1 Read through the following passage that describes the process of blood clotting, then write on the dotted lines the most appropriate word or words to complete the passage.

(6)

A blood clot may form when a blood vessel wall becomes damaged.

Cell fragments called ..... stick to the wall of the damaged blood vessel forming a plug. A series of chemical changes occur in the blood, resulting in ..... being converted into thrombin. Thrombin is an ..... that catalyses the conversion of ..... into long insoluble strands of ..... . These strands form a mesh that trap ..... to form the clot.

(Total for Question 1 = 6 marks)

2 Transcription and translation are two main stages in protein synthesis.

(a) Complete the table below by writing the word **transcription** or **translation** next to the appropriate statement about protein synthesis.

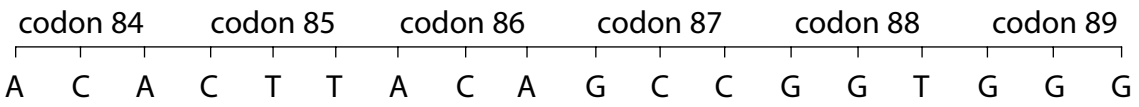
(5)

Statement	Stage of protein synthesis
Ribosomes are involved	
DNA acts as a template	
tRNA is involved	
Peptide bonds are made	
mRNA is made	

(b) The table below shows some amino acids and their corresponding DNA triplet codons. The DNA triplet codons for a stop signal are also shown.

Amino acid / stop signal	DNA triplet codons
Proline	GGT GGG GGA
Alanine	CGG CGA CGT CGC
Cysteine	ACA ACG
Serine	AGG AGA AGT AGC
Leucine	GAA GAG GAT GAC
Arginine	GCA GCG GCT GCC
Glutamine	CTT CTC
Glycine	CCT CCG CCA CCC
Threonine	TGC TGA TGT TGG
Stop signal	ATT ATC ACT

The diagram below shows part of a DNA molecule.



(i) Place a cross ☒ in the box next to the amino acid coded for by codon 85.

(1)

Leucine ☐

Glutamine ☐

Glycine ☐

Serine ☐

(ii) Place a cross ☒ in the box next to the sequence of amino acids found in the polypeptide chain that is coded for by this part of the DNA strand.

(1)

cysteine glutamine cysteine arginine proline proline ☒

threonine leucine threonine alanine glycine glycine ☒

cysteine glutamine cysteine arginine glycine glycine ☒

cysteine proline cysteine arginine proline proline ☒

(iii) If codon 89 coded for the last amino acid in the polypeptide chain, place a cross ☒ in the box next to codon 90.

(1)

GGG ☒

ATC ☒

TAG ☒

AGT ☒

(iv) Place a cross ☒ in the box next to the sequence of bases on a molecule of messenger RNA (mRNA) synthesised from this part of the DNA molecule.

(1)

A C A C T T A C A G C C G G T G G G ☒

T G T G A A T G T C G G C C A C C C ☒

U G U G A A U G U C G G C C A C C C ☒

A G A C U U A G A C G G C C U G G G ☒

(v) Place a cross ☒ in the box next to the statement that best describes what the polypeptide chain would be like if the 90th codon was ACT and the 91st codon was CTT on the DNA molecule.

(1)

The polypeptide chain would be no more than 89 amino acids long ☒

The 89th amino acid would be threonine and the 90th amino acid would be leucine ☒

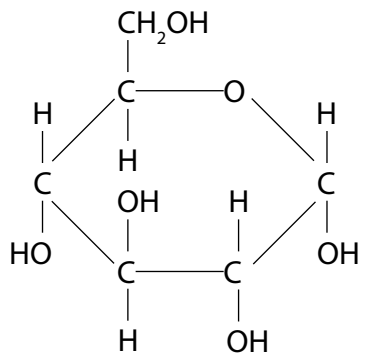
The polypeptide chain would be more than 90 amino acids long ☒

The polypeptide chain would be more than 91 amino acids long ☒

(Total for Question 2 = 10 marks)

3 Starch is a storage carbohydrate found in plants. Starch is composed of many α-glucose molecules that bond together by condensation reactions.

(a) The diagram below shows the structure of α-glucose.



(i) In the space below, draw a diagram to show the products formed when two α-glucose molecules join together by means of a condensation reaction to form maltose.

(3)

(ii) Name the bond that joins the two α-glucose molecules together.

(1)

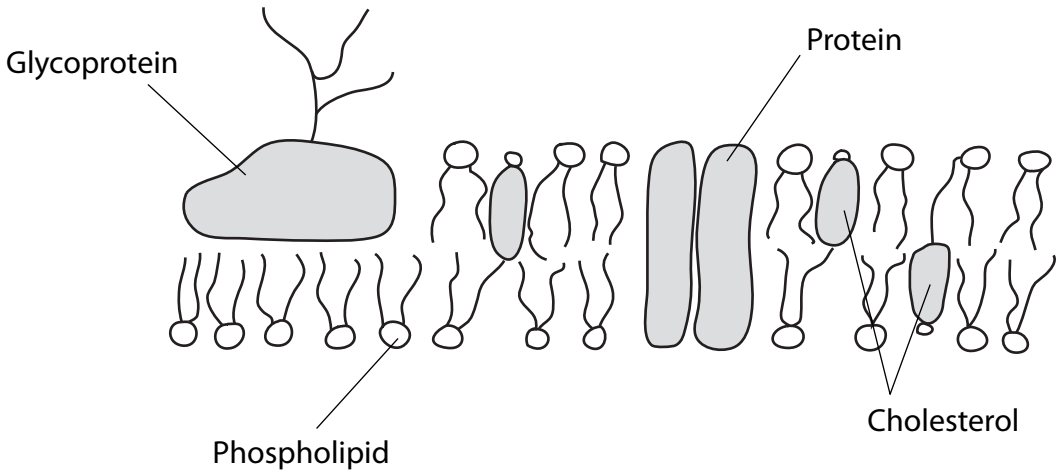
(b) Describe the structure of starch and explain why this structure makes it a suitable molecule for storing energy.

(4)

(Total for Question 3 = 8 marks)

Turn over ▶

4 The diagram below represents the structure of the cell surface membrane.



(a) Explain why the phospholipid molecules form a bilayer.

(3)

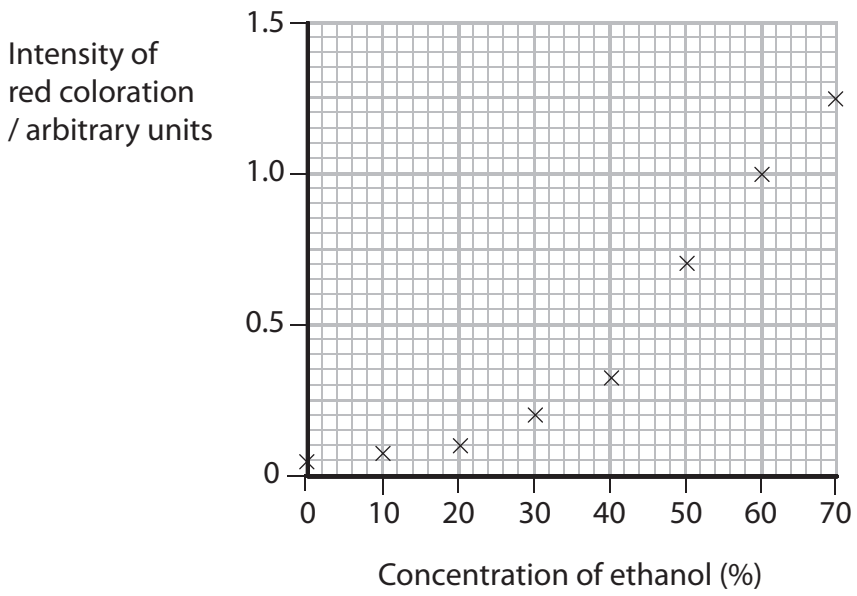
Turn over ▶

(b) A student carried out an experiment to investigate the effect of alcohol concentration 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.

Eight pieces of beetroot were cut. One piece of beetroot was placed into a tube containing 15 cm^3 of water and left for 15 minutes. The procedure was repeated for seven different concentrations of ethanol.

After 15 minutes, each piece of beetroot was removed from the tubes and a sample of the fluid removed and placed in a colorimeter. The colorimeter was used to determine the intensity of red coloration of the fluid.

The results of the investigation are shown in the graph below.



(i) Suggest **two** variables, other than those stated above, which should be kept constant during this experiment.

(2)

1 .....

.....

2 .....

.....

(ii) There was some red coloration in the tube containing only water. Suggest an explanation for this.

(2)

(iii) Describe what the student should have done to reduce the red coloration in the tube containing only water.

(1)

(c) The graph on page 10 shows that ethanol has an effect on the permeability of beetroot.

(i) State the effect that the ethanol concentration has on the intensity of the red coloration.

(1)

(ii) Suggest an explanation for this effect.

(2)

(Total for Question 4 = 11 marks)

5 (a) In the space below, draw a labelled diagram to show the structure of an artery.

(3)

(b) Explain how the structure of an artery relates to its function.

(2)

.....

.....

.....

.....

.....

.....

(c) Give **two** differences between the structure of a vein and the structure of a capillary.

(2)

1 .....

.....

2 .....

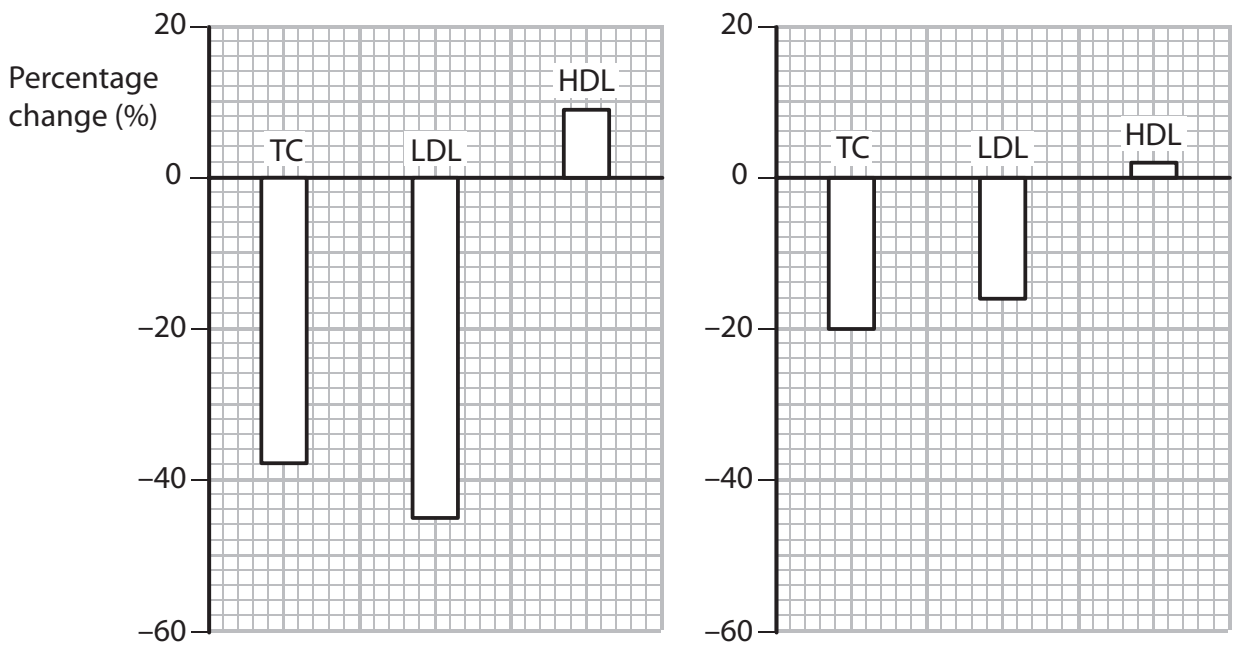
.....

(Total for Question 5 = 7 marks)

6 High blood cholesterol levels are associated with an increased risk of developing cardiovascular disease (CVD). There are cholesterol-reducing drugs available to lower this risk.

(a) Two groups of patients were treated with a different type of cholesterol-reducing drug, Drug A or Drug B.

The graphs below show the percentage changes of total cholesterol (TC), low-density lipoproteins (LDL) and high-density lipoproteins (HDL) in the blood of these patients, after treatment.



(i) Compare the effects of Drug A and Drug B on the percentage changes in total cholesterol (TC), LDL and HDL in the blood of these two groups of patients.

(3)

Turn over ▶

(ii) The enzyme HMG-CoA reductase catalyses the synthesis of cholesterol. When this enzyme is active, there are fewer LDL receptors on liver cells. These receptors are needed to remove LDL from the blood.

Statins are a group of cholesterol-reducing drugs that act by inhibiting this enzyme. Suggest which of the two drugs, Drug A or Drug B, is more likely to be a statin. Give reasons for your answer.

(3)

(b) State **two** risks of treatments using statins.

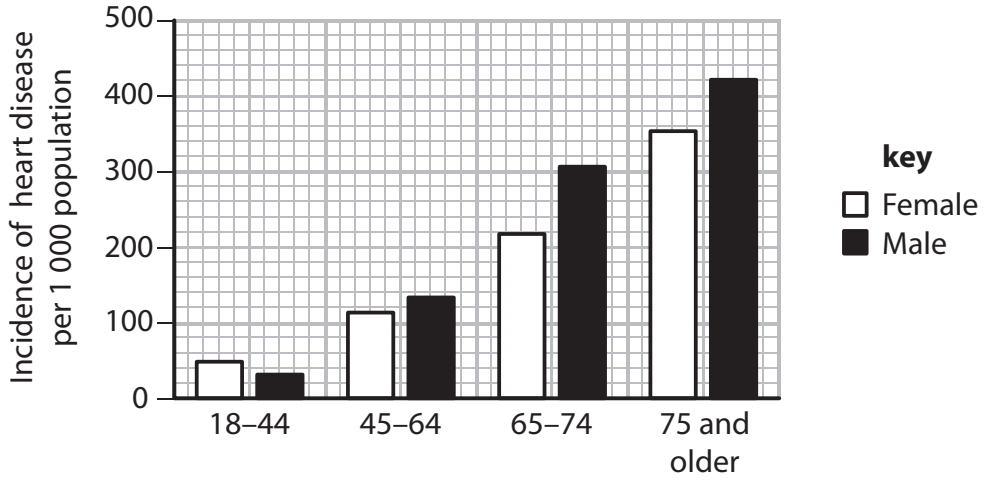
(2)

1

2

(c) Age and gender are two other factors that may influence the development of heart disease in an individual.

The graph below shows the results of a survey in America, on the incidence of heart disease in adults aged 18 and older.



(i) Using the information in the graph, describe how the incidence of heart disease is affected by age and gender.

(3)

(ii) Calculate the increased risk that a man who is 75 or older has of developing heart disease, compared to a man aged between 18 and 44 years old.

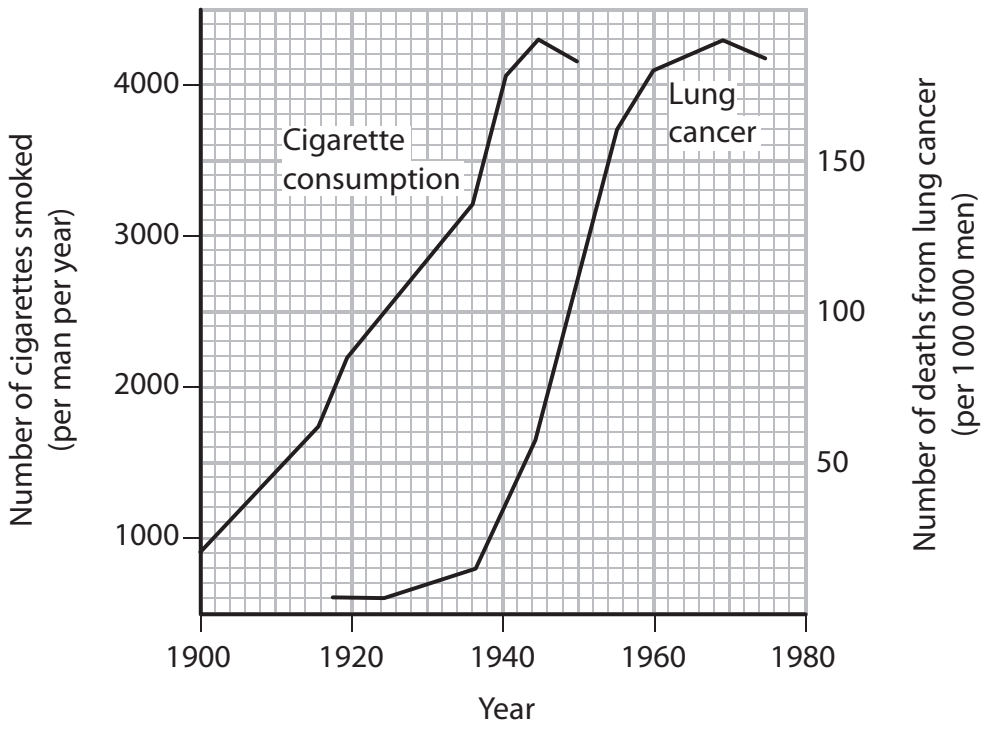
(2)

Answer .....

(Total for Question 6 = 13 marks)

Turn over ▶

7 A study was carried out into the number of cigarettes smoked by men per year and the number of deaths from lung cancer.
The graph below shows the results of this study.



(a) Describe the changes in the number of deaths from lung cancer between 1920 and 1975.

(3)

Turn over ▶

(b) The results of this study indicate that there is a correlation between cigarette smoking and lung cancer.

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

(1)

(ii) Describe the evidence shown in this graph that suggests there is a correlation between cigarette smoking and the number of deaths from lung cancer.

(2)

(iii) Give **two** additional pieces of information that would increase the **validity** of any conclusions made from this study.

(2)

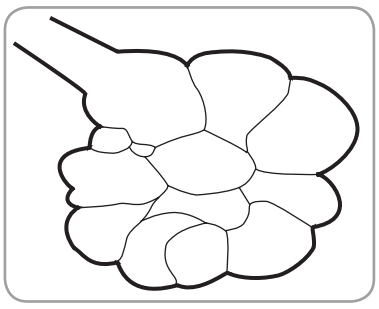
1

2

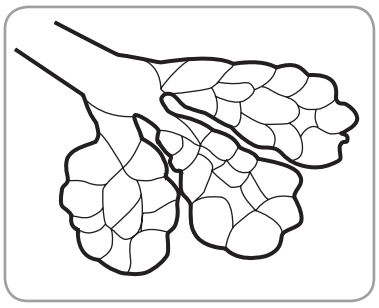
(c) Emphysema is another lung disease associated with cigarette smoking. One symptom of emphysema is shortness of breath. This is due to the damage to the alveoli and destruction of capillaries surrounding the alveoli.

The diagram below show alveoli from a lung of a person with emphysema and some alveoli from a healthy person.

Alveoli from a lung of a person with emphysema



Alveoli from a healthy person



Use your knowledge of the structure of the lung and its adaptations for gas exchange to explain why a person with emphysema has problems with gas exchange.

(4)

(Total for Question 7 = 12 marks)

8 Phenylketonuria is a recessive genetic disorder characterised by a lack of the enzyme phenylalanine hydroxylase. When there is an excess of phenylalanine in the diet, this enzyme converts the amino acid phenylalanine into the amino acid tyrosine.

(a) The diagram below shows the structure of the R group of phenylalanine and tyrosine.

Phenylalanine **Tyrosine**

(i) In the space below draw a diagram to show the structure of the amino acid phenylalanine.

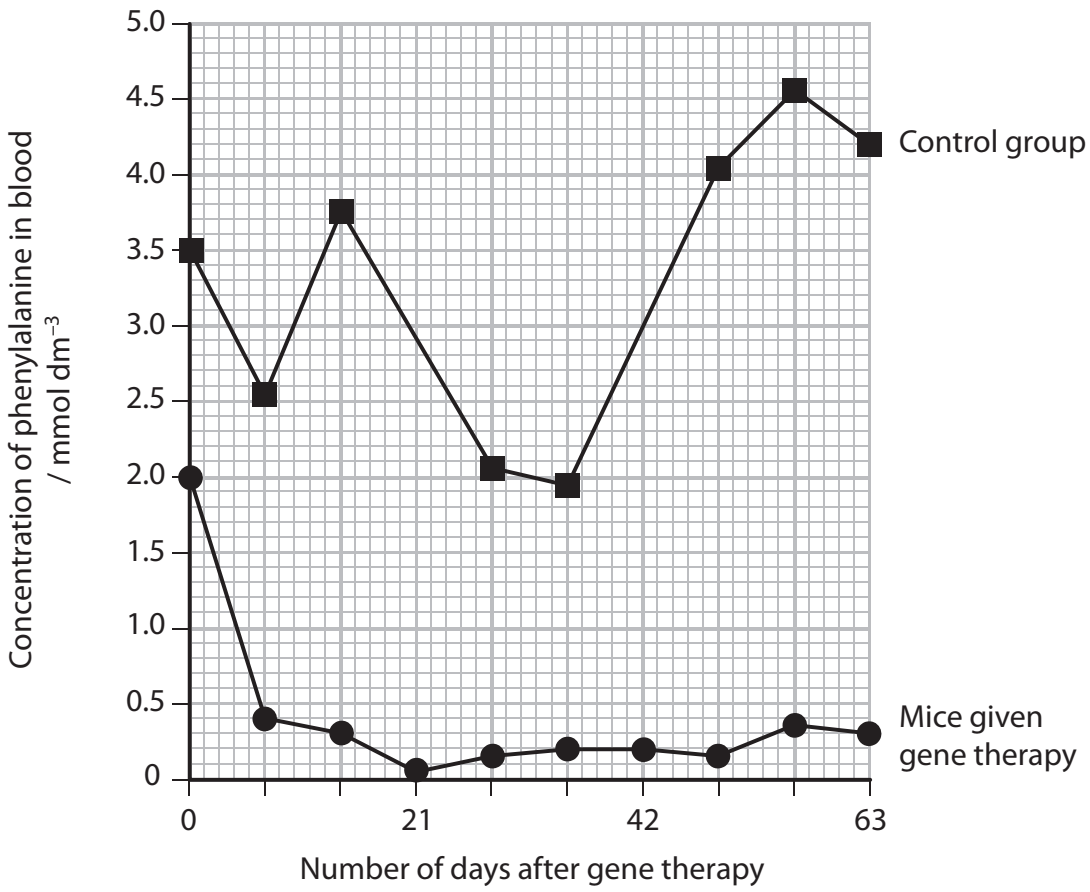
(3)

Turn over ▶

(ii) The enzyme phenylalanine hydroxylase converts its substrate, phenylalanine, into the product, tyrosine. Using the information shown in the diagram and your knowledge of the mechanism of action of enzymes, suggest how this reaction takes place.

(4)

(b) A number of investigations have been carried out into the use of somatic gene therapy to treat mice that have phenylketonuria.
The graph below shows the results of one such investigation.



(i) Use the graph to describe the effect that gene therapy has on the phenylalanine concentration in the blood of these mice.

(2)

(ii) Describe how somatic gene therapy may have been carried out to treat phenylketonuria in these mice.

(3)

(iii) Suggest what treatment the control group of mice may have been given in this investigation.

(1)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

1 DNA and lipids are important molecules found in living organisms.

(a) A triglyceride is one type of lipid.

For each of the descriptions below, put a cross (☒) in the box that corresponds to the correct statement about lipids or triglycerides.

(i) Triglycerides are composed of:

(1)

- 3 glycerol molecules and 3 fatty acid molecules ☒
- 1 glycerol molecule and 3 fatty acid molecules ☒
- 1 glycerol molecule and 1 fatty acid molecule ☒
- 3 glycerol molecules and 1 fatty acid molecule ☒

(ii) The bond between a glycerol molecule and a fatty acid molecule is:

(1)

- A glycosidic bond ☒
- A peptide bond ☒
- A phosphodiester bond ☒
- An ester bond ☒

(iii) This bond is formed by:

(1)

- Hydrolysis ☒
- Condensation ☒
- A chain reaction ☒
- An automatic reaction ☒

(iv) Unsaturated lipids:

(1)

- Do not have any double bonds ☒
- Have double bonds only between carbon atoms ☒
- Have double bonds between carbon atoms and between carbon and oxygen atoms ☒
- Have double bonds only between carbon and oxygen atoms ☒

(v) Saturated lipids have:

(1)

More hydrogen atoms than unsaturated lipids ☒

Fewer hydrogen atoms than unsaturated lipids ☒

The same number of hydrogen atoms as unsaturated lipids ☒

No hydrogen atoms ☒

(b) DNA is a double-stranded molecule composed of mononucleotides.

(i) In the space below, draw a diagram to show **two** mononucleotides joined together in a **single** strand of DNA (polynucleotide). Use the symbols shown below for each component in your diagram.

(3)

Phosphate group 

Base 

Deoxyribose sugar 

Bond —

(ii) Name an enzyme involved in DNA replication.

(1)

.....

(Total for Question 1 = 9 marks)

2 Cystic fibrosis is a genetic disorder caused by one of a number of possible gene mutations. Prenatal testing can be used to determine whether or not a fetus has cystic fibrosis.

(a) Name **one** method of prenatal testing and explain how it can be used to detect cystic fibrosis.

(3)

(b) Describe **one** benefit and **one** risk, to a pregnant woman, of prenatal testing.

(4)

Benefit .....

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Risk .....

.....

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(c) Discuss either **one** ethical issue or **one** social issue relating to the use of prenatal testing.

(2)

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(Total for Question 2 = 9 marks)

Turn over ▶

3 The cardiac cycle involves the contraction and relaxation of heart muscle. This brings about changes in blood pressure within the heart.

(a) The table below refers to the three phases of the cardiac cycle. Complete the table by stating whether the atria and ventricles are **contracted** or **relaxed** in each of these three phases.

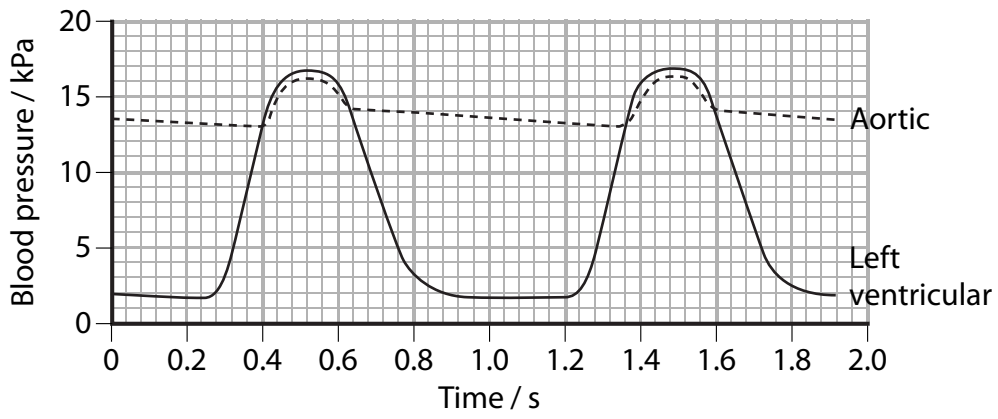
(3)

Phase of cardiac cycle	Atria	Ventricles
Atrial systole		
Ventricular systole		
Diastole		

(b) Describe the roles of the atrioventricular (bicuspid and tricuspid) valves during the cardiac cycle.

(4)

(c) The graph below shows changes in the blood pressure in the aorta and the left ventricle during two complete cardiac cycles.



(i) Use the information in the graph to calculate the heart rate. Show your working.

(3)

Answer .....

(ii) During the cardiac cycle, the pressure in the right ventricle rises to a maximum of about 3.3 kPa. Suggest reasons for the difference between this pressure and the maximum pressure in the left ventricle, as shown in the graph.

(3)

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(Total for Question 3 = 13 marks)

4 Data on the cholesterol levels and blood pressure for different adult populations in America were collected.
The mean cholesterol level and the percentage of each population with high blood pressure were calculated. The results are shown in the table below.

Adult population (ethnic groups)	Mean cholesterol level / mg dm^{-3}	Percentage of population with high blood pressure (%)
Black and African American	204	40
White American	206	27
Mexican American	205	29
American Indian and Alaskan Native	Statistically unreliable data	Statistically unreliable data

(a) There could be a causal link or correlation between high blood pressure and the other variables shown in the table.

Distinguish between the terms **causation** and **correlation**.

(2)

(b) (i) Using the information in the table above, describe the relationship between ethnic group, cholesterol levels and the percentage of the population with high blood pressure.

(2)

(ii) Suggest **one** reason why the data on the American Indian and Alaskan Native population are described as statistically unreliable.

(1)

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(c) A student concluded from the results for gender, shown in the table below, that higher cholesterol levels cause lower blood pressure.

Adult population (gender)	Mean cholesterol level / mg dm^{-3}	Percentage of population with high blood pressure (%)
Female	207	26
Male	204	30

Using the information in both tables, explain why this is not a valid conclusion.

(3)

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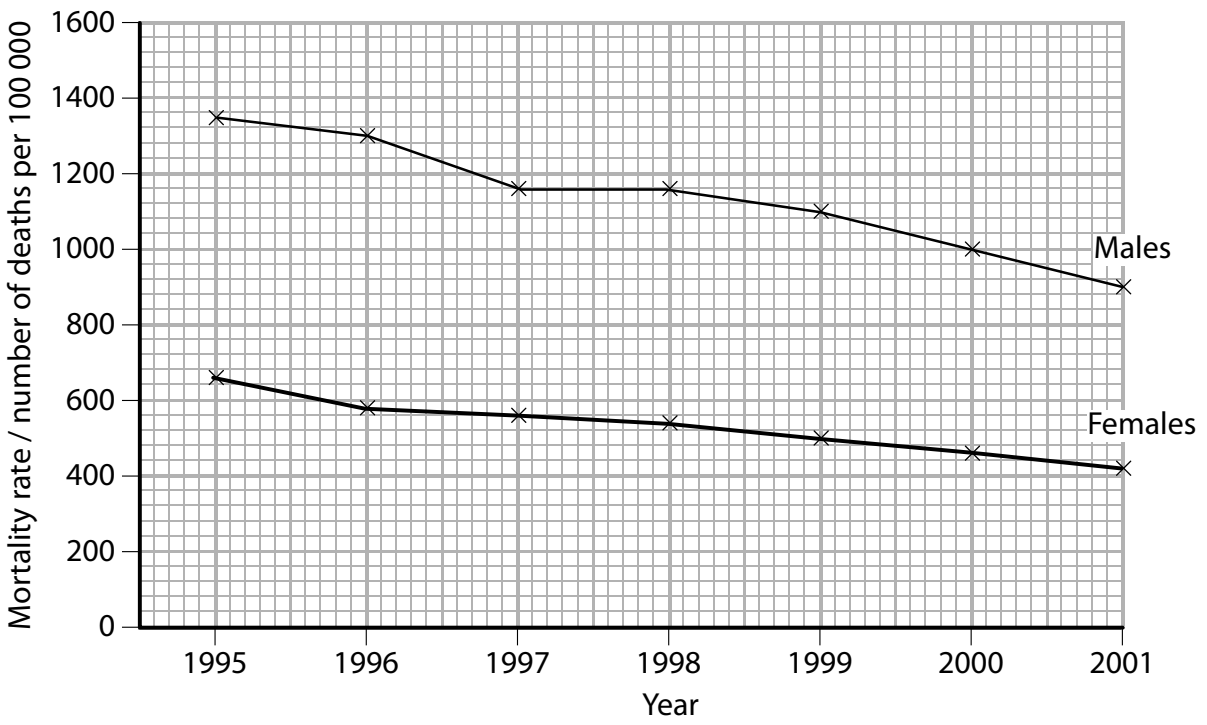
(Total for Question 4 = 8 marks)

5 The graph below shows the mortality rate (number of deaths per 100 000) from coronary heart disease in people aged between 65 and 74 in Scotland between 1995 and 2001.



(a) Compare the mortality rate from coronary heart disease in males with that of females, between 1995 and 2001.

(3)

(b) The graph shows a change in the number of deaths from coronary heart disease between 1995 and 2001. Suggest **three** reasons for this change.

(3)

1 .....

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2 .....

.....

3 .....

.....

(c) One cause of coronary heart disease is atherosclerosis. Describe how atherosclerosis develops.

(4)

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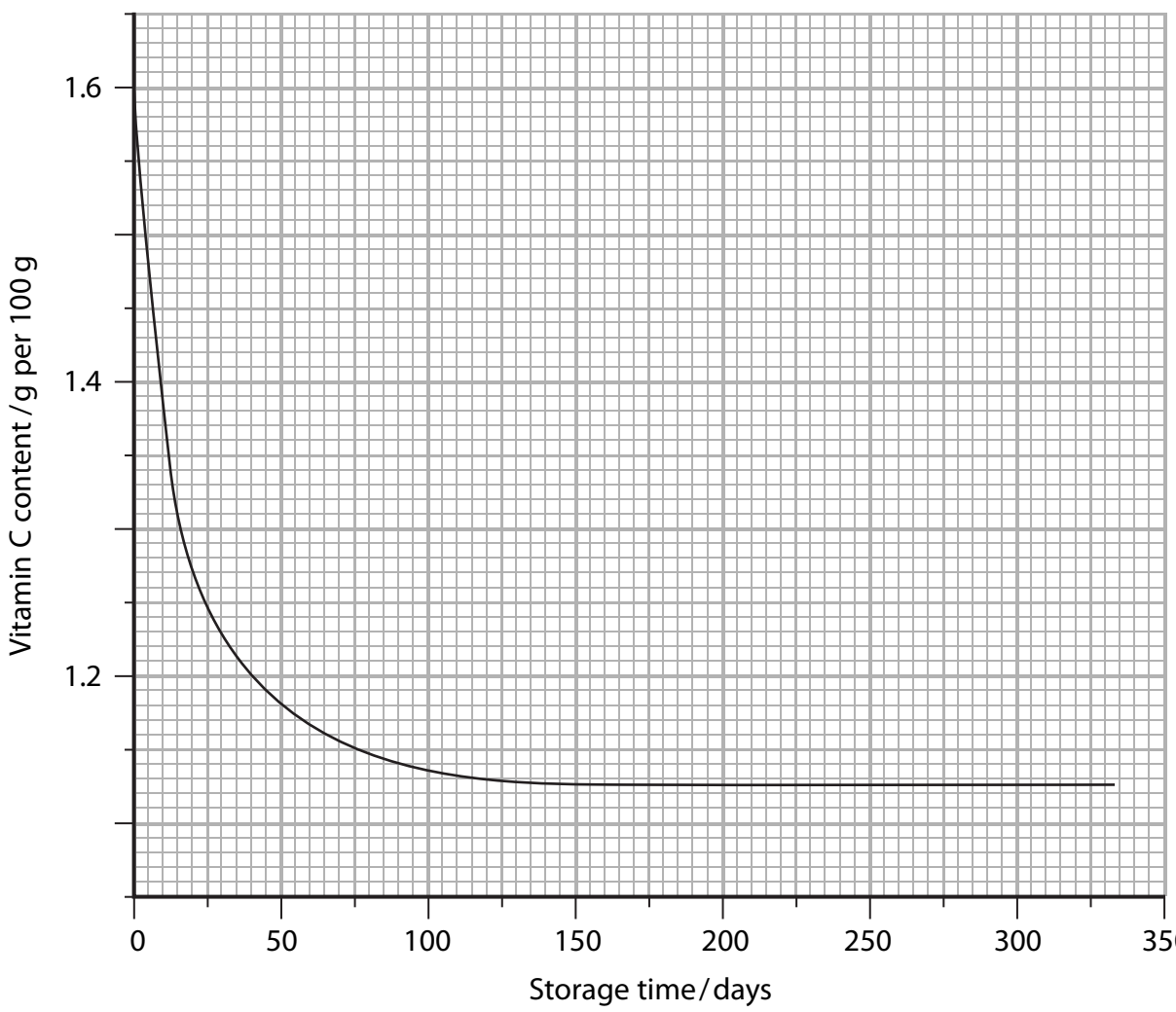
(Total for Question 5 = 10 marks)

6 Camu-camu are fruit that grow in the Amazon region of South America and are shown in the photograph below. They have a very high vitamin C content.

(a) An investigation was carried out into the effect of storage time on the concentration of vitamin C in camu-camu fruit. The results of this investigation are shown in the graph below.



Using the information in the graph, describe the effect of storage time on the vitamin C content of the camu-camu fruit.

(3)

Turn over ▶

(b) Paraná state is another region in South America that produces camu-camu fruit. The camu-camu fruit from this region have a different vitamin C content from those grown in the Amazon region.

Describe how an investigation could be carried out to compare the effect of storage time on the vitamin C content of the Paraná state camu-camu fruit with those from the Amazon region.

(5)

(Total for Question 6 = 8 marks)

7 Albinism is a genetic trait resulting from the inheritance of recessive alleles.

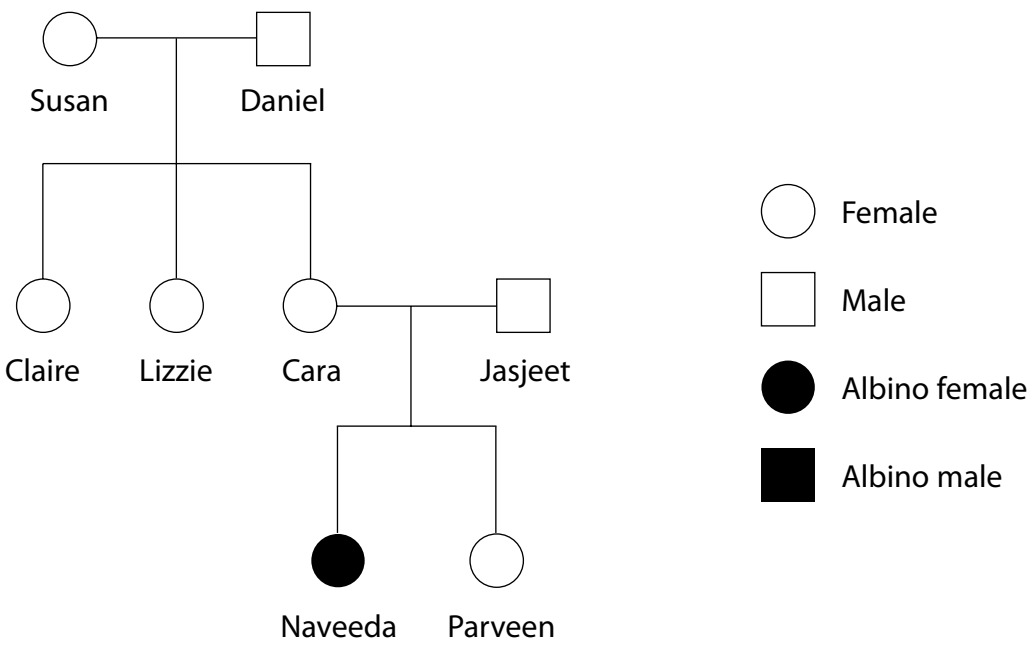
(a) (i) Distinguish between the terms **allele** and **gene**.

(2)

(ii) Explain the meaning of the term **recessive** allele.

(1)

(b) The pedigree diagram below shows the inheritance of albinism in one family.



(i) Naveeda is homozygous. Explain the meaning of the term **homozygous**.

(1)

(ii) Susan is also homozygous. Name the members of this family who are definitely carriers of albinism, giving reasons for your answer.

(4)

Turn over ▶

(c) Albinism occurs in a number of different animals, including squirrels as shown in the photograph below.

The incidence of albinism in squirrels is 1 in 100 000 births, which is much lower than the incidence of albinism in humans. Suggest why the incidence of albinism in squirrels is lower than the incidence in humans, giving a reason for your answer.

(2)

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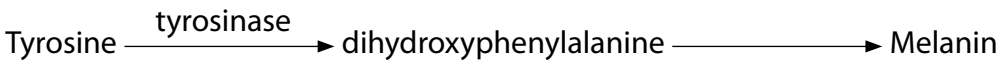
(d) Individuals with albinism are unable to produce the pigment melanin. This can be due to the absence of the enzyme tyrosinase. The diagram below shows the role of tyrosinase in melanin production.



Explain why melanin cannot be produced in the absence of the enzyme tyrosinase.

(2)

(Total for Question 7 = 12 marks)

8 In an osmosis investigation, a student prepared five pieces of raw potato of equal mass and a range of sucrose solutions of different concentrations.

One piece of potato was placed in each sucrose solution. After two hours, the potato pieces were removed and blotted dry and the change in mass of each potato piece was calculated.

The results are shown in the table below.

Concentration of sucrose solution / mol dm^{-3}	Change in mass of potato piece / g
0.2	+1.34
0.4	+0.82
0.6	+0.31
0.8	–0.11
1.0	–0.65

(a) Explain the meaning of the term **osmosis**.

(2)

(b) (i) Explain why the piece of potato placed in 0.2 mol dm^{-3} sucrose solution had the largest change in mass.

(3)

(ii) The student suggested that there would be no change in the mass of a piece of potato placed in a sucrose solution of 0.75 mol dm^{-3}. Give an explanation for this suggestion.

(2)

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.....

(c) The student repeated this investigation using another potato and the results were different.

The student concluded that there was a difference in water content of the two potatoes. Suggest **two** reasons for this difference in water content.

(2)

1 .....

.....

2 .....

.....

(d) A second student wanted to perform this investigation by measuring the change in length of the potato pieces. The student was advised that this method would not be as accurate as weighing the potato pieces.

Suggest **two** reasons why measuring the change in length would not be as accurate as weighing the potato pieces.

(2)

1 .....

.....

2 .....

.....

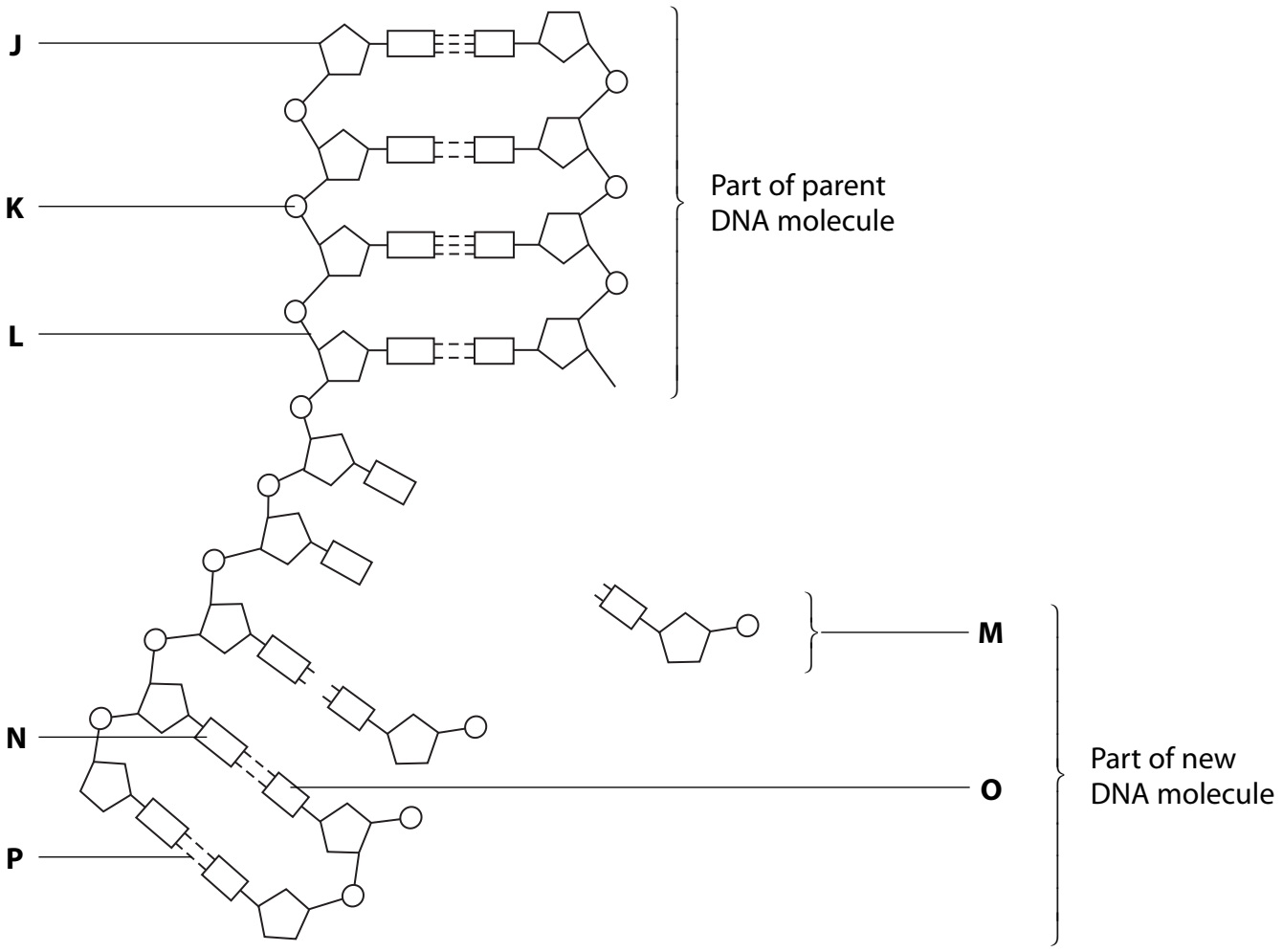
(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

mock papers 3

1 DNA is a very important molecule in living organisms as it carries the genetic code that controls all characteristics. When a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

The diagram below shows part of this process of DNA replication.



For each of the statements below, put a cross in the box that corresponds to the correct statement about DNA structure or DNA replication.

(a) The structure labelled **J** is

(1)

- ☒ **A** ribose
- ☒ **B** α glucose
- ☒ **C** β glucose
- ☒ **D** deoxyribose

(b) The structure labelled **K** is a

(1)

- ☒ **A** phosphate group
- ☒ **B** phosphorus atom
- ☒ **C** sulphate group
- ☒ **D** potassium atom

(c) The bond labelled **L** is a

(1)

- ☒ **A** peptide bond
- ☒ **B** phosphodiester bond
- ☒ **C** hydrogen bond
- ☒ **D** glycosidic bond

(d) The structure labelled **M** is a

(1)

- ☒ **A** polynucleotide
- ☒ **B** mononucleotide
- ☒ **C** polypeptide
- ☒ **D** mononucleoside

(e) If the base labelled **N** on the parent DNA molecule is adenine, the base labelled **O** on the new DNA molecule is

(1)

☒ **A** uracil

☒ **B** guanine

☒ **C** thymine

☒ **D** cytosine

(f) The bond labelled **P** is a

(1)

☒ **A** peptide bond

☒ **B** phosphodiester bond

☒ **C** hydrogen bond

☒ **D** glycosidic bond

(Total for Question 1 = 6 marks)

2 Read through the following passage on protein synthesis, then write on the dotted lines the most appropriate word or words to complete the passage.

(6)

Protein synthesis involves two stages. The first stage is ..... and takes place in the nucleus of the cell. During this stage, a molecule called ..... is made using the antisense DNA strand as a template.

The second stage, known as ..... , takes place in the cytoplasm of the cell on structures called ..... . During this stage, ... molecules enable the amino acids attached to them to line up in the correct order. The amino acids are joined together by the formation of ..... bonds.

(Total for Question 2 = 6 marks)

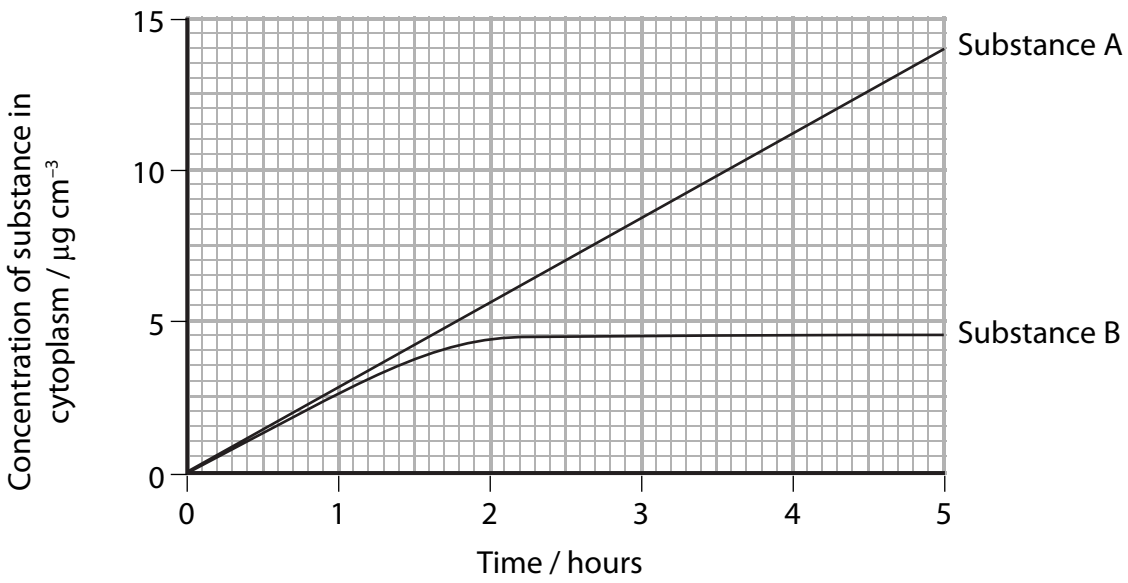
Turn over ▶

3 *Amoeba* is a single-celled aquatic organism. Substances in the water can enter the cell by a variety of mechanisms.

An experiment was carried out to compare the uptake into *Amoeba* of substance A and substance B.

Some of these organisms were placed in a solution containing equal concentrations of both substances and kept at 25 °C. The concentration of substances A and B, in the cytoplasm of these organisms, was measured every 30 minutes over a period of 5 hours.

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



(a) Using the information in the graph, compare the uptake of substance A with the uptake of substance B during this period of 5 hours.

(3)

*(b) Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.

(4)

(c) Substance A enters the cells by active transport. Give **two** differences between active transport and diffusion.

(2)

1 .....

2 .....

(Total for Question 3 = 9 marks)

Turn over ▶

4 Many animals have hearts that pump blood through a network of blood vessels.

(a) The table below refers to blood flow in the four major blood vessels of the human heart. If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✗) in the appropriate box.

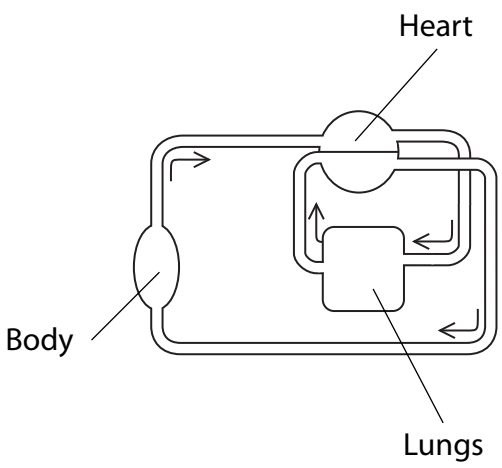
(4)

Name of blood vessel	Carries blood away from the heart	Carries oxygenated blood
Aorta		
Vena cava		
Pulmonary artery		
Pulmonary vein		

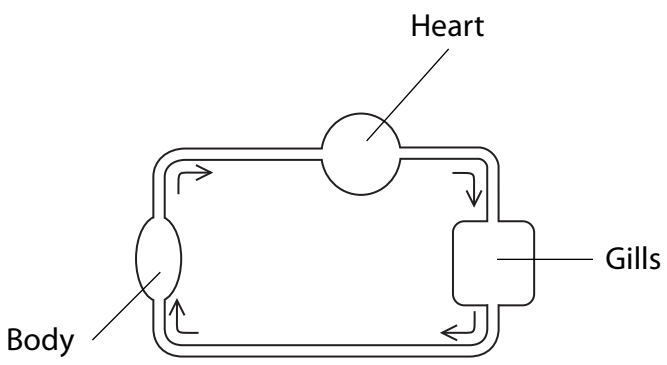
(b) Humans and fish are both animals that have a heart and a network of blood vessels. However, there are some differences in their circulatory systems.

The diagrams below illustrate a human circulatory system and the circulatory system in a fish.

Human circulatory system



Fish circulatory system



The arrows show the direction of blood flow.

(i) Using the information in the diagram, describe the circulation of blood in a fish.

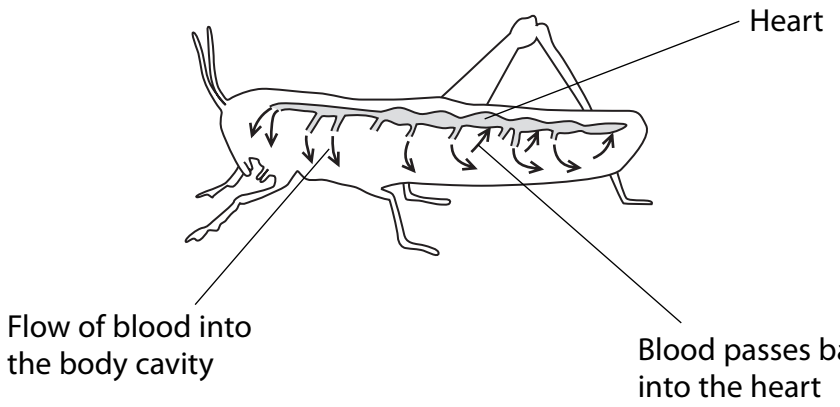
(3)

(ii) Using the information in both diagrams, suggest the advantages that the human circulatory system has compared with that of a fish.

(2)

(c) The heart of an insect is a long tube. It pumps blood into the body cavity so that blood surrounds the cells. The blood then passes back into the heart from the body cavity.

The diagram below illustrates the circulatory system of an insect.



Suggest why the insect does not need blood vessels to transport its blood around the body.

(2)

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(Total for Question 4 = 11 marks)

5 There are many venomous (poisonous) snakes in the world. Many of the venoms from these snakes affect the blood clotting process.

*(a) Describe the blood clotting process.

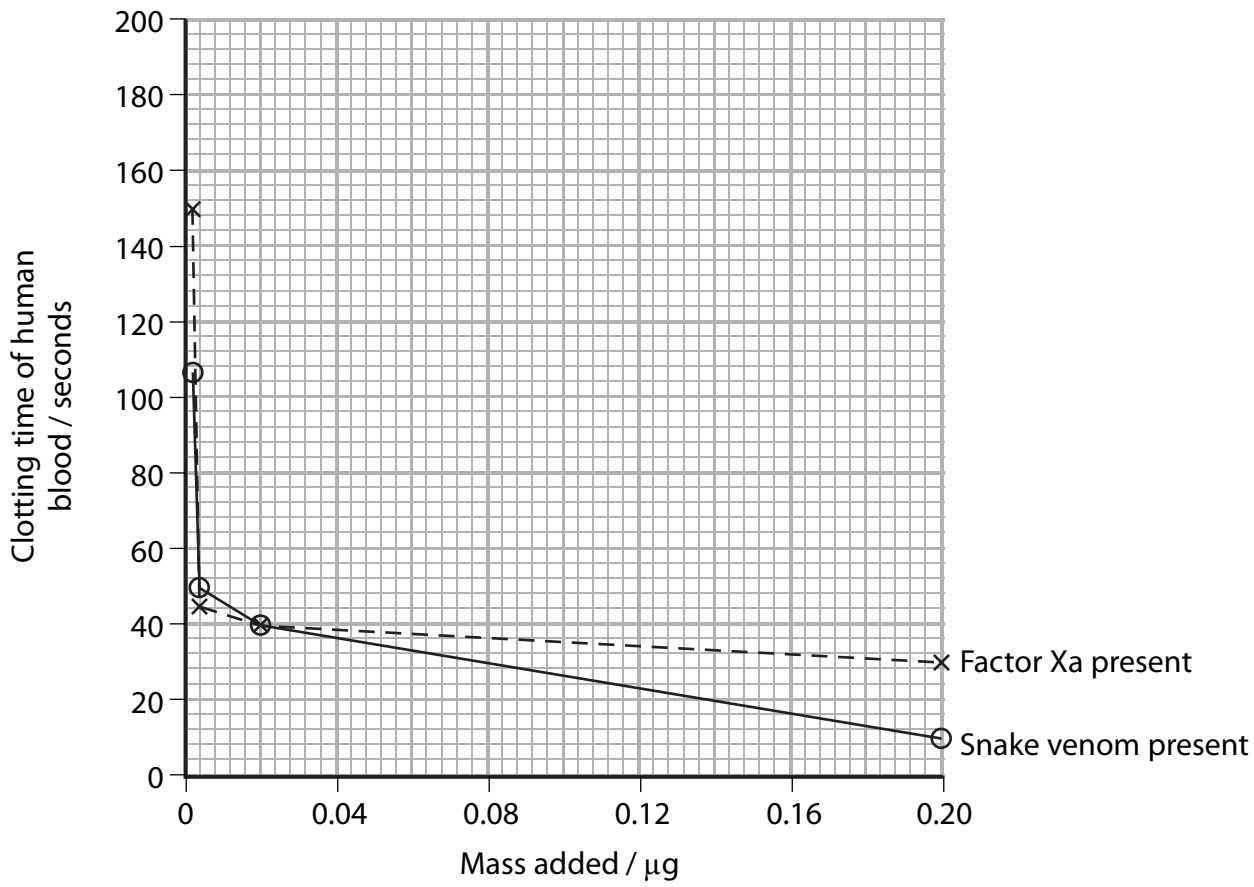
(4)

Turn over ▶

(b) Factor Xa is a clotting factor present in human blood.

An experiment was carried out to investigate the time taken for human blood to clot in the presence of different masses of Factor Xa. The experiment was repeated using snake venom in place of Factor Xa.

The graph below shows the results of these experiments.



(i) Using the information in the graph, describe the effect of the snake venom on the clotting time of human blood.

(3)

(ii) Suggest why the clotting time of the human blood with snake venom added was compared with the clotting time in the presence of Factor Xa.

(1)

(c) The component of the snake venom that affects blood clotting is an enzyme.

(i) Describe the structure of an enzyme.

(3)

(ii) Suggest how the enzyme in the snake venom could be involved in the blood clotting process.

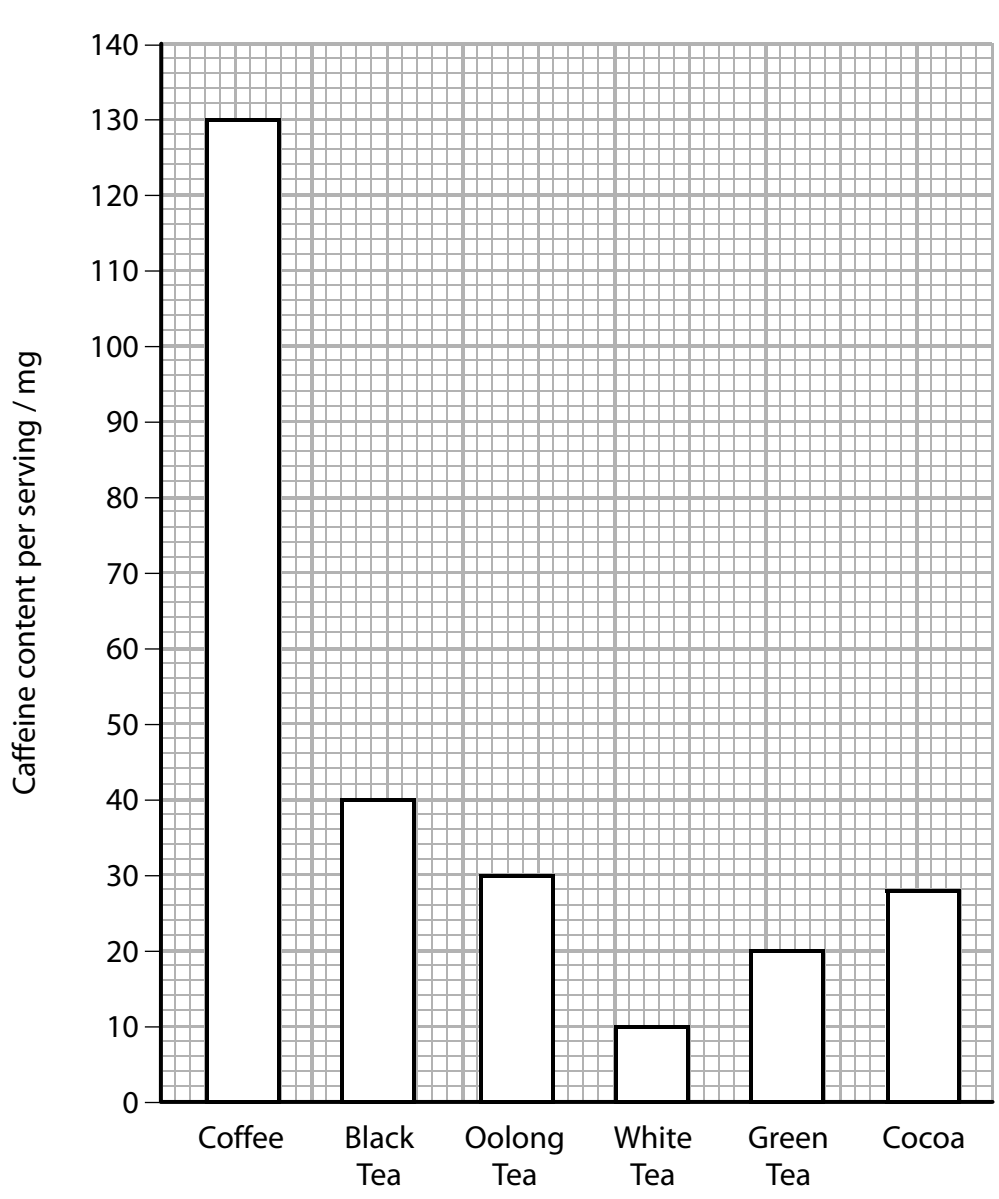
(2)

(Total for Question 5 = 13 marks)

Turn over ▶

6 A number of different drinks contain the drug caffeine. These drinks may be consumed to increase mental alertness. Caffeine also increases the heart rate and can interrupt sleep in some people.

A student found that certain drinks affected her sleep, so she carried out some research into the caffeine content of these drinks. The graph below shows the caffeine content of the drinks that the student researched.



(a) Using the information in the graph, describe the conclusions that the student could make about the caffeine content of these drinks.

(3)

(b) A friend of the student suggested that herbal tea might have a lower caffeine content than these drinks. The student decided to use *Daphnia* to compare the caffeine content of herbal tea with the caffeine content of these other drinks.

(i) Describe an experiment that the student could perform, using *Daphnia*, to confirm that herbal tea has the lowest caffeine content.

(4)

(ii) The friend did not agree with using *Daphnia* in this experiment. Give **one** ethical reason for the use of invertebrates and **one** ethical reason against the use of invertebrates in experiments of this type.

(2)

Reason for the use of invertebrates .....

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.....

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Reason against the use of invertebrates .....

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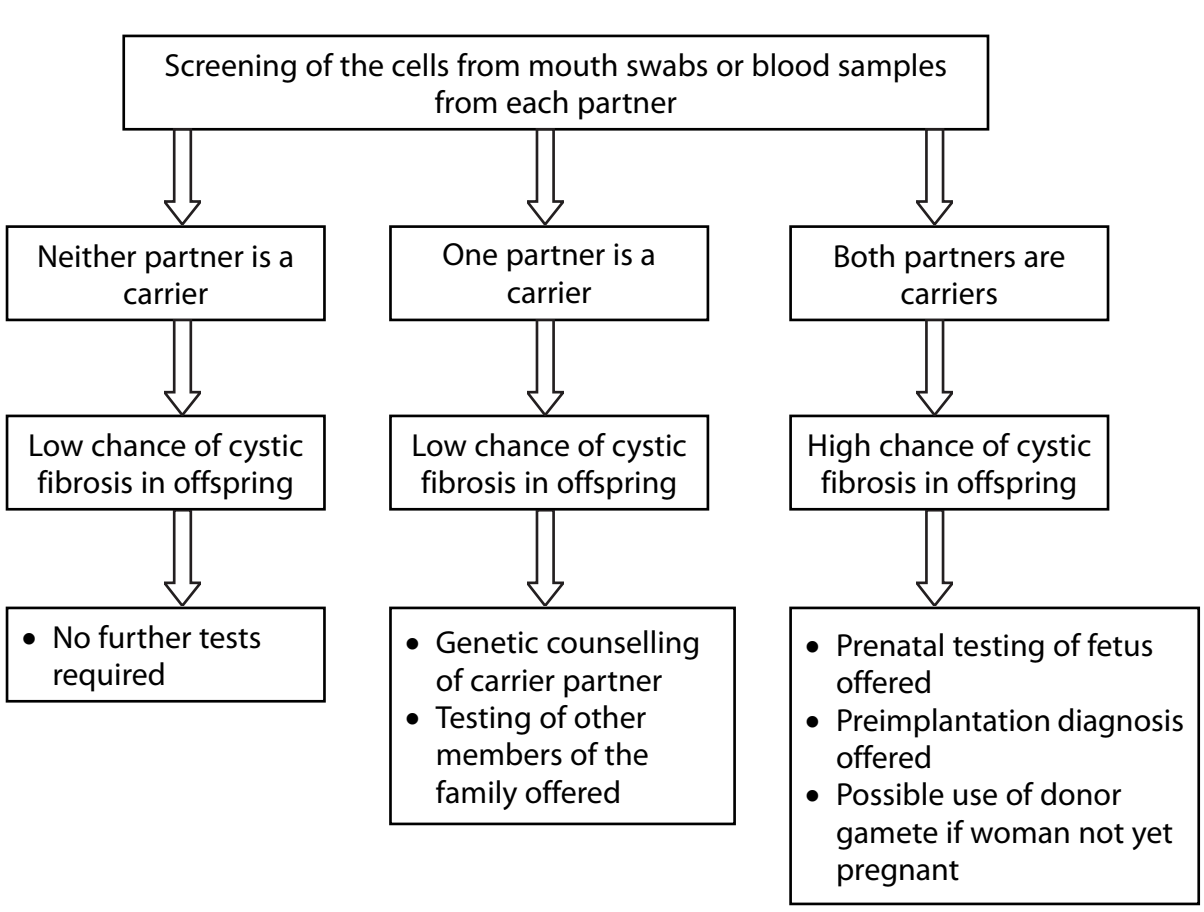
.....

(Total for Question 6 = 9 marks)

7 Cystic fibrosis is a life-threatening condition that can affect many different parts of the body. It is a recessive genetic trait. Genetic screening can be used to test for the presence of recessive alleles. A person found to possess a recessive allele is called a carrier.

The diagram below illustrates a risk analysis following the screening for recessive alleles of a couple, who are planning a pregnancy.



(a) Suggest why cells from mouth swabs or blood samples are used rather than gametes.

(2)

(b) Explain why it is necessary to test for several different recessive alleles in the screening for cystic fibrosis.

(2)

(c) In the risk analysis shown, if neither partner is a carrier then it is considered that the chance of having a child with cystic fibrosis is low. Explain why the probability of having a child with cystic fibrosis is low and **not** zero.

(2)

(d) In the risk analysis shown, if one of the partners is found to be a carrier then screening for cystic fibrosis may be offered to other family members. Explain why this screening is offered to other family members.

(2)

Turn over ▶

(e) Using your knowledge of monohybrid crosses, calculate the probability of having a child with cystic fibrosis if both partners are found to be carriers. Draw a genetic diagram to explain how you calculated this probability.

(5)

Answer .....

(Total for Question 7 = 13 marks)

8 Obesity is a significant problem in western countries and an increasing problem in other parts of the world. An obese person has a greater risk of developing heart disease.

Body Mass Index (BMI) is one measure used to help decide if a person's weight is reasonable for their height. The BMI can be calculated by dividing mass in kilograms by height in metres squared. A table is then used to judge if the BMI is reasonable or not. A copy of this table is shown below.

BMI range	Less than 18.5	18.5 to 24.9	25.0 to 29.9	30.0 to 39.9	40.0 or above
Description	Underweight	Healthy weight	Overweight	Obese	Morbidly obese

(a) A man was concerned that he was overweight and could be at risk from coronary heart disease. He was 1.8 m tall and had a mass of 83.0 kg.

(i) Calculate this man's body mass index (BMI) using the formula below.

$$\text{BMI} = \frac{\text{mass in kilogrammes}}{(\text{height in metres})^2}$$

(2)

Answer .....

(ii) Using the information in the table, interpret this man's BMI.

(2)

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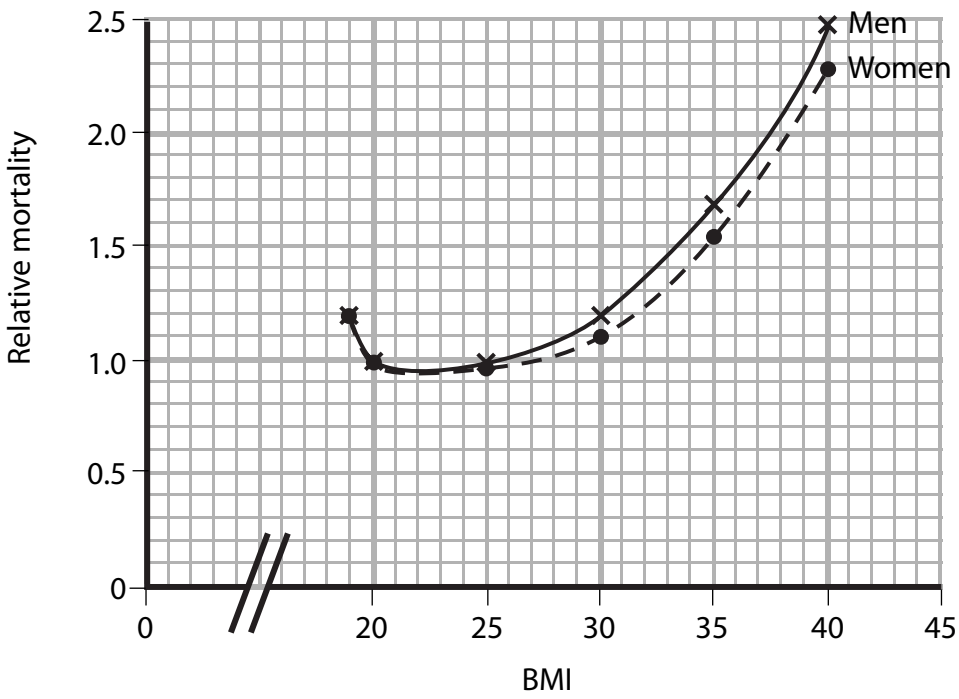
Turn over ▶

(b) The graph below shows one analysis of relative mortality compared with BMI, for men and women.



Compare the effect of BMI on relative mortality for men and women.

(3)

(c) (i) A relative mortality of 1.2 or less indicates a low risk of dying. Using the information given, discuss whether or not a woman with a BMI of 32.5 should be concerned about her risk of dying.

(2)

*(ii) Cardiovascular disease (CVD) is responsible for many deaths.

Describe two changes that this woman may be able to make to her lifestyle, to reduce her risk of dying from CVD. Explain how each change would reduce the risk.

(4)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

mock papers 4

1 The questions below refer to some important biological molecules.
Place a cross (☒) in the most appropriate box that describes the structure or role of these biological molecules.

(a) Disaccharides can be split by

(1)

☒ **A** hydrolysis of glycosidic bonds

☒ **B** condensation of glycosidic bonds

☒ **C** hydrolysis of ester bonds

☒ **D** condensation of ester bonds

(b) Amylose is an example of a

(1)

☒ **A** monosaccharide

☒ **B** disaccharide

☒ **C** polysaccharide

☒ **D** trisaccharide

(c) The role of starch is to

(1)

☒ **A** be a source of energy to plants

☒ **B** store energy in all living organisms

☒ **C** store energy in plants

☒ **D** store energy in animals

(d) Proteins are polymers of amino acids joined by peptide bonds formed between the

(1)

☒ **A** R groups

☒ **B** R group and the amino group

☒ **C** R group and the carboxyl group

☒ **D** carboxyl group and the amino group

(e) The three-dimensional structure of a protein is held together by

(1)

☒ **A** peptide, hydrogen and ionic bonds

☒ **B** hydrogen, ester and ionic bonds

☒ **C** disulphide bridges and ester bonds

☒ **D** disulphide bridges, hydrogen and ionic bonds

(f) DNA consists of mononucleotides joined together by bonds between

(1)

☒ **A** two pentose sugars

☒ **B** one ribose sugar and one phosphate group

☒ **C** one deoxyribose sugar and one phosphate group

☒ **D** two phosphate groups

(g) Water is described as a dipolar molecule because it has a

(1)

☒ **A** positively charged hydrogen end and a negatively charged oxygen end

☒ **B** positively charged hydrogen end and a positively charged oxygen end

☒ **C** negatively charged hydrogen end and a negatively charged oxygen end

☒ **D** negatively charged hydrogen end and a positively charged oxygen end

(Total for Question 1 = 7 marks)

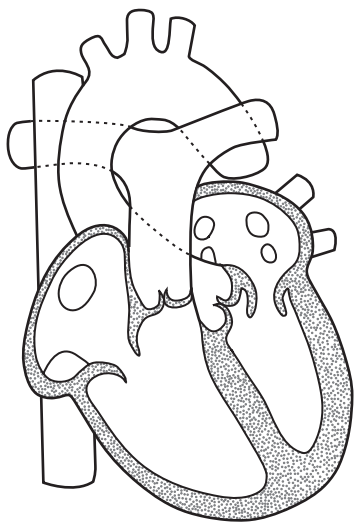
2 (a) Read through the following passage about the heart and its major blood vessels, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

The mammalian heart consists of four chambers, two upper chambers called ..... and two lower chambers called ventricles.

The ..... carries oxygenated blood away from the ..... ventricle to the cells of the body and the pulmonary ..... carries deoxygenated blood to the lungs. The ..... returns deoxygenated blood back to the heart from the body.

(b) The diagram below shows the structure of the heart.



Suggest which stage of the cardiac cycle is shown in the diagram and give a reason for your answer.

(2)

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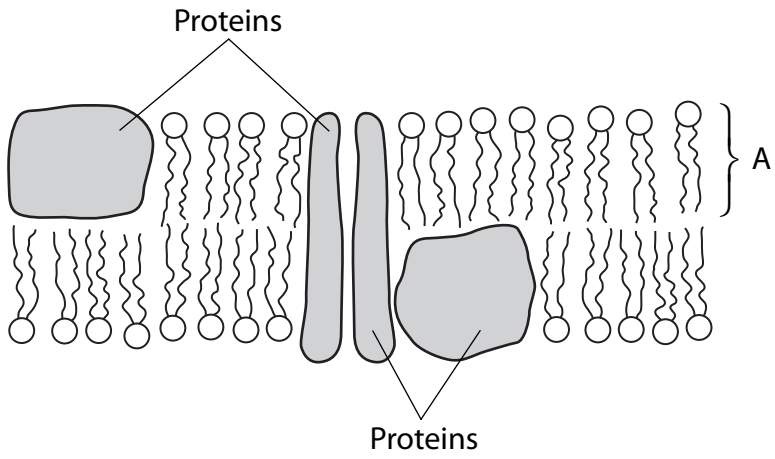
(Total for Question 2 = 7 marks)

3 The fluid mosaic model describes the structure and properties of cell membranes.

(a) The diagram below shows the structure of a cell membrane based on this model.



(i) Name the molecule labelled A and describe its structure.

(3)

Name .....

Structure .....

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.....

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Turn over ▶

(ii) Explain how the properties of molecule A contribute to the structure of the cell membrane.

(3)

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(b) Some proteins in the cell membrane are involved in active transport and facilitated diffusion. Describe the role of proteins in these cell transport mechanisms.

(3)

Active transport .....

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Facilitated diffusion .....

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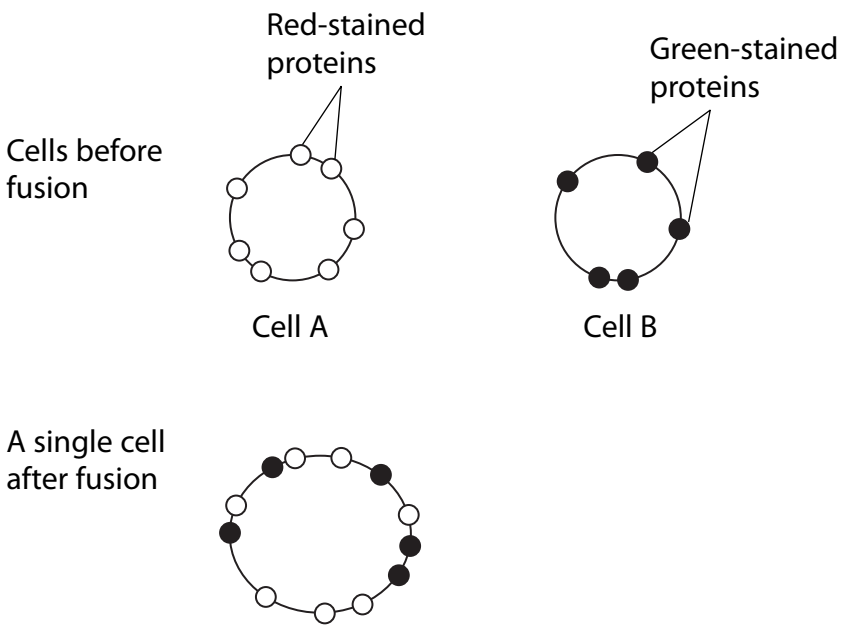
(c) In an investigation into the properties of the cell membrane, the proteins in the membranes of two cells, A and B, were stained using different dyes. The proteins of one cell were stained green and the proteins of the other cell were stained red. The cells were then fused (merged together) to form a single cell.

The diagram below shows the distribution of the proteins in the cell membranes before and after fusion.



(i) Describe the distribution of the proteins in this single cell after fusion.

(2)

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(ii) Describe how the results of this investigation can be explained by the fluid mosaic model.

(2)

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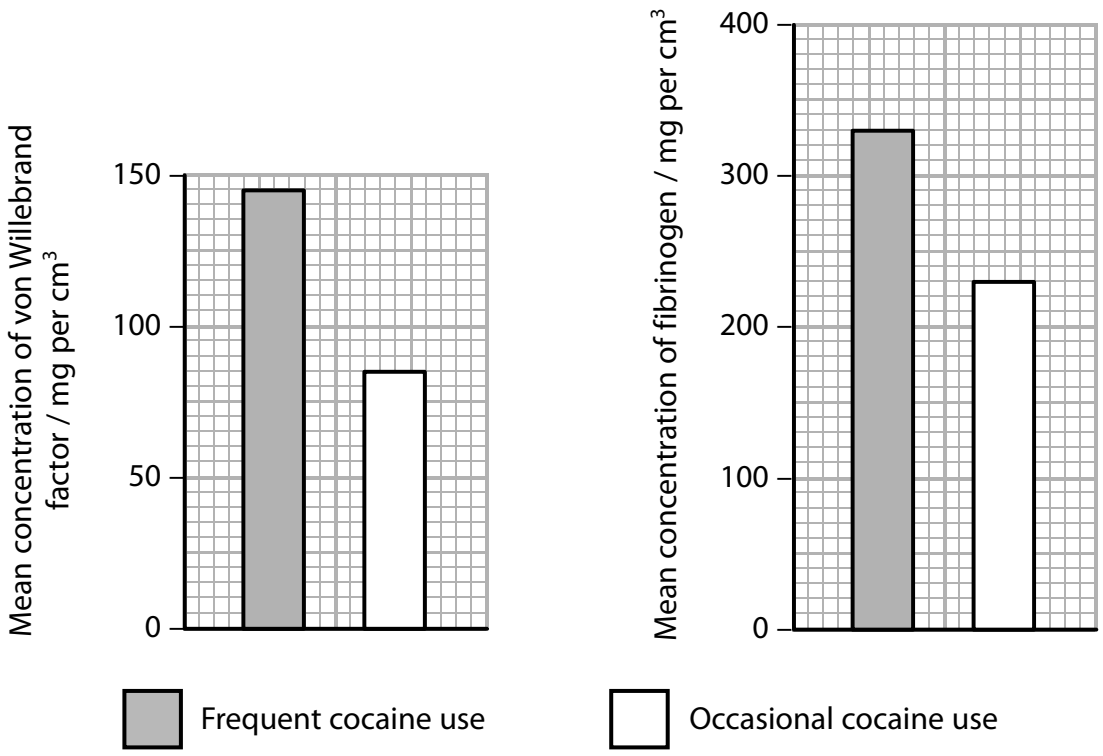
(Total for Question 3 = 13 marks)

4 Cocaine use increases the risk of a heart attack.
Cocaine also affects the levels of a number of blood components, including von Willebrand factor and fibrinogen. These two components are involved in blood clotting.

(a) The normal range for von Willebrand factor is 50 to 150 mg per cm^3 and for fibrinogen is 150 to 300 mg per cm^3.
The graphs below show the effects of frequent and occasional cocaine use on the mean concentration of von Willebrand factor and fibrinogen in the blood.



(i) Describe the effects of frequent and occasional cocaine use on the mean concentrations of von Willebrand factor and fibrinogen in the blood.

(3)

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(ii) Using the information given, explain why conclusions cannot be made about the effect of occasional cocaine use on the concentrations of these blood components.

(1)

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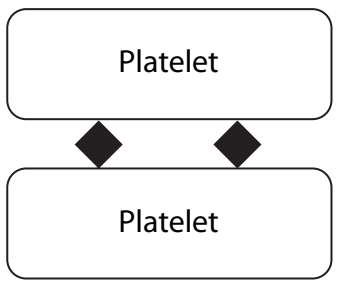
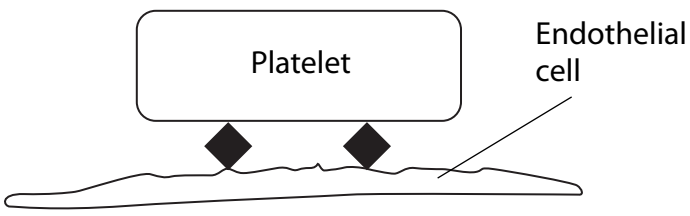
*(b) The diagram below shows two functions of von Willebrand factor.



Platelets stick together



Platelets stick to endothelial cells lining blood vessels

◆ von Willebrand factor

Using the information in this diagram and your own knowledge of the blood clotting process, suggest why frequent cocaine use could increase the risk of a blood clot forming.

(4)

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(c) It has been suggested that there is a correlation between the change in the concentrations of fibrinogen in the blood and the increased risk of heart disease due to cocaine use. Explain why this suggestion is valid.

(2)

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(Total for Question 4 = 10 marks)

5 Cystic fibrosis is a genetic disease that can affect many body systems, including the respiratory system.

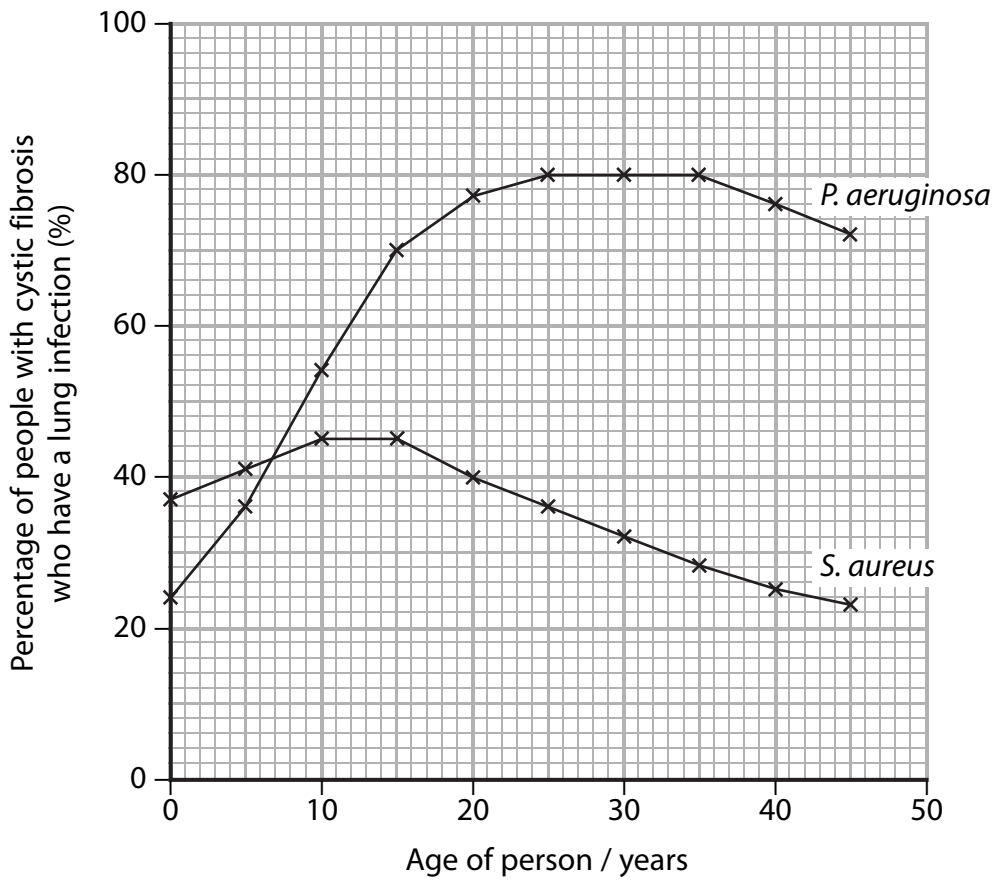
*(a) Explain how a gene mutation causes a build up of mucus in the respiratory system of a person with cystic fibrosis.

(5)

Turn over ▶

(b) Lung infections can be caused by bacteria such as *P. aeruginosa* and *S. aureus*. People with cystic fibrosis may develop these lung infections.

The graph below shows the relationship between the percentage of people with cystic fibrosis who have a lung infection and the age of the person.



(i) Suggest why people with cystic fibrosis are more likely to suffer from these lung infections than people without cystic fibrosis.

(2)

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(ii) Using the information in the graph, describe the relationship between the age of a person and the incidence of a lung infection due to *P. aeruginosa*.

(3)

(iii) Using the information in the graph, give **two** differences between the percentages of people with infections due to *P. aeruginosa* and infections due to *S. aureus*.

(2)

1

2

(Total for Question 5 = 12 marks)

Turn over ▶

6 Enzymes are biological catalysts that change the activation energy of chemical reactions.

(a) Explain the meaning of the terms **biological catalyst** and **activation energy**.

(4)

Biological catalyst .....

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Activation energy .....

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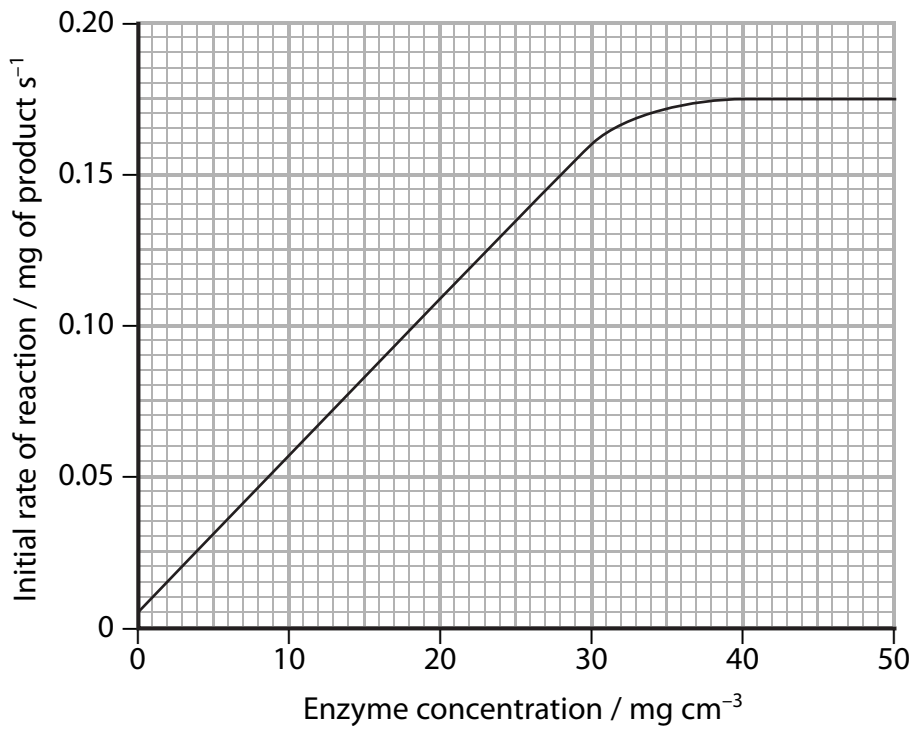
(b) The graph below shows the results of an investigation into the effect of enzyme concentration on the initial rate of this reaction.



Explain why it is necessary to measure the **initial rate** of reaction when investigating the effect of enzyme concentration on the rate of reaction.

(2)

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(c) In this investigation, the substrate concentration was a factor that was kept constant.
Suggest **two** other factors that should be kept constant. For each factor, state how it can be kept constant.

(4)

Factor 1 .....

How the factor can be kept constant .....

.....

.....

Factor 2 .....

How the factor can be kept constant .....

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(Total for Question 6 = 10 marks)

Turn over ▶

7 Plant statins are used in the treatment of cardiovascular disease (CVD). Some fungi can produce chemicals that can be used as statins. One example is a chemical referred to as drug S.

One study into the effect of drug S on the health of people taking it involved 20 000 people and ran for a period of 5 years. One group of people was given drug S and the other group was given a placebo. Each group had 10 000 people in it.

The table below shows some of the findings from this study.

Event	Percentage of people (%)	
	Taking drug S	Taking the placebo
Death	12.9	14.7
CVD	8.7	11.8
Stroke	4.3	5.7

(a) (i) Name **two** factors that increase the risk of CVD.

(1)

1 .....

2 .....

(ii) Suggest why it was necessary to have so many people involved in this study.

(2)

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(b) Suggest what the placebo could be in this study.

(1)

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(c) Suggest why this study had to run for a number of years.

(1)

.....

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(d) Using the data in the table, what is the evidence that drug S is safe for people to take?

(2)

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.....

.....

.....

(e) (i) Calculate how many more people given the placebo had CVD compared with those given drug S.

(3)

Answer .....

(ii) Explain why drug S could be a potential statin.

(1)

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.....

(Total for Question 7 = 11 marks)

8 Some types of cancer lead to the production of tumours (a group of rapidly-dividing cancer cells).

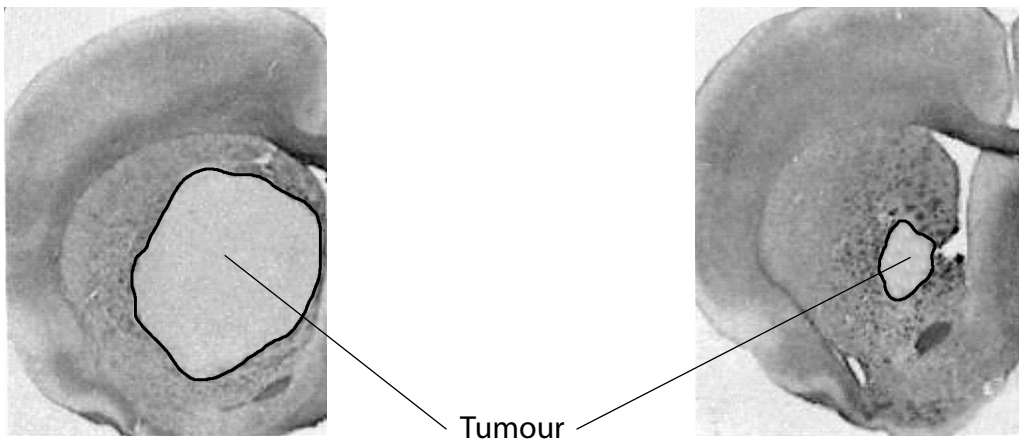
Gene therapy has the potential to cure a number of human diseases, including cancer. At present, research into gene therapy relies on animal models of diseases.

(a) In one investigation, brain tumours were induced in two groups of rats.
One group of rats was given gene therapy and the other group of rats acted as a control.

The photographs below show the appearance of a tumour in the brain of a control rat and in a rat given gene therapy.
Both photographs have the same magnification.

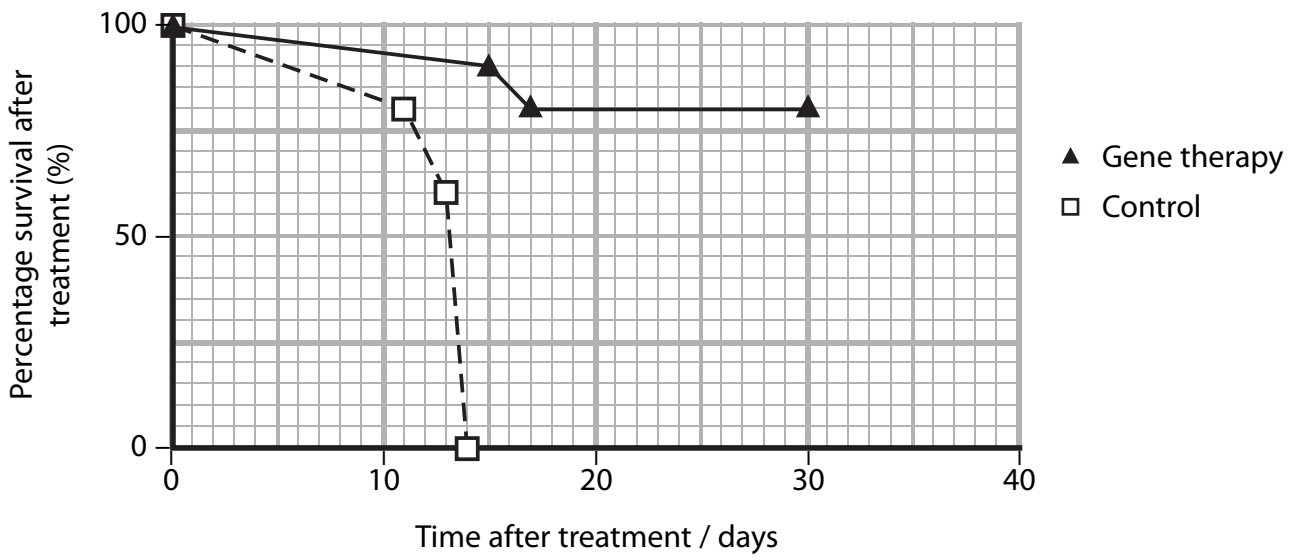
Brain of control rat

Brain of rat receiving gene therapy



Magnification ×10

The graph below shows the percentage survival after treatment of the rats in the two groups.



Using the information shown in the photographs and in the graph, describe the effects of gene therapy on these rats.

(3)

(b) Cancer can cause a lot of pain. Pain can be reduced by a chemical called endorphin that is made by cells in the brain and spinal cord. Endorphin reduces the activity of neurones that carry impulses from pain receptors.

Gene therapy has been used in rats to increase the tolerance to pain. Viruses, containing a gene coding for endorphin, were developed. These viruses were injected into the spinal cords of a group of rats. The level of tolerance to pain was tested in these rats and in the rats in a control group.

(i) Describe the role of the viruses in this investigation.

(2)

(ii) Suggest why the injection was made into the spinal cord.

(1)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(iii) Suggest why a gene coding for an endorphin was used in this investigation.

(1)

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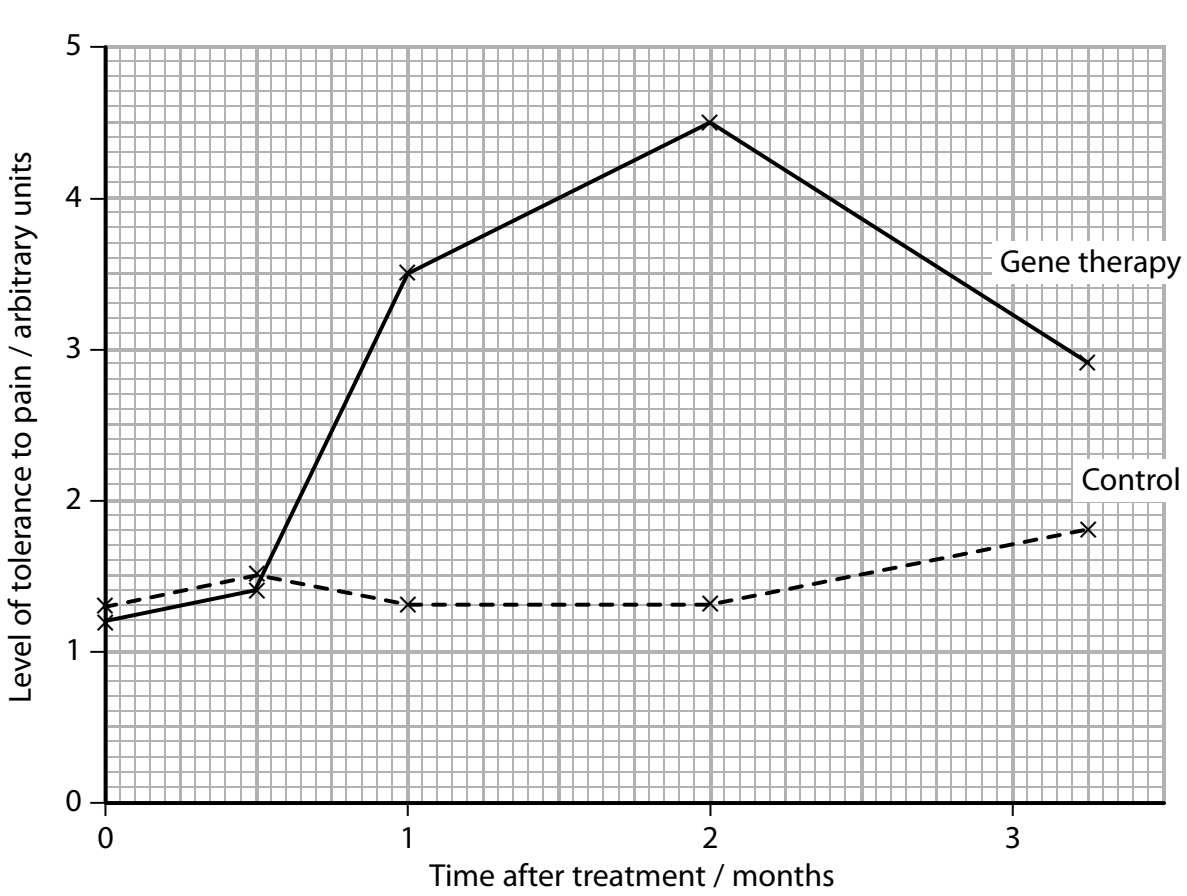
(iv) The results of this investigation are shown in the graph below.



Using the information in the graph, compare the levels of tolerance to pain in the rats given gene therapy with the control group.

(3)

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(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 80 MARKS

mock papers 5

1 Cardiovascular diseases are very common in the Western World.

(a) Many cardiovascular diseases result from atherosclerosis.

Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) Atherosclerosis usually results from the formation of plaques inside

(1)

☒ **A** arteries

☒ **B** capillaries

☒ **C** veins

☒ **D** ventricles

(ii) The plaques begin to form after damage to

(1)

☒ **A** endothelial cells

☒ **B** epidermal cells

☒ **C** red blood cells

☒ **D** white blood cells

(iii) These cells may be damaged due to

(1)

☒ **A** blood flowing slowly under low pressure

☒ **B** blood flowing quickly under low pressure

☒ **C** blood flowing slowly under high pressure

☒ **D** blood flowing quickly under high pressure

(iv) The plaque consists of

(1)

☒ **A** carbohydrate deposits

☒ **B** fatty deposits

☒ **C** plasma deposits

☒ **D** protein deposits

(v) The presence of a plaque in the vessels supplying blood to the brain could result in

(1)

☒ **A** cancer

☒ **B** a heart attack

☒ **C** kidney damage

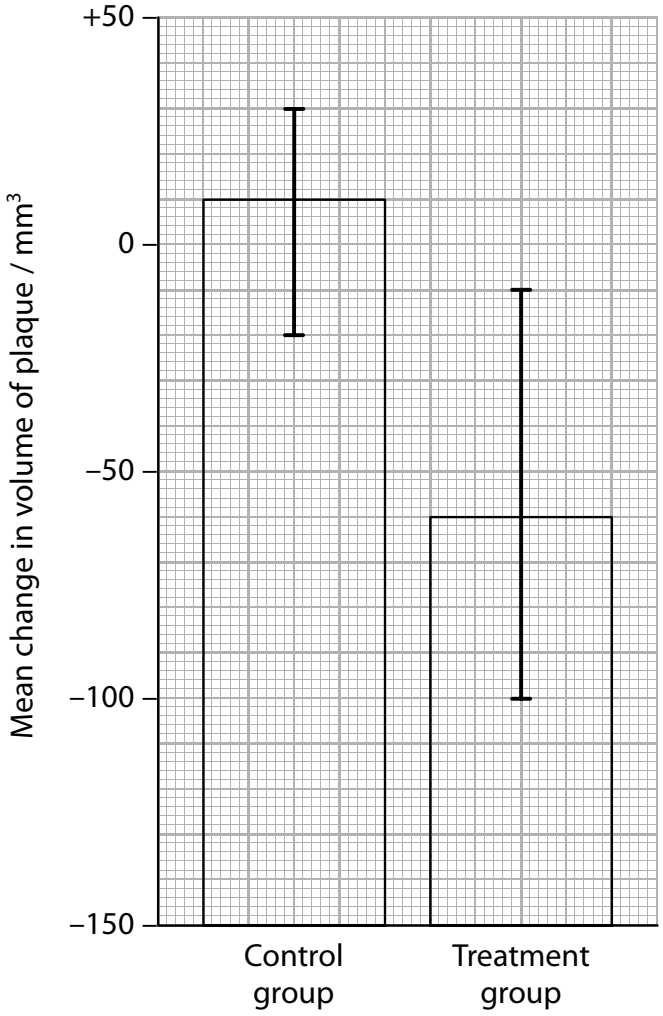
☒ **D** a stroke

(b) A clinical trial was carried out to investigate the effect of a drug on the volume of plaques in patients with atherosclerosis.

Forty patients with atherosclerosis were divided into two groups of twenty. Each patient had the volume of their plaque determined. One group was the control group and the treatment group took the drug daily for two months.

At the end of the two months, the volume of the plaque in each patient was determined again. The mean change in volume of the plaque was calculated.

The results of the clinical trial are shown in the graph below.



(i) Using the information in the graph, describe what the results of this trial show.

(2)

(ii) Suggest **two** reasons why the results of this trial do **not** indicate that this drug could be useful in treating patients with atherosclerosis.

(2)

1

2

(Total for Question 1 = 9 marks)

2 Blood is carried around the body of many animals in different types of blood vessels. The structures of these blood vessels relate to their function.

(a) The table below refers to the structure of capillaries and veins. If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✗) in the appropriate box.

(3)

Type of blood vessel	Valves present along the length of the vessel	Wall consists of a single layer of cells	Endothelial cells present
Capillary			
Vein			

(b) Semilunar valves and elastic fibres are found in the aorta.
For each of these structures, describe its location in the aorta and explain its function.

Semilunar valves

(3)

Location .....

Function .....

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.....

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.....

Elastic fibres

(3)

Location .....

Function .....

.....

.....

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.....

(Total for Question 2 = 9 marks)

3 Read through the following passage on the structure of DNA, then write on the dotted lines the most appropriate word or words to complete the passage.

(8)

A DNA molecule consists of two strands of mononucleotides. Each of these strands

is twisted around the other, forming a ..... .

Each mononucleotide consists of a pentose sugar called ..... ,

a base and a ..... . In each strand, the mononucleotides are

held together by ..... bonds.

The two strands are held together by complementary base pairing. Adenine bonds

with ..... and cytosine bonds with ..... .

The name of the bond that forms between these bases is a

..... bond. A DNA molecule that is composed of 34% adenine

will be composed of ..... % cytosine.

(Total for Question 3 = 8 marks)

4 Many animals have a heart and circulatory system.

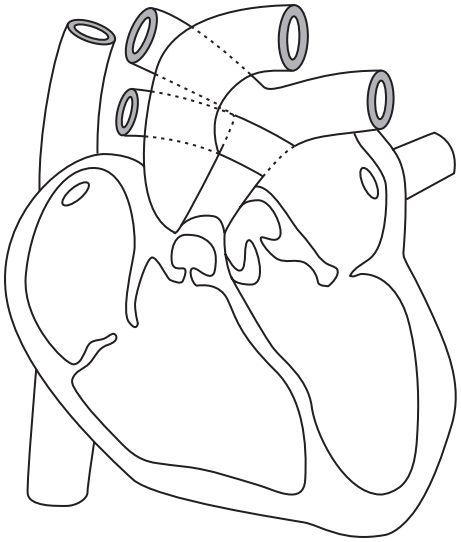
(a) Give **one** reason why many animals have a circulatory system.

(1)

(b) The diagram below shows a section through a mammalian heart.

On the diagram, draw arrows to show the flow of blood into and through the right side of the heart during one beat of the heart.

Right side



Left side

(3)

(c) Explain why a mammalian heart is divided into a right side and a left side.

(2)

(Total for Question 4 = 6 marks)

5 Thalassaemia is the name of a group of inherited blood disorders that affect the body's ability to produce haemoglobin in red blood cells. Red blood cells are produced in bone marrow.

Oxygen in the lungs binds to haemoglobin and is carried to the cells of the body to be used in respiration.

Beta thalassaemia is the result of a mutation in the gene coding for the β chain of haemoglobin. If a person inherits gene mutations from both parents, this person will show symptoms of anaemia and will require blood transfusions. Symptoms of anaemia include tiredness and breathlessness.

*(a) Using the information given above and your knowledge of gene mutation, suggest why a person with beta thalassaemia has symptoms of anaemia.

(4)

(b) If the phenotypes of the parents are known, the probabilities of having a child with beta thalassaemia, an unaffected child or a child who is a carrier, can be calculated.

Complete the table below to show the results of these calculations.

(4)

Parent 1	Parent 2	Probability of having a child with beta thalassaemia	Probability of having an unaffected child	Probability of having a child who is a carrier
Unaffected	carrier	no chance	50%	50%
Carrier	carrier			
Unaffected	has beta thalassaemia			
Carrier	has beta thalassaemia	50%	no chance	50%

(c) Gene therapy could potentially be used to treat beta thalassaemia.

Suggest how gene therapy could be carried out to treat this disorder.

(4)

(Total for Question 5 = 12 marks)

6 The size and solubility of molecules has an effect on their ability to be taken up by cells.

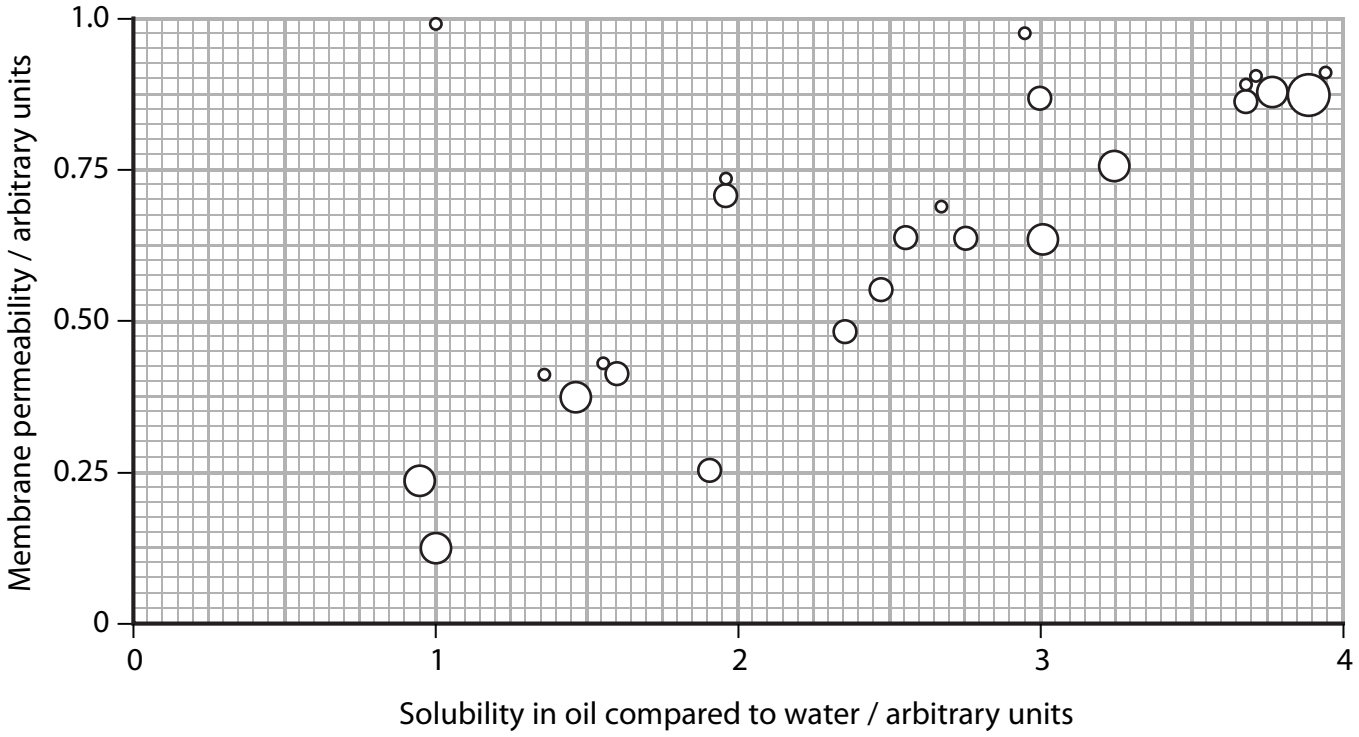
*(a) Describe an experiment you have carried out to investigate the permeability of cell membranes.

(5)

(b) An investigation was carried out into the permeability of a cell membrane to a number of different non-polar, organic molecules. The molecules differed in their size and in their solubility in oil compared with their solubility in water.
The higher the solubility, the more soluble the molecule is in oil compared with water.

The graph below shows the results of this investigation.

The size of the circle drawn on the graph indicates the size of the molecule; the larger the circle, the larger the molecule.



(i) Describe what relationship, if any, there is between the permeability of this cell membrane and the **size** of the molecules.

(1)

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.....

(ii) Describe what relationship, if any, there is between the permeability of this cell membrane and the **solubility** of the molecules in oil compared with water.

(1)

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(iii) Water is able to diffuse through a cell membrane, even though it is a polar molecule.

On the graph, draw a circle, labelled W, to indicate the permeability of the cell membrane to water. The size of the circle should represent the size of the water molecule.

(2)

(iv) Use your knowledge of the structure and properties of cell membranes to explain the results of this investigation.

(3)

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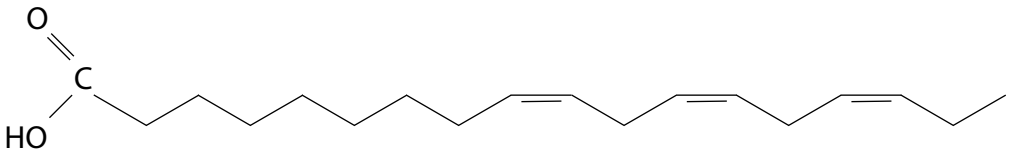
(Total for Question 6 = 12 marks)

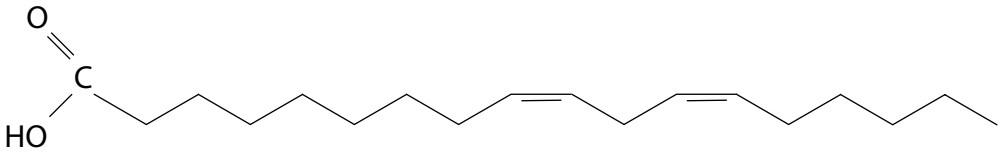
7 Some fatty acids are classed as essential fatty acids. These fatty acids need to be included in our diet, because the human metabolism cannot synthesise them. Omega 3 and omega 6 are two examples of essential fatty acids.

(a) The diagrams below represent the structures of the fatty acids omega 3 and omega 6.

Omega 3



Omega 6



(i) Using the diagram of omega 3 above, describe its structure.

(2)

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(ii) Give **one** difference between the structure of omega 3 and the structure of omega 6.

(1)

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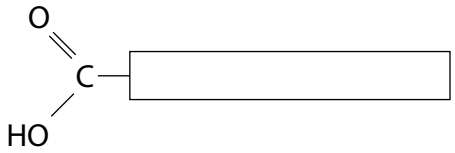
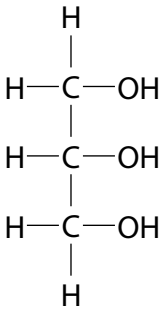
(iii) The diagram below shows a more simplified structure of omega 3.



A glycerol molecule is drawn below. Use these diagrams to show how **one** omega 3 molecule bonds to the glycerol molecule, by means of a condensation reaction, during the synthesis of a triglyceride.

(3)

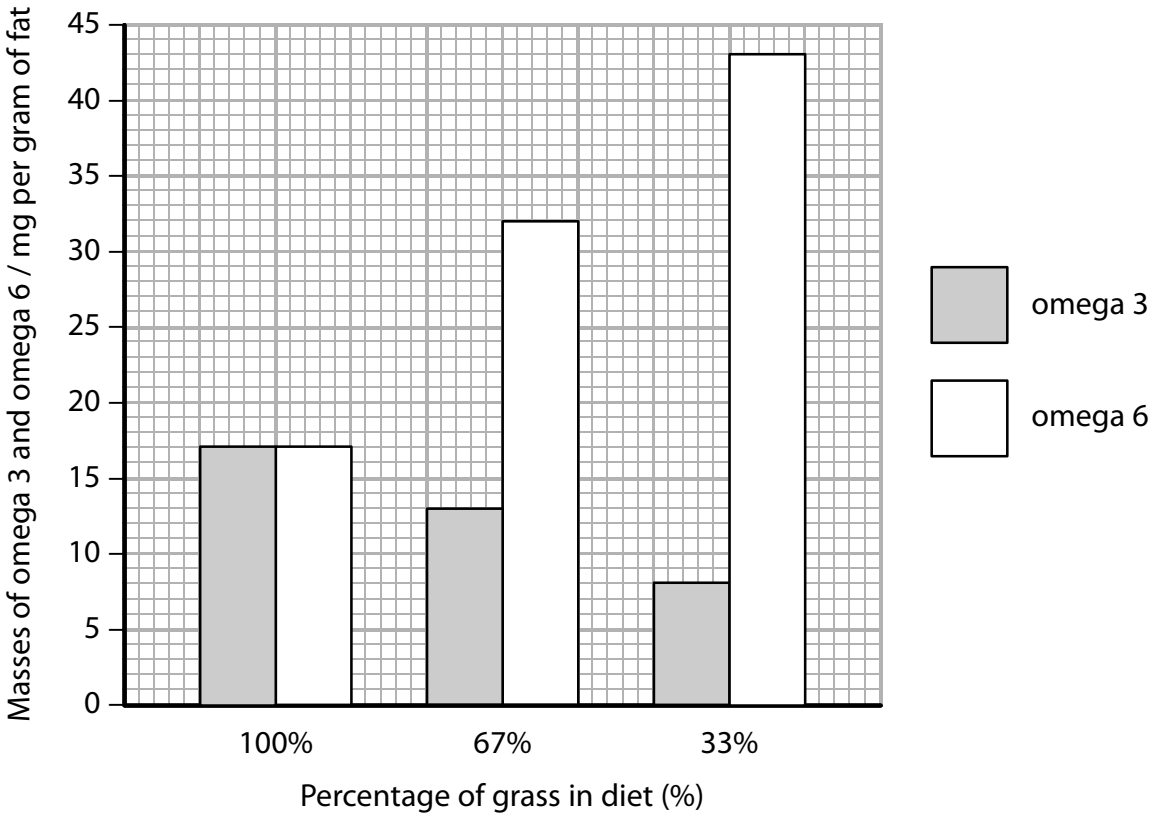


(b) Omega 3 and omega 6 are both present in animal fats.

The proportion of omega 3 and omega 6 in animal fat has been shown to depend on the diet of the animals.

In an investigation, the masses of omega 3 and omega 6, per gram of fat, were determined in the fat from cows fed on a diet containing 100%, 67% or 33% grass.

The results of this investigation are shown in the graph below.



Describe what effect the percentage grass content of a cow's diet has on the proportion of omega 3 and omega 6 in its fat.

(3)

(c) A high ratio of omega 6 to omega 3 has been linked to an increased risk of cardiovascular disease (CVD).

(i) High blood pressure is another factor that increases the risk of CVD.

Give **two** other dietary factors that increase the risk of CVD.

(1)

1 .....

2 .....

(ii) Omega 3 has been shown to lower blood pressure. Antihypertensives can also be used to lower blood pressure.

State **one** risk of using antihypertensives.

(1)

.....

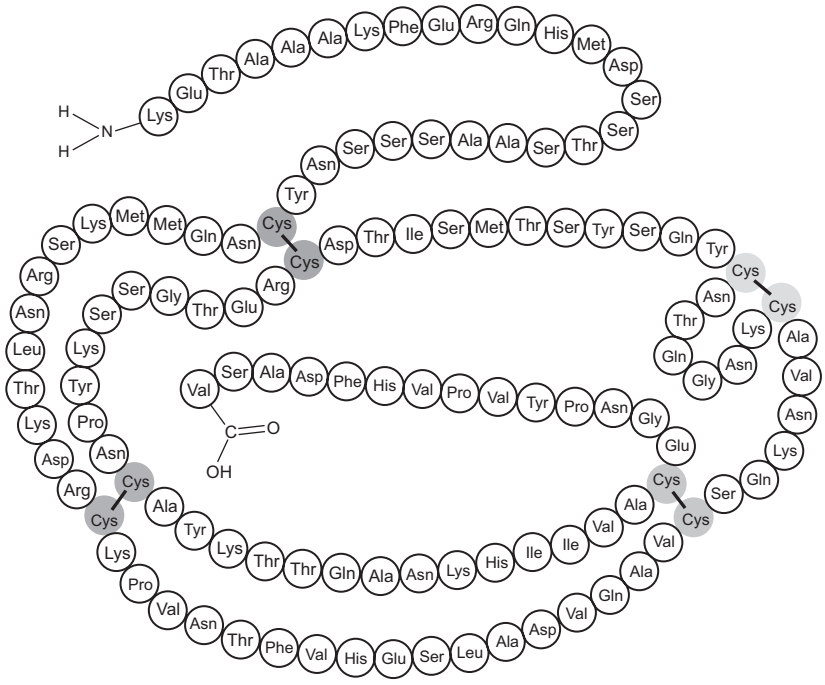
.....

.....

(Total for Question 7 = 11 marks)

8 Enzymes, messenger RNA (mRNA) and transfer RNA (tRNA) are involved in the synthesis of proteins.

(a) The diagram below represents the structure of an enzyme.
Each circle represents an amino acid.



(i) An enzyme is a protein and has a primary structure.
Explain the meaning of the term **primary structure**.

(2)

(ii) Using the diagram and your own knowledge of enzymes, explain the importance of the primary structure of an enzyme to its function.

(5)

(b) Describe the roles of messenger RNA (mRNA) and transfer RNA (tRNA) in protein synthesis.

(i) Messenger RNA

(3)

(ii) Transfer RNA

(3)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

mock papers 6

1 Molecules are transported into and out of cells by several mechanisms.

(a) Read through the following passage that describes some of these mechanisms, then write on the dotted lines the most appropriate word or words to complete the passage.

(4)

Some molecules move across a cell surface membrane by passing down a concentration gradient, through the phospholipid bilayer. The movement of some polar molecules across the membrane involves carrier and channel ..... molecules. When this movement occurs down a concentration gradient, the process is called ..... and when it occurs against a concentration gradient the process is called ..... .

Energy in the form of ..... is used in the movement of molecules against a concentration gradient.

(b) A student wanted to sweeten some strawberries, so she sprinkled some sugar on top of them, one hour before eating them. The student noticed that the sugar that she had sprinkled on them was no longer visible and that there was some juice at the bottom of the bowl.

Appearance on adding sugar

Appearance one hour after adding sugar

The student thought that the juice was the sugar dissolved in water and that the water had come from the fruit.

In order to test this hypothesis, she weighed some fresh strawberries and sprinkled them with sugar. One hour later she rinsed off the juice and reweighed the strawberries. The mass of the strawberries before adding the sugar was 77 g. The mass after rinsing off the juice was 70 g.

(i) Calculate the percentage decrease in the mass of the strawberries.

Show your working.

(2)

Answer ..... %

(ii) Suggest **one** possible source of error in the student's procedure that could make this value for the percentage decrease in the mass of the strawberries inaccurate.

Explain how this source of error would affect the value for the percentage decrease in the mass of the strawberries.

(3)

Source of error .....

.....

.....

Effect on value and explanation .....

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(iii) Using your knowledge of cell transport mechanisms and the properties of water, explain how the juice is formed from the water that came from the fruit.

(3)

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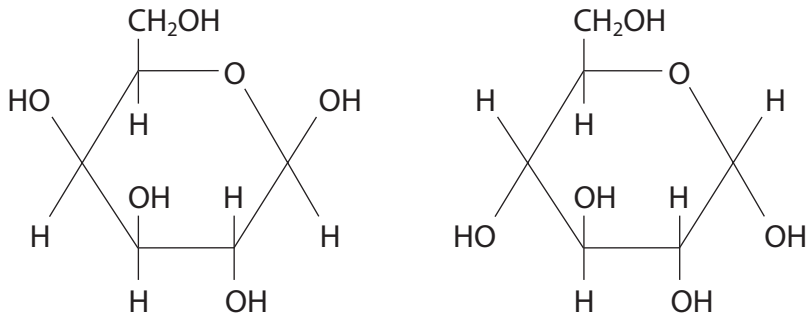
(Total for Question 1 = 12 marks)

2 Galactosaemia is a genetic disorder that affects an individual's ability to metabolise the monosaccharide galactose.

Dairy products contain the disaccharide lactose, which is broken down into galactose and glucose during digestion. If the galactose is not broken down further this may result in damage to the brain, kidneys or liver.

(a) The diagram below shows the structure of a galactose molecule and a glucose molecule.



(i) In the space below, draw a diagram to show the products formed when these two molecules join together to form lactose.

(3)

(ii) Name the chemical reaction that joins the galactose and glucose molecules together.

(1)

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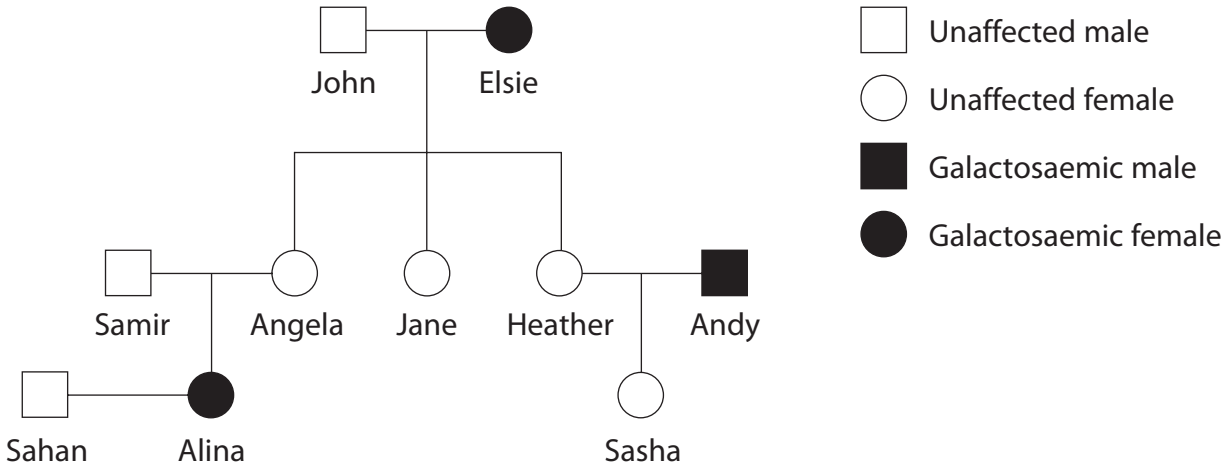
(iii) Name the bond that joins the galactose and glucose molecules together.

(1)

.....

(b) The pedigree diagram below shows the inheritance of galactosaemia in a family.



The normal allele is represented by G and the defective recessive allele by g.

Place a cross ☒ in the box next to the correct letter that completes each of the following statements.

(i) An allele is a

(1)

☒ **A** form of a gene

☒ **B** length of DNA

☒ **C** part of a gene

☒ **D** protein

(ii) If John is heterozygous for galactosaemia, Jane's genotype must be

(1)

☒ **A** GG

☒ **B** Gg

☒ **C** gg

☒ **D** impossible to tell

(iii) Samir's genotype must be

(1)

☒ **A** GG

☒ **B** Gg

☒ **C** gg

☒ **D** impossible to tell

(c) (i) Use a genetic diagram to calculate the probability that Sahan and Alina's first child will be heterozygous (a carrier) if Sahan is heterozygous.

(4)

Answer .....

(ii) What is the probability that their second child would also be a carrier?

(1)

.....

.....

(Total for Question 2 = 13 marks)

3 Cystic fibrosis is a genetic disease that can affect many body systems, including the digestive system. In a carrier of this disorder, preimplantation genetic diagnosis can be used to detect the presence of an allele for cystic fibrosis.

*(a) Explain how cystic fibrosis affects the digestive system.

(4)

(b) Explain how **preimplantation** genetic diagnosis is performed to detect cystic fibrosis.

(3)

(c) Discuss either **one** ethical issue or **one** social issue relating to the use of preimplantation genetic diagnosis.

(2)

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(Total for Question 3 = 9 marks)

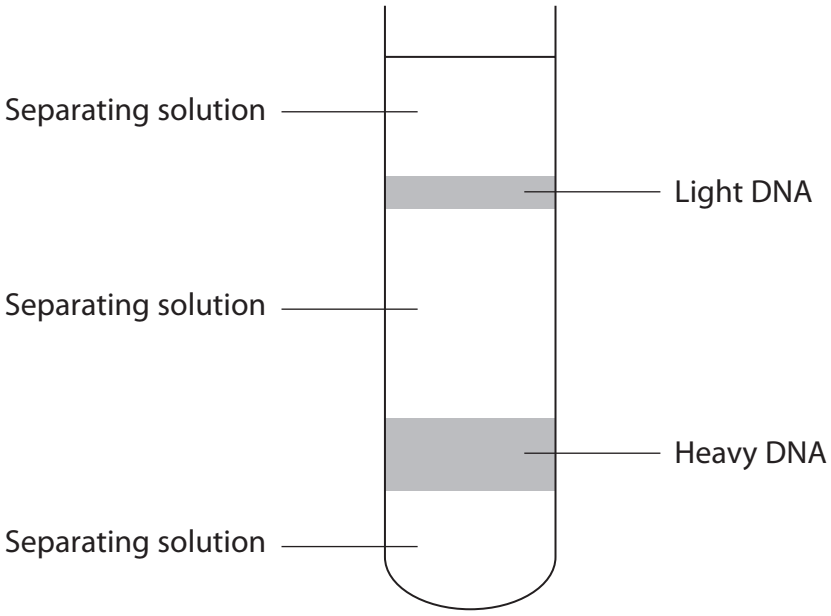
4 In the late 1950s, Meselson and Stahl performed some important experiments. These experiments provided evidence to support the idea that new DNA was synthesised by semi-conservative replication.

(a) Name an enzyme involved in DNA replication.

(1)

.....

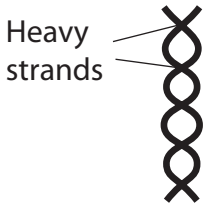
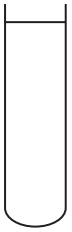
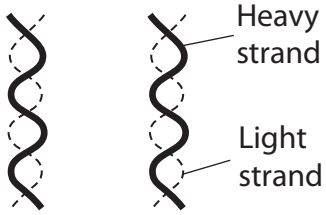
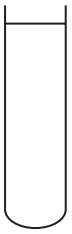
(b) Meselson and Stahl's experiments involved growing bacteria in culture media containing either heavy nitrogen (^{15}N) or light nitrogen (^{14}N). The DNA was then extracted from the bacteria. The DNA was analysed as shown in the diagram below.



The table below summarises the three stages of Meselson and Stahl's experiment and their results.

Complete the table by drawing, in the appropriate boxes, diagrams of the DNA molecules and mark the position and size of the DNA bands in the tubes.

(6)

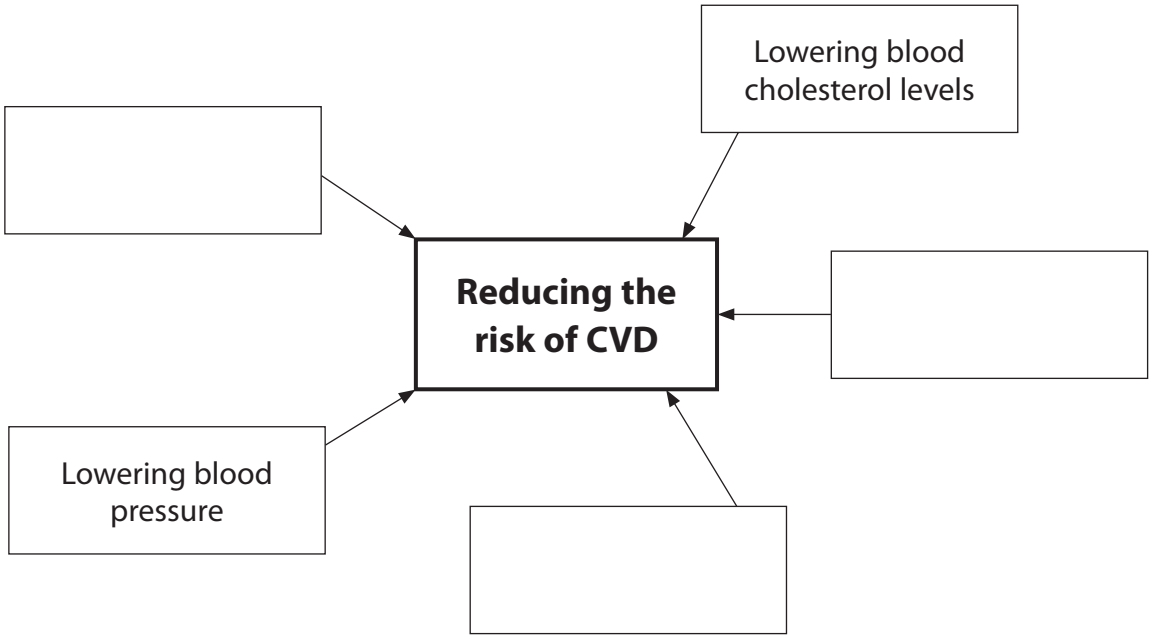
Experimental stage	Diagram to show the strands in the DNA molecules of the bacteria	Position and size of DNA bands in the tube of separating solution
Stage 1 Bacteria grown for several generations in culture medium containing heavy nitrogen		
Stage 2 The bacteria from the end of stage 1 were grown for another generation in culture medium containing light nitrogen		
Stage 3 The bacteria from the end of stage 2 were grown for one more generation in culture medium containing light nitrogen		

(Total for Question 4 = 7 marks)

5 The risk of developing cardiovascular disease (CVD) can be reduced in several ways. Lowering blood cholesterol levels and lowering blood pressure are two ways of reducing CVD.

(a) (i) Complete the diagram below by giving three other ways in which the risk of CVD may be reduced. Write your answers in the empty boxes.

(3)



(ii) Explain how lowering blood cholesterol levels can reduce the risk of CVD.

(2)

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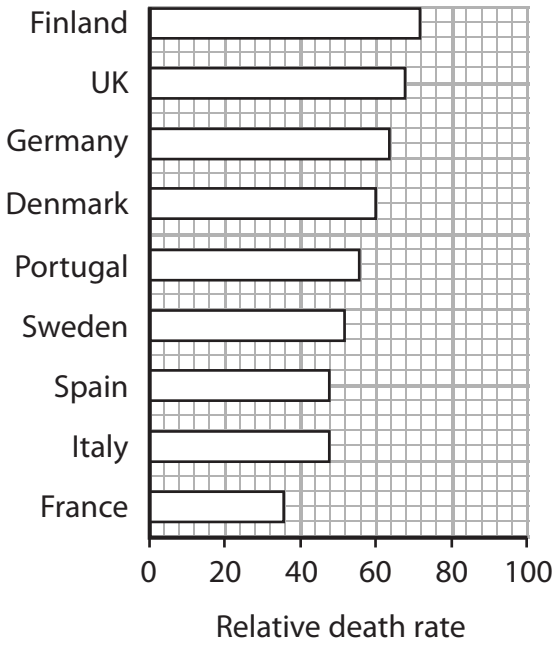
.....

(b) Risk calculators can be used to estimate the probability that a person will develop CVD. Many of these calculators start by asking for the age and gender of the person using them. Explain why information about age and gender is important in estimating the risk of developing CVD.

(2)

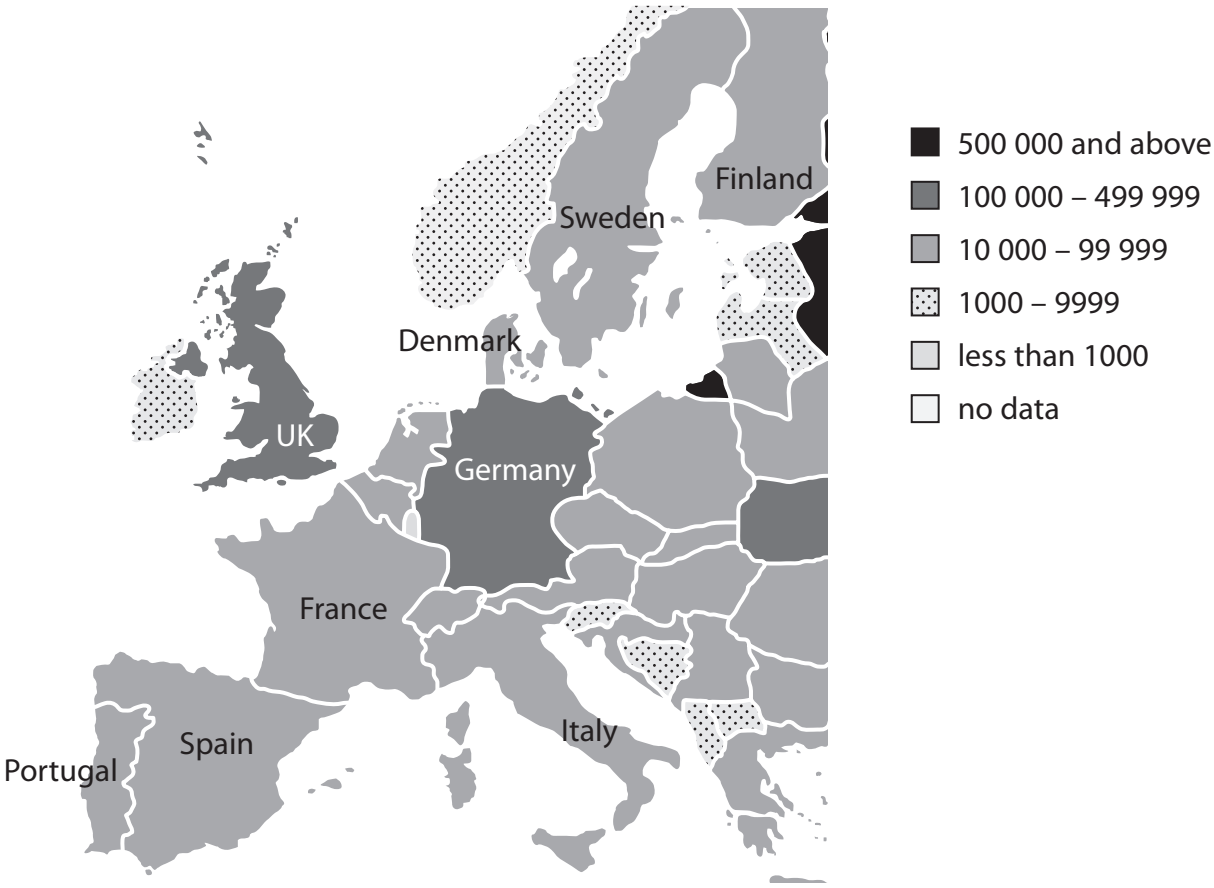
(c) The graph below shows the relative death rate from CVD in some countries in Western Europe.



(i) Compare the relative death rates from CVD in Finland, Denmark and Sweden.

(3)

(ii) The map below shows the number of deaths from CVD in one year in Western Europe.



Describe **two** differences between the data presented in the map and the data shown in the graph.

(2)

1 .....

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2 .....

.....

(iii) Suggest **one** reason for the differences between the data presented in the map and the data shown in the graph.

(1)

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(Total for Question 5 = 13 marks)

6 The sequence of amino acids in a polypeptide chain is determined by the sequence of bases in DNA. This sequence of bases is used as a template to synthesise messenger RNA (mRNA).

(a) Describe the structure of an amino acid.

(2)

(b) Describe how mRNA is synthesised.

(4)

(c) The table below shows the amino acids coded for by the codons on **mRNA**.

Three-letter codons of mRNA and the amino acids specified by the codons			
AAU, AAC — Asparagine	CAU, CAC — Histidine	GAU, GAC — Asparatic acid	UAU, UAC — Tyrosine
AAA, AAG — Lysine	CAA, CAG — Glutamine	GAA, GAG — Glutamate	UAA, UAG — Stop
ACU, ACC, ACA, ACG — Threonine	CCU, CCC, CCA, CCG — Proline	GCU, GCC, GCA, GCG — Alanine	UCU, UCC, UCA, UCG — Serine
AGU, AGC — Serine AGA, AGG — Arginine	CGU, CGC, CGA, CGG — Arginine	GGU, GGC, GGA, GGG — Glycine	UGU, UGC — Cysteine UGA — Stop UGG — Tryptophan
AUU, AUC, AUA — Isoleucine AUG — Methionine	CUU, CUC, CUA, CUG — Leucine	GUU, GUC, GUA, GUG — Valine	UUU, UUC — Phenylalanine UUA, UUG — Leucine

The diagram below shows part of a messenger RNA molecule.

(i) Place a cross ☒ in the box next to the complementary sequence of bases found on the strand of the **DNA** molecule, from which part of this mRNA molecule was synthesised.

(1)

☒ **A** G G T A A G C G C C T T

☒ **B** G G U A A C G C G G A A

☒ **C** A A C G G A U A U U G G

☒ **D** A A C G G A T A T T G G

(ii) Place a cross ☒ in the box next to the sequence of amino acids found in the polypeptide chain that is coded for by this part of the **mRNA** molecule.

(1)

☒ **A** proline lysine alanine valine

☒ **B** proline phenylalanine alanine valine

☒ **C** glycine lysine arginine glutamine

☒ **D** proline lysine alanine glutamine

(iii) Place a cross ☒ in the box next to the final codon on this **mRNA** molecule if GUU is the last codon for an amino acid.

(1)

☒ **A** AGU

☒ **B** ACU

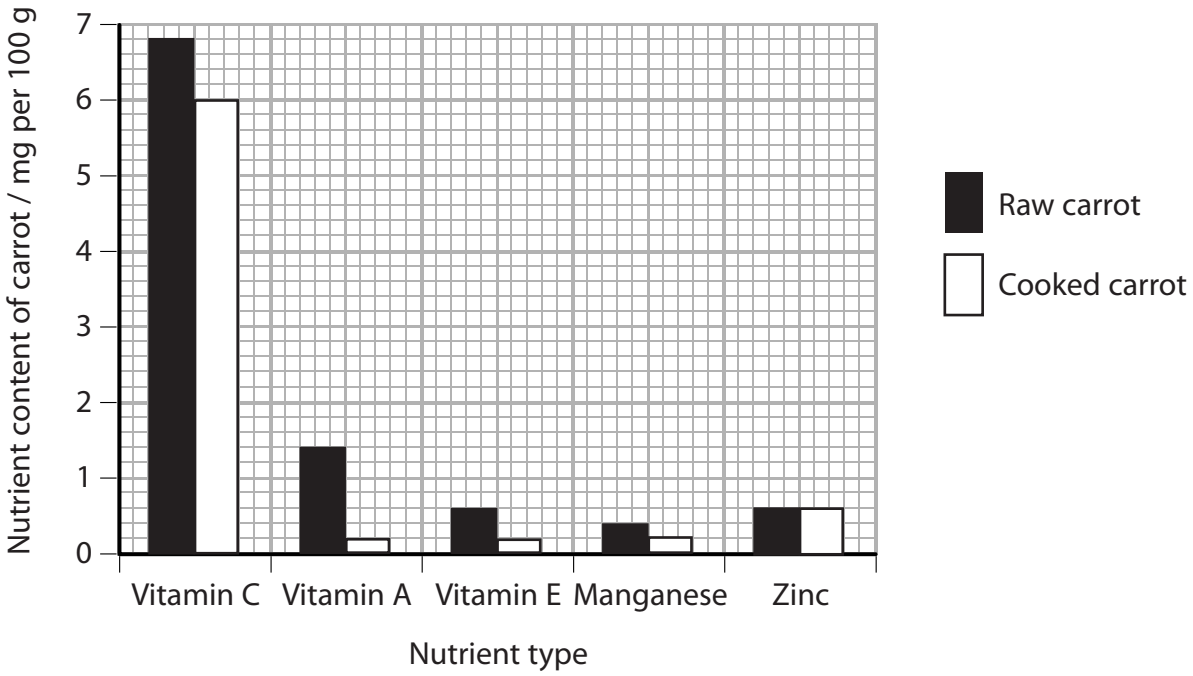
☒ **C** UCA

☒ **D** UGA

(Total for Question 6 = 9 marks)

7 When vegetables are cooked in boiling water, they may lose some of their nutrients.

The graph below shows the effect of cooking on the content of three vitamins and two minerals found in carrots.



(a) Using the information in the graph, compare the effects of cooking on the content of vitamins and minerals found in carrots.

(3)

*(b) It has been suggested that cooking food in a microwave oven does not reduce the nutrient content of foods by as much as cooking in boiling water.

A student wanted to test this idea on the vitamin C content of carrots.

Describe an investigation that the student could carry out to compare these two methods of cooking on the vitamin C content of carrots.

(5)

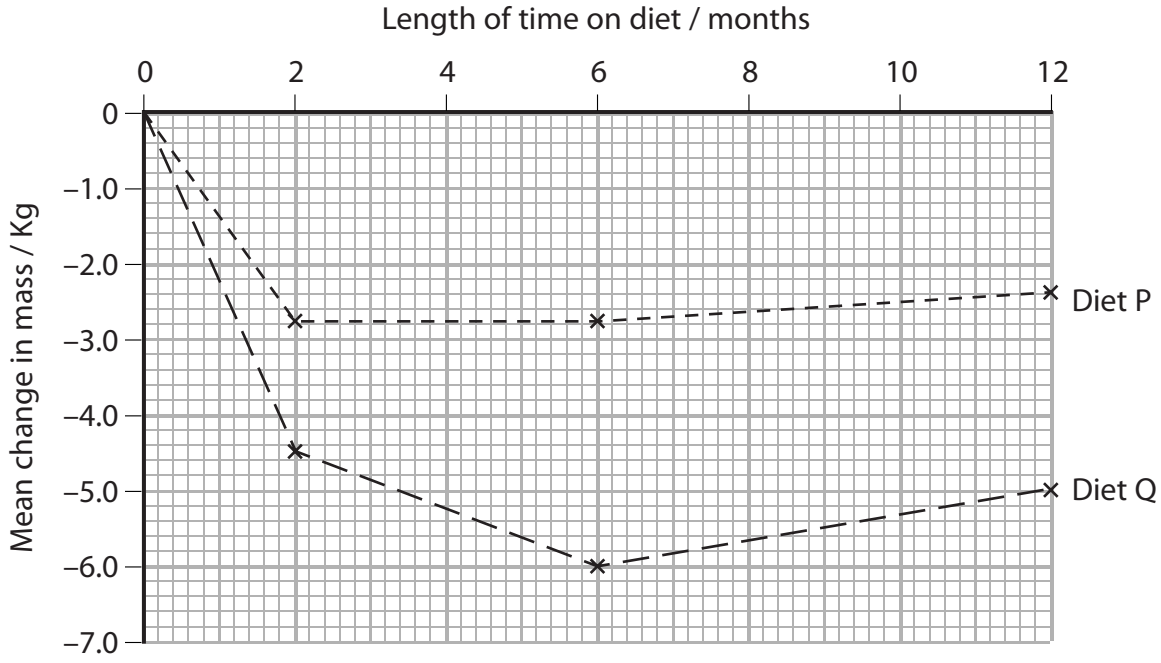
(Total for Question 7 = 8 marks)

8 Many different diets are available for people who want to lose weight. There is a lot of confusion over the merits of each one.

A scientist carried out an investigation to compare the effects of diet P and diet Q, on volunteers.

The changes in mass of two groups of volunteers on each of these diets were monitored over a 12-month period.

The graph below shows the mean changes in mass for each group of volunteers.



(a) (i) Compare the mean change in mass, over the first 6 months, for these two groups of volunteers.

(3)

(ii) Suggest why there was an increase in the mean mass of the volunteers on both diets between 6 months and 12 months.

(1)

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.....

(iii) State **two** variables that the scientist needed to control in this investigation.

(2)

1 .....

2 .....

(b) Suggest why exercise is usually included as part of a weight loss programme.

(3)

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(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 80 MARKS

mock papers 7

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)

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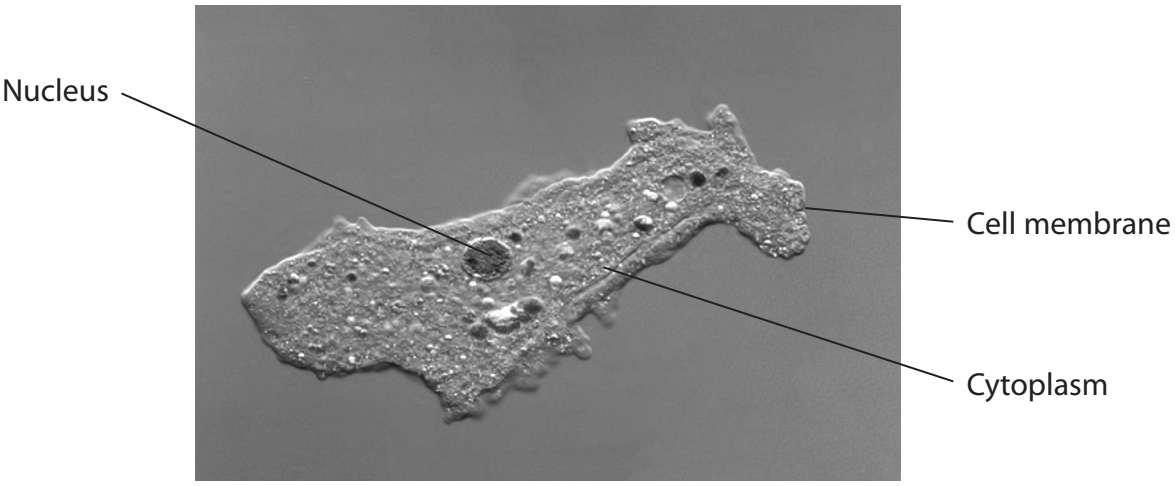
(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

(Total for Question 1 = 11 marks)

2 An amoeba is a single-celled organism that lives in water. Gas exchange in an amoeba occurs between the water and the cytoplasm.

The photograph below shows an amoeba, as seen using a microscope.



Magnification x800

Dr Jeremy Burgess / Science Photo Library

*(a) Using the information shown in the photograph and your own knowledge, suggest how gas exchange occurs in an amoeba.

(4)

(b) Suggest how oxygen passes from the cell membrane into the centre of an amoeba.

(2)

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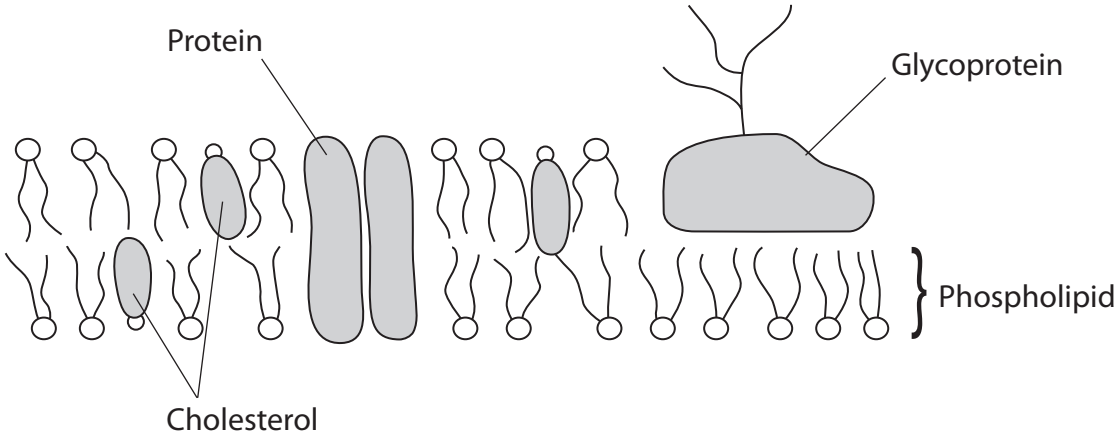
(Total for Question 2 = 6 marks)

3 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

(1)

☒ **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

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

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

(1)

☒ **A** endocytosis

☒ **B** exocytosis

☒ **C** facilitated diffusion

☒ **D** phagocytosis

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

(1)

☒ **A** cholesterol

☒ **B** glycoprotein

☒ **C** phospholipid

☒ **D** protein

(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)

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(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)

1 .....

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2 .....

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

(2)

1 .....

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2 .....

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(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)

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(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)

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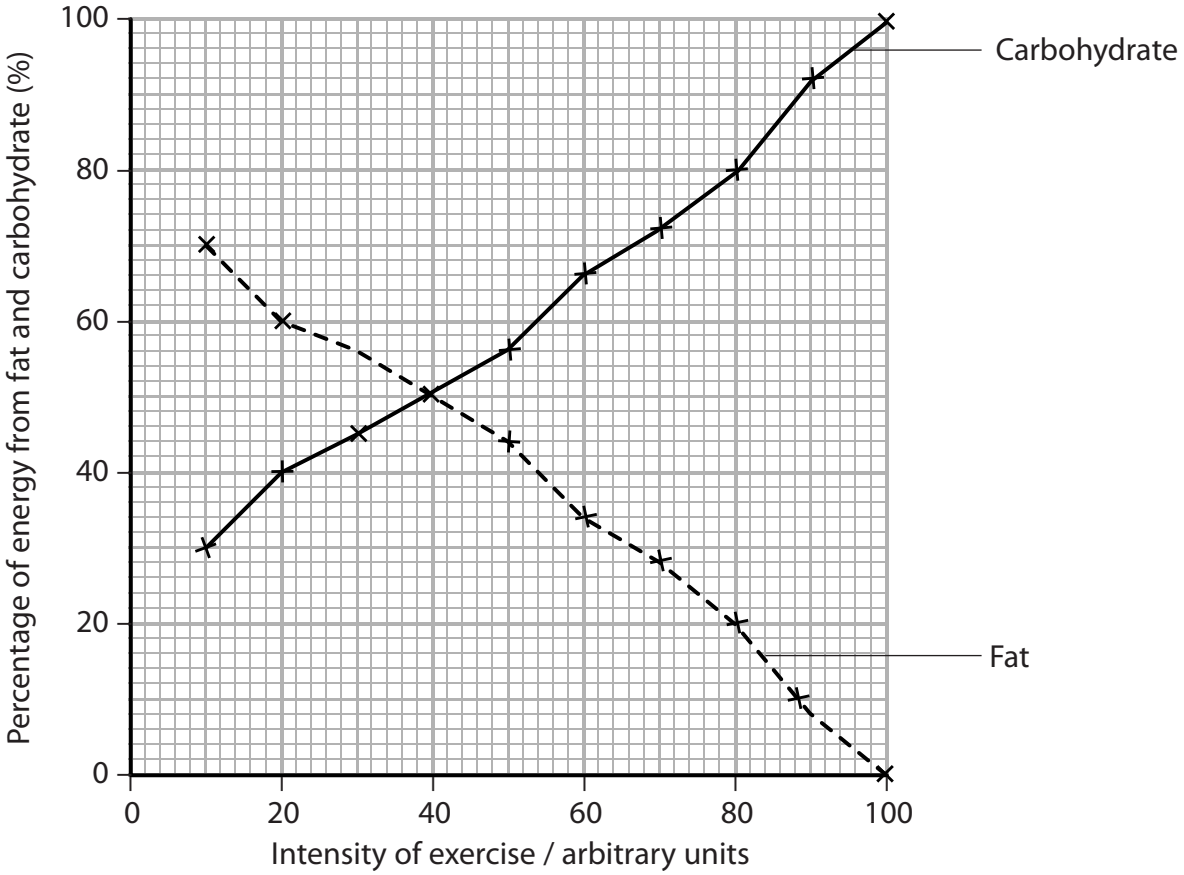
(Total for Question 3 = 12 marks)

4 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)

(Total for Question 4 = 10 marks)

5 Genetic screening can be used to determine if an embryo has a genetic disorder, such as cystic fibrosis.

(a) The table below refers to the methods used in preimplantation genetic diagnosis and prenatal genetic screening.
If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✗) in the appropriate box.

(2)

Method of screening	Statement	
	Screening performed during pregnancy	**Cells removed from the embryo**
Preimplantation genetic diagnosis		
Prenatal genetic screening		

(b) (i) Name **one** method of prenatal genetic screening.

(1)

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(ii) Discuss either **one** ethical issue or **one** social issue relating to the use of this method of prenatal genetic screening.

(2)

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(c) Gene therapy has the potential to treat some genetic disorders.

(i) Explain why gene therapy has the potential to treat some genetic disorders.

(2)

(ii) Suggest how patients with cystic fibrosis could be treated using gene therapy.

(3)

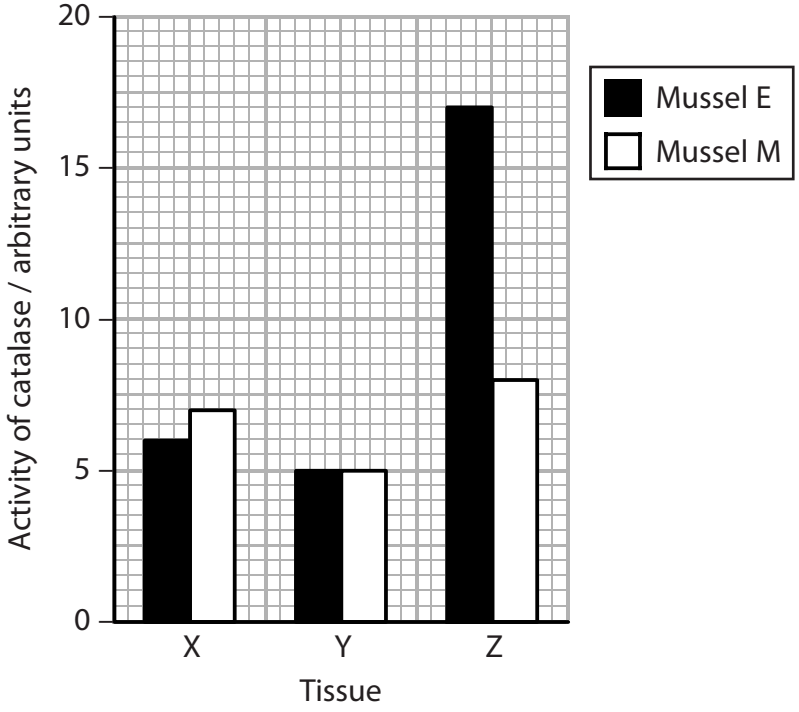
(Total for Question 5 = 10 marks)

6 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)

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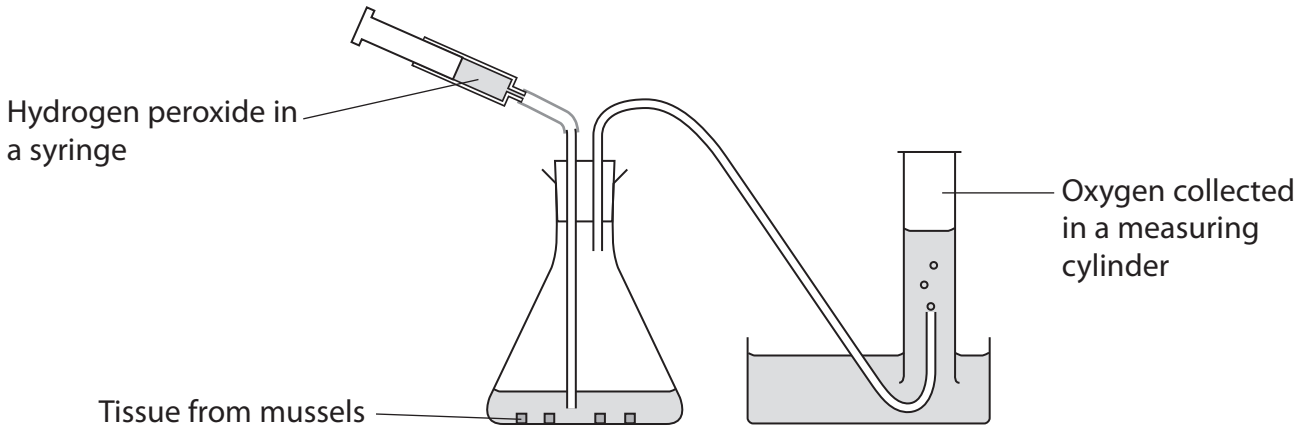
(b) Catalase activity in tissue from mussels can be studied using the apparatus shown below.

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.



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

(4)

(Total for Question 6 = 9 marks)

7 Cardiovascular disease (CVD) is responsible for many deaths.

*(a) One cause of CVD is atherosclerosis. Describe how atherosclerosis develops.

(4)

(b) A number of factors have been identified that increase the risk of CVD. One of these factors is genetic.

The genotype of some individuals causes them to be more at risk of developing CVD. One gene that influences this risk is the *KIF6* gene. Carriers of the 719 Arg allele of this gene are more at risk of CVD.

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

(1)

(ii) Explain the meaning of the term **allele**.

(1)

(c) Give **two** factors, other than genetic factors, that increase the risk of developing CVD.

(1)

1 .....

2 .....

(d) Trials have shown that plant statin therapy is more effective in 719 Arg carriers than in non-carriers of this allele.

Describe the risks of using plant statins to treat CVD.

(2)

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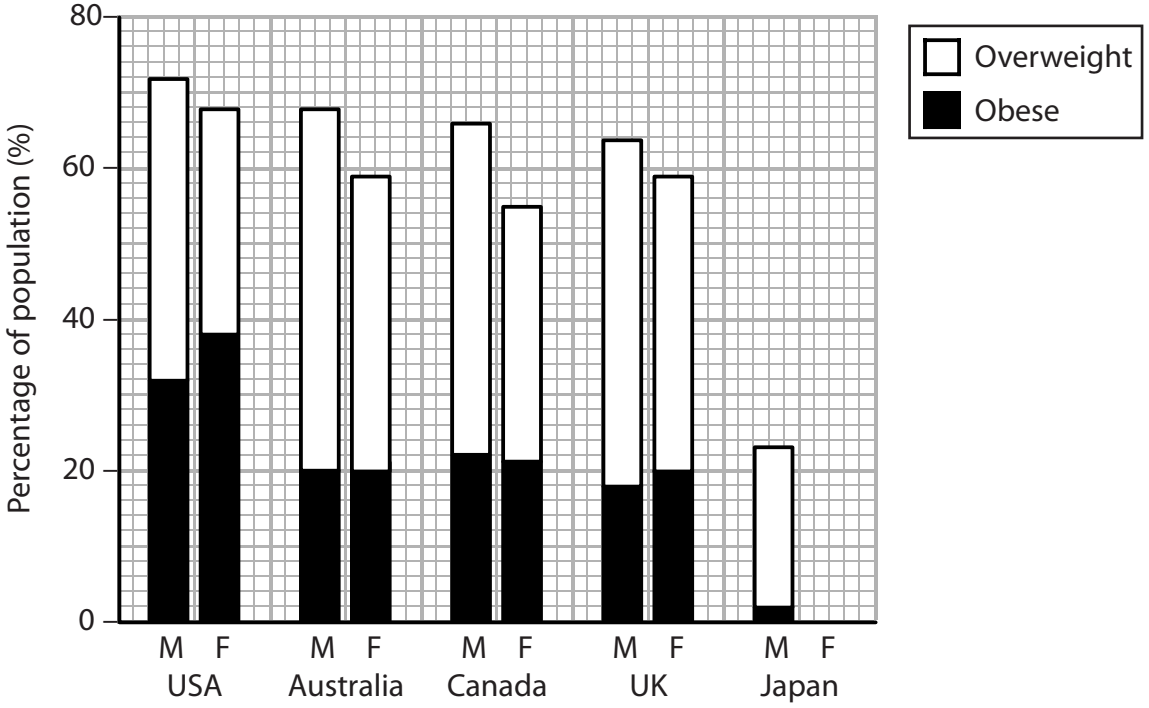
(Total for Question 7 = 9 marks)

8 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

(1)

- ☒ **A** 4 : 3
- ☒ **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)

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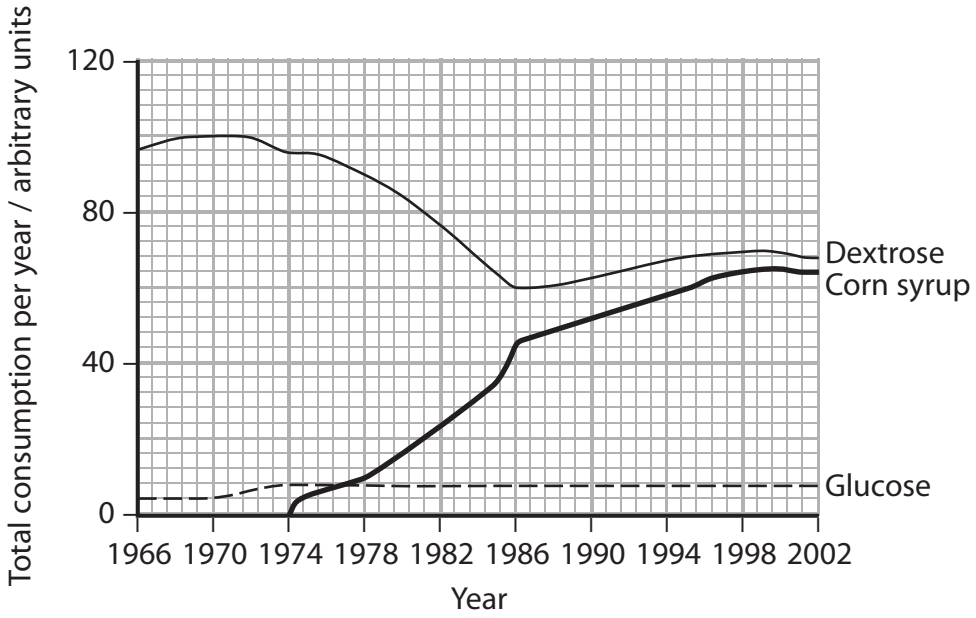
(d) The graph below shows the consumption of three types of sweetener in the USA, from 1966 to 2002.



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)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS