1)

Proteins, such as enzymes, are important molecules found in all living organisms.

(a) Read through the following passage on the primary structure of proteins, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

Proteins are made of monomers called ..... . These monomers are joined together by ..... bonds, formed during ..... reactions.

Each monomer of a protein consists of a central carbon atom attached to a hydrogen atom, an R group, an ..... group and a ..... group. The sequence of monomers determines the primary structure of the protein.

(b) (i) Describe the three-dimensional (tertiary) structure of an enzyme.

(3)

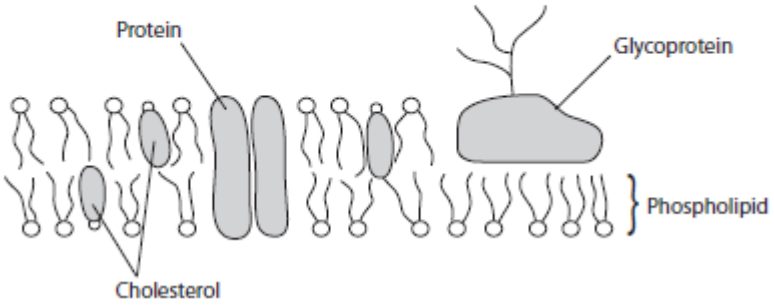
(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

2)

One function of the cell membrane is to control which molecules can enter or leave the cell.

The diagram below represents the structure of the cell membrane.



(a) For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(i) The phospholipids form a bilayer because

☐ **A** the hydrophobic heads dissolve in the aqueous (water) environment

☐ **B** the hydrophobic heads move away from the aqueous environment

☐ **C** the hydrophobic tails dissolve in the aqueous environment (1)

☐ **D** the hydrophobic tails move away from the aqueous environment

(ii) The protein, labelled in the diagram, could be involved in

- ☐ **A** endocytosis
- ☐ **B** exocytosis
- ☐ **C** facilitated diffusion
- ☐ **D** phagocytosis

(1)

(iii) The fluidity of the membrane is determined by the proportion of

- ☐ **A** cholesterol
- ☐ **B** glycoprotein
- ☐ **C** phospholipid
- ☐ **D** protein

(1)

(b) A student carried out an experiment to investigate the effect of temperature on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through membranes.

Six cubes of beetroot were cut. One piece of beetroot was placed into a tube containing 10 cm^3 of water and left for 20 minutes at 5 °C. After the 20 minutes, each piece of beetroot was removed from the tubes and the colour of the fluid recorded.

The procedure was repeated at five other temperatures.

The results of this experiment are shown in the table below.

Temperature / °C	Colour of fluid
5	pale pink
22	pale pink
42	pale pink
64	pink
87	dark pink
93	red

Using the information in the table, describe the effect that temperature has on the permeability of the membranes of the beetroot cells.

(2)

(c) A second student carried out a very similar experiment, using three samples of beetroot at each temperature. She used a colorimeter to determine the intensity of the colour of the fluid produced.

The results of her experiment are shown in the table below.

Temperature / °C	Intensity of colour of fluid / arbitrary units		
	Sample 1	Sample 2	Sample 3
5	0.0	0.0	0.0
22	10.1	9.8	11.1
42	26.3	29.9	31.0
64	80.1	77.0	76.9
87	93.9	95.0	96.0
93	100.0	100.0	100.0

(i) State **two** variables that both of these students must keep the same if their results are to be compared.

(2)

(ii) Give **two** reasons why the results obtained by the second student are more reliable than those of the first student.

(2)

(iii) In the first student's experiment at 5 °C, the fluid was pale pink but the fluid in the second student's experiment was colourless.

Suggest an explanation for this difference. (2)

(iv) Each of the students used their own results to describe the effect of temperature on the permeability of the membranes of the beetroot cells.

Suggest **one** way in which these two descriptions might differ. (1)

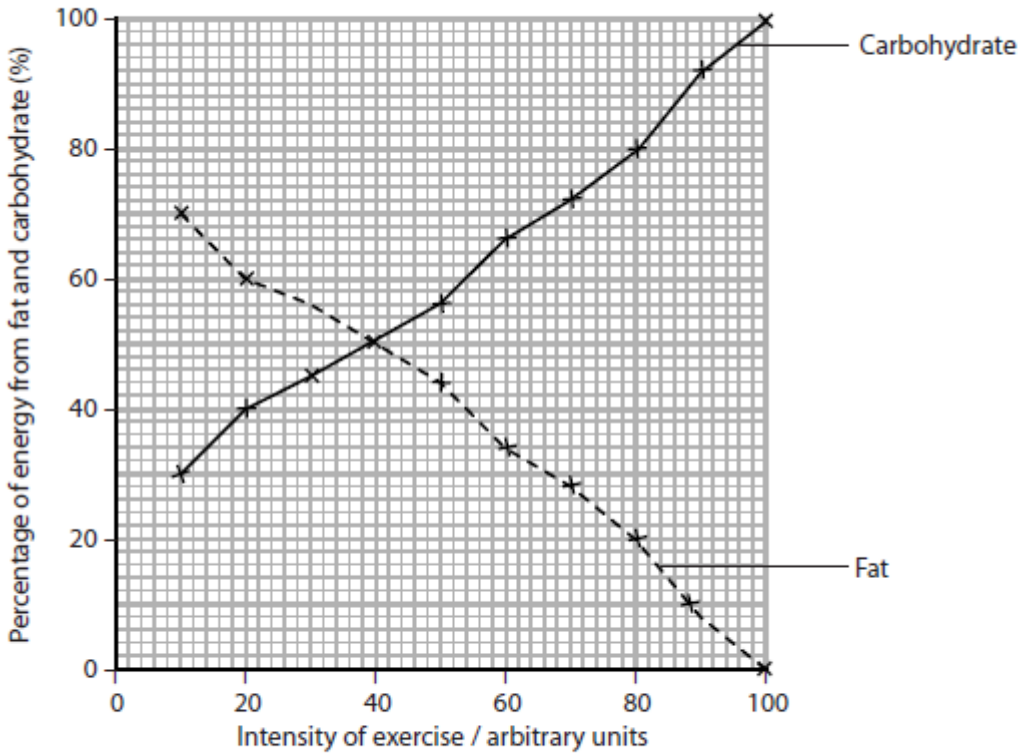
3)

Fats and carbohydrates such as glycogen are important energy storage molecules. These are broken down during exercise.

(a) Describe the structure of glycogen and explain why it is a suitable molecule for storing energy.

(4)

(b) The graph below shows how the percentage of energy obtained from fat and carbohydrate varies according to the intensity of exercise being carried out.



(i) Using the information in the graph, describe how the source of energy used depends on the intensity of exercise.

(3)

(ii) A carbohydrate-loading diet is used by athletes in preparation for some athletic events. This diet involves increasing carbohydrate intake and decreasing activity, several days before the event.

Carbohydrate-loading is not a suitable method of preparation for all athletic events.

Using the information in the graph and your knowledge of glycogen, explain what type of athletic event could be prepared for using a carbohydrate-loading diet.

(3)

(ii) A carbohydrate-loading diet is used by athletes in preparation for some athletic events. This diet involves increasing carbohydrate intake and decreasing activity, several days before the event.

Carbohydrate-loading is not a suitable method of preparation for all athletic events.

Using the information in the graph and your knowledge of glycogen, explain what type of athletic event could be prepared for using a carbohydrate-loading diet.

(3)

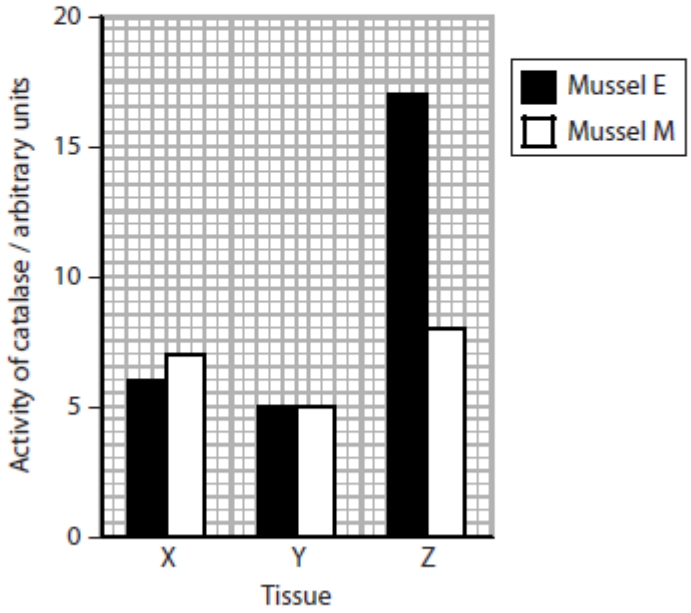
4)

Catalase is an enzyme present in many tissues of most living organisms. Its role is to break hydrogen peroxide down into oxygen and water. Hydrogen peroxide is produced by cells and is very harmful if it is not broken down.

(a) A study compared the activity of catalase in the tissues of freshwater mussels. Mussels from two different rivers: mussel E from the river Eo and mussel M from the river Masma were studied.

The catalase activity was measured in three tissues, X, Y and Z, taken from each type of mussel.

The graph below shows the results of this study.



(i) Use the information in the graph to state the conclusions that can be made about the activity of catalase in the tissues of mussel E.

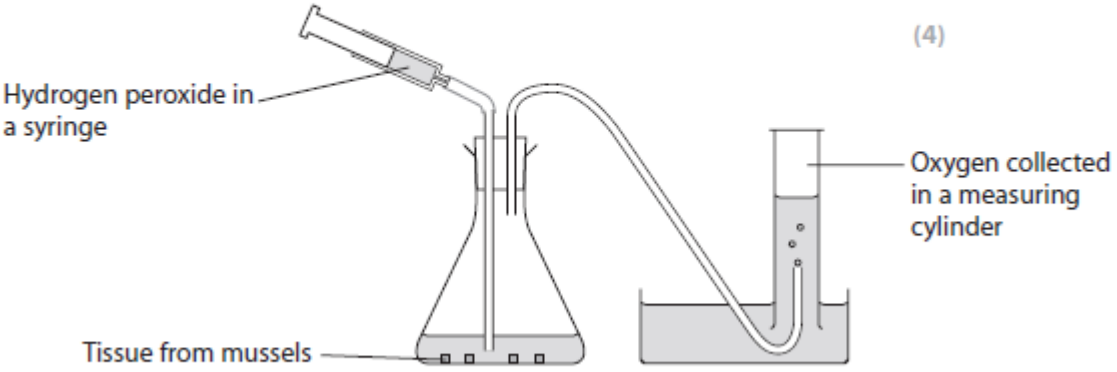
(3)

(ii) Using the information in the graph, compare the activity of catalase in mussel E and mussel M.

(2)

(b) Catalase activity in tissue from mussels can be studied using the apparatus shown below.

Tissue from mussels is placed in the flask and hydrogen peroxide is added using the syringe. The oxygen produced from the breakdown of hydrogen peroxide is collected in the measuring cylinder.



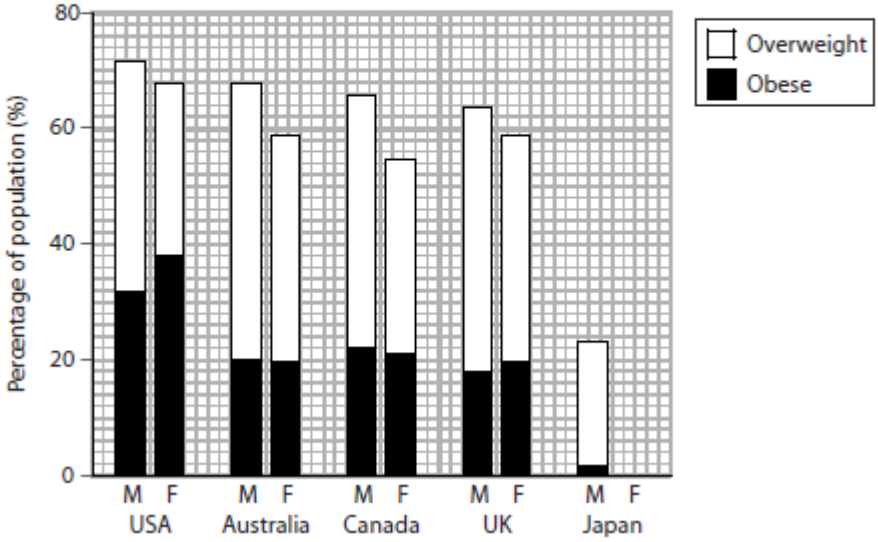
(4)

Describe how this apparatus could be used to compare the catalase activity in two different types of mussel.

5)

Obesity is a significant problem in western countries and an increasing problem in some other parts of the world.

The graph below shows the percentage of the male population (M) and the female population (F) who are either overweight or obese in five different countries.



(a) The graph above shows that in Japan 2% of the male population are obese and 23% are overweight.

In the female population of Japan, 2% are obese and 16% are overweight. Add this information to the graph above.

(3)

(b) For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(i) The graph shows that

(1)

☐ **A** a higher percentage of males are overweight than females

☐ **B** a higher percentage of females are overweight than males

☐ **C** there is no correlation between being overweight and gender

☐ **D** an equal percentage of males and females are overweight

(ii) The country with the highest percentage of males who are obese is

(1)

☐ **A** Australia

☐ **B** Canada

☐ **C** Japan

☐ **D** USA

(iii) The country with the same percentage of females as the UK who are overweight is

(1)

☐ **A** Australia

☐ **B** Canada

☐ **C** Japan

☐ **D** USA

(iv) In the USA, the ratio of overweight males to females is

☐ **A** 4 : 3 (1)

☐ **B** 17 : 18

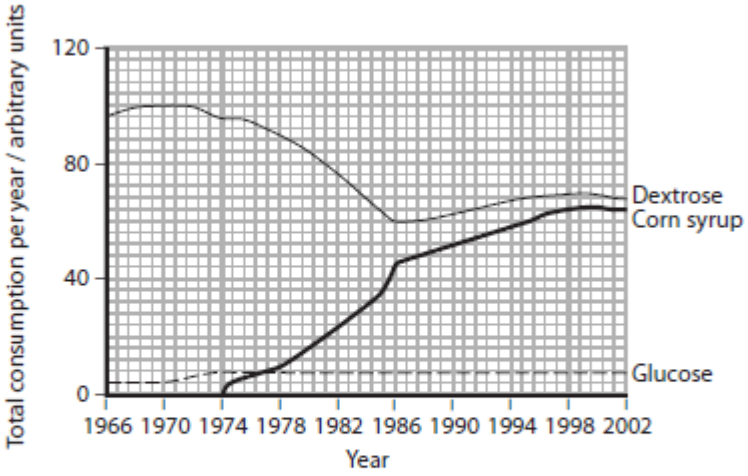
☐ **C** 18 : 17

☐ **D** 24 : 23

(c) Explain why it would be incorrect to conclude that, in Japan, the same number of males as females are obese.

(2)

(d) The graph below shows the consumption of three types of sweetener in the USA, from 1966 to 2002.



From 1976, the number of obese people in the USA started to increase rapidly. It was suggested that there was a correlation between the consumption of corn syrup and obesity.

(i) Explain the meaning of the term **correlation**.

(1)

(ii) Using the information in part (d), describe the evidence that suggests there is a correlation between the consumption of corn syrup and obesity.

(3)

6)

Carbohydrates are important components of our diets.

(a) Distinguish between the structures of each of the following pairs of carbohydrate molecules.

(i) Monosaccharides and disaccharides

(2)

(ii) Amylose and amylopectin

(2)

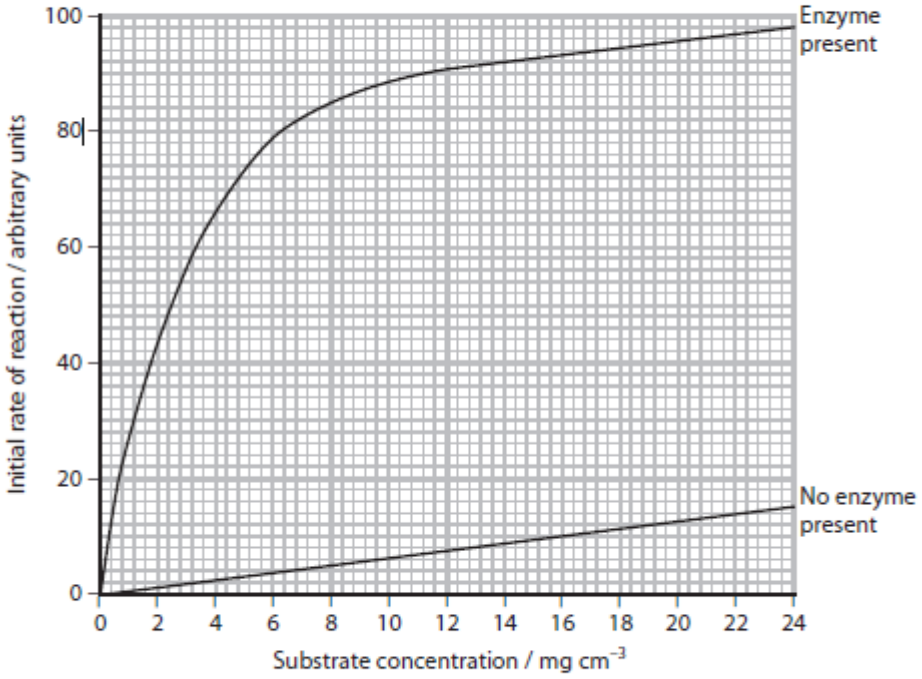
(b) Explain why a diet consisting of a high proportion of carbohydrates could lead to obesity.

(2)

7)

Enzymes are biological catalysts. They are involved in many chemical reactions in the body, including the digestion of lipids.

(a) The graph below shows the effect of an enzyme on the initial rate of reaction at different concentrations of the substrate.



Describe the effects that the enzyme had on this reaction.

(2)

(b) Lipases are enzymes that are involved in the breakdown of lipids, such as triglycerides.

(i) Name the bond broken by lipases.

(1)

(ii) Name **two** products formed from the breakdown of triglycerides by lipases.

(2)

(iii) Suggest what effect the breakdown of triglycerides could have on the pH of a reaction mixture.

(1)

*(c) The action of lipase can be investigated using a triglyceride as the substrate.

Describe an experiment, using lipase and a triglyceride, that could be carried out to collect data to plot a graph similar to the one shown in part (a).

(5)