AQA A-LEVEL · 7402

BIOLOGY



EXAM QUESTION PACK

3.1.3 LIPIDS

SCORE	PERCENTAGE
/168	%

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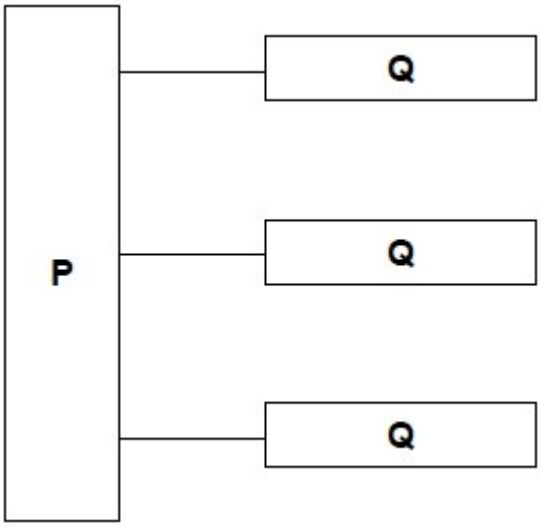
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Q1.

The diagram represents a triglyceride.



(a) Name the molecules represented in the diagram by:

Box **P** _____

Box **Q** _____

(2)

(b) Name the type of bond between **P** and **Q** in the diagram.

_____

(1)

(c) Describe how you would test a liquid sample for the presence of lipid **and** how you would recognise a positive result.

_____

_____

_____

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_____

(2)

(Total 5 marks)

Q2.

(a) Describe the gross structure of the human gas exchange system and how we breathe in and out.

(6)

(b) Mucus produced by epithelial cells in the human gas exchange system contains triglycerides and phospholipids.

Compare and contrast the structure **and** properties of triglycerides and phospholipids.

(5)

(c) Mucus also contains glycoproteins. One of these glycoproteins is a polypeptide with the sugar, lactose, attached.

Describe how lactose is formed and where in the cell it would be attached to a polypeptide to form a glycoprotein.

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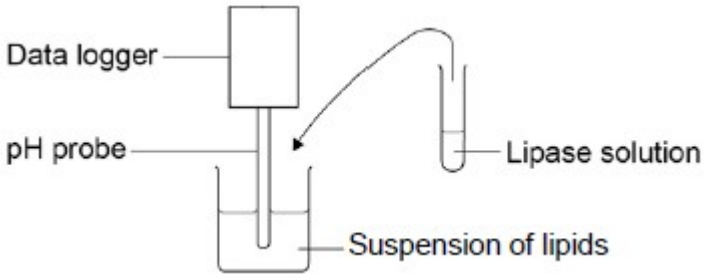
(4)

(Total 15 marks)

Q3.

A student investigated the effect of lipase concentration on the hydrolysis of lipids.

He took a beaker containing a suspension of lipids. He placed a pH probe attached to a data logger into the beaker. After 5 minutes, he added the lipase solution. The data logger recorded the pH. The apparatus used is shown in the diagram below.



(a) The student did **not** add a buffer to the lipase solution.

Explain why.

_____

_____

_____

(1)

(b) Give **two** variables the student would have controlled in this investigation.

1. _____

2. _____

(2)

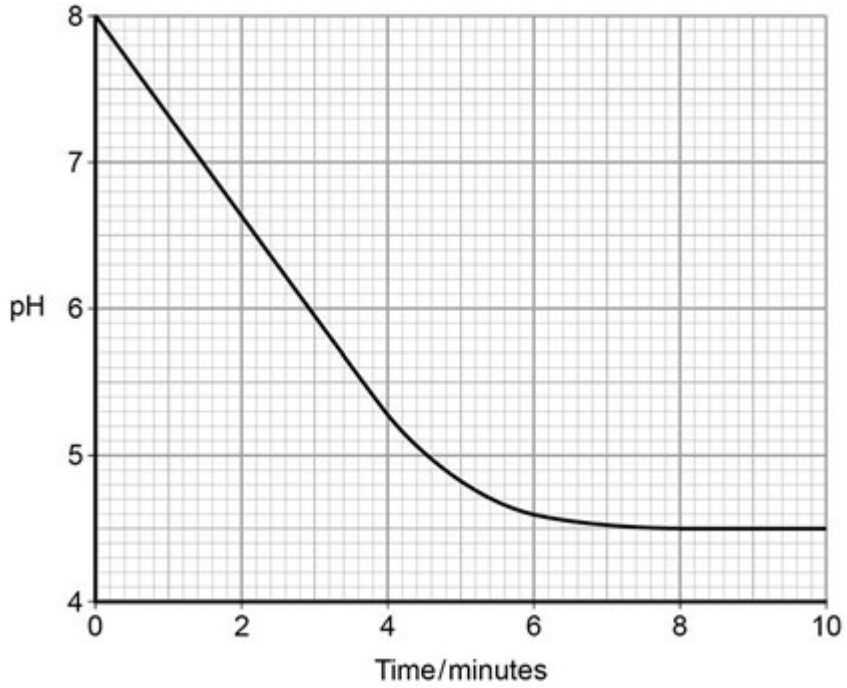
(c) Give the suitable control for this investigation.

_____

_____

(1)

The data logger recorded the pH. The graph below shows what happened after he added the lipase solution.



(d) Draw a tangent on the graph and use it to calculate the rate of change at 5 minutes.

Rate of change at 5 minutes = _____ pH minute^{-1}

(2)

(e) Explain the results shown in the graph.

_____

_____

_____

_____

_____

(2)

(f) The student repeated the experiment with a higher concentration of lipase solution.

Describe and explain the results you would expect him to get.

_____

_____

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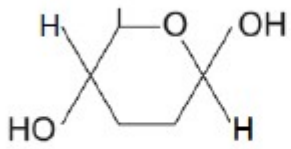
(3)

(Total 11 marks)

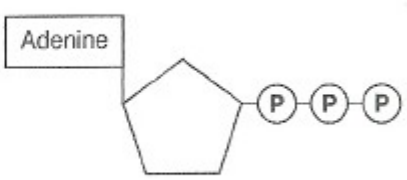
Q4.

The diagram shows four biological molecules.

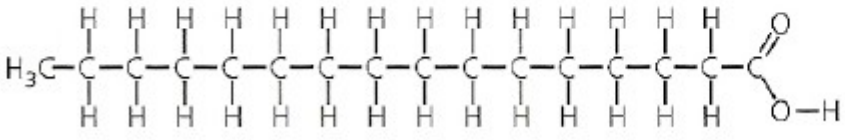
Molecule **A**



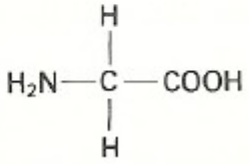
Molecule **B**



Molecule **C**



Glycine



(a) Give the **full** name of:

Molecule **A** _____

Molecule **B** _____

(2)

(b) What type of molecule is molecule **C**?

_____

(2)

(c) Glycine, shown in the diagram, is an amino acid.

In the space below, draw a diagram to show the dipeptide produced when two molecules of glycine are joined together.

(2)

(d) Name the other molecule formed when two molecules of glycine are joined together.

_____

(1)

(Total 7 marks)

Q5.

(a) Describe how you would test a piece of food for the presence of lipid.

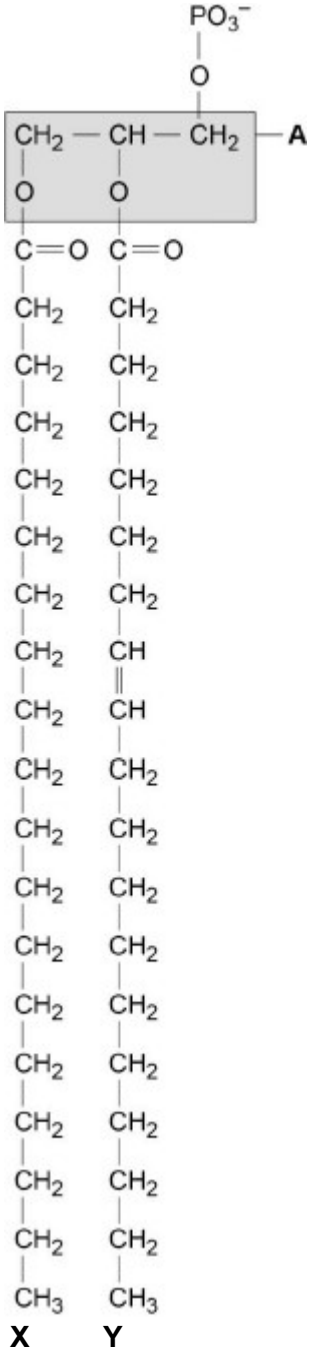
_____

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(2)

The figure below shows a phospholipid.



(b) The part of the phospholipid labelled **A** is formed from a particular molecule. Name this molecule.

_____

(1)

(c) Name the type of bond between **A** and fatty acid **X**.

_____

(1)

(d) Which of the fatty acids, **X** or **Y**, in the figure above is unsaturated? Explain your answer.

_____

_____

_____

_____

(1)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	**Percentage of lipid in plasma membrane by mass**		
	Cell lining ileum of mammal	**Red blood cell of mammal**	**The bacterium *Escherichia coli***
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

(e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

_____

_____

_____

_____

(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

(f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

_____

_____

_____

(1)

(g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q6.

Newborn babies can be fed with breast milk or with formula milk. Both types of milk contain carbohydrates, lipids and proteins.

- Human breast milk also contains a bile-activated lipase. This enzyme is thought to be inactive in milk but activated by bile in the small intestine of the newborn baby.
- Formula milk does not contain a bile-activated lipase.

Scientists investigated the benefits of breast milk compared with formula milk.

(a) The scientists used kittens (newborn cats) as model organisms in their laboratory investigation.

Other than ethical reasons, suggest **two** reasons why they chose to use cats as model organisms.

1. _____

_____

2. _____

_____

(2)

(b) Before starting their experiments, the scientists confirmed that, like human breast milk, cat's milk also contained bile-activated lipase.

To do this, they added bile to cat's milk and monitored the pH of the mixture.

Explain why monitoring the pH of the mixture could show whether the cat's milk contained lipase.

_____

_____

_____

_____

(2)

The scientists then took 18 kittens. Each kitten had been breastfed by its mother for the previous 48 hours.

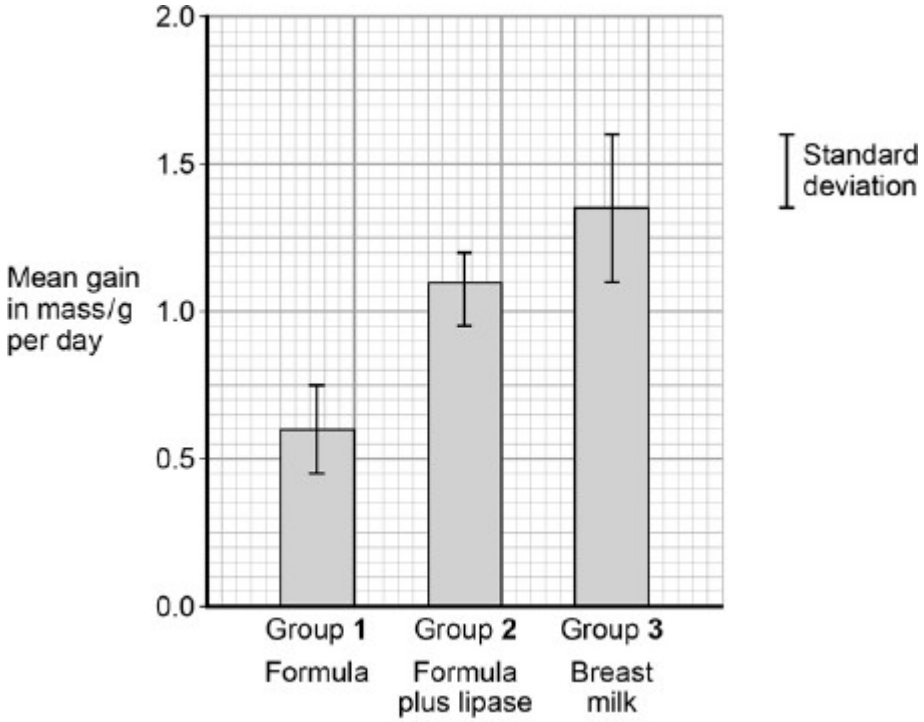
The scientists divided the kittens randomly into three groups of six.

- The kittens in group **1** were fed formula milk.
- The kittens in group **2** were fed formula milk plus a supplement containing bile-activated lipase.
- The kittens in group **3** were fed breast milk taken from their mothers.

Each kitten was fed 2 cm^3 of milk each hour for 5 days.

The scientists weighed the kittens at the start of the investigation and on each day for 5 days.

The figure below shows the scientists' results.



Type of milk given to kittens

(c) What can you conclude from the figure about the importance of bile-activated lipase in breast milk?

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q7.

(a) Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

_____

_____

_____

(1)

(b) Describe how you would test for the presence of a lipid in a sample of food.

_____

_____

_____

_____

(2)

(c) Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

Describe how a saturated fatty acid is different from an unsaturated fatty acid.

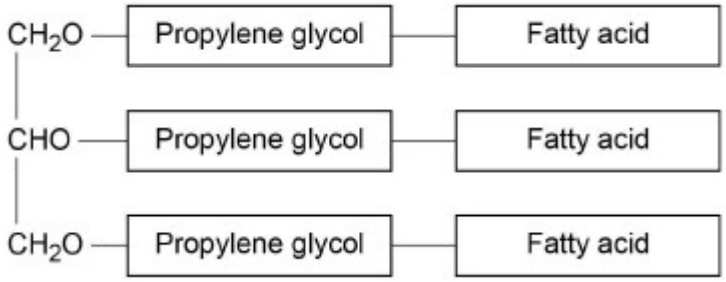
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(1)

The diagram shows the structure of a fat substitute.



(d) This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

_____

_____

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_____

(2)

(e) This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

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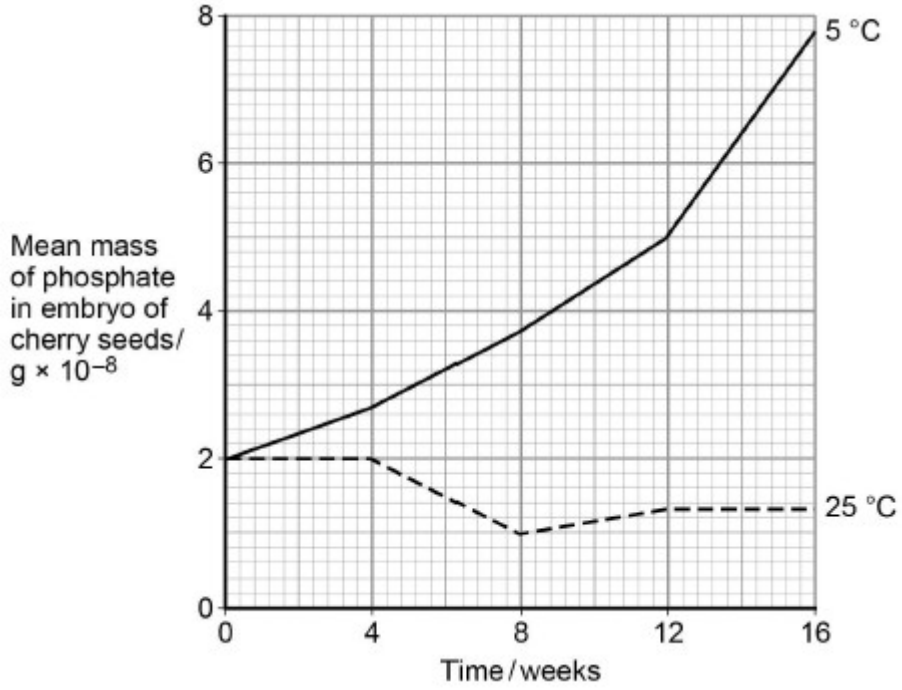
(1)

(Total 7 marks)

Q8.

The seeds of some plant species require chilling (exposure to low temperatures) before the embryos they contain grow into plants. During chilling, storage molecules in the seed that contain phosphate are broken down and phosphates are transported to the embryo. Scientists investigated the change in the mass of phosphate in the embryos of cherry seeds exposed to two different temperatures for 16 weeks.

The following graph shows their results.



(a) Phospholipids are one of the storage molecules found in cherry seeds.

Name the type of reaction used to break down phospholipids to release phosphate.

_____

(1)

(b) The scientists concluded that an increase in phosphate in the embryo was linked to growth of the embryo.

Suggest **two** reasons why an increase in phosphate can be linked to growth of the embryo.

1. _____

_____

_____

2. _____

_____

_____

(2)

(c) Calculate the ratio of the mean mass of phosphate found at 5 °C to the mean mass of phosphate found at 25 °C after 9 weeks of chilling.

Ratio = _____

(1)

(d) The chilling requirement of seeds of certain plant species is considered to be an adaptation for survival in countries with seasonal changes in environmental conditions.

Suggest how this adaptation may enable these plant species to survive and respond to seasonal changes.

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(3)

(Total 7 marks)

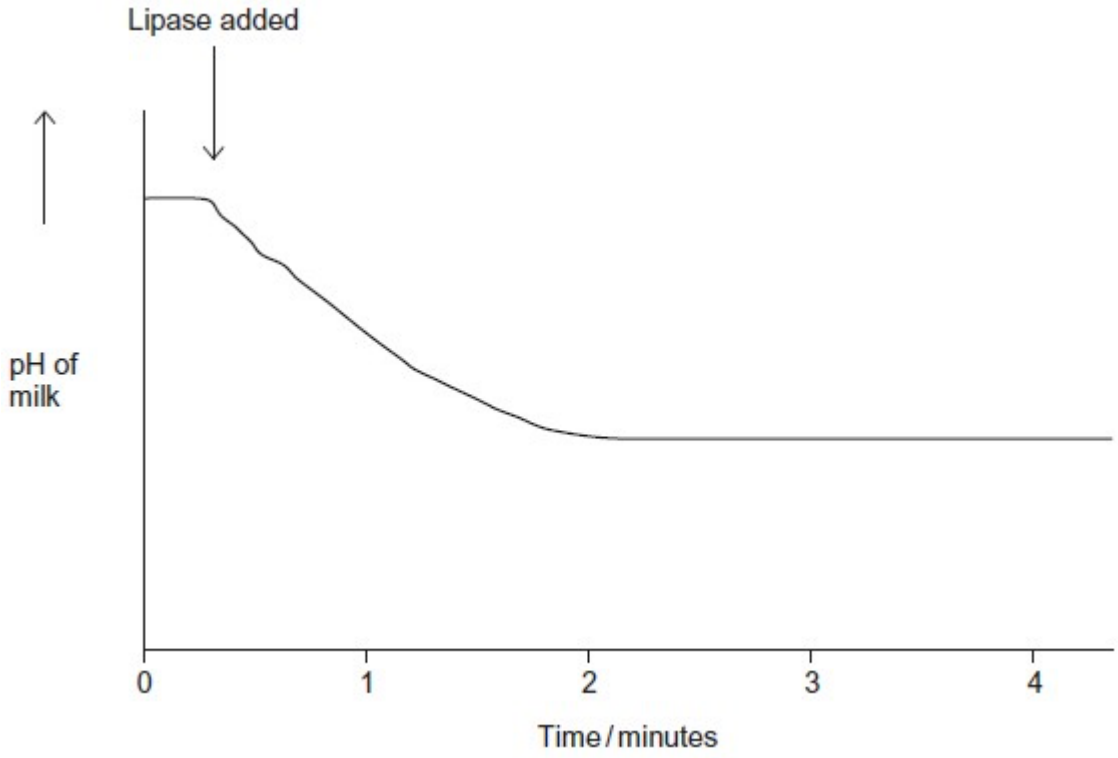
Q9.

Lipase is an enzyme that hydrolyses triglycerides.

A student investigated the hydrolysis of triglycerides in milk by human lipase at 20 °C.

He recorded the pH of a sample of milk before and after adding lipase. He used a pH meter to record pH.

His results are shown in the graph.



(a) Suggest **one** advantage of using a pH meter rather than a pH indicator in this experiment.

_____

_____

_____

(1)

(b) Explain why the pH decreases when the lipase is added to the milk.

_____

_____

_____

(1)

(c) Suggest why the pH remained constant after 2 minutes.

_____

_____

_____

_____

_____

(2)

(d) The student carried out his experiment at 20 °C. He then repeated the experiment at 15 °C.
Draw a line on the graph to show the results you would expect at 15 °C.

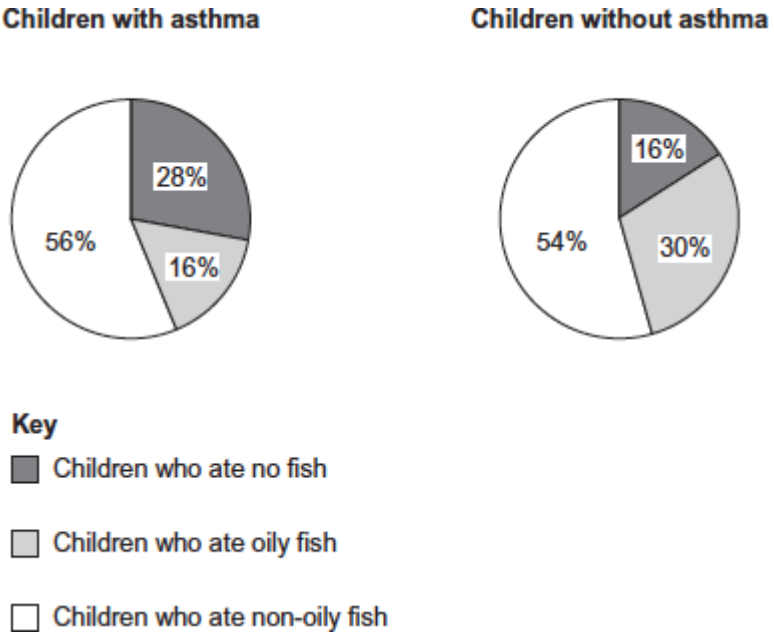
(2)

(Total 6 marks)

Q10.

Nutritionists investigated the relationship between eating oily and non-oily fish and the incidence of asthma. They analysed the diets of children with asthma and the diets of children without asthma.

The pie charts show the results.



(a) What conclusions can you make from the data?

_____

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_____

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(3)

(b) Describe how you could use the emulsion test to show the presence of oil in a

sample of fish.

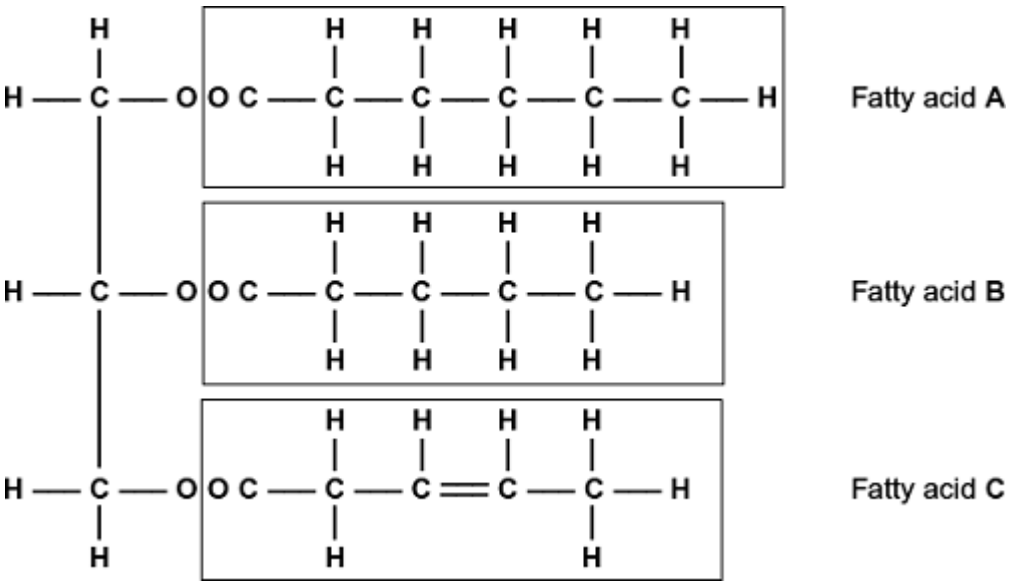
(3)
(Total 6 marks)

Q11.

(a) Some seeds contain lipids. Describe how you could use the emulsion test to show that a seed contains lipids.

(3)

(b) A triglyceride is one type of lipid. The diagram shows the structure of a triglyceride molecule.



(i) A triglyceride molecule is formed by condensation. From how many molecules is this triglyceride formed?

(1)

(ii) The structure of a phospholipid molecule is different from that of a triglyceride. Describe how a phospholipid is different.

(2)

(iii) Use the diagram to explain what is meant by an unsaturated fatty acid.

(2)

(Total 8 marks)

Q12.

(a) Omega-3 fatty acids are unsaturated. What is an unsaturated fatty acid?

_____

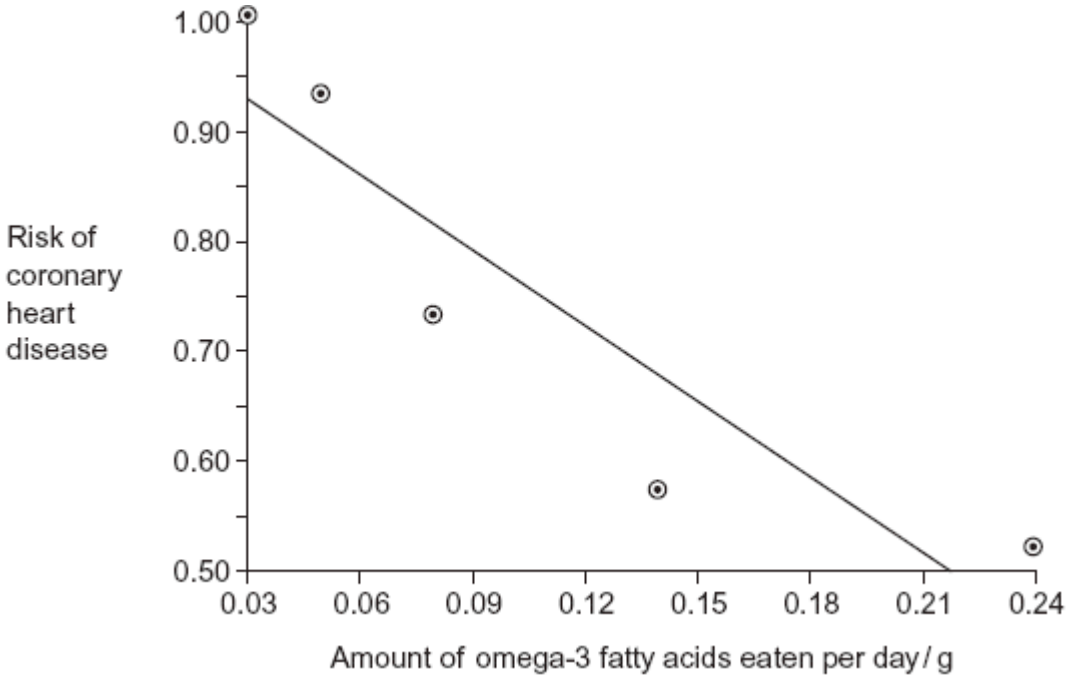
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(2)

(b) Scientists investigated the relationship between the amount of omega-3 fatty acids eaten per day and the risk of coronary heart disease. The graph shows their results.



Do the data show that eating omega-3 fatty acids prevents coronary heart disease? Explain your answer.

_____

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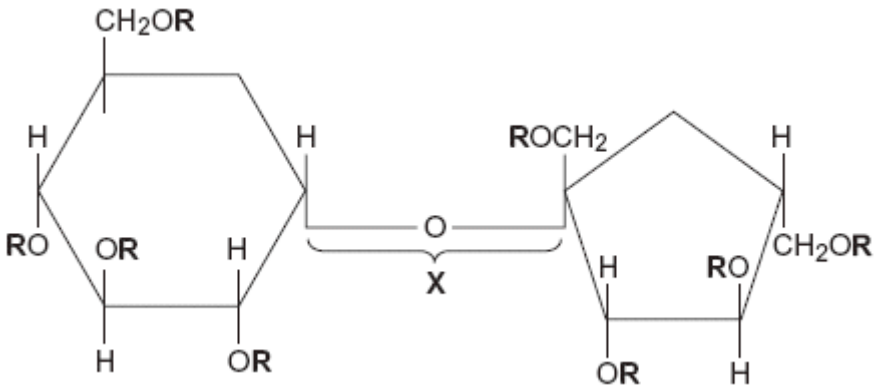
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(3)

(c) Olestra is an artificial lipid. It is made by attaching fatty acids, by condensation, to a sucrose molecule. The diagram shows the structure of olestra. The letter **R** shows where a fatty acid molecule has attached.



(i) Name bond **X**.

_____

(1)

(ii) A triglyceride does **not** contain sucrose or bond **X**. Give **one** other way in which the structure of a triglyceride is different to olestra.

_____

_____

(1)

(iii) Starting with separate molecules of glucose, fructose and fatty acids, how many molecules of water would be produced when one molecule of olestra is formed?

☐

(1)

(Total 8 marks)

Q13.

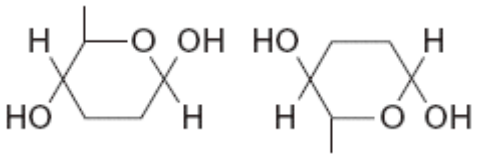
(a) The table shows some substances found in cells. Complete the table to show the properties of these substances. Put a tick in the box if the statement is correct.

Statement	**Substance**			
	Starch	Glycogen	Deoxyribose	DNA helicase
Substance contains only the elements carbon, hydrogen and oxygen				
Substance is made from amino acid monomers				
Substance is found in				

both animal cells and plant cells				

(4)

(b) The diagram shows two molecules of β-glucose.



On the diagram, draw a box around the atoms that are removed when the two β-glucose molecules are joined by condensation.

(2)

(c) (i) Hydrogen bonds are important in cellulose molecules. Explain why.

_____

_____

_____

_____

(2)

(ii) A starch molecule has a spiral shape. Explain why this shape is important to its function in cells.

_____

_____

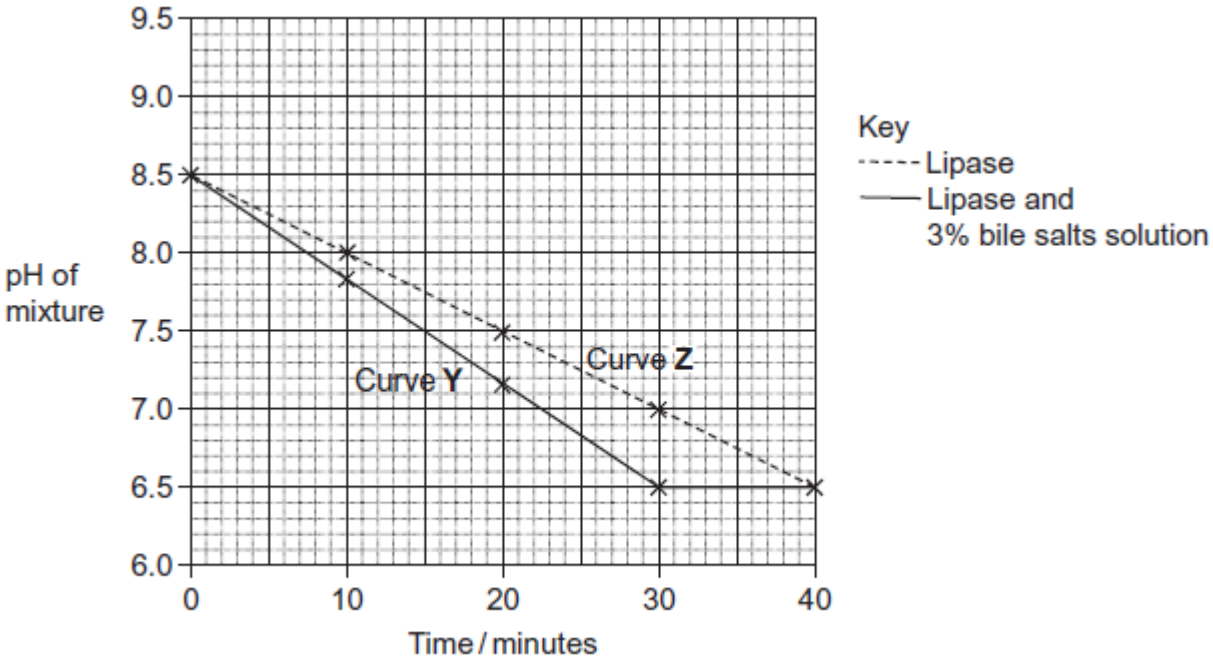
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(1)

(Total 9 marks)

Q14.

Scientists investigated the effect of lipase and a 3% bile salts solution on the digestion of triglycerides. The graph below shows their results.



(a) Describe what curve **Y** shows about the effect of lipase and bile salts on the pH of the mixture.

_____

_____

_____

_____

_____

(2)

(b) The concentration of lipase did not change during the course of the investigation. Explain why.

_____

_____

_____

(1)

(c) One of the scientists decided to repeat the investigation at a temperature 10°C below the original temperature.
Describe how you would expect his plotted curve to be different from curve **Z**.

_____

_____

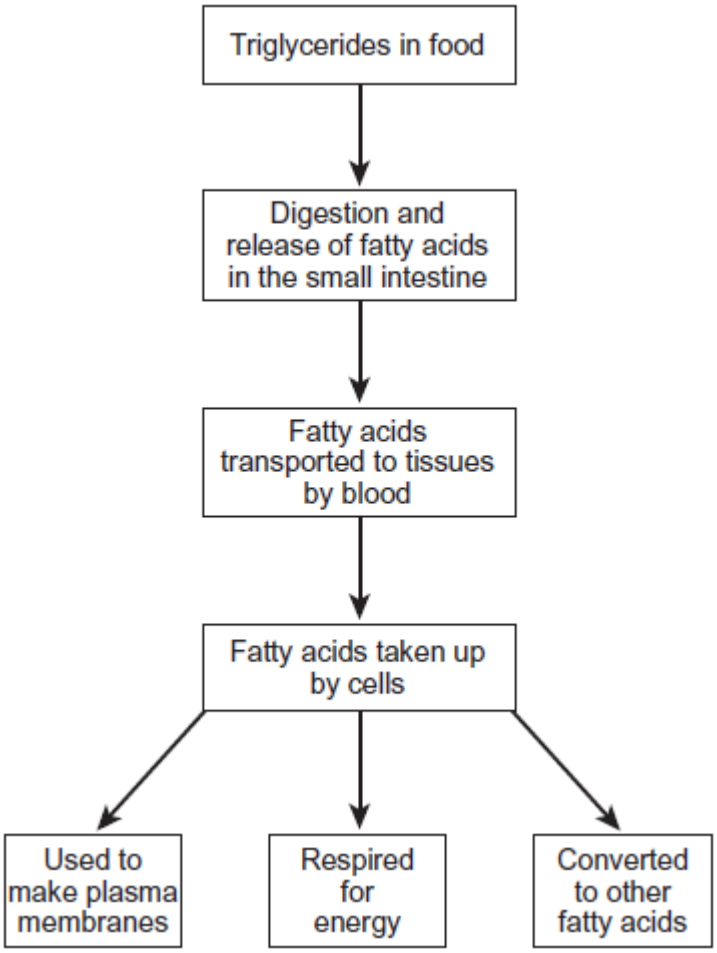
(1)

(Total 4 marks)

Q15.

Triglycerides are taken into the body as part of a balanced diet. These triglycerides contain fatty acids including omega-3 fatty acids. It has been discovered that omega-3 fatty acids are associated with health benefits. The benefits include faster development of nerve cells and clearer vision. Omega-3 fatty acids are also associated with protection from heart disease, arthritis and cancer.

The following figure shows how omega-3 and other fatty acids are taken in and used by the bodies of animals including humans.



Use the information in the figure to explain **two** ways in which fatty acids are important in the formation of new cells.

1. _____

_____

_____

_____

2. _____

_____

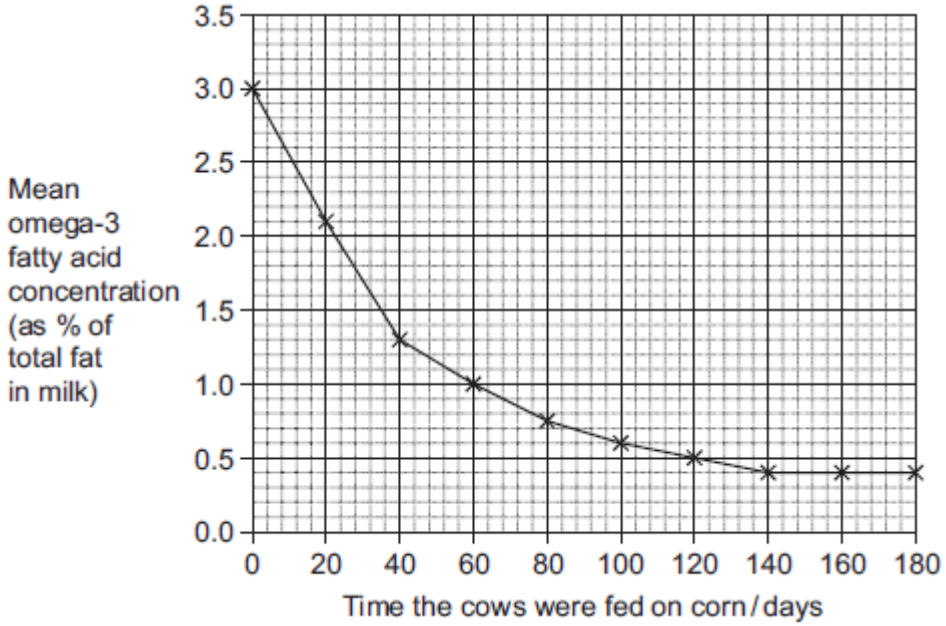
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(Total 4 marks)

Q16.

Omega-3 fatty acids are found in cows' milk. Scientists investigated changes in the concentration of omega-3 fatty acids in milk when cows were moved from eating grass in fields to eating corn in cattle sheds. The following figure shows the results of one investigation.



(a) The concentration of omega-3 fatty acids in milk changed when cows were fed on corn instead of grass. Describe how.

_____

_____

_____

_____

(2)

(b) (i) Calculate the rate of decrease in the mean omega-3 fatty acid concentration between 0 and 40 days.
Show your working.

Answer_____% per day

(2)

(ii) The omega-3 fatty acid concentration is expressed as a percentage of total fat. Explain the advantage of this.

_____

_____

_____

_____

(2)

(iii) One farmer concluded from the graph that feeding cows on corn reduces the omega-3 fatty acid content in milk. Evaluate this conclusion.

_____

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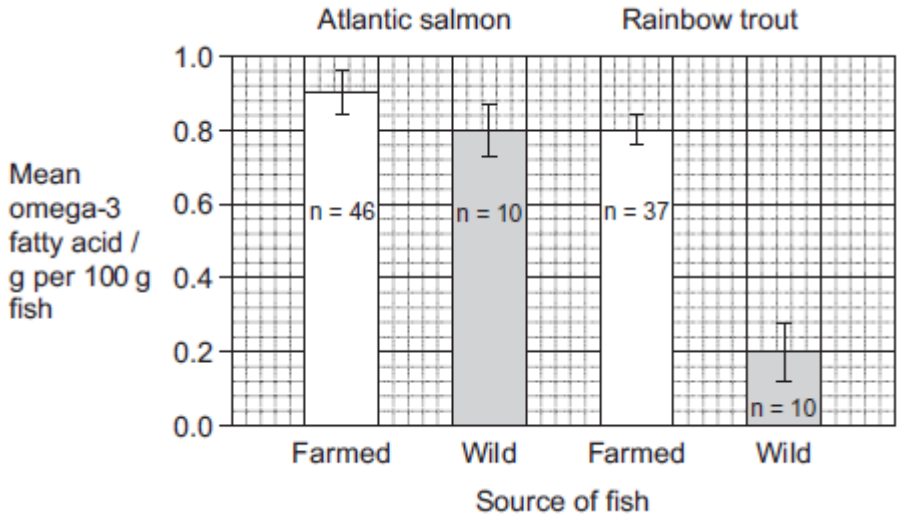
_____

(4)

(Total 10 marks)

Q17.

Omega-3 fatty acids are also found in fish. Scientists investigated the concentration of omega-3 fatty acids from wild-caught and farmed fish. Their results are shown in the figure below.



The bars show standard deviation; n is the sample size.

It is **not** possible to conclude from the data that the concentration of omega-3 fatty acids in the farmed salmon is higher than that of the wild salmon. Use the data to explain why.

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_____

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_____

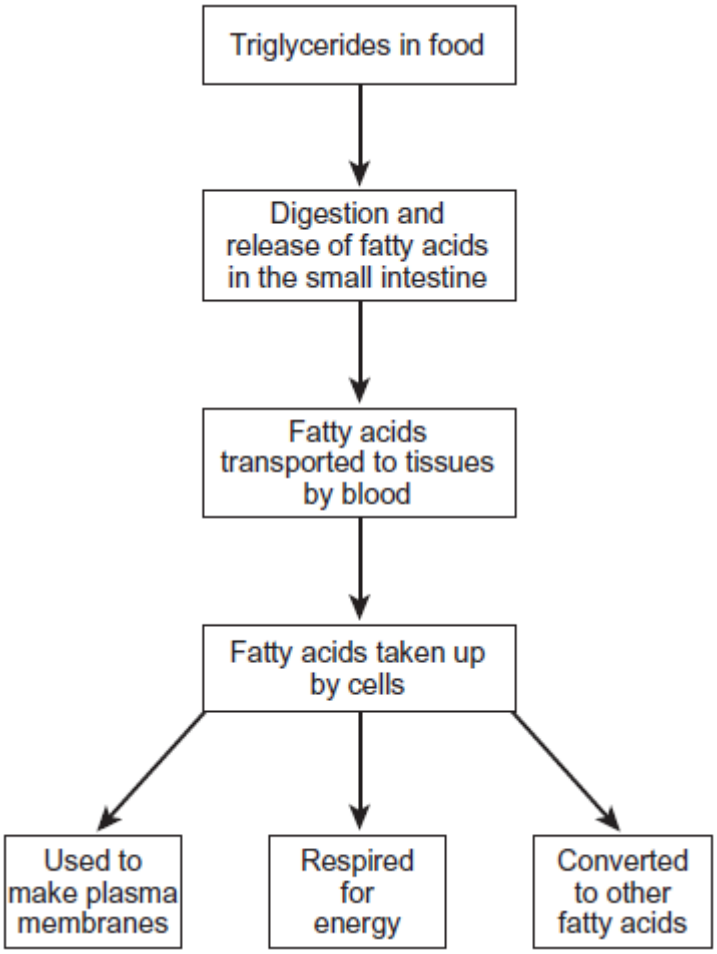
(Total 2 marks)

Q18.

Triglycerides are taken into the body as part of a balanced diet. These triglycerides contain fatty acids including omega-3 fatty acids. It has been discovered that omega-3 fatty acids are associated with health benefits. The benefits include faster development of nerve cells and clearer vision. Omega-3 fatty acids are also associated with protection from heart disease, arthritis and cancer.

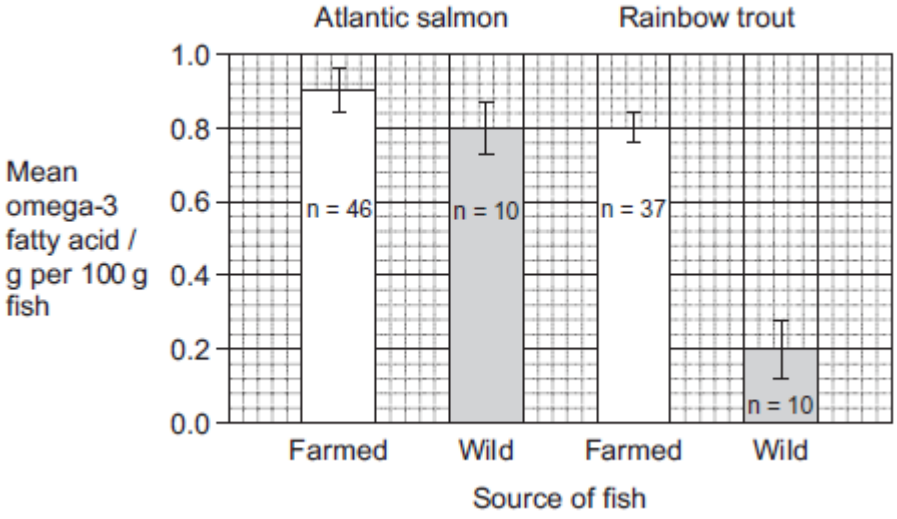
Figure 1 shows how omega-3 and other fatty acids are taken in and used by the bodies of animals including humans.

Figure 1



Omega-3 fatty acids are also found in fish. Scientists investigated the concentration of omega-3 fatty acids from wild-caught and farmed fish. Their results are shown in **Figure 2**.

Figure 2



The bars show standard deviation; n is the sample size.

There is a difference between the concentration of omega-3 fatty acids in the wild trout and trout farmed in cages. Suggest **two** causes of this difference.

1. _____

_____

2. _____

_____

(Total 2 marks)

Q19.

(a) Dietary recommendations are that lipid intake should make up 30% of energy intake. The recommended energy intake for most women aged 19-49 is 8100 kJ day^{-1}.The energy content of lipid is 37.8 kJ g^{-1}. Calculate the recommended lipid intake per day for these women. Show your working.

Answer _____ g

(2)

In humans, triglycerides are the main form of dietary lipids. They are digested in the gut and the products of digestion are absorbed by the small intestine.

(b) Describe a biochemical test that could be performed on a sample of food to determine whether it contained triglycerides.

_____

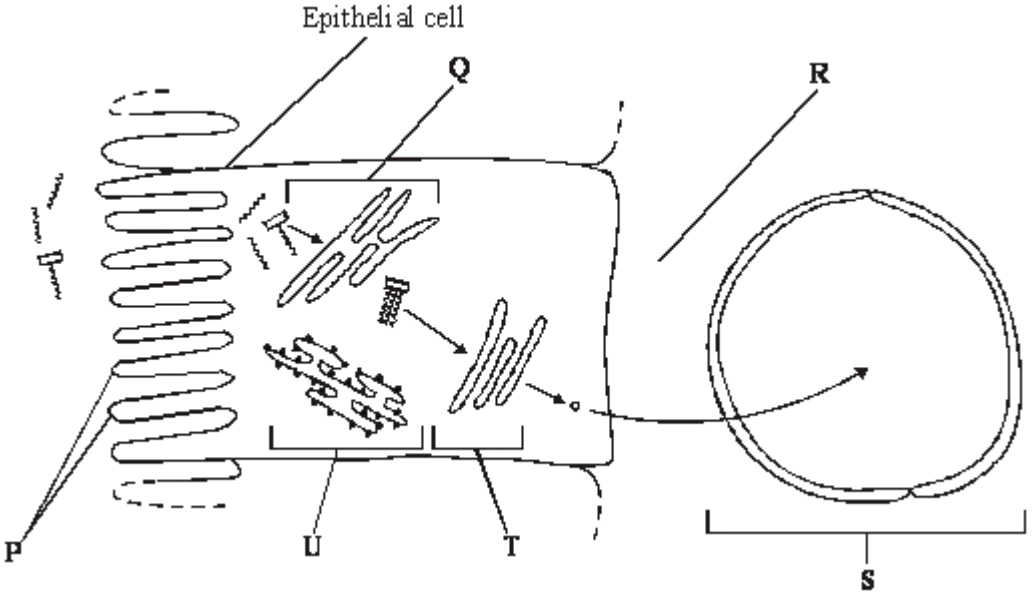
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_____

_____

(2)

(c) The diagram shows the events that occur in the absorption of monoglycerides and fatty acids. These molecules enter the epithelial cells of the small intestine by diffusion. Once inside they are reassembled into triglycerides in organelle **Q**. The triglyceride molecules are formed into chylomicrons in organelle **T**. Chylomicrons are made from many triglyceride molecules surrounded with protein molecules. The chylomicrons leave the cell and enter vessel **S**.



(i) Explain the importance of the structures labelled **P**.

_____

_____

(1)

(ii) Name

R; _____

S. _____

(2)

(iii) Describe the role played by organelle **U** in the formation of chylomicrons.

_____

_____

_____

_____

(2)

(iv) Suggest how the chylomicrons leave the epithelial cell. Give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 11 marks)

Q20.

(a) Starch and protein are biologically important polymers.

(i) Explain what is meant by a polymer.

_____

_____

(1)

(ii) Give **one** example of a biologically important polymer other than starch or protein.

_____

(1)

(b) In an investigation, the enzyme amylase was mixed in a test tube with a buffer solution and a suspension of starch. The amylase broke down the starch to maltose. When all the starch had been broken down, a sample was removed from the test tube and tested with biuret reagent.

(i) Explain why a buffer solution was added to the amylase-starch mixture.

_____

_____

_____

(2)

(ii) What colour would you expect the sample to go when tested with biuret reagent?

_____

(1)

(iii) Give an explanation for your answer to part (ii)

_____

_____

_____

(2)

(Total 7 marks)

Q21.

In an investigation, the effects of caffeine on performance during exercise were measured. One group of athletes (**A**) was given a drink of decaffeinated coffee. Another group (**B**) was given a drink of decaffeinated coffee with caffeine added. One hour later the athletes started riding an exercise bike and continued until too exhausted to carry on. Three days later the same athletes repeated the experiment, with the drinks exchanged.

(a) (i) The researchers added caffeine to decaffeinated coffee. Explain why they did not just use normal coffee.

_____

_____

(1)

(ii) The performance of the athletes might have been influenced by how they expected the caffeine to affect them. How could the researchers avoid this possibility?

_____

_____

(1)

During the exercise the concentrations of glycerol and fatty acids in the blood plasma were measured. The results are shown in the table.

Drink	**Mean time to exhaustion /minutes**	**Mean concentration of blood glycerol/ mmol dm^{-3}**	**Mean concentration of blood fatty acids/ mmol dm^{-3}**
With caffeine	90.2	0.20	0.53
Without caffeine	75.5	0.09	0.31

(b) (i) Describe the effect of caffeine on exercise performance.

_____

_____

(1)

(ii) Suggest **one** explanation for the higher glycerol and fatty acid concentrations in the blood plasma of the athletes after they were given caffeine.

_____

_____

_____

_____

(2)

(c) The researchers measured the volumes of carbon dioxide exhaled and oxygen

inhaled during the exercise. From the results they calculated the respiratory quotient (RQ), using the formula

$$RQ = \frac{\text{volume of carbon dioxide exhaled per minute}}{\text{volume of oxygen inhaled per minute}}$$

When a person is respiring carbohydrate only, RQ = 1.0

When a person is respiring fatty acids only, RQ = 0.7

(i) The basic equation for the respiration of glucose is

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Explain why the RQ for glucose is 1.0.

_____

_____

_____

_____

(2)

(ii) The researchers found that, when the athletes were given the drink containing caffeine, their mean RQ was 0.85. When given the drink without caffeine their mean RQ was 0.92.

The researchers concluded that when the athletes had caffeine they used glycogen more slowly than when they did not have caffeine, and that the store of glycogen in their muscles was used up less quickly during the exercise.

Explain the evidence from the information above and from the table which supports these conclusions.

_____

_____

_____

_____

_____

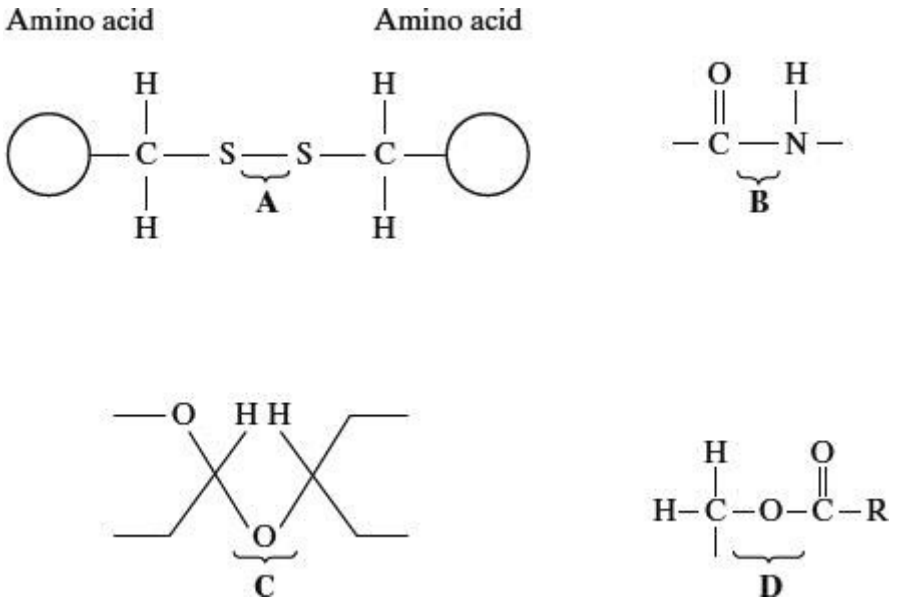
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(3)

(Total 10 marks)

Q22.

The diagrams show four types of linkage, **A** to **D**, which occur in biological molecules.



(a) Name the chemical process involved in the formation of linkage **B**.

_____

(1)

(b) Give the letter of the linkage which

(i) occurs in a triglyceride molecule;

_____

(1)

(ii) might be broken down by the enzyme amylase;

_____

(1)

(iii) may occur in the tertiary, but not the primary structure of protein.

_____

(1)

(c) Describe how a saturated fatty acid differs in molecular structure from an unsaturated fatty acid.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q23.

(a) **Figure 1** shows the structure of a molecule of glycerol and a molecule of fatty acid.

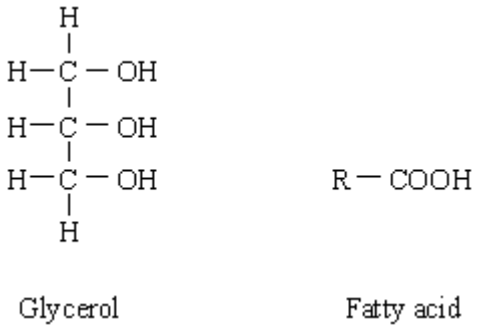


Figure 1

Draw a diagram to show the structure of a triglyceride molecule.

(2)

(b) Explain why triglycerides are **not** considered to be polymers.

_____

_____

(1)

(c) **Figure 2** shows two types of fat storage cell. Mammals living in cold conditions have more brown fat cells than mammals living in tropical conditions.

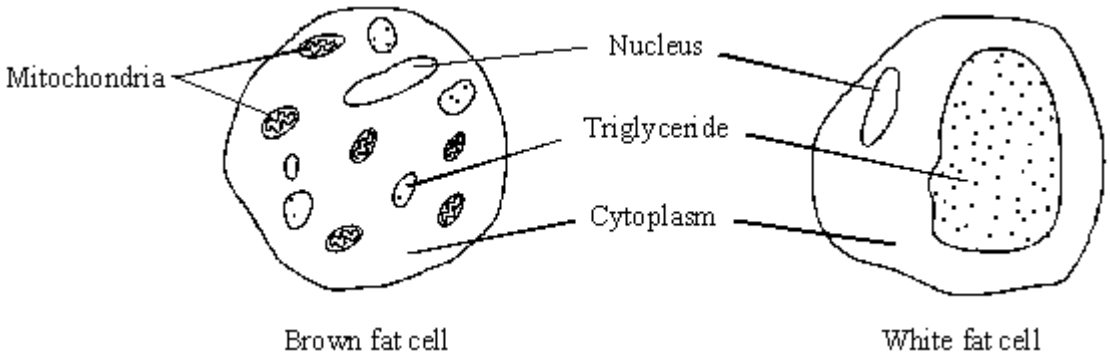


Figure 2

Using evidence from **Figure 2** to support your answer, suggest how the function of brown fat cells differs from that of white fat cells.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)