BIOLOGICAL MOLECULES

Lipids EXAM Q&A

Q1.

(a) Explain the arrangement of phospholipids in a cell-surface membrane.

(2)

(b) Describe how an ester bond is formed in a phospholipid molecule.

(2)

(c) State and explain the property of water that helps to prevent temperature increase in a cell.

Property _____

Explanation _____

(2)

(Total 6 marks)

Q2.

To study lipid digestion, a scientist placed a tube into the gut of a healthy 20-year-old man. The end of the tube passed through the stomach but did not reach as far as the ileum.

The scientist fed the man a meal containing triglycerides through the tube.
The scientist also used the tube to remove samples from the man's gut at intervals after the meal.

The scientist measured the type of lipid found in the samples. Some of her results are shown in the table below.

Sample	Time of collection after meal / min	Concentration of fatty acids / mg cm^{-3}	Concentration of triglycerides / mg cm^{-3}
A	45	2.7	0.6
B	75	3.3	0.0

(a) Use your knowledge of lipid digestion to explain the differences in the results for samples **A** and **B** shown in the table above.

You should assume that **no** absorption had occurred.

(3)

(b) After collecting the samples, the scientist immediately heated them to 70 °C for 10 minutes.

Explain why.

(2)

(c) Describe the role of micelles in the absorption of fats into the cells lining the ileum.

(3)

(Total 8 marks)

Q3.

(a) Explain **five** properties that make water important for organisms.

(5)

(b) Describe the biochemical tests you would use to confirm the presence of lipid, non-reducing sugar and amylase in a sample.

(5)

(c) Describe the chemical reactions involved in the conversion of polymers to monomers and monomers to polymers.

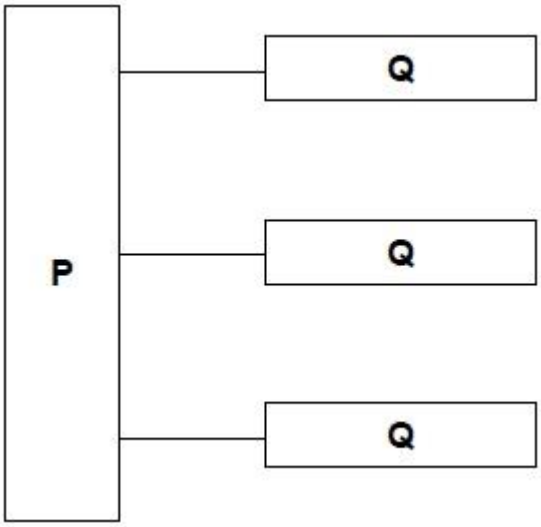
Give **two** named examples of polymers and their associated monomers to illustrate your answer.

(5)

(Total 15 marks)

Q4.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q5.

(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.

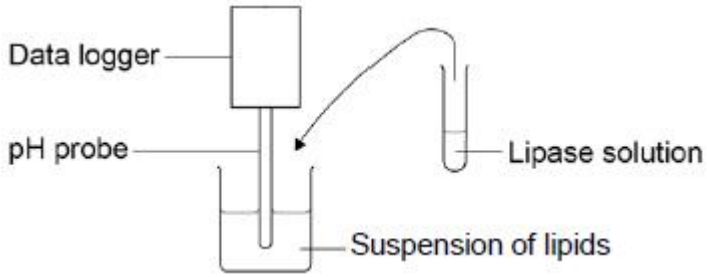
(4)

(Total 15 marks)

Q6.

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)

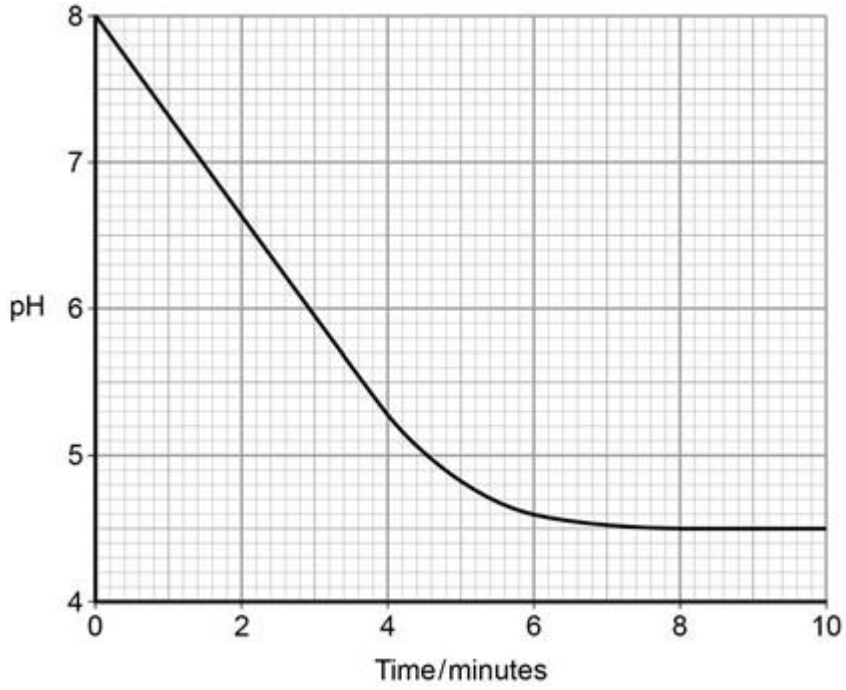
(c) Give the suitable control for this investigation.

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

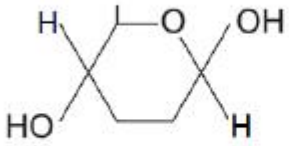
(3)

(Total 11 marks)

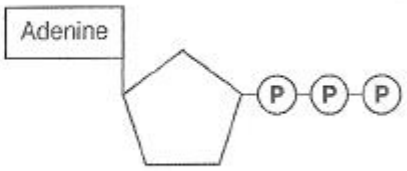
Q7.

The diagram shows four biological molecules.

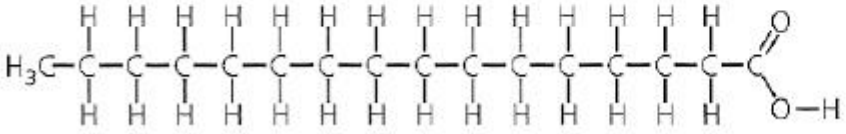
Molecule **A**



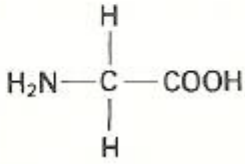
Molecule **B**



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)

Q8.

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

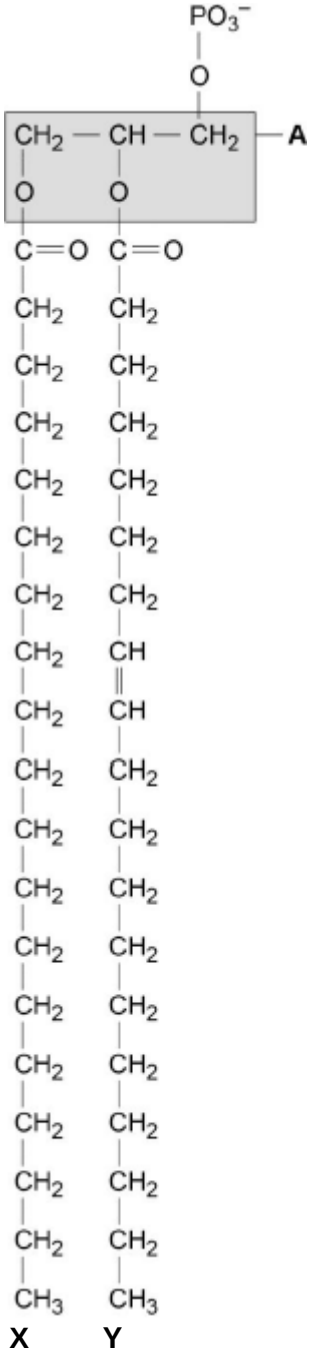
_____

_____

_____

(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)

Q9.

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.

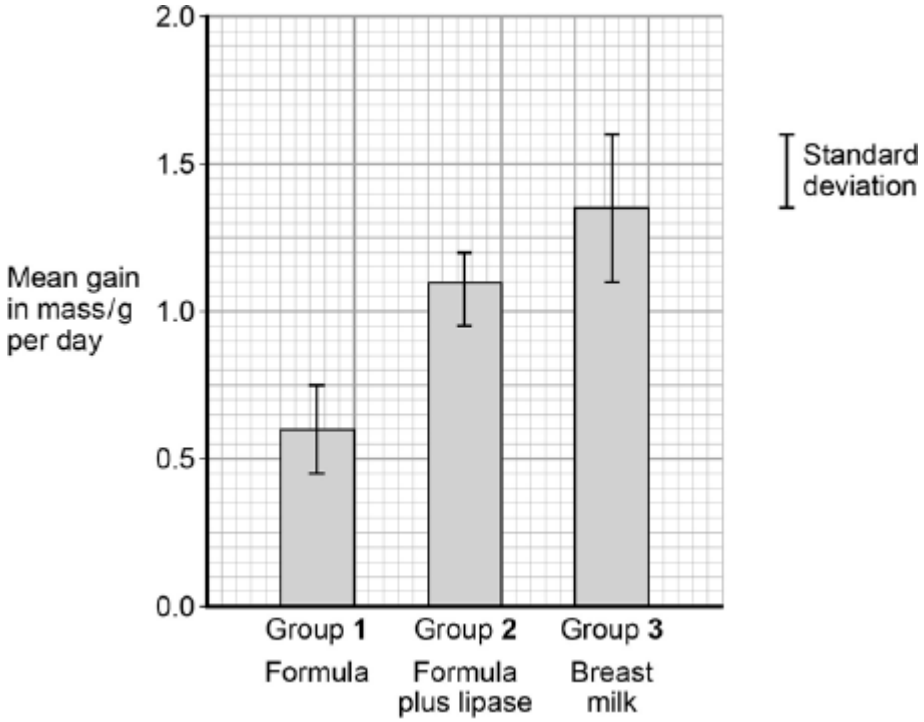
The scientists divided the kittens randomly into three groups of six.

- 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)

Q10.

(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.

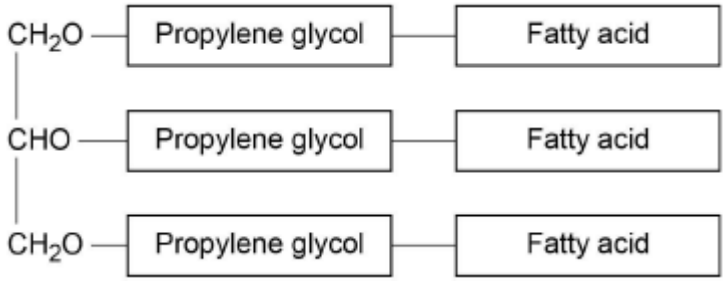
(2)

(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.

(1)

The diagram shows the structure of a fat substitute.



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

Suggest why.

(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.

_____

_____

_____

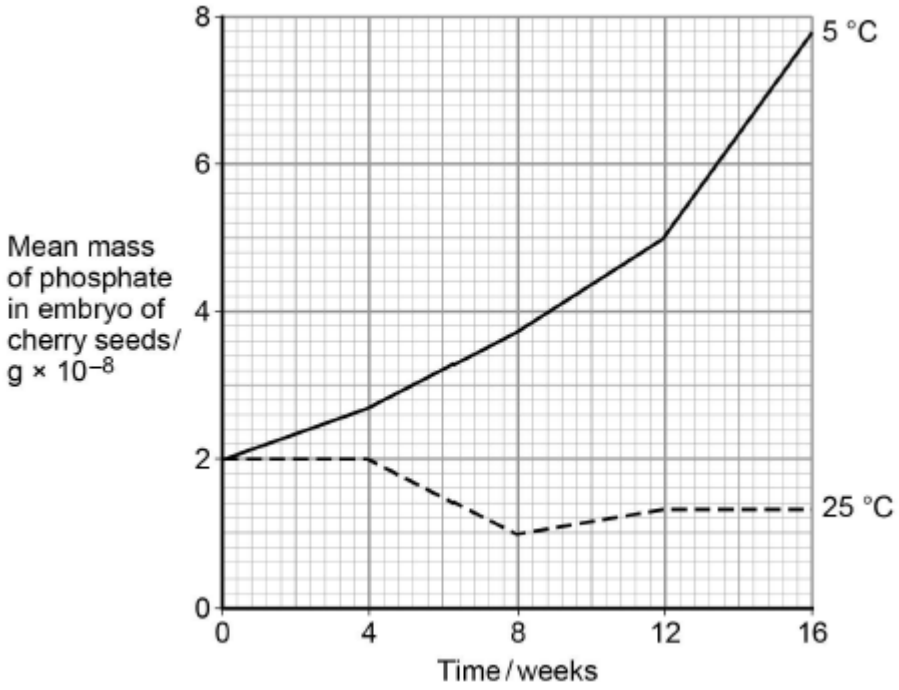
(1)

(Total 7 marks)

Q11.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

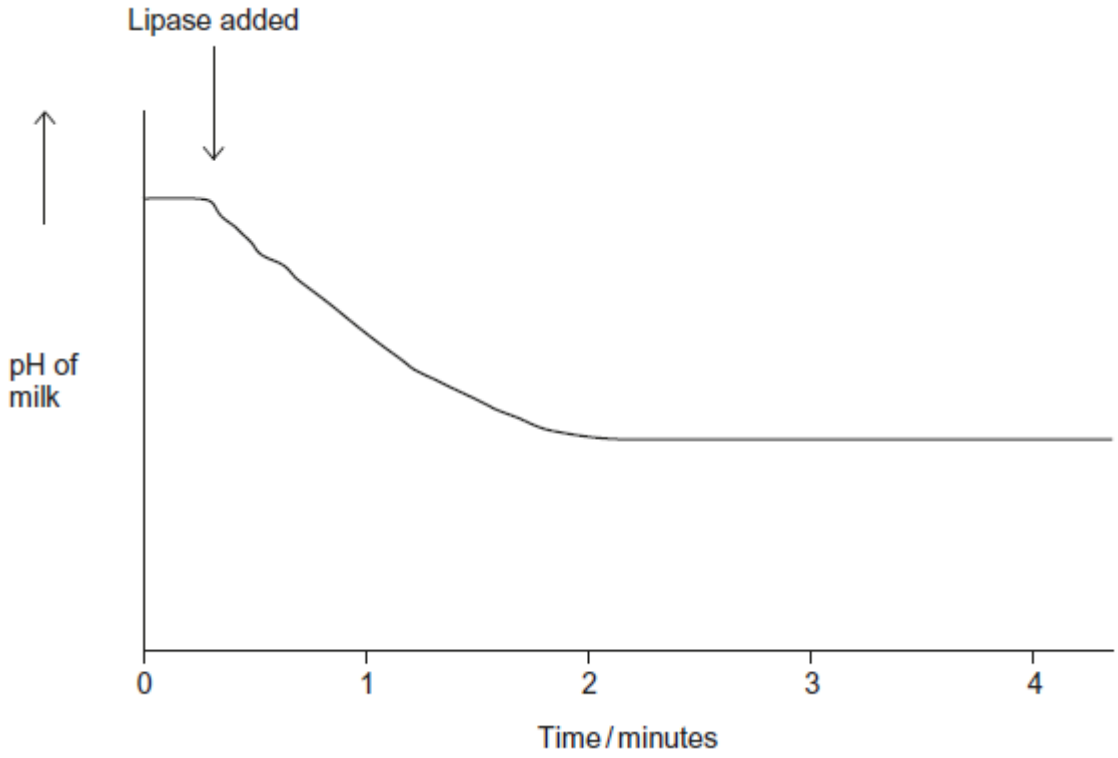
Q12.

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.

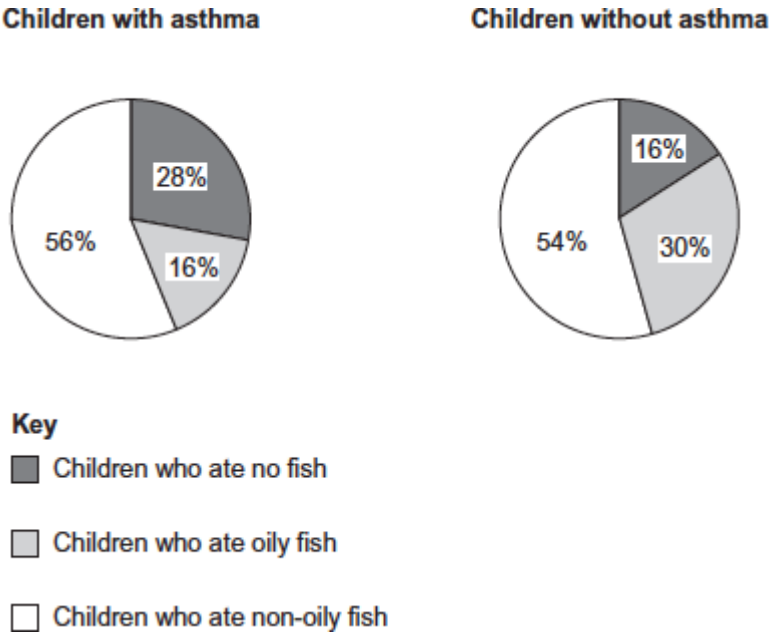
(2)

(Total 6 marks)

Q13.

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?

(3)

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

sample of fish.

(3)

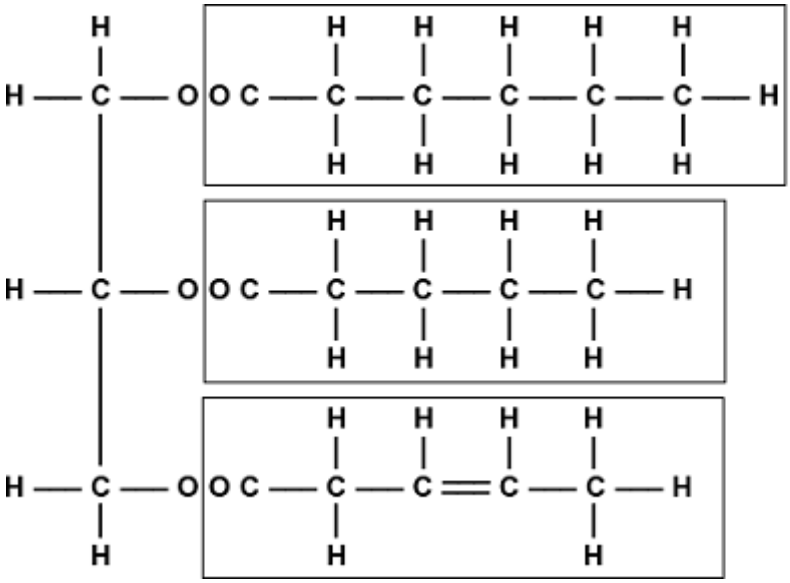
(Total 6 marks)

Q14.

(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)

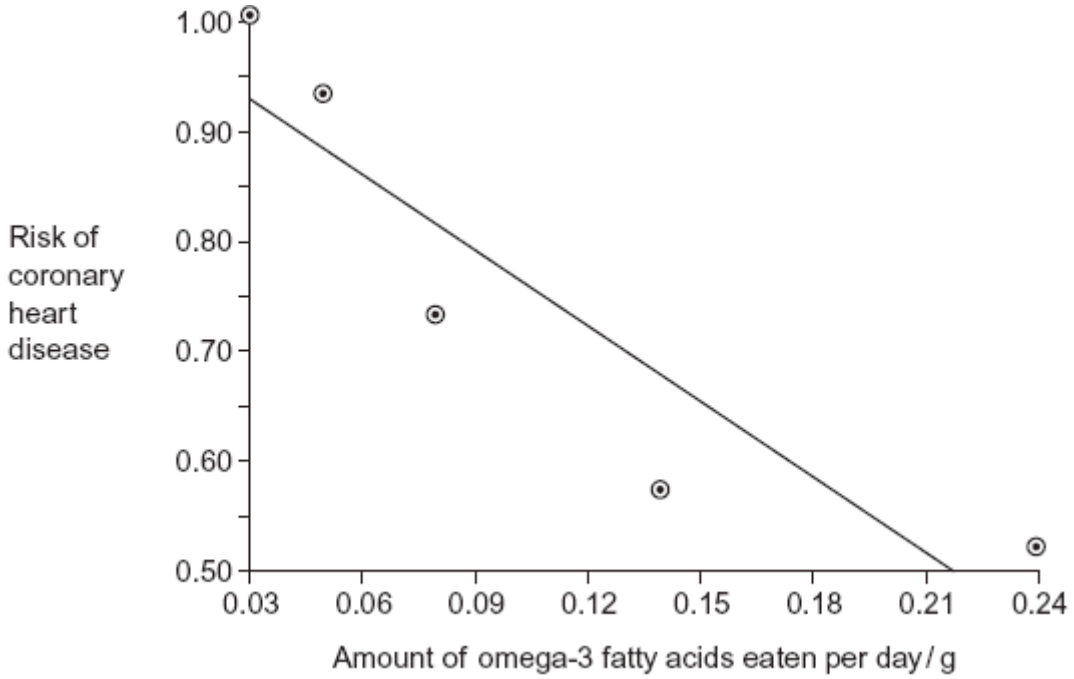
(Total 8 marks)

Q15.

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

(2)

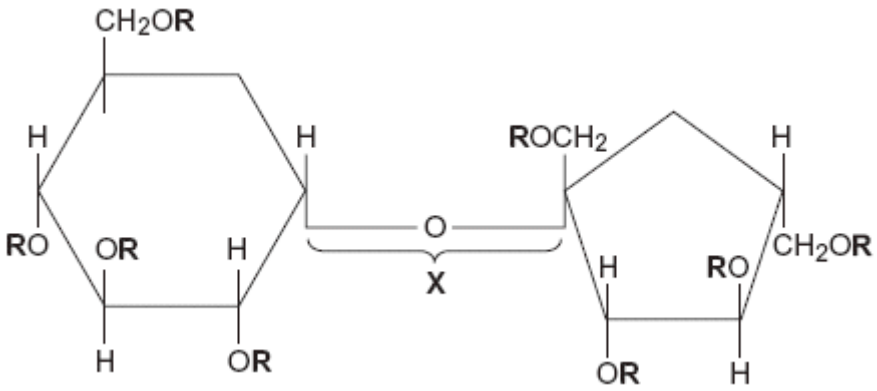
(b) Scientists investigated the relationship between the amount of omega-3 fatty acids eaten per day and the risk of coronary heart disease. The graph shows their results.



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

(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)

Q16.

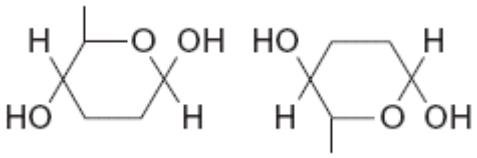
(a) The table shows some substances found in cells. Complete the table to show the properties of these substances. Put a tick in the box if the statement is correct.

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.

_____

_____

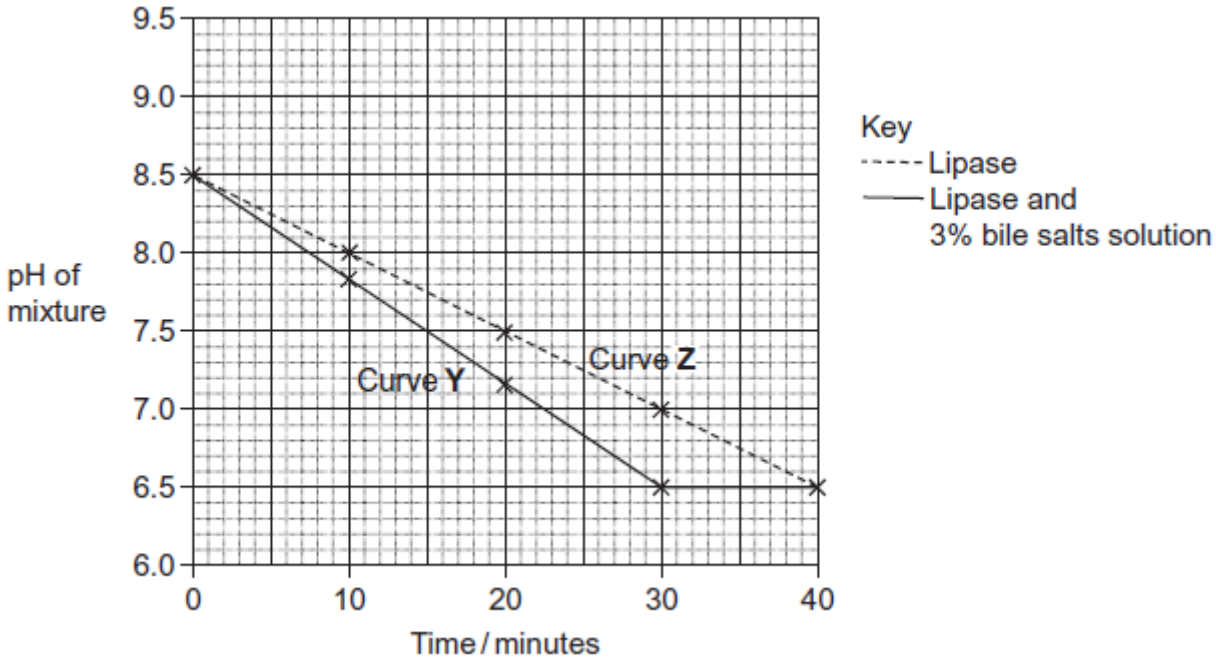
_____

(1)

(Total 9 marks)

Q17.

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**.

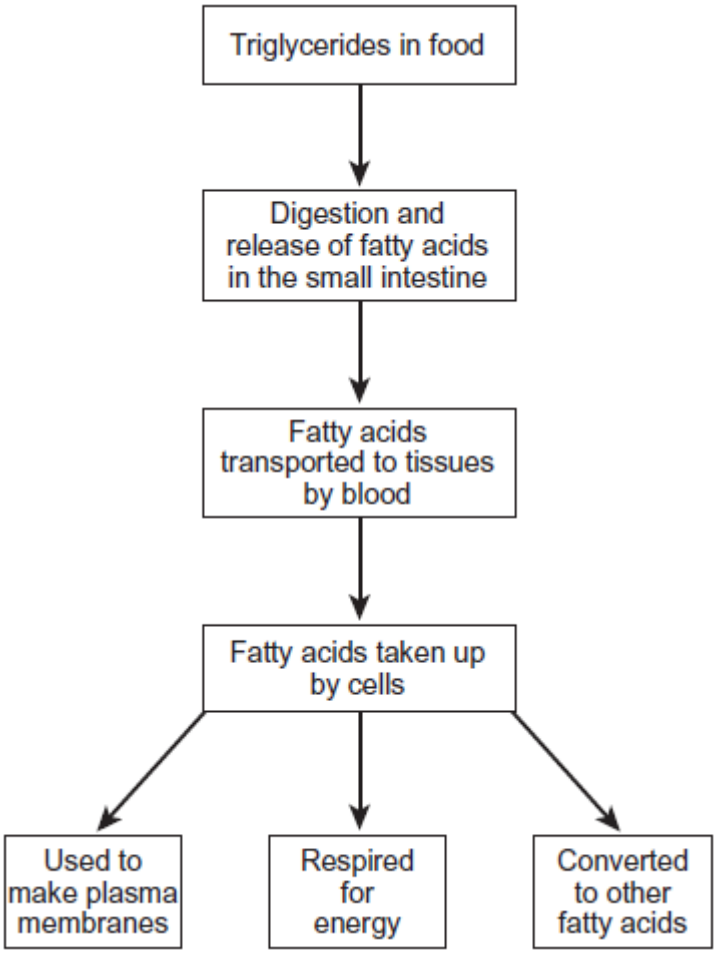
(1)

(Total 4 marks)

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.

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. _____

_____

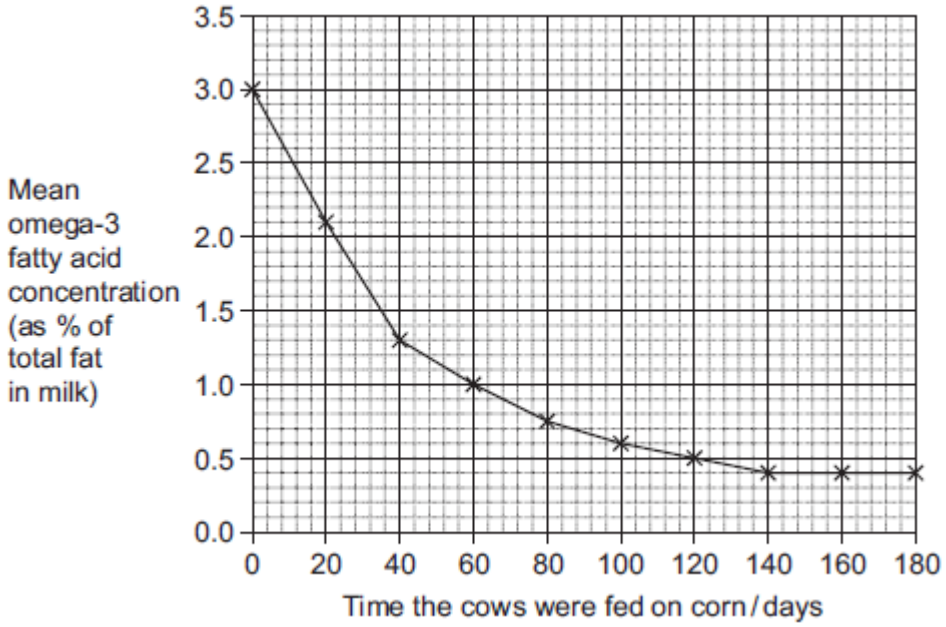
_____

_____

(Total 4 marks)

Q19.

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)

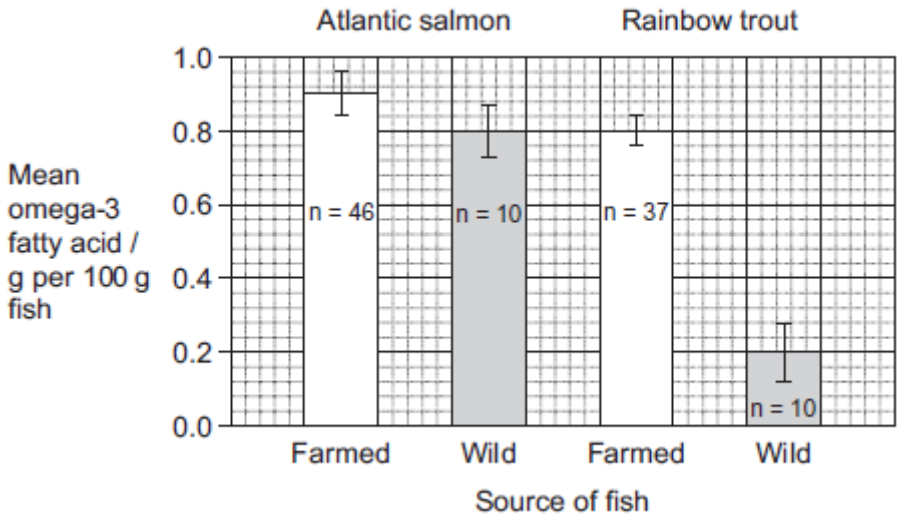
(iii) One farmer concluded from the graph that feeding cows on corn reduces the omega-3 fatty acid content in milk. Evaluate this conclusion.

(4)

(Total 10 marks)

Q20.

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.

_____

_____

_____

_____

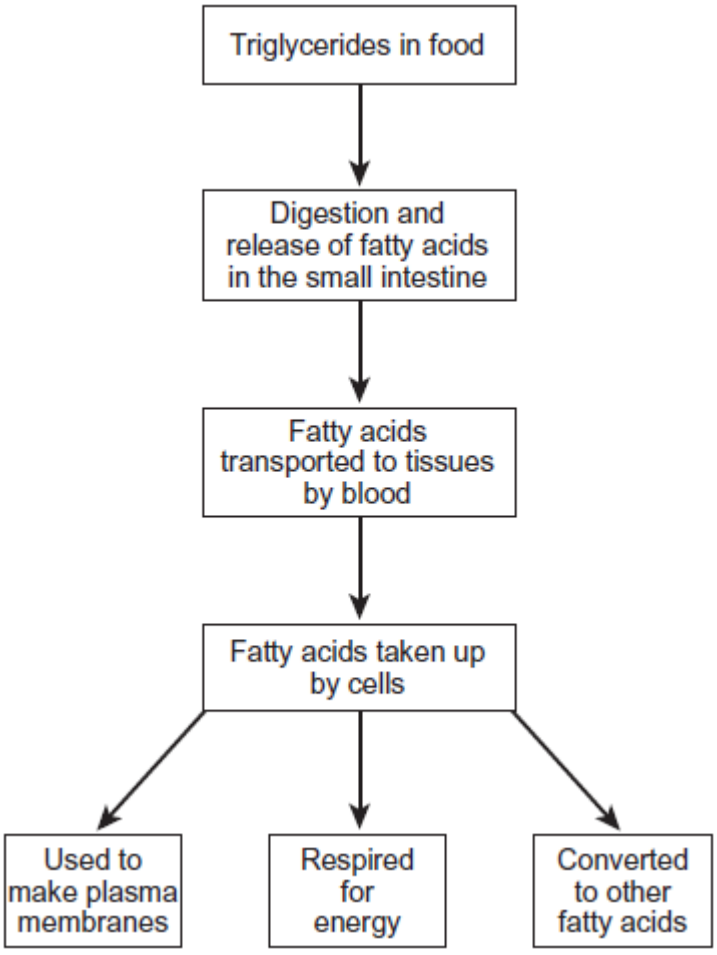
(Total 2 marks)

Q21.

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.

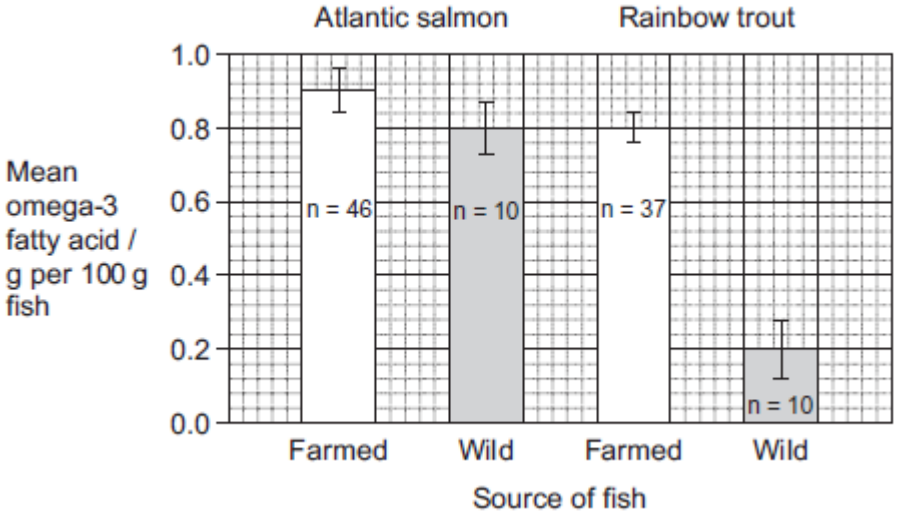
Figure 1 shows how omega-3 and other fatty acids are taken in and used by the bodies of animals including humans.

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)

Q22.

(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.

_____

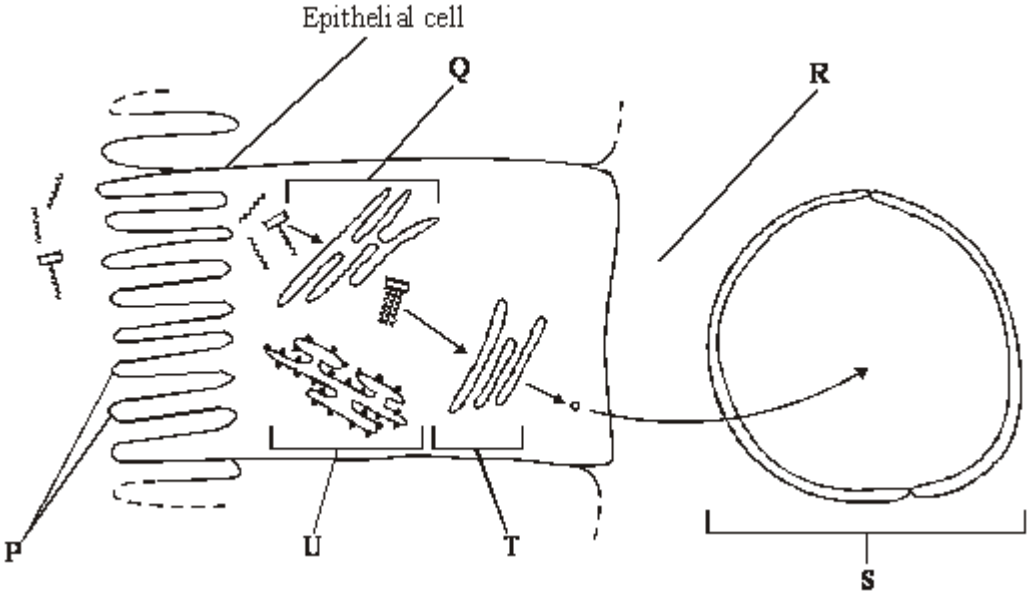
_____

_____

_____

(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)

Q23.

(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)

Q24.

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.

_____

_____

_____

_____

_____

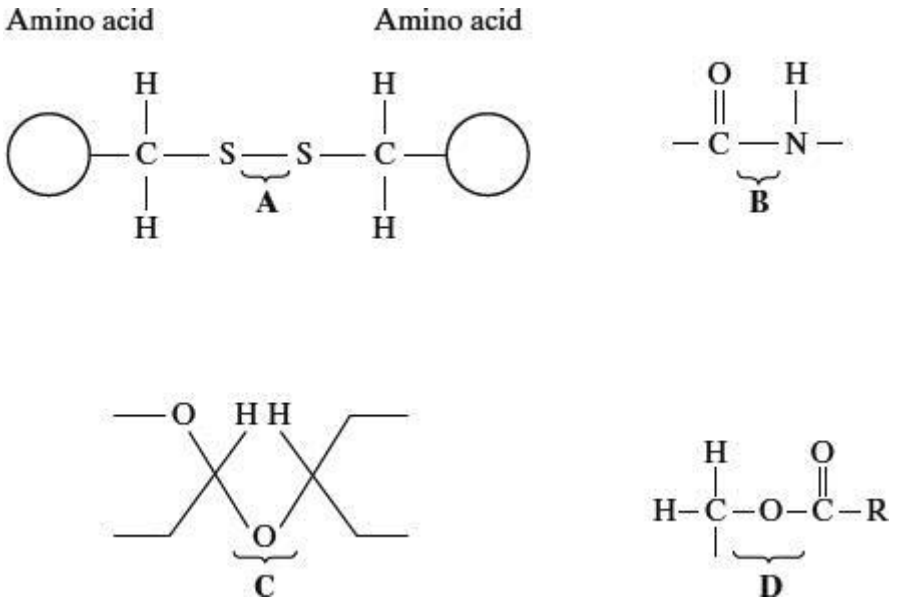
_____

(3)

(Total 10 marks)

Q25.

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)

Q26.

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

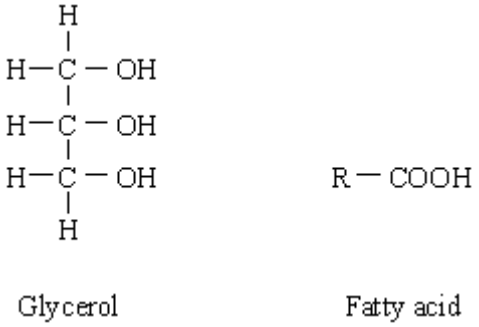


Figure 1

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.

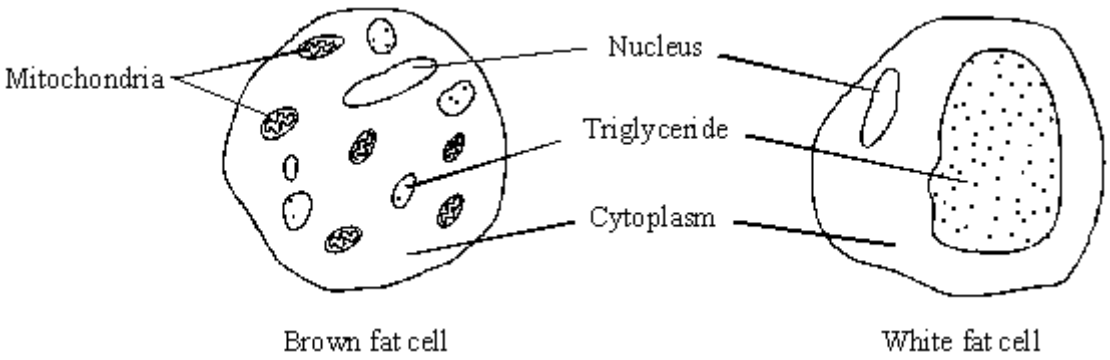


Figure 2

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)

Q27.

(a) Name the substance that muscles use as their immediate energy source.

_____

(1)

(b) Sports scientists investigated the change in energy sources used during exercise. They measured the percentage of energy obtained from carbohydrate and the percentage of energy obtained from fat in two groups of athletes.

- **Group A** exercised at different intensities for the same time.
- **Group B** exercised at the same intensity for different times.

They calculated the intensity of the exercise as a percentage of VO_2 max.
VO_2 max is the maximum volume of oxygen the athletes can take in per minute.

The results for **Group A** are shown in **Figure 1** and the results for **Group B** are shown in **Figure 2**.

Figure 1

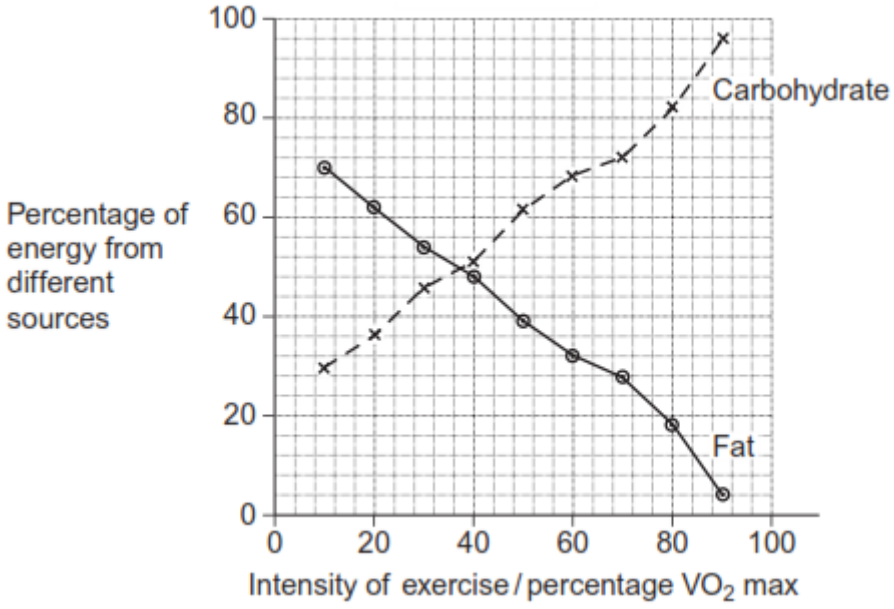
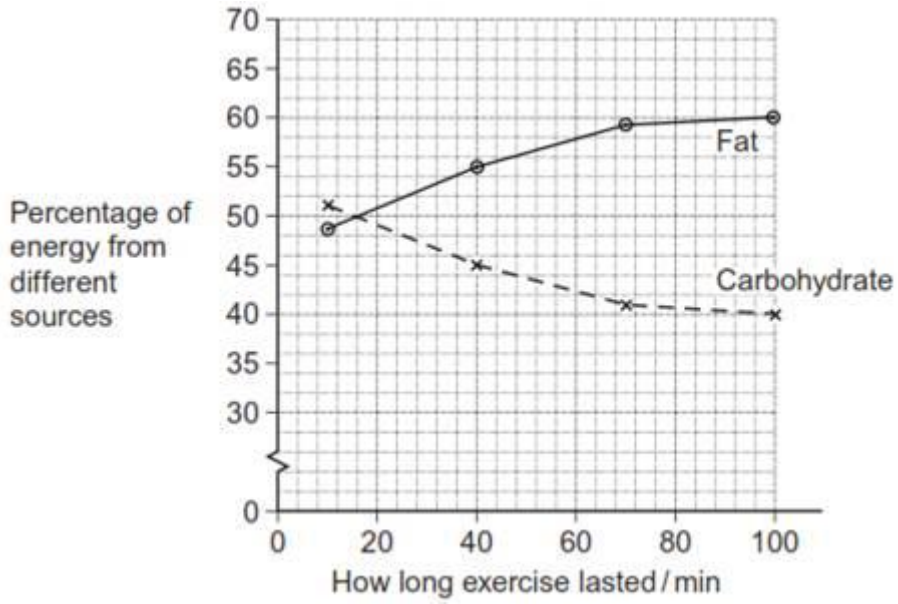


Figure 2



(i) Calculate the ratio of the percentage of energy from carbohydrate to the percentage of energy from fat when the intensity of exercise is 70% VO_2 max. Show your working.

Answer _____

(2)

(ii) A person wishes to lose some body fat by exercising. What sort of exercise would be most effective? Use the information in **Figures 1** and **2** to explain your answer.

_____

_____

_____

_____

_____

_____

(*Extra space*) _____

_____

_____

(3)

(Total 6 marks)

Q1.

(a) 1. Bilayer

OR

Water is present inside and outside a cell;

Accept annotated diagram for 'bilayer'

Accept cytoplasm/tissue fluid for water

Accept for two marks, annotated diagram of bilayer with water labelled on each side

2. Hydrophobic (fatty acid) tails point away/are repelled from water

OR

Hydrophilic (phosphate) heads point to/are in/are attracted to water;

2

Ignore hydrophilic/phosphate heads protect hydrophobic/fatty acid tails

(b) 1. Condensation (reaction)

OR

Loss of water;

2. Between of glycerol **and** fatty acid;

Accept labelled diagram

2

(c) 1. High (specific) heat capacity;

2. Buffers changes in temperature;

Accept ideas such as a lot of energy needed/gained to change temperature

2

[6]

Q2.

(a) 1. Triglycerides decrease **because** of the action of <u>lipase</u>

OR

Fatty acids increase **because** of the action of <u>lipase;</u>

2. Triglycerides decrease **because** of hydrolysis (of triglycerides)

OR

Fatty acids increase **because** of hydrolysis (of triglycerides);

3. Triglycerides decrease **because** of digestion of <u>ester</u> bonds (between fatty acid and glycerol)

OR

Fatty acids increase **because** of digestion of ester bonds (between fatty acid and glycerol);

Triglycerides decreasing or fatty acids increasing only need to be stated once.

Accept 'lower/higher/quoted numbers' for 'decrease/increase'.

Only withhold one mark if there is no/incorrect reference to triglycerides decreasing or fatty acids increasing.

3

(b) 1. To denature the enzymes/lipase;

Accept description of denaturation in terms of change in tertiary structure.

2. So no further digestion/hydrolysis/catalysis occurred;

Accept 'break down' for digestion.

2

(c) 1. Micelles include bile salts and fatty acids;

Ignore other correct components of micelles.

2. Make the fatty acids (more) soluble in water;

For 'fatty acids' accept fats / lipids.

3. Bring/release/carry fatty acids to cell/lining (of the ileum);

For 'fatty acids' accept fats/lipids.

4. Maintain high(er) concentration of fatty acids to cell/lining (of the ileum);

5. Fatty acids (absorbed) by <u>diffusion</u>;

Reject if absorbed by facilitated diffusion

Ignore if micelles themselves are being absorbed.

Ignore references to monoglycerides.

3 max

[8]

Q3.

(a) 1. A <u>metabolite</u> **in** condensation/hydrolysis/ photosynthesis/respiration;

2. A solvent **so** (metabolic) reactions can occur
OR
A solvent **so** allowing transport of substances;

3. High heat capacity **so** buffers changes in temperature;

For 'buffer' accept 'resist'.

4. Large latent heat of vaporisation **so** provides a cooling effect (through evaporation);

5. Cohesion (between water molecules) **so** supports columns of water (in plants);

For 'columns of water' accept 'transpiration stream'.

Do not credit 'transpiration' alone but accept description of

'stream'.

For 'columns of water' accept 'cohesion-tension (theory)'.

For cohesion accept hydrogen bonding

6. Cohesion (between water molecules) **so** produces surface tension supporting (small) organisms;

For cohesion accept hydrogen bonding

Ignore reference to pH.

Allow other suitable properties but must have a valid explanation.

For example

- *ice floating **so** maintaining aquatic habitat beneath*
- *water transparent **so** allowing light penetration for photosynthesis*

5 max

(b)

4 max if marks gained from only 2 substance tests.

Lipid

1. Add ethanol/alcohol **then** add water **and** shake/mix
OR
Add ethanol/alcohol **and** shake/mix **then** pour into/add water;

Reject heating emulsion test.

Accept 'Add Sudan III and mix'.

2. White/milky emulsion
OR
emulsion test turns white/milky;

Ignore cloudy.

Reject precipitate.

Accept (for Sudan III) top (layer) red.

Non-reducing sugar

3. Do Benedict's test **and** stays blue/negative;

Ignore details of method for Benedict's test for this mp.

4. Boil with acid **then** neutralise with alkali;

Accept named examples of acids/alkalis.

5. Heat with Benedict's **and** becomes red/orange (precipitate);

Do not credit mp5 if no attempt at mp4.

For 'heat' ignore 'warm'/'heat gently'/'put in a water bath' but accept stated temperatures ≥ 60°C.

Heat must be stated again, do not accept using residual heat from mp4.

*Accept 'do the Benedict's test' **if** full correct method given elsewhere.*

Accept 'sodium carbonate, sodium citrate and copper sulfate solution' for Benedict's but must have all three if term 'Benedict's' not used.

Amylase

6. Add biuret (reagent) **and** becomes purple/violet/mauve/lilac;

Accept 'sodium or potassium hydroxide and copper sulfate solution' for 'biuret'.

Reject heating biuret test.

7. Add starch, (leave for a time), test for reducing sugar/absence of starch;

5 max

(c)

Ignore reference to dimers.

1. A condensation reaction joins monomers together **and** forms a (chemical) bond **and** releases water;

2. A hydrolysis reaction breaks a (chemical) bond between monomers **and** uses water;

3. A suitable example of polymers and the monomers from which they are made;

3. and 4. Polymers must contain many monomers.

3. and 4: suitable examples include

- *amino acid **and** polypeptide, protein, enzyme, antibody or specific example*
- *nucleotide **and** polynucleotide, DNA or RNA*
- *Alpha glucose **and** starch/glycogen*
- *Beta glucose **and** cellulose.*

If neither specific carbohydrate example is given, allow monosaccharide/glucose and polysaccharide.

3. and 4. Reject (once) reference to triglycerides.

4. A second suitable example of polymers and the monomers from which they are made;

5. Reference to a correct bond within a named polymer;

Reject reference to ester bond.

5

[15]

Q4.

(a) P – glycerol

Q – fatty acid (chains)

Accept phonetic spelling

2

(b) Ester (bond);

1

(c) 1. (Mix / shake sample) with ethanol, then water;

Sequence is important

2. White / milky (emulsion);

Ignore cloudy

Reject precipitate

2

[5]

Q5.

(a) 1. Named structures – trachea, bronchi, bronchioles, alveoli;

Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

2. Above structures named in correct order
OR
Above structures labelled in correct positions on a diagram;

Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

3. Breathing in – diaphragm contracts **and** external intercostal muscles contract;

4. (Causes) volume increase and pressure decrease in thoracic cavity (to below atmospheric, resulting in air moving in);

For thoracic cavity accept 'lungs' or 'thorax'.

Reference to 'thoracic cavity' only required once.

5. Breathing out - Diaphragm relaxes **and** internal intercostal muscles contract;

*Accept diaphragm relaxes **and** (external) intercostal muscles relax **and** lung tissue elastic (so recoils).*

6. (Causes) volume decrease and pressure increase in thoracic cavity (to above atmospheric, resulting in air moving out);

For thoracic cavity accept 'lungs' or 'thorax'.

Reference to 'thoracic cavity' only required once.

If idea of thoracic cavity is missing or incorrect, allow ECF for mark point 6.

6

(b) 1. Both contain ester bonds (between glycerol and fatty acid);

All statements must be clearly comparative or linked by the candidate, not inferred from separate statements.

Accept mark points shown on adjacent annotated diagrams.

2. Both contain glycerol;

3. Fatty acids on both may be saturated or unsaturated;

4. Both are insoluble in water;

5. Both contain C, H and O but phospholipids also contain P;

Must relate to element.

6. Triglyceride has three fatty acids and phospholipid has two fatty acids plus phosphate group;

7. Triglycerides are hydrophobic/non-polar and phospholipids have hydrophilic and hydrophobic region;
Accept 'non-polar' for hydrophobic and 'polar' for hydrophilic.

8. Phospholipids form monolayer (on surface)/micelle/bilayer (in water) but triglycerides don't;

5 max

(c) 1. Glucose **and** galactose;
Ignore α or β for glucose

2. Joined by condensation (reaction);

3. Joined by glycosidic bond;

4. Added to polypeptide in Golgi (apparatus);;

4

[15]

Q6.

(a) Student was measuring change in pH
OR
Buffer would maintain a constant pH.

1 max

(b) 1. Volume of suspension of lipids;

2. Concentration of suspension of lipids;

3. Volume of lipase solution;

4. Temperature;

2 max

(c) Boiled lipase solution;

1

(d) –0.34 = 2 marks

0.34 = 1 mark

2

(e) 1. Fatty acids produced;

2. Curve levels off as all substrate used up.
accept the lower pH inactivates / denatures the enzyme

2

(f) 1. Faster fall in pH **and** levels off at same point;

2. More enzyme = substrate complexes formed;

3. Same amount of fatty acids produced / product

3

[11]

Q7.

(a) 1. A = β glucose;

B = Adenosine triphosphate;

do not accept ATP

2

(b) 1. Saturated;

1

2. Fatty acid;

1

(c) 1. Peptide bond shown correctly;

2. Rest of dipeptide structure shown correctly;

2

(d) Water;

1

[7]

Q8.

(a) 1. Dissolve in alcohol, then add water;
2. White emulsion shows presence of lipid.

2

(b) Glycerol.

1

(c) Ester.

1

(d) **Y** (no mark)
Contains double bond between (adjacent) carbon atoms in hydrocarbon chain.

1

(e) 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
2. Multiply answer by 100.

2

(f) Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape;

Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining shape.

1

(g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein.

2 max

[10]

Q9.

(a) **Two** suitable suggestions;

E.g.

1. (Are mammals so) likely to have same physiology / reactions as humans;
2. Small enough to keep in laboratory / produce enough milk to extract;
3. (Can use a) large number.

Ignore references to ethical issues

2 max

(b) 1. Hydrolysis of lipids produces fatty acids;
2. Which lower pH of mixture.

2

(c) 1. (Bile-activated lipase / it) increases growth rate (of kittens);
2. Results for formula with lipase not (significantly) different from breast milk / are (significantly) different from formula milk alone;
3. Showing addition of (bile-activated) lipase is the likely cause (of increased growth);
4. Lipase increases rate of digestion of lipids / absorption of fatty acids.

3 max

[7]

Q10.

(a) 1. In phospholipid, one fatty acid replaced by a phosphate;

Ignore references to saturated and unsaturated

Accept Pi/PO_4^{3-} / (P)

Reject P/Phosphorus

Accept annotated diagrams

1

(b) 1. Add ethanol, then add water;

Reject ethanal/ethonal

Accept 'Alcohol/named alcohol'

2. White (emulsion shows lipid);

Accept milky – Ignore 'cloudy'

Sequence must be correct

If heated then DQ point 1

Reject precipitate

2

(c) Saturated single/no double bonds (between carbons)

OR

Unsaturated has (at least one) double bond (between carbons);

Accept hydrocarbon chain/R group for 'between carbons' for either

Accept Sat = max number of H atoms bound

'It' refers to saturated

1

(d) 1. (Fat substitute) is a different/wrong shape/not complementary;

OR

Bond between glycerol/fatty acid and propylene glycol different (to that between glycerol and fatty acid)/no ester bond;

2. Unable to fit/bind to (active site of) lipase/no ES complex formed;

If wrong bond name given (e.g. peptide/glycosidic), then penalise once

2

(e) It is hydrophilic/is polar/is too large/is too big;

Ignore 'Is not lipid soluble'

1

[7]

Q11.

(a) Hydrolysis (reaction);

1

(b) 1. (Phosphate required) to make RNA;
2. (Phosphate required) to make DNA;

1 and 2. If neither DNA or RNA are named allow one mark for nucleotide/nucleic acid/phosphodiester bonds/sugar-phosphate backbone.

3. (Phosphate required) to make ATP/ADP;
4. (Phosphate required) to make membranes;

Ignore: phospholipids without reference to membranes.

5. (Phosphates required) for phosphorylation;

Accept: as additional mark points any named biological molecule containing phosphate e.g. NADP, AMP, RuBP.

2 max

(c) Accept answer in range from 3.7 : 1 to 4.1 : 1;

Reject any ratio not : 1.

1

(d) 1. Seeds/embryo remain dormant/inactive in winter/cold
OR
Growth/development of seed/embryo during winter/cold;

Ignore: hibernate.

Accept: 'seed survives winter/cold'.

Reject: plant develops or seed germinates during winter/cold.

2. Seeds/plants develop in spring/summer
OR
Seeds/plants develop when temperature/light increases;

Accept: seeds/plants develop when more light or when temperature is higher.

Accept: seed germinates/'sprouts' during spring/summer or when temp/light increases.

3. Plant photosynthesise (in spring/when warm);
4. Produce (more) seeds/offspring in spring/growing season;

3 max

[7]

Q12.

(a) Any **one** from:

1. Numerical readings / not subjective / colour change subjective / gives quantitative data / not qualitative / gives continuous data;
2. Greater accuracy;

Accept greater precision

1 max

(b) Fatty acids produced;

1

(c) 1. No more (fatty) acids produced;
2. All triglycerides/fat//lipids/substrate used up / enzyme denatured;

2

(d) 1. Line starting at same point and falling above original line;
2. Levels off at same pH, but later;

Accept the line still falling at 4 minutes

Do not credit if levels off at higher pH

2

[6]

Q13.

(a) 1. Fewer children / less likely that children with asthma eat fish;

Accept converse.

2. Fewer children / less likely that children with asthma eat oily fish;

MP1 and 2 − Allow use of numbers.

3. Little / only 2% / no difference in (children with or without asthma who eat) non-oily fish.

Do not accept arguments related to amount of fish eaten

3

(b) 1. (Shake with) ethanol / alcohol;

1. Accept named alcohol

2. Then add (to) water;

2. Order must be correct

3. White / milky / cloudy (layer indicates oil).

3. Ignore forms emulsion as in stem

3. Ignore precipitate

3

[6]

Q14.

(a) 1. Crush / grind;

2. With ethanol / alcohol;

3. Then add water / then add to water;

2. Water must be added after ethanol for third mark.

4. Forms emulsion / goes white / cloudy;

4. Do not accept carry out emulsion test.

3

(b) (i) 4 / four;

1

(ii) 1. Phosphate / PO_4;

"It" refers to phospholipid.

2. Instead of one of the fatty acids / and two fatty acids;

1. Accept minor errors in formula. Do not accept phosphorus / phosphorus group.

2

(iii) 1. Double bonds (present) / some / two carbons with only one hydrogen / (double bonds) between carbon atoms / not saturated with hydrogen;

Answer refers to unsaturated unless otherwise clearly indicated.

May be shown in appropriate diagram.

2. In (fatty acid) **C** / 3;

2

[8]

Q15.

(a) Double bond(s);

(Bonds) between carbon;

C=C bond(s) = 2 marks

'No' C=C bond(s) disqualifies 1 mark only

Accept: does not contain maximum number of H for 1 mark

Neutral: contains C=O bonds

2

(b) Graph shows negative correlation / description given;

Correlation does not mean causation / prevention / shows lower risk not prevention;

May be due to another factor / example given;

Neutral: refs. to methodology e.g. sample size / line of best fit

***Q**: Do not allow 'casual' relationship*

3

(c) (i) Glycosidic;

Accept: if phonetically correct

Reject: ester bond

1

(ii) Contains glycerol / three fatty acids / forms three ester bonds;

Neutral: contains less fatty acids

Answers must refer to a triglyceride
Ignore refs. to incorrect bond names
Neutral: olestra has eight fatty acids / R groups
Reject: contains three glycerols

1

(iii) 9;

1

[8]

Q16.

(a)

✓	✓	✓	
			✓
		✓	✓

One mark for each correct column
Mark ticks only and ignore crosses

4

(b) 1. Two marks for box round two hydrogens and one of the oxygens from OH groups on carbons 1 and 4;;

2. One mark from incorrect answer involving any two hydrogens and an oxygen from carbons 1 and 4;

Do not award marks if all atoms concerned are on same carbon atom or are on carbon atoms other than 1 and 4 or where the answer does not have two hydrogen and one oxygen

2

(c) (i) 1. Holds chains / cellulose molecules together / forms cross links between chains / cellulose molecules / forms microfibrils, providing strength / rigidity (to cellulose / cell wall);

2. Hydrogen bonds strong in large numbers;x

Principles here are first mark for where hydrogen bonds are formed and second for a consequence of this.

Accept microfibres

2

(ii) Compact / occupies small space / tightly packed;

Answer indicates depth required. Answers such as "good for storage", "easily stored" or "small" are insufficient.

1

[9]

Q17.

(a) pH goes down and levels out;
after 30 min / pH 6.5;

2

(b) Enzyme not used up in reaction;

1

(c) Curve will be less steep:

*Only accept answers relating to curve **not** rate of reaction*

1

[4]

Q18.

Fatty acids used to make phospholipids;
Phospholipids in membranes;
More phospholipids more membranes made;

2 max

Fatty acids respired to release energy;
More triglycerides more energy released;
Energy used for cell production / production of named cell component;

Do not allow credit for 'making' energy

2 max

[4]

Q19.

(a) (Omega-3 concentration) falls more rapidly at first;
Levels out at 140 days / concentration of 0.4%;

2

(b) (i) Two marks for correct answer of 0.04 or 0.043;;

One mark for incorrect answer which clearly identifies total fall of 1.7;

2

(ii) To take into account variation in fat content of milk / fat content varies from cow to cow;
Allows comparison;

2

(iii) The graph shows a decrease with time feeding on corn;
No control group;
Might have fallen anyway / might decrease with time rather than with time spend feeding on corn;
Other factors / other named factor might also have changed;
Only one investigation so might not be representative;

4 max

[10]

Q20.

Standard deviation shows there is overlap of the 2 data sets;
Small sample of wild salmon so may not be representative of population;

[2]

Q21.

The different diet of the fish;
Omega-3 fatty acids used in respiration / as a source of energy;

Wild trout are more active / use more energy;

[2]

Q22.

(a) Two marks for correct answer of 64.285 / 64.3 / 64;
(allow 1 mark for (8100 / 100 × 30) / 37.8)

2

(b) dissolve in / add ethanol then mix with water;
emulsion / white colour indicates triglycerides present;

2

(c) (i) increase the surface area for absorption;
(ignore wrong ref. to name)

1

(ii) **R** = tissue fluid / interstitial fluid / extracellular fluid / intercellular space;
S = lymph(atic) vessel / lymph capillary / lacteal;

2

(iii) proteins are synthesised by **U**;
involvement of ribosomes;
protein isolation / transport (inside RER);
vesicle formation;

2 max

(iv) exocytosis / description of;
because of size / too large to leave by other methods;

2

[11]

Q23.

(a) (i) (Molecule) made up of many identical / similar molecules / monomers / subunits;
Not necessary to refer to similarity with monomers.

1

(ii) Cellulose / glycogen / nucleic acid / DNA / RNA;

1

(b) (i) To keep pH constant;
A change in pH will slow the rate of the reaction / denature the amylase / optimum for reaction;

2

(ii) Purple / lilac / mauve / violet;
Do not allow blue or pink.

1

(iii) Protein present / the enzyme / amylase is a protein;
Not used up in the reaction / still present at the end of the reaction;

2

[7]

Q24.

(a) (i) in case normal coffee differs in some other way /
to control concentration of caffeine;

1

(ii) not telling them what the drink contained / purpose of experiment;

1

(b) (i) able to continue for longer; *(not just increases performance)*
(disqualify if also refers to fatty acids and glycerol)

1

(ii) breakdown of fats;
at increased rate / by mobilisation of fat stores;

2

(c) (i) idea that volumes of oxygen and carbon dioxide the same;
reference to equal moles, or quotient as 1 divided by 1 / or 6 by 6;

2

(ii) glycogen is a carbohydrate / broken down to glucose, linked to RQ;
with no caffeine, RQ nearer 1.0 / less carbon dioxide exhaled and more oxygen inhaled (or vice versa) / with caffeine higher proportion of fats / fatty acids respired;
increased time to exhaustion suggests slower use of glycogen:

3

[10]

Q25.

(a) (i) condensation;

1

(b) (i) **D**;

1

(ii) **C**;

1

(iii) **A**;

1

(c) absence of a double bond;
in the (hydrocarbon) chain;
unable to accept more <u>hydrogen</u> / saturated with hydrogen;

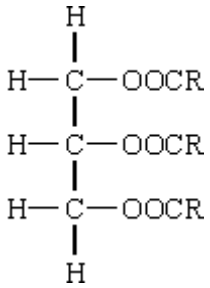
2 max

[6]

Q26.

(a) 3 fatty acids attached;
ester bond correct;

(H on glycerol component, O attached to carbon, R at other end)



2

(b) not made of monomers / many repeating units;

1

(c) (many) mitochondria present in brown fat cells;
mitochondria release heat / energy; (*ignore ATP*)
white fat cells for fat storage / reduced fat storage in brown fat cells;

3

[6]

Q27.

(a) ATP

1

(b) (i) 2.57:1/2.6:1/18:7;
Correct answer however derived scores two marks
72:28 scores one mark
Correct working from wrong figures scores 1 mark

Accept

0.4 / 0.39 / 0.389 / 0.3889

2 max

(ii) Low intensity;
At low intensity/below 40% mainly fat used / at high intensity/ above 40% mainly carbohydrate used;
Long duration exercise;
Percentage fat used increases with time / percentage carbohydrate used decreases with time;

3

[6]