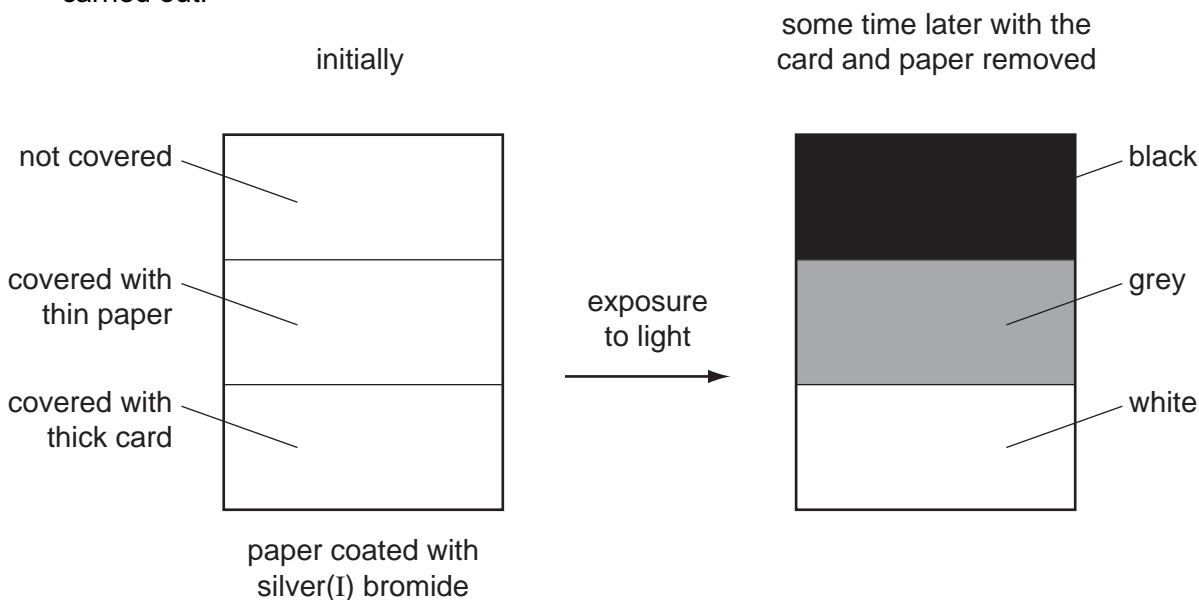
(c) The fermentation of glucose is catalysed by enzymes from yeast. Yeast is added to aqueous glucose, the solution starts to bubble and becomes cloudy as more yeast cells are formed.

$$C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5OH(aq) + 2CO_2(g)$$
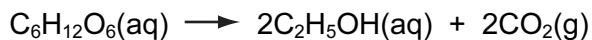
The reaction is exothermic.

Eventually the fermentation stops when the concentration of ethanol is about 12%.

(i) What is an enzyme?

.... [1]

(ii) Pasteur said that fermentation was respiration in the absence of air. Suggest a definition of *respiration*.

....

.... [2]

(iii) On a large scale, the reaction mixture is cooled. Suggest a reason why this is necessary.

.... [1]

(iv) Why does the fermentation stop? Suggest **two** reasons.

....

.... [2]

(v) When the fermentation stops, there is a mixture of dilute aqueous ethanol and yeast. Suggest a technique which could be used to remove the cloudiness due to the yeast.

.... [1]

Name a technique which will separate the ethanol from the ethanol / water mixture.

.... [1]
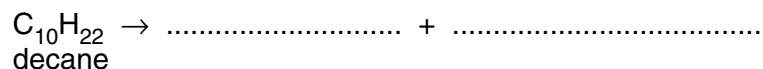
[Total: 14]

4 Alkenes are unsaturated hydrocarbons. They undergo addition reactions.

(a) Two of the methods of making alkenes are cracking and the thermal decomposition of chloroalkanes.

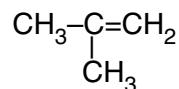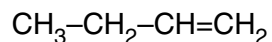**(i)** Complete an equation for the cracking of the alkane, decane.

$C_{10}H_{22}$ → .... + ...
decane

(ii) Propene can be made by the thermal decomposition of chloropropane.
Describe how chloropropane can be made from propane.

reagents   propane and ....

conditions   ....   [4]

(b) The following alkenes are isomers.

$CH_3–CH_2–CH=CH_2$ $CH_3–C=CH_2$
                                                      $|$
                                                   CH_3

(i) Explain why they are isomers.

....

....

(ii) Give the name and structural formula of another hydrocarbon that is isomeric with the above.

name ....

structural formula

[4]

(c) Give the name of the product when but-1-ene reacts with each of the following.

steam ....

hydrogen ....

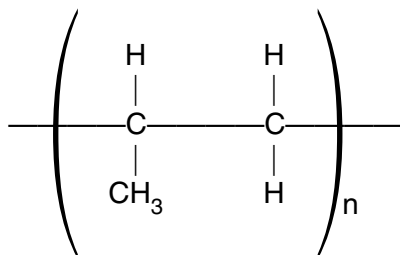bromine ....   [3]

(d) Alkenes can polymerise.

    (i) Deduce the name and structural formula of the monomer from the structure of the polymer.

name of monomer ....

structural formula

    (ii) Draw the structure of the polymer formed from the following monomer.
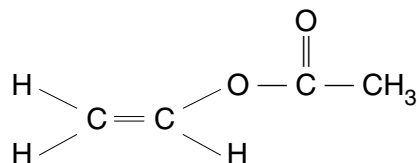
[4]

(iii) Describe the pollution problems caused by the disposal of polymers in landfill sites and by burning.

landfill sites ....

....[2]

burning ....

....[1]

5 Some of the facto   on, temperature
and light intensity.

(a) A small piece of calcium carbonate was added to an excess of hydrochloric acid. The time taken for the carbonate to react completely was measured.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

The experiment was repeated at the same temperature, using pieces of calcium carbonate of the same size but with acid of a different concentration. In all the experiments an excess of acid was used.

concentration of acid / mol dm^{-3}	4	2	2	……….
number of pieces of carbonate	1	1		
time / s	……….	80	……….	160

  (i) Complete the table (assume the rate is proportional to both the acid concentration and the number of pieces of calcium carbonate). [3]

 **(ii)** Explain why the reaction rate would increase if the temperature was increased.

....

....[2]

  (iii) Explain why the rate of this reaction increases if the piece of carbonate is crushed to a powder.

....[1]

  (iv) Fine powders mixed with air can explode violently. Name an industrial process where there is a risk of this type of explosion.

....

....[1]

(b) Sodium chlorate(I) decomposes to form oxygen and sodium chloride. This is an example of a photochemical reaction. The rate of reaction depends on the intensity of the light.

$$2NaClO(aq) \rightarrow 2NaCl(aq) + O_2(g)$$
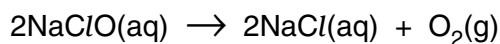
  (i) Describe how the rate of this reaction could be measured.

....

....[2]

(ii) How could you show that this reaction is photochemical?

....

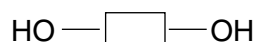..[1]

(c) Photosynthesis is another example of a photochemical reaction. Glucose and more complex carbohydrates are made from carbon dioxide and water.

(i) Complete the equation.

$6CO_2$ + $6H_2O$ $\rightarrow$ $C_6H_{12}O_6$ + ……….. [2]
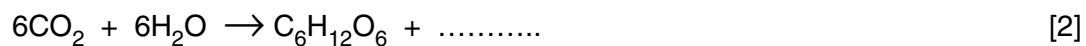
(ii) Glucose can be represented as

$$HO-\boxed{}-OH$$

Draw the structure of a more complex carbohydrate that can be formed from glucose by condensation polymerisation.

[2]