NOTICE TO CUSTOMER:

The sale of this product is intended for use of the original purchaser only and for use only on a single computer system. Duplicating, selling, or otherwise distributing this product is a violation of the law ; your license of the product will be terminated at any moment if you are selling or distributing the products.

Answer **all** the questions.

1 **(a)** List **three** reasons why a large, multicellular animal, such as a mammal, needs a transport system.

.....

.....

.....

.....

.....

..... **[3]**

Fig. 1.1, **on the insert**, shows the nervous pathways that coordinate heart action.

Above the diagram is a trace showing the electrical activity associated with one heart beat.

(b) **(i)** State the full name given to a trace showing the electrical activity of the heart.

..... **[1]**

(ii) Identify the components of the heart labelled **A** and **B** on Fig. 1.1.

A .....

B .....
[2]

(c) **(i)** During the electrical stimulation of the heart, there is a short delay between the excitation of the atria and excitation of the ventricles.

Explain why this delay is essential.

.....

.....

.....

.....

.....

..... **[2]**

(ii) The Purkyne tissue carries the excitation wave down the septum to the apex of the heart.

Explain why the excitation wave is carried to the apex.

.....

.....

.....

.....

.....

.....

..... **[2]**

[Total: 10]

2 **(a)** Fig. 2.1, **on the insert**, shows a yeast cell with scars resulting from its reproductive process.

(i) Name the process of asexual reproduction in yeast.

..... **[1]**

(ii) Outline the process of asexual reproduction in yeast.

.....

.....

.....

.....

.....

..... **[2]**

(b) **(i)** A yeast cell can continue producing new cells until its surface is covered by scars.

The surface area of a sphere is given by the formula $4\pi r^2$, where $\pi = 3.14$.

The area of a circle is given by the formula πr^2.

Assuming that the cell in Fig. 2.1 contained no scars, calculate how many potential new cells could be produced by this cell.

Show your working.

Answer = ... **[2]**

(ii) Even when the environmental conditions are perfect, one yeast cell rarely produces the calculated number of potential new cells.

Suggest why the reproductive potential of the yeast cell is not reached.

.....

.....

..... **[1]**

(c) Yeast cells separate after cell division. In a multicellular organism, the cells do not separate but become organised to form the body structure.

Describe how the cells in a multicellular organism are organised.

In your answer you should use appropriate technical terms, spelled correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[5]**

[Total: 11]

3 **(a)** The structure of cell membranes can be described as 'proteins floating in a sea of lipids'. This membrane structure allows certain substances to pass through freely whereas other substances cannot.

State the term used to describe a membrane through which some substances can pass freely but others cannot.

..... **[1]**

(b) Complete the following paragraph about cell membranes, using the most appropriate terms.

The model of cell membrane structure is called the .... model. Phospholipid bilayers with specific membrane proteins account for the ability of the membrane to allow both passive and ..... transport mechanisms. Ions and most polar molecules are insoluble in the phospholipid bilayer. However, the bilayer allows diffusion of most non-polar molecules such as .....Protein channels, which may be gated, and ..... proteins enable the cell to control the movement of most polar substances. **[4]**

(c) One function of membranes that is not mentioned in **(b)** is cell signalling.

(i) State what is meant by *cell signalling*.

.....

.....

.....

..... **[1]**

(ii) Explain how cell surface membranes contribute to the process of cell signalling.

In your answer you should use appropriate technical terms, spelled correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

[Total: 10]

4 **(a)** A student used a potometer to investigate the effect of leaf area on the rate of transpiration.

This apparatus is shown in Fig. 4.1.

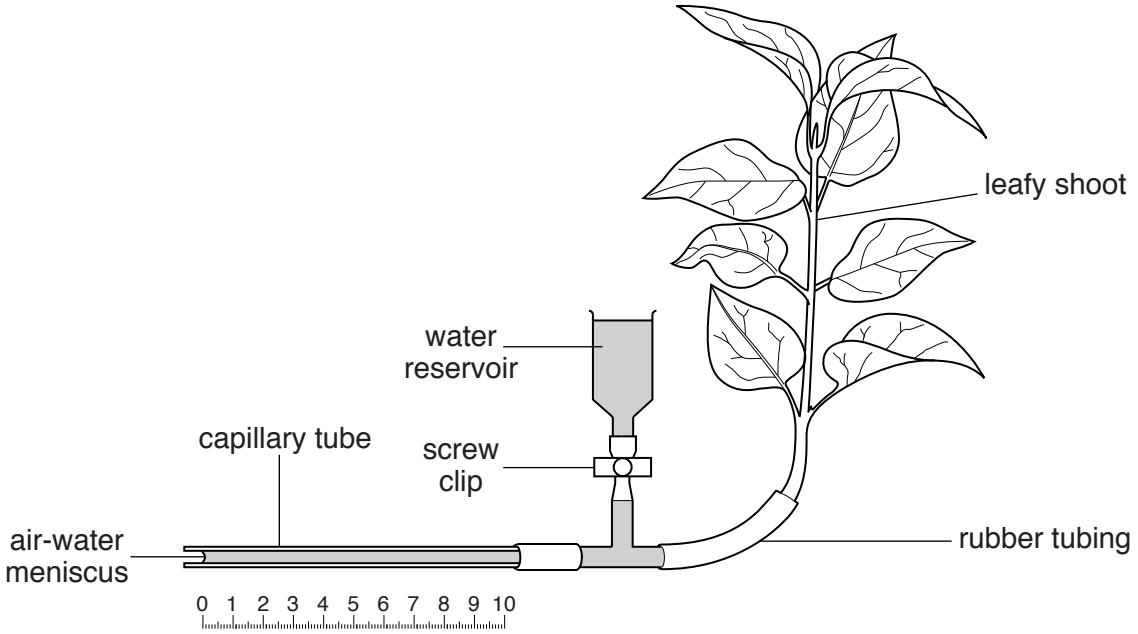


Fig. 4.1

The student presented the results of their investigation in a table, as shown below.

Number of leaves present on shoot attached to potometer	Mean rate of bubble movement
0	7
2	28
4	49
6	73
8	92

Table 4.1

(i) State what information the student has **not** included in their table of results.

.....

.....

..... **[2]**

(ii) Describe **and** explain the data shown by the student's results.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

QUESTION 4(b) STARTS ON PAGE 10

(b) As part of the evaluation of the investigation, the student wrote the following statements:

1 One limitation is that the leaves were not all the same size.

2 I assembled the potometer under water and the leaves got wet.

3 During my investigation the sun came out and the lab warmed up very quickly.

For each statement, explain why this may affect the results **and** suggest how the student could improve the investigation.

Statement 1

.....

.....

.....

.....

.....

Statement 2

.....

.....

.....

.....

.....

Statement 3

.....

.....

.....

.....

.....

[6]

[Total: 11]

BLANK PAGE

Question 5 starts on page 12

PLEASE DO NOT WRITE ON THIS PAGE

5 **(a)** Complete Table 5.1 below which compares different types of cell.

Place a tick (✓) or a cross (✗) in each box to indicate whether the feature is present or absent. The first row has been completed for you.

	Cell type		
Feature	**Plant cell**	**Animal cell**	**Bacterial cell**
mitochondria	✓	✓	✗
chloroplasts			
cellulose cell wall			
centrioles			
ribosomes			

Table 5.1 **[4]**

(b) In an investigation, cells were broken up (homogenised) and the component organelles were separated into tubes.

Each tube was then tested to determine the identity of the component organelle(s).

The observations are shown in Table 5.2.

Test for the…	**Tube**			
	1	**2**	**3**	**4**
ability to make ATP	no ATP produced	ATP produced	no ATP produced	no ATP produced
presence of DNA	DNA present	trace amount	no DNA present	no DNA present
ability to produce proteins	no proteins made	no proteins made	no proteins made	proteins made
ability to digest bacteria	none	some ability	none	none

Table 5.2

(i) Identify the tube that contains the following organelles:

nuclei .....

ribosomes .....

mitochondria .....

lysosomes ..... **[4]**

(ii) Which of the organelles listed in **(i)** is the smallest in size?

..... **[1]**

[Total: 9]

Question 6 starts on page 14

6 **(a)** The lignin in the xylem vessel walls of plants and the C-rings of cartilage in the mammalian trachea perform an important role.

(i) Explain why lignin is essential in the wall of a xylem vessel.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(ii) Explain why cartilage is essential in the trachea.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(b) All living organisms exchange substances with their external environment.

The following data apply to an average person:

- the surface area of the body is approximately 1.8 m^2
- the volume of the body is approximately 0.07 m^3
- the surface area of the lungs is approximately 70 m^2.

Comment on the significance of this information for gas exchange.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

[Total: 9]

END OF QUESTION PAPER

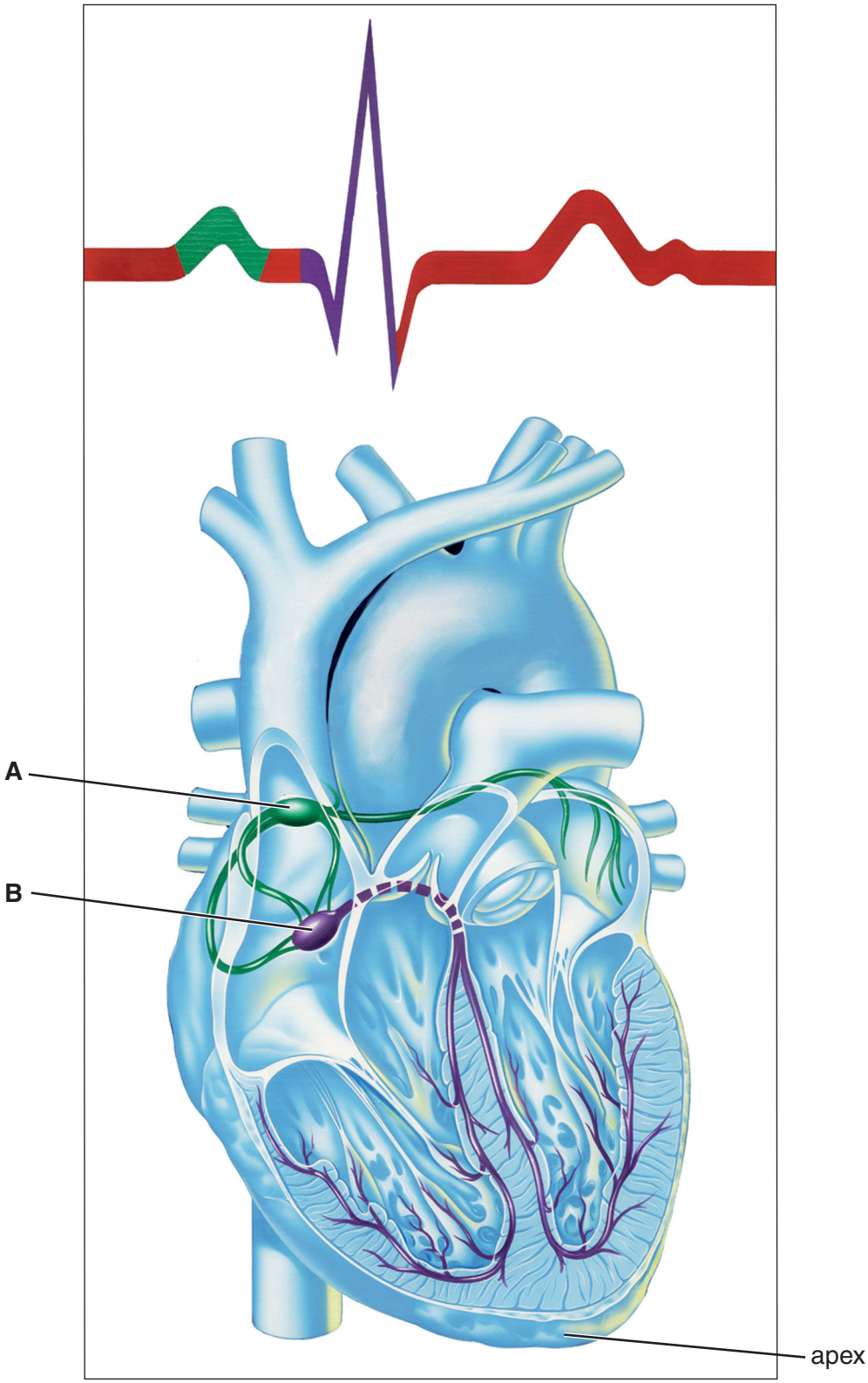


Fig. 1.1

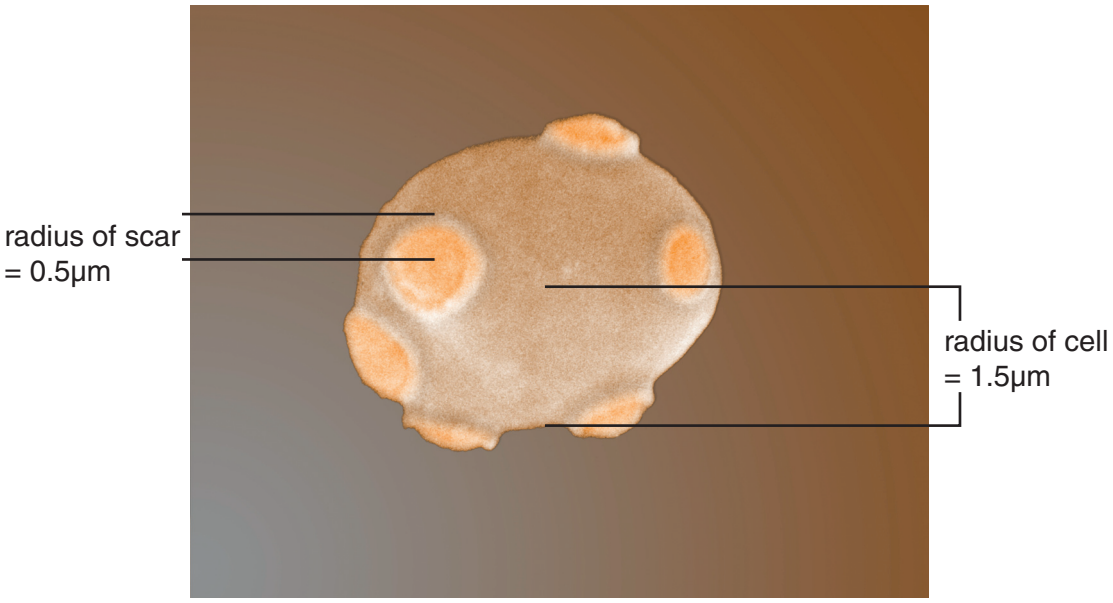


Fig. 2.1

Answer **all** the questions.

1 Many insects live in freshwater habitats such as rivers and ponds for part of their life cycle.

Fig. 1.1 shows a labelled diagram of a generalised insect along with six common insects found in freshwater in the UK.

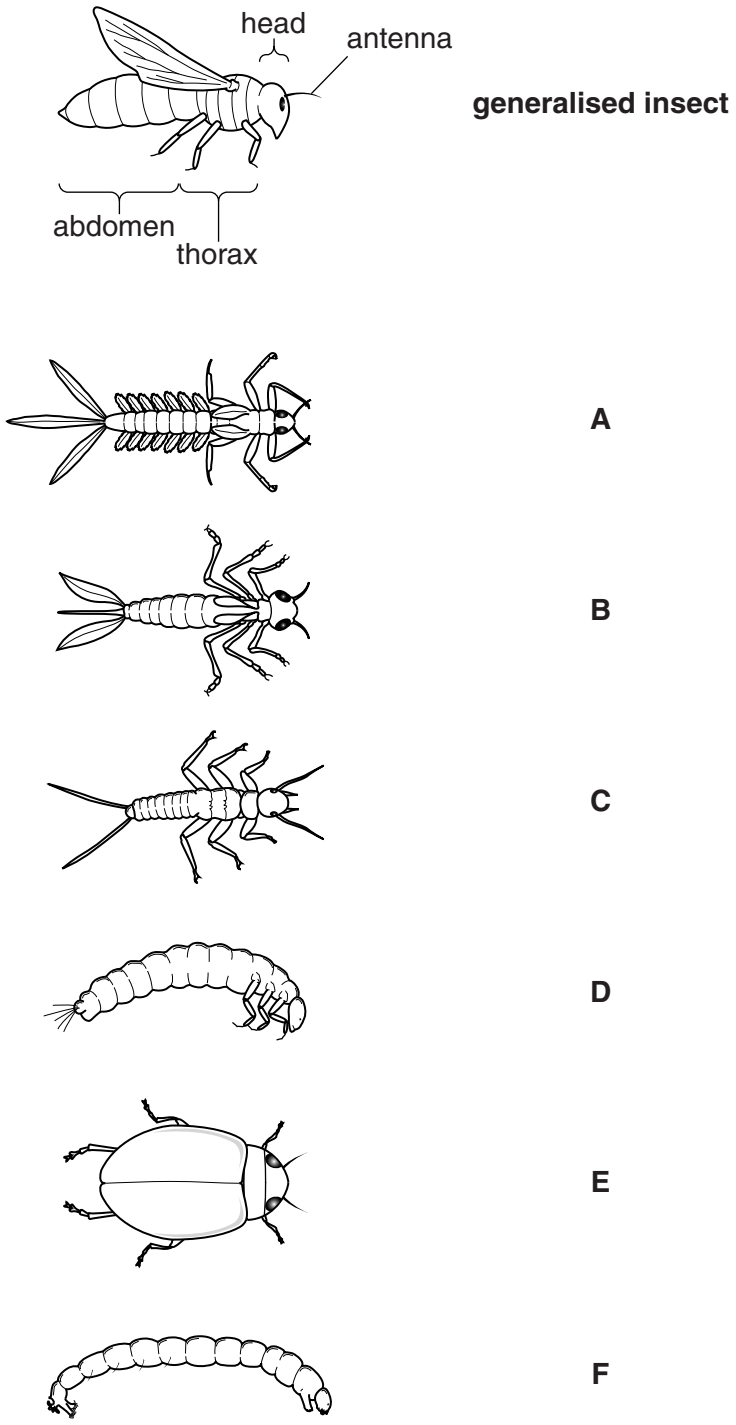


Fig. 1.1

Table 1.1 below shows a dichotomous key used for the classification of insects.

Key:			
Question 1	Does it have jointed limbs?	yes no	go to question 2 **bloodworm**
Question 2	Does it have an oval body shape?	yes no	**diving beetle** go to question 3
Question 3	Is the length of the tail greater than the length of three abdominal segments?	yes no	go to question 4 **caddis fly larva**
Question 4	Are gills attached to the abdominal segments?	yes no	**mayfly larva** go to question 5
Question 5	Does it have two narrow tails?	yes no	**stonefly larva** **damsel fly larva**

Table 1.1

(a) (i) Use Table 1.1 to identify the insects labelled **A** to **F** shown in Fig. 1.1.

A .....

B .....

C.....

D .....

E .....

F .....

[2]

(ii) Why is the key in Table 1.1 described as a *dichotomous* key?

.....

..... **[1]**

(b) Suggest an adaptation shown by at least one of the insects in Fig. 1.1 that allows them to survive in an aquatic habitat.

.....

..... **[1]**

(c) Insects belong to the animal kingdom within the domain *Eukaryota*.

(i) Suggest **one** feature of the cells of insects that would identify insects as belonging to the domain *Eukaryota*.

.....

..... **[1]**

(ii) State **two** features that are present in the eukaryotic cells of plants that are **absent** from the cells of insects.

1 .....

2 .....

[2]

[Total: 7]

BLANK PAGE

Question 2 begins on page 6

PLEASE DO NOT WRITE ON THIS PAGE

2 **(a)** In the UK in 2009, there was a major outbreak of a type of influenza known as 'swine flu'.

'Swine flu' was caused by a new strain of the influenza virus.

Explain why the influenza virus is usually described as a *pathogen* rather than a *parasite*.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(b) When an individual is infected with a virus, an immune response is triggered.

(i) Define the term *immune response*.

.....

.....

.....

..... **[2]**

(ii) One type of cell involved in an immune response is a plasma cell, which releases antibodies.

Plasma cells contain RNA.

Outline the roles of RNA in plasma cells.

In your answer you should give an account of the different roles of RNA.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

(iii) Outline **two** ways in which antibodies reduce the threat from pathogens.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(c) (i) In an attempt to reduce the consequences of further outbreaks of influenza, the government encourages immunisation of key groups of people, such as the elderly and children that have another risk factor.

Suggest **two other** groups who should be immunised **and** explain why immunisation for them would be particularly important.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(ii) Immunisation of large numbers of people costs the UK government a lot of money.

Other than the direct effects on health or reducing the number of deaths, suggest a reason why spending a large amount of money on immunisation is considered worthwhile.

.....

.....

..... **[1]**

(iii) Much of the money spent on immunisation programmes is used to publicise the health benefits of immunisation. Despite this, some individuals are reluctant to have the immunisation.

Give **one** reason why, despite being aware of the immunisation programme, some people choose not to be immunised.

.....

.....

..... **[1]**

[Total: 21]

Question 3 begins on page 10

3 **(a)** Complete the passage below using the most appropriate terms.

Enzymes are ..... proteins and are therefore soluble. They alter the rate of metabolic reactions and are described as biological ..... .

Some enzymes, such as those found in cytoplasm, are described as ..... enzymes. Other enzymes, such as those that digest food in the small intestine, are known as ..... enzymes. Some medicinal drugs reduce enzyme activity. These are called enzyme ..... . **[5]**

(b) Many enzymes are associated with non-protein molecules known as cofactors. Some cofactors are small inorganic ions.

Rennin is an enzyme that is involved in the digestion of milk. It converts soluble caseinogen in milk into insoluble casein. The cofactor Ca^{2+} is associated with this reaction.

A student wished to investigate the effect of Ca^{2+} on the action of rennin.

Describe how the student could carry out this investigation and produce valid results.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[5]**

(c) Enzyme cofactors are often derived from vitamins and minerals in the diet.

Proteins are required in large amounts in the diet whereas vitamins and minerals are required only in small amounts.

Suggest why.

.....

.....

..... **[1]**

[Total: 11]

Question 4 begins on page 12

4 **(a)** Lipids form an important part of a balanced diet but if too many lipids are consumed this can result in obesity.

What is meant by the term *balanced diet*?

.....

.....

.....

..... **[2]**

(b) **(i)** Lipids are used for energy storage and as a respiratory substrate.

List **three** other roles of lipids in the human body.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Other than obesity, outline why a diet high in lipids might have a negative effect on the health of an individual.

.....

.....

.....

.....

.....

.....

..... **[3]**

(c) Two examples of lipid molecules are triglycerides and phospholipids.

Identify **two** differences and **two** similarities in the **structures** of triglycerides and phospholipids.

Write your answers in the appropriate boxes in the table below.

	Triglyceride	**Phospholipid**
Difference		
Difference		
Similarity		
Similarity		

[4]

(d) It is possible to test for the presence of lipids in a food sample.

(i) Name the test used to identify the presence of lipids.

..... **[1]**

(ii) Describe how you would carry out this test on a food sample.

.....

.....

.....

.....

.....

.....

..... **[3]**

(iii) State the expected result if lipid is present in the food sample.

.....

..... **[1]**

[Total: 17]

5 Scientists have identified approximately 1.8 million different species. The number of species that actually exist is likely to be significantly higher than 1.8 million.

(a) Suggest **two** reasons why the number of species identified is likely to be lower than the actual number of species present on Earth.

1 .....

.....

2 .....

.....

[2]

(b) Many organisations, such as the International Union for the Conservation of Nature (IUCN), gather annual data about the number of species that are known to exist and to what extent they are considered to be endangered.

Fig. 5.1 shows the total number of species assessed by the IUCN over a 10 year period and the number of those species assessed that are considered to be threatened with extinction.

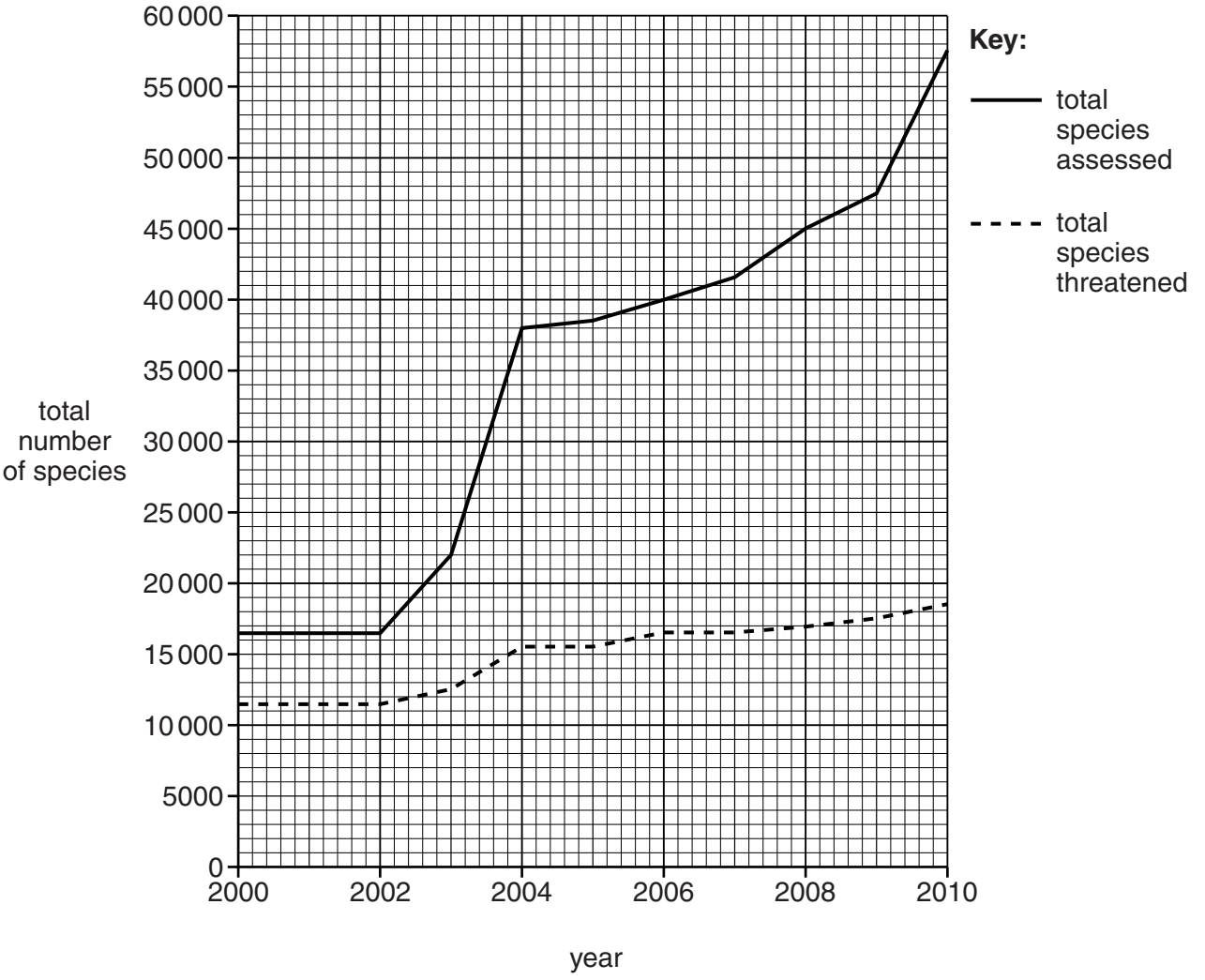


Fig. 5.1

(i) Using Fig. 5.1, **compare** the changes in the total number of species assessed with the changes in the total number of threatened species over the 10 year period.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(ii) Using Fig. 5.1, calculate the percentage of species assessed that were threatened with extinction in **2010**.

Show your working. Give your answer to the **nearest whole number**.

Answer = ... % **[2]**

(iii) Suggest explanations for the shape of the two curves between **2005** and **2010**.

.....

.....

.....

.....

.....

..... **[2]**

(c) A study of the biodiversity of an area considers not only the total number of species but also the relative number of individuals within each species.

State **one** further factor that could be taken into account when describing the biodiversity of an area.

.....

..... **[1]**

(d) In any attempt to protect global biodiversity, cooperation between countries is important.

Two examples of such international cooperation are:

- Convention on International Trade in Endangered Species (CITES)
- Rio Convention on Biological Diversity.

Other than the conservation of biodiversity, state **two** aims for each of these conventions.

Convention on International Trade in Endangered Species .....

.....

.....

.....

.....

.....

Rio Convention on Biological Diversity .....

.....

.....

.....

.....

.....

[4]

[Total: 14]

BLANK PAGE

Question 6 begins on page 18

PLEASE DO NOT WRITE ON THIS PAGE

6 **(a)** Glucose is a hexose sugar and is a monomer in many carbohydrates.

Name the precise group of carbohydrate molecules of which glucose is an example.

..... **[1]**

(b) Fig. 6.1 represents the structure of a **β-glucose** molecule.

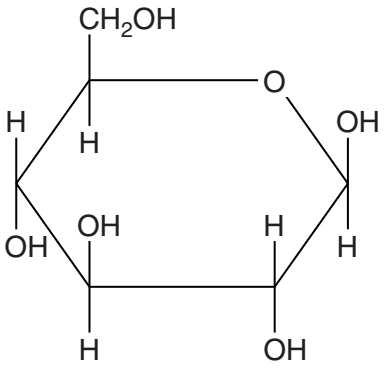


Fig. 6.1

(i) Use Fig. 6.1 to draw a similar representation of an **α-glucose** molecule in the space provided below.

[2]

(ii) The cells of living organisms require glucose.

State and explain **two** ways in which the glucose molecule is well suited to its function in living organisms.

.....

.....

.....

..... **[2]**

(c) Deoxyribose is a pentose sugar that is a component of the double-stranded DNA molecule.

Describe the structural relationship between deoxyribose and the other components of the DNA molecule.

.....

.....

.....

.....

.....

.....

..... **[3]**

(d) Cellulose is a carbohydrate.

A student described the structure of cellulose as follows:

> The cellulose molecule is insoluble.
> It contains only the elements carbon, hydrogen and oxygen.
> It is made up of α-glucose subunits.
> The glucose subunits are linked by 1-4 glycosidic bonds formed by hydrolysis reactions.
> It also has some 1-6 glycosidic bonds.
> It is made of many long chains.
> The chains have branches.

(i) Identify **three** mistakes made by the student when describing the structure of cellulose.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Suggest the name of a molecule that closely matches the student's description.

..... **[1]**

[Total: 12]

7 **(a)** Humans have been using microorganisms to make food for over 4000 years. Yoghurt is a dairy product that is produced by the action of microorganisms on milk.

Suggest why yoghurt production relies on a plentiful supply of plants.

.....

..... **[1]**

(b) Protein known as mycoprotein is promoted as a healthy alternative to meat. Mycoprotein is made using fungal microorganisms.

Discuss the advantages **and** disadvantages of using microorganisms to produce protein for human consumption.

In your answer you should consider a range of advantages and disadvantages.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[8]**

(c) Microorganisms can also be responsible for food spoilage. In order to prevent this spoilage, a range of food preservation methods are used.

Complete the table below to explain how the **three** methods of food preservation reduce food spoilage.

Method	Explanation
Freezing	
Pickling	
Irradiation	

[3]

[Total: 12]

Question 8 begins on page 22

8 The table below shows some biological terms and descriptions that are used in topics on evolution, biodiversity and conservation.

Complete the table using the most appropriate terms or descriptions.

The first one has been done for you.

Biological Term	Description
Natural Selection	The theory proposed by Darwin on the evolution of species.
Speciation	
	Differences between individuals that cover a range of values rather than discrete categories.
Adaptation	
	A system of naming organisms that uses two scientific (Latin) names for species.
	The type of conservation of which seed banks are an example.
	A study carried out by a local planning authority in order to judge the effect of a development on the biodiversity of an area.

[6]

[Total: 6]

END OF QUESTION PAPER

Answer **all** the questions.

1 **(a)** Fig. 1.1 represents a sensory neurone connected to its associated receptor cells.

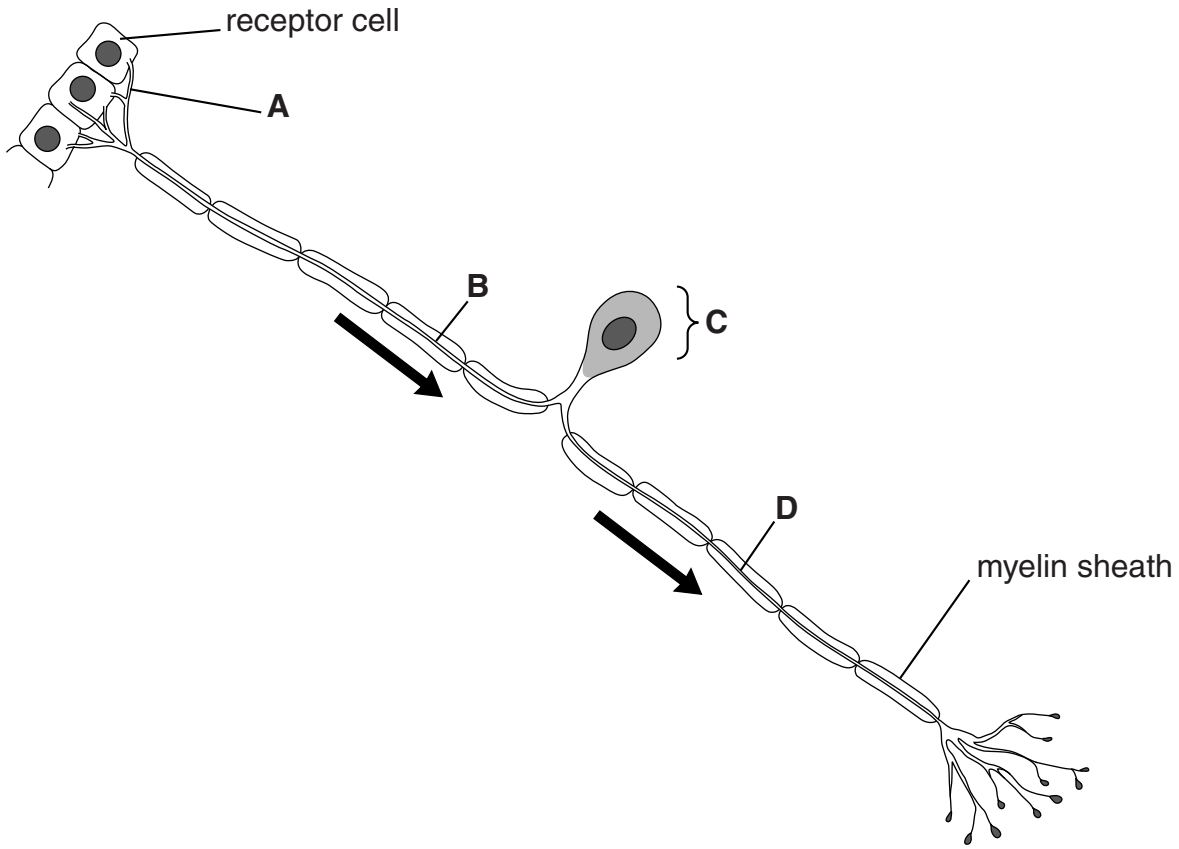


Fig. 1.1

(i) Identify the parts of the neurone labelled **A** to **D**.

A .....

B .....

C .....

D .....

[4]

(ii) What is represented by the arrows on Fig. 1.1?

.....

..... **[1]**

(b) Describe and explain how the **resting potential** is established **and** how it is maintained in a sensory neurone.

In your answer, you should use appropriate technical terms, spelled correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(c) Fig. 1.2 shows the changes in the membrane potential of a sensory neurone when the receptor cells are stimulated.

Fig. 1.3 indicates the strength of the stimuli that results in the corresponding changes in membrane potential.

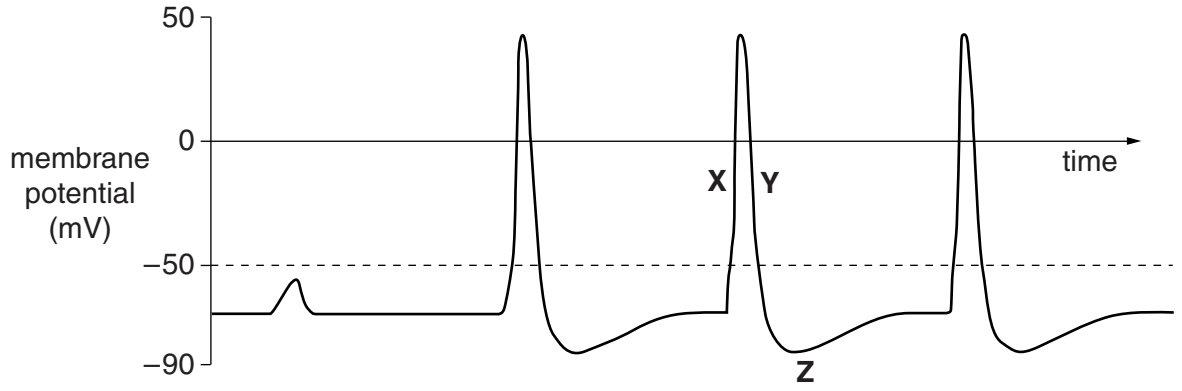


Fig. 1.2

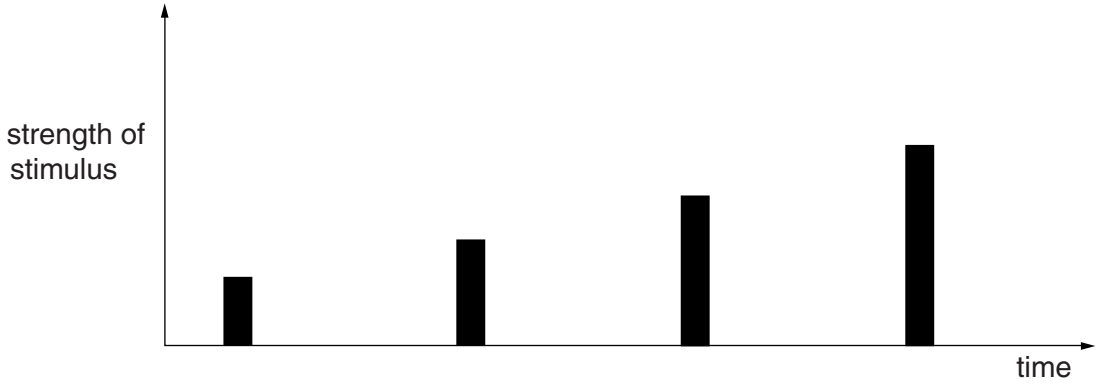


Fig. 1.3

(i) State the term used to describe what is happening at each of the points **X**, **Y** and **Z** on Fig. 1.2.

X .....

Y .....

Z .....

[3]

(ii) What term is used to refer to the value of –50 mV on Fig. 1.2?

..... **[1]**

(iii) Comment on the relationship between the strength of a stimulus, as shown in Fig. 1.3, and the resulting action potential, as shown in Fig 1.2.

.....

.....

.....

.....

.....

..... **[2]**

[Total: 15]

2 The liver is an organ that is metabolically very active, carrying out over 500 different functions. Some of its important functions include converting chemicals including toxins, into other compounds.

Fig. 2.1 outlines some of the reaction pathways that take place in the liver cells.

The ***underlined words*** represent toxic compounds.

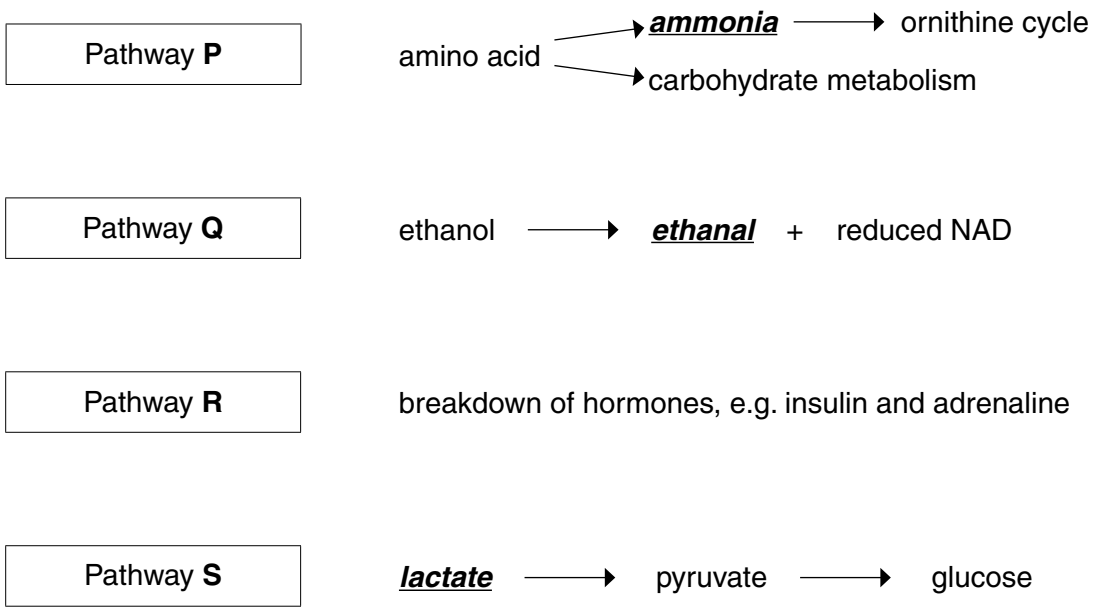


Fig. 2.1

(a) (i) State the product of the ornithine cycle in Pathway **P** and the organ to which this product is transported for removal from the body.

product .....

organ the product is transported to .....

[2]

(ii) The lactate that enters pathway **S** is produced by cells, such as muscle cells, undergoing anaerobic respiration.

Suggest why this lactate is converted into pyruvate by the hepatocytes (liver cells) rather than by the respiring cells in which it is produced.

.....

.....

..... **[1]**

(b) Insulin only remains in the bloodstream for a relatively short time. Pathway **R** breaks down insulin in the liver.

Explain what might happen to a person if the liver did not break down insulin.

.....

.....

.....

.....

.....

..... **[2]**

(c) Alcohol (ethanol) is oxidised in the liver by Pathway **Q**. If a person has a high alcohol intake, it will result in the production of excess reduced NAD.

(i) Excess reduced NAD in the liver cells will influence some metabolic pathways by:

- inhibiting the conversion of lactate to pyruvate
- inhibiting fatty acid oxidation
- promoting fatty acid synthesis.

Using this information **and** the information in Fig. 2.1, suggest the consequences for **liver metabolism** if a person has a regular high alcohol intake.

.....

.....

.....

.....

.....

.....

.....

..... **[2]**

(ii) State **precisely** where in the liver cell the excess reduced NAD can be re-oxidised.

..... **[1]**

[Total: 8]

3 **(a)** Explain what is meant by the terms *autotroph* and *heterotroph*.

autotroph .....

.....

.....

heterotroph .....

.....

.....

[2]

(b) Fig. 3.1 is a transmission electron micrograph showing part of a chloroplast, including some of the internal membranes.

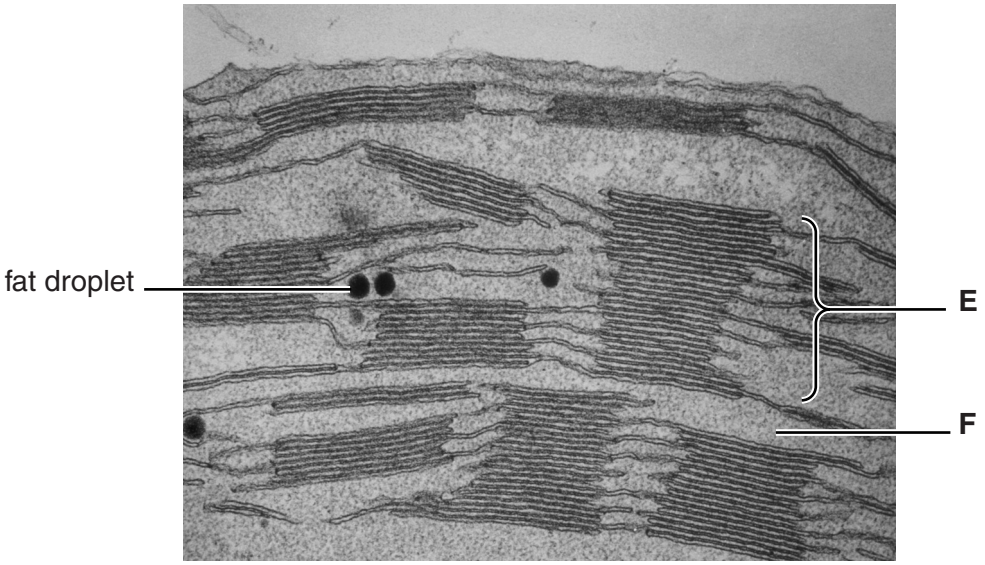


Fig. 3.1

(i) Identify **E** and **F** in Fig. 3.1.

E .....

F .....

[2]

(ii) The chloroplast contains fat droplets, as shown in Fig. 3.1. These act as a reserve of raw material **for the chloroplast**.

Suggest what this raw material might be used for in the chloroplast.

.....

.....

..... **[1]**

(c) Fig. 3.2 represents the light harvesting system found on the surface of the internal membranes of the chloroplast.

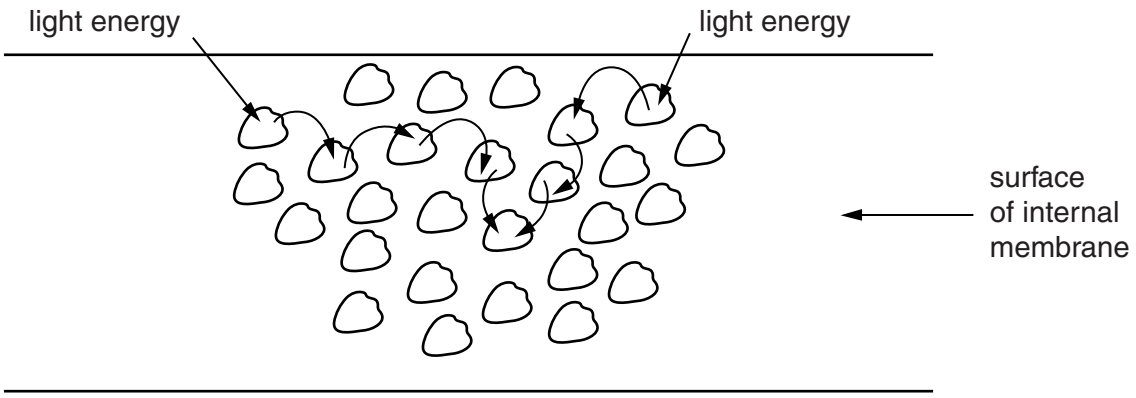


Fig. 3.2

Use the information in Fig. 3.2 to describe how light is harvested in the chloroplast membranes.

In your answer, you should use appropriate technical terms, spelled correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[5]**

(d) Many herbicides act by inhibiting photosynthesis in weeds. A series of research studies were carried out to evaluate the effectiveness of a triazine herbicide on the yield of a crop of corn, *Zea mays*. Some of the data obtained is shown in Table 3.1.

Study	Plots not treated with herbicide		Plots treated with herbicide		Yield difference with herbicide	
	Number of plots	Mean yield ($kg\,ha^{-1}$)	Number of plots	Mean yield ($kg\,ha^{-1}$)	($kg\,ha^{-1}$)	(%)
A	90	8321.4	51	8756.9	+435.5	+5.2
B	21	10344.8	3	11457.0	+1112.2	+10.8
C	30	10411.8	14	10954.5	+542.7	+5.2
D	20	13982.9	7	13607.7	–375.2	–2.7
E	2	6532.5	8	11041.6	+4509.1	+69.0
F	66	8750.2	63	8971.3	+221.1	+2.5
G	17	11671.4	7	10807.1		

Table 3.1

(i) Calculate the yield difference caused by the application of herbicide in study **G**.

Show your working.

Answer = ... $kg\,ha^{-1}$

..... % **[2]**

(ii) Suggest why the researchers concluded that the data obtained from Study **E** was not useful in evaluating the effectiveness of the herbicide.

.....

..... **[1]**

(iii) Triazine herbicide acts on the weeds by binding to a specific protein associated with photosystem II, blocking the movement of electrons between electron carriers.

Explain the effect that the herbicide binding to this protein will have on photosynthesis.

.....

.....

.....

..... **[2]**

(iv) Plants treated with triazine herbicide can, when illuminated under experimental conditions, be seen to fluoresce (emit light) and give off small quantities of heat.

Suggest how this experimental finding could be explained.

.....

.....

..... **[1]**

[Total: 16]

4 Biological terms are often used incorrectly. This may be because they have similar spelling or refer to similar structures.

glucagon	***glycogenolysis***
gluconeogenesis	***glycolysis***
glycogen	***insulin***
glycogenesis	***negative feedback***

Select from the list above, the term(s) that refer to:

(a) a stage in respiration

..... **[1]**

(b) hormone(s)

..... **[1]**

(c) process(es) that produce glucose

..... **[1]**

(d) process(es) that have glucose as a starting point

..... **[1]**

[Total: 4]

5 **(a)** Adenosine tri-phosphate (ATP) is an important product of respiration. The ATP molecule is made up of five sub-units, as shown in Fig. 5.1.

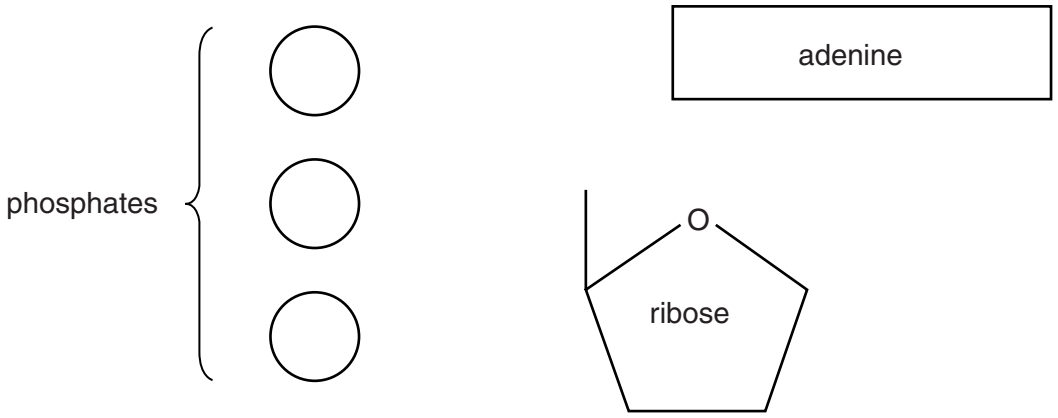


Fig. 5.1

(i) In the space below, indicate how these sub-units are joined in a molecule of ATP.

[2]

(ii) Suggest the type of reaction that removes a phosphate group from an ATP molecule.

..... **[1]**

(b) The formation of ATP is now widely accepted as being achieved by the process of **chemiosmosis**.

Various pieces of evidence have been documented to support this theory. Three of these are described below.

1	In isolated mitochondria that have had their outer membranes removed, electron transfer takes place but the mitochondria are unable to produce ATP.
2	The pH of the inter-membrane space is lower than the pH inside the rest of the mitochondrion.
3	The outer mitochondrial membrane is permeable to protons. If isolated mitochondria are supplied with ADP and inorganic phosphate and placed in a solution of pH 8, no ATP is produced. If, however, these mitochondria are placed in an acidic solution, ATP is produced.

Identify the pieces of evidence above, **1**, **2** or **3**, that supports each of the following statements about the theory of chemiosmosis.

Write '**none**' if a statement is not supported by any of the pieces of evidence above.

(i) Electron transfer occurs on the inner membrane of the mitochondrion. ..... **[1]**

(ii) Protons are actively pumped across the inner mitochondrial membrane into the inter-membrane space. ..... **[1]**

(iii) Protons accumulate in the inter-membrane space. ..... **[1]**

[Total: 6]

6 The kidney is a vital organ in the body and is responsible for excretion. It also plays an important role in homeostasis.

(a) Complete the passage, using the **most suitable** term in each case.

The blood in the glomerulus has a high ..... pressure, which forces small molecules, such as glucose and ....., out of the glomerulus and into the lumen of the Bowman's capsule. This process is known as ..... .

In the proximal convoluted tubule, the glucose, most of the ..... and some of the salts are reabsorbed into blood ..... that surround the nephron at this point. **[5]**

(b) One aspect of the kidney's homeostatic role is the ability of anti-diuretic hormone (ADH) to increase the number of aquaporins in the plasma membranes of the cells lining the collecting duct. This increases the amount of water reabsorbed.

ADH is released in response to a decrease in the water potential of the blood plasma.

(i) State precisely where the cells that detect a decrease in the water potential of the blood plasma are found.

..... **[1]**

(ii) Name the cells that detect this decrease.

..... **[1]**

(c) Fig. 6.1 outlines some of the events that take place if the blood volume decreases, for example, due to a significant loss of blood.

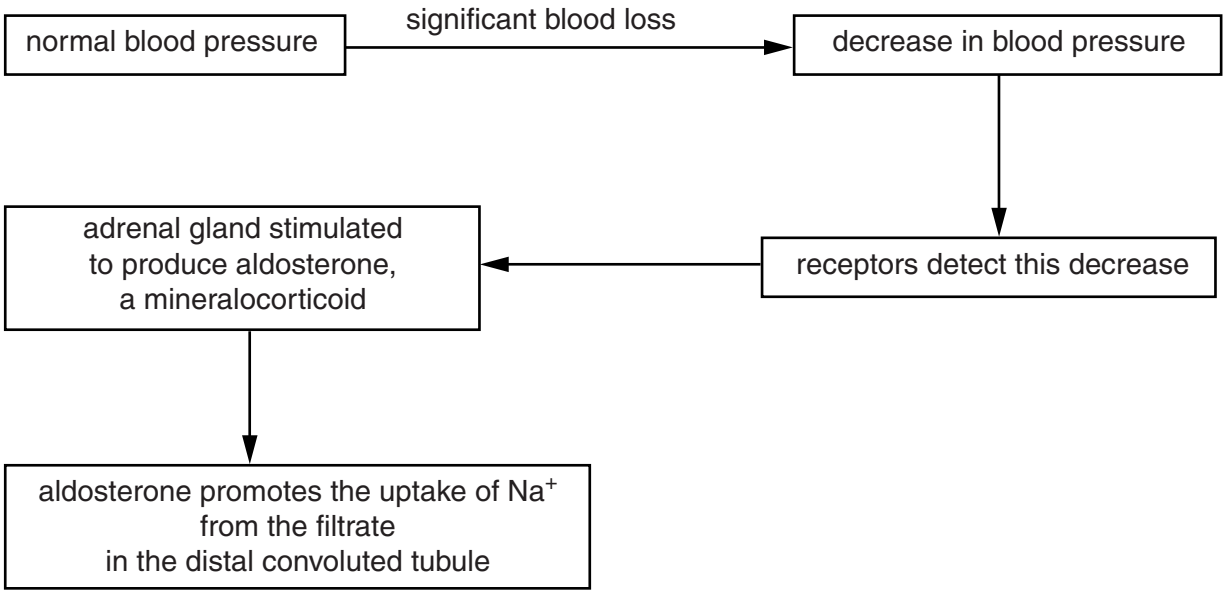


Fig. 6.1

(i) Name the part of the adrenal gland that releases aldosterone.

..... **[1]**

(ii) Suggest **and** explain what effect the action of aldosterone will have on the secretion of ADH.

.....

.....

.....

.....

.....

..... **[2]**

(iii) As the action of aldosterone takes effect, this is detected by receptors in the body and secretion of aldosterone decreases.

State the name of the mechanism that results in this decrease in aldosterone secretion.

..... **[1]**

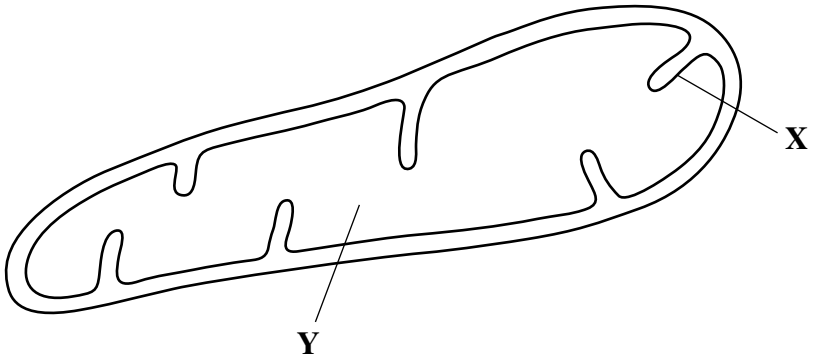
[Total: 11]

END OF QUESTION PAPER

Areas outside the box will not be scanned for marking

Answer **all** questions in the spaces provided.

1 The diagram shows a mitochondrion.



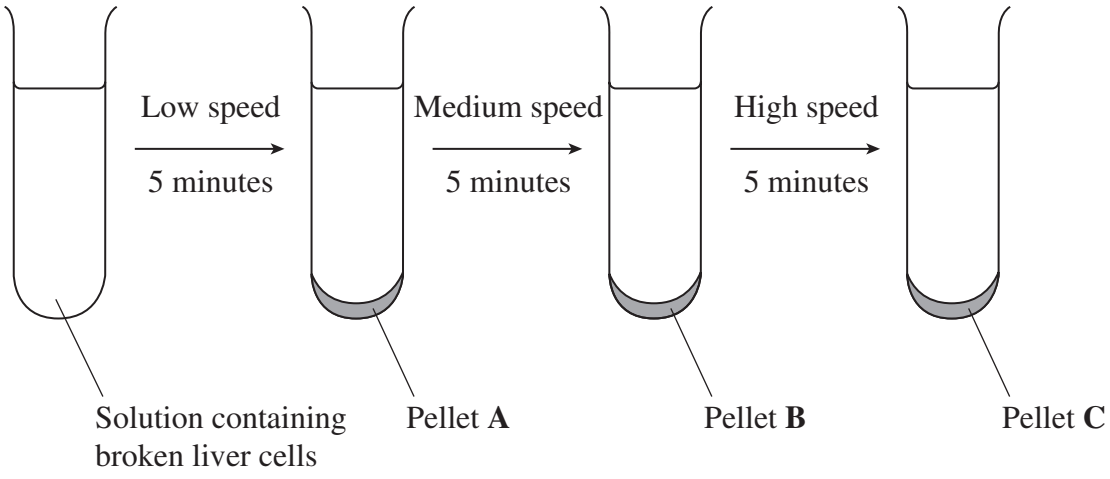
1 (a) Name the parts labelled **X** and **Y**.

1 (a) (i) **X** .....

1 (a) (ii) **Y** .....

(2 marks)

Scientists isolated mitochondria from liver cells. They broke the cells open in an ice-cold, isotonic solution. They then used a centrifuge to separate the cell organelles. The diagram shows some of the steps in the process of centrifugation.



1 (b) Suggest which pellet, **A**, **B** or **C** contained the mitochondria.

(1 mark)

1 (c) Explain why the solution used was

1 (c) (i) ice-cold

.....

.....

(1 mark)

1 (c) (ii) isotonic.

.....

.....

.....

.....

(2 marks)

Extra space .....

.....

1 (d) People with mitochondrial disease have mitochondria that do not function properly. Some people with mitochondrial disease can only exercise for a short time. Explain why a person with mitochondrial disease can only exercise for a short time.

.....

.....

.....

.....

(2 marks)

Extra space .....

.....

8

2 (a) The sinoatrial node (SAN) is in the right atrium of the heart. Describe the role of the sinoatrial node.

.....

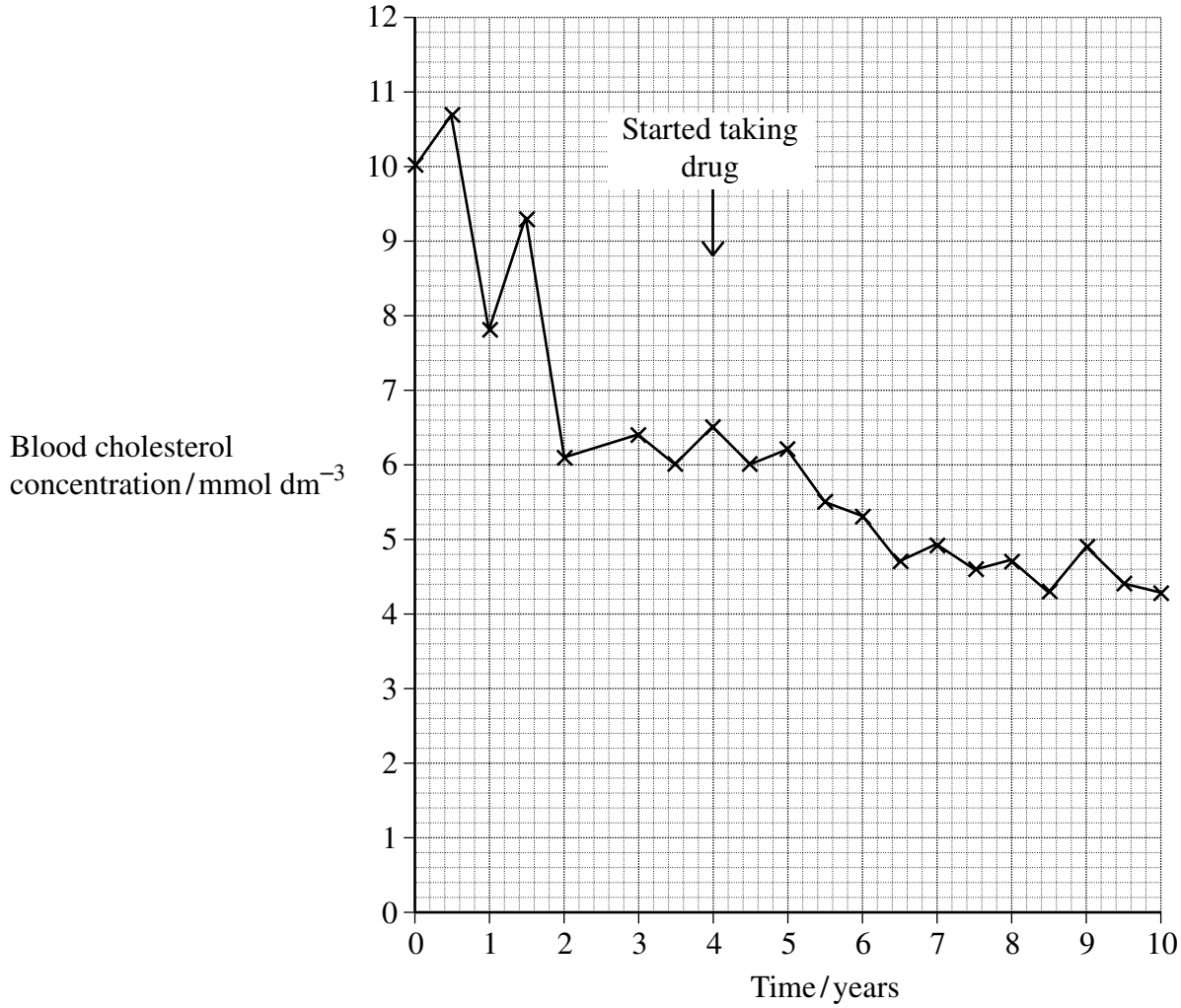
.....

.....

.....

(2 marks)

Ten years ago, a woman was found to have a high concentration of cholesterol in her blood. As a result, she was put on a special diet. She has been on this diet ever since. Four years after starting the diet, she started taking a drug to lower her blood cholesterol. The graph shows the concentration of cholesterol in her blood over the ten-year period.



2 (b) Describe how the concentration of cholesterol in her blood changed over the ten-year period.

.....

.....

.....

.....

.....

(2 marks)

2 (c) Explain the overall change in cholesterol concentration in the blood in the first two years.

.....

.....

.....

.....

.....

(2 marks)

2 (d) Use the graph to evaluate the success of the special diet and of the drug in reducing the risk of coronary heart disease.

.....

.....

.....

.....

(2 marks)

Extra space .....

.....

8

3 A glucose biosensor is an instrument used to measure glucose concentration. It contains an enzyme called glucose oxidase.

3 (a) A glucose biosensor detects only glucose. Use your knowledge of the way in which enzymes work to explain why.

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space).....

.....

.....

3 (b) It is better to use a biosensor than the Benedict's test to measure the concentration of glucose in a sample of blood. Suggest **two** reasons why.

1 .....

.....

2 .....

.....

(2 marks)

3 (c) (i) Diabetes mellitus is a disease that can lead to an increase in blood glucose concentration. Some diabetics need insulin injections. Insulin is a protein so it cannot be taken orally. Suggest why insulin cannot be taken orally.

.....

.....

.....

(1 mark)

3 (c) (ii) A drug company produced a new type of insulin. Scientists from the company carried out a trial in which they gave this new type of insulin to rats. They reported that the results of this trial on rats were positive. A newspaper stated that diabetics would benefit from this new drug. Suggest **two** reasons why this statement should be viewed with caution.

1 .....

.....

2 .....

.....

(2 marks)

8

Turn over for the next question

4 (a) Give **two** ways in which pathogens can cause disease when they enter the body of their host.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) Vaccines provide protection against disease. What is a vaccine?

.....

.....

.....

.....

(2 marks)

4 (c) The only vaccine used against pulmonary tuberculosis is the BCG vaccine. Scientists have carried out trials on a 'booster' vaccine, MVA85A. This 'booster' vaccine is designed to increase the immune response to the BCG vaccine. One trial involved measuring the increase in the number of memory T cells in three groups of adult volunteers following different vaccination programmes.

- Group **A** – injected with BCG
- Group **B** – injected with MVA85A
- Group **C** – injected with BCG and, two weeks later, injected with MVA85A

4 (c) (i) Suggest **two** factors the scientists should have considered when selecting adult volunteers for this trial.

1 .....

2 .....

(2 marks)

4 (c) (ii) The adults in group **C** produced the greatest increase in the number of memory T cells.
Suggest what this shows about the BCG and MVA85A vaccines.

.....

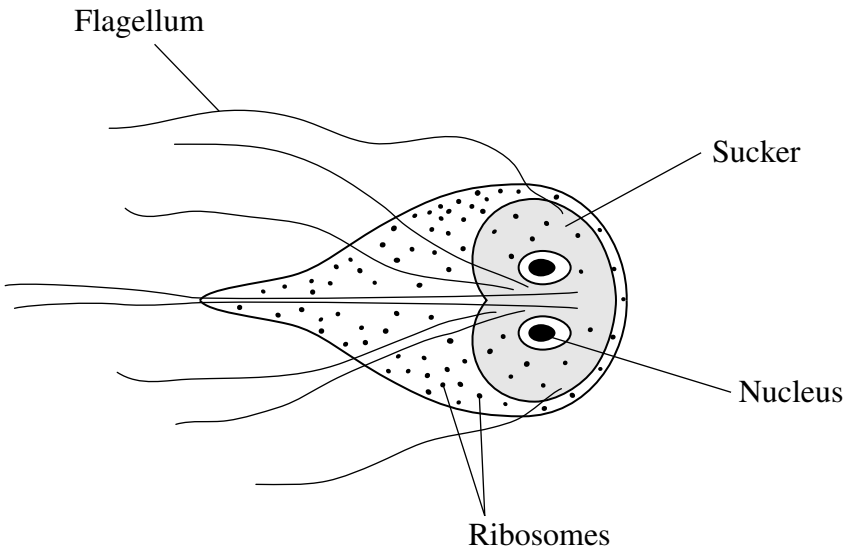
.....

(1 mark)

7

Turn over for the next question

5 Giardiasis is an intestinal disease. It is caused by the microorganism *Giardia lamblia*. The drawing shows some of the structures present in *G. lamblia*.



5 (a) Name **one** structure shown in the drawing which confirms that *G. lamblia* is a eukaryotic organism.

.....

(1 mark)

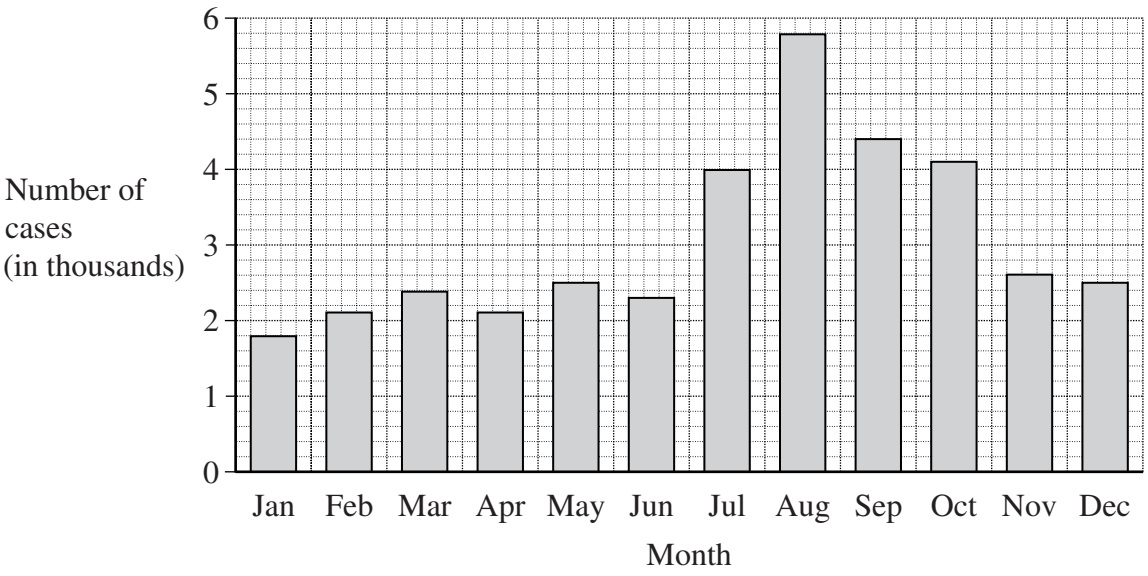
5 (b) *G. lamblia* can attach itself with its sucker. Explain how this is an adaptation to living in the intestines.

.....

.....

(1 mark)

5 (c) Giardiasis is one of the main causes of diarrhoea in the USA. It is usually transmitted by drinking contaminated water. The bar chart shows the number of cases of giardiasis in one state of the USA during one year.



5 (c) (i) Calculate the percentage increase in the number of cases of giardiasis from January to August. Show your working.

Answer ..... *(2 marks)*

5 (c) (ii) Suggest **one** reason for the number of cases being highest in the late summer months.

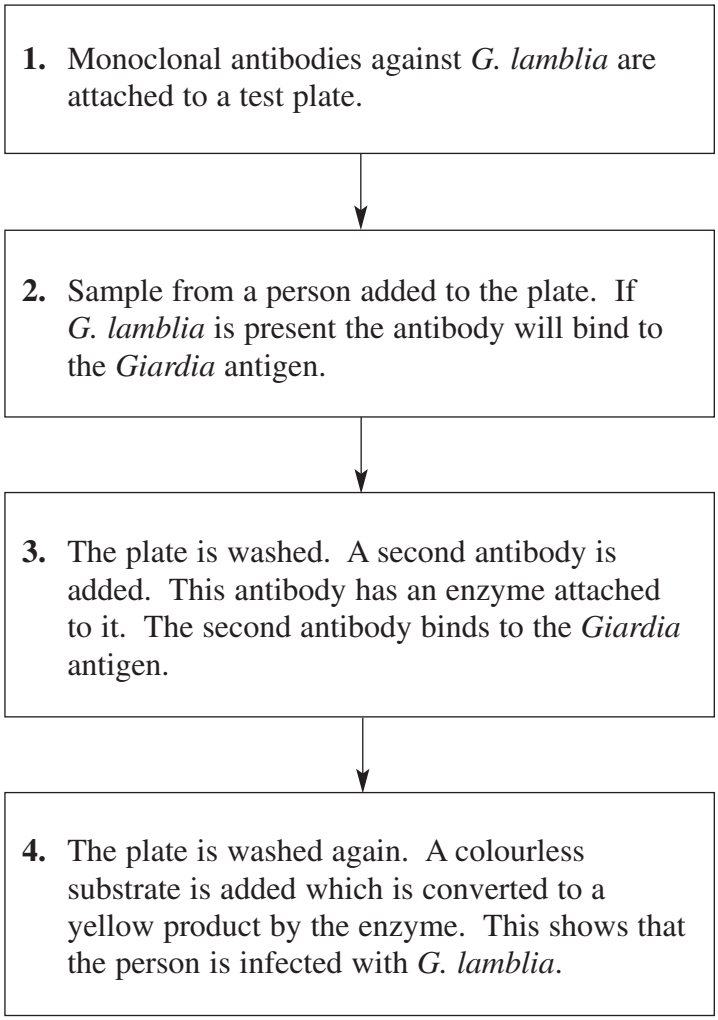
.....

.....

(1 mark)

Question 5 continues on the next page

5 (d) A test has been developed to find out whether a person is infected with *G. lamblia* The test is shown in the flow chart.



5 (d) (i) Explain why the antibodies used in this test must be monoclonal antibodies.

.....

.....

(1 mark)

5 (d) (ii) Explain why the *Giardia* antigen binds to the antibody in step **2**.

.....

.....

(1 mark)

5 (d) (iii) The plate must be washed at the start of step **4**, otherwise a positive result could be obtained when the *Giardia* antigen is not present. Explain why a positive result could be obtained if the plate is not washed at the start of step **4**.

.....

.....

.....

.....

(2 marks)

Extra space .....

.....

9

Turn over for the next question

6 Read the following passage.

Several diseases are caused by inhaling asbestos fibres. Most of these diseases result from the build up of these tiny asbestos fibres in the lungs.

One of these diseases is asbestosis. The asbestos fibres are very small and enter the bronchioles and alveoli. They cause the destruction of phagocytes and the surrounding lung tissue becomes scarred and fibrous. The fibrous tissue reduces the elasticity of the lungs and causes the alveolar walls to thicken. One of the main symptoms of asbestosis is shortness of breath caused by reduced gas exchange.

People with asbestosis are at a greater risk of developing lung cancer. The time between exposure to asbestos and the occurrence of lung cancer is 20–30 years.

Use information in the passage and your own knowledge to answer the following questions.

6 (a) Destruction of phagocytes (lines 4–5) causes the lungs to be more susceptible to infections. Explain why.

.....

.....

.....

.....

(2 marks)

Extra space .....

.....

6 (b) (i) The reduced elasticity of the lungs (lines 6–7) causes breathing difficulty. Explain how.

.....

.....

.....

.....

(2 marks)

Extra space .....

.....

6 (b) (ii) Apart from reduced elasticity, explain how changes to the lung tissue reduce the efficiency of gas exchange.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(Extra space) .....

.....

.....

.....

6 (c) (i) Doctors did not make the link between exposure to asbestos and an increased risk of developing lung cancer for many years. Use information in the passage to explain why.

.....

.....

(1 mark)

6 (c) (ii) Give **one** factor, other than asbestos, which increases the risk of developing lung cancer.

.....

(1 mark)

10

7 (a) Describe the role of the enzymes of the digestive system in the complete breakdown of starch.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

.....

.....

.....

.....

.....

7 (b) Describe the processes involved in the absorption of the products of starch digestion.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

(Extra space) .....

.....

.....

.....

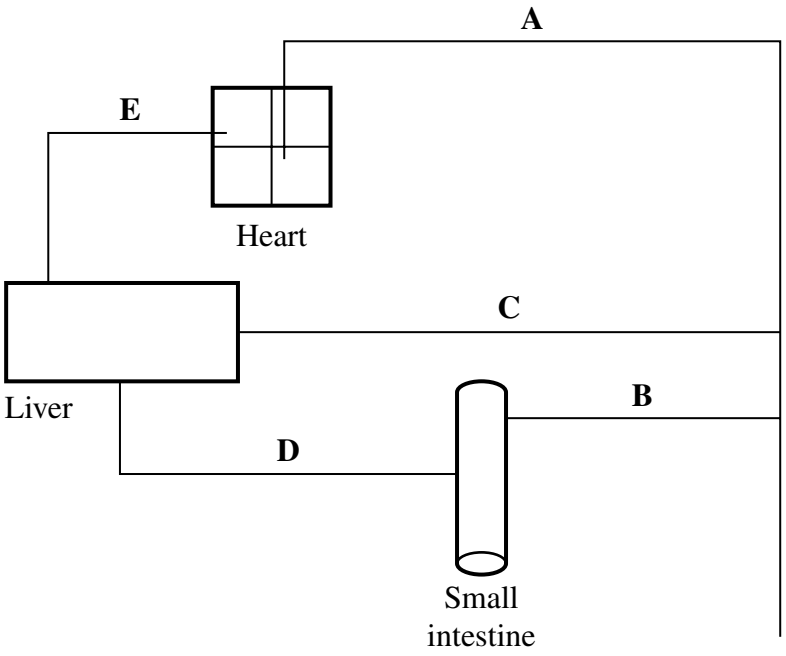
.....

10

END OF QUESTIONS

Answer **all** questions in the spaces provided.

1 The diagram shows some of the large blood vessels in a mammal.



1 (a) Add arrows to the diagram to show the direction of blood flow in each of the blood vessels **A** to **E**. *(1 mark)*

1 (b) (i) Which of blood vessels **A** to **E** is the hepatic portal vein?

(1 mark)

1 (b) (ii) Which of blood vessels **A** to **E** contains blood at the lowest pressure?

(1 mark)

1 (c) Complete the table to show **two** differences between the structure of vessel **C** and the structure of vessel **E**.

Structural feature	Vessel C	Vessel E

(2 marks)

1 (d) Blood vessel **B** contains smooth muscle in its walls. Explain how this muscle may reduce the blood flow to the small intestine.

.....

.....

.....

.....

(2 marks)

(*Extra space*).....

.....

1 (e) Elastic tissue in the walls of blood vessel **A** helps to even out the pressure of blood through this vessel. Explain how.

.....

.....

.....

.....

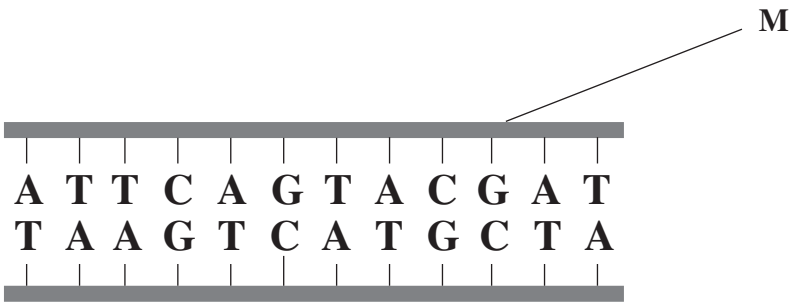
(2 marks)

(*Extra space*).....

.....

9

2 The diagram shows part of a DNA molecule.



2 (a) Name the **two** components of the part of the DNA molecule labelled **M**.

1 .....

2 .....

(2 marks)

2 (b) What is the maximum number of amino acids for which this piece of DNA could code?

(1 mark)

2 (c) Scientists calculated the percentage of different bases in the DNA from a species of bacterium. They found that 14% of the bases were guanine.

2 (c) (i) What percentage of the bases in this species of bacterium was cytosine?

Answer ..... *(1 mark)*

2 (c) (ii) What percentage of the bases in this species of bacterium was adenine?

Answer ..... *(1 mark)*

2 (d) The scientists found that, in a second species of bacterium, 29% of the bases were guanine.

Explain the difference in the percentage of guanine bases in the two species of bacterium.

.....

.....

.....

.....

(2 marks)

(*Extra space*).....

.....

7

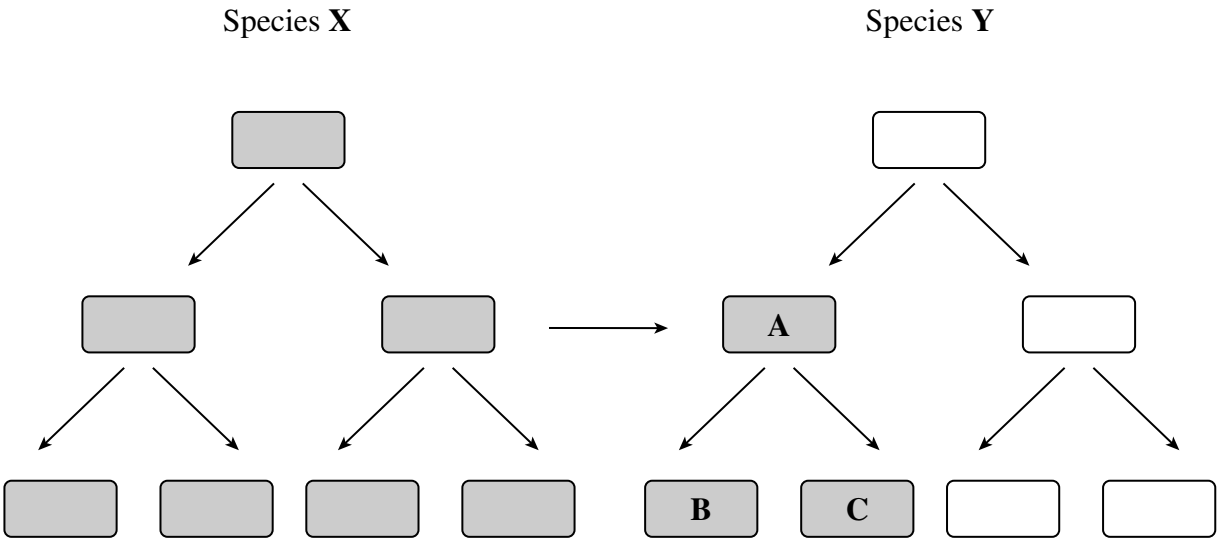
3 (a) Give **one** way in which a DNA molecule in a prokaryote, such as a bacterium, is different from a DNA molecule in a eukaryote.

.....

.....

(1 mark)

Species **X** and **Y** are bacteria. The diagram shows gene transfer between bacteria in these two species. The bacteria that are shaded are resistant to the antibiotic penicillin.



3 (b) (i) Use the diagram to explain why bacterium **A** is resistant to penicillin.

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

3 (b) (ii) Use the diagram to explain why bacteria **B** and **C** are resistant to penicillin.

.....

.....

.....

.....

(2 marks)

(Extra space) .....

.....

3 (c) A person is infected with bacteria of species **Y**. Some of these bacteria are resistant to penicillin. A doctor gives the person a course of penicillin.

What would happen to the proportion of species **Y** bacteria that are resistant to penicillin? Explain your answer.

.....

.....

.....

.....

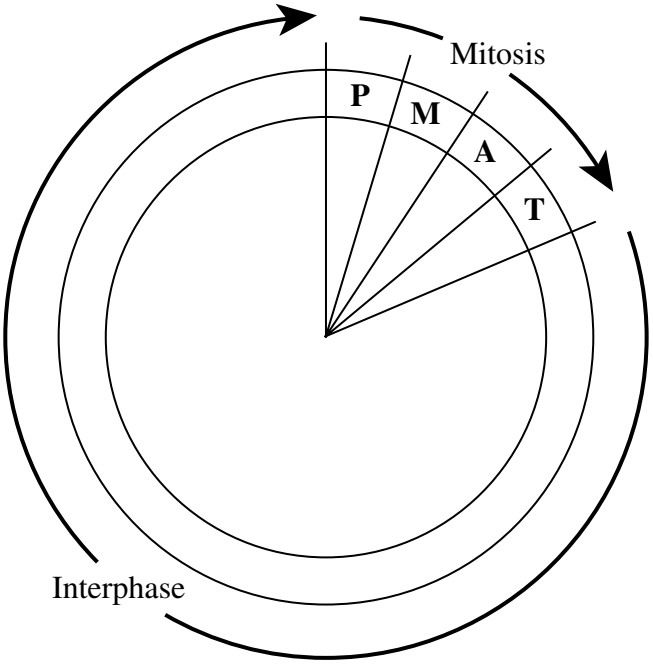
(2 marks)

(Extra space).....

.....

8

4 The diagram shows a cell cycle.



Key

P prophase

M metaphase

A anaphase

T telophase

4 (a) The table shows the number of chromosomes and the mass of DNA in different nuclei. All the nuclei come from the same animal. Complete this table.

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At prophase of mitosis	26	60
At telophase of mitosis		
From a sperm cell		

(4 marks)

4 (b) If the DNA of the cell is damaged, a protein called p53 stops the cell cycle.

Mutation in the gene for p53 could cause cancer to develop. Explain how.

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space).....

.....

.....

4 (c) Drugs are used to treat cancer. At what phase in the cell cycle would each of the following drugs act?

4 (c) (i) A drug that prevents DNA replication

.....

(1 mark)

4 (c) (ii) A drug that prevents spindle fibres shortening

.....

(1 mark)

9

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

5 (a) What is a tissue?

.....

.....

(1 mark)

5 (b) A student cut a thin section of tissue from a potato and examined it with an optical microscope.

5 (b) (i) Starch was present in the cells of this tissue. Describe how the student could find out where in the cells the starch was present.

.....

.....

.....

.....

.....

(2 marks)

5 (b) (ii) The student cut a thin section of the tissue. Explain why it was important that the section was thin.

.....

.....

.....

.....

.....

(2 marks)

5 (c) The cell walls of potato cells contain cellulose. Cellulose and starch are both carbohydrates. Describe **two** ways in which molecules of cellulose are similar to molecules of starch.

.....

.....

.....

.....

(2 marks)

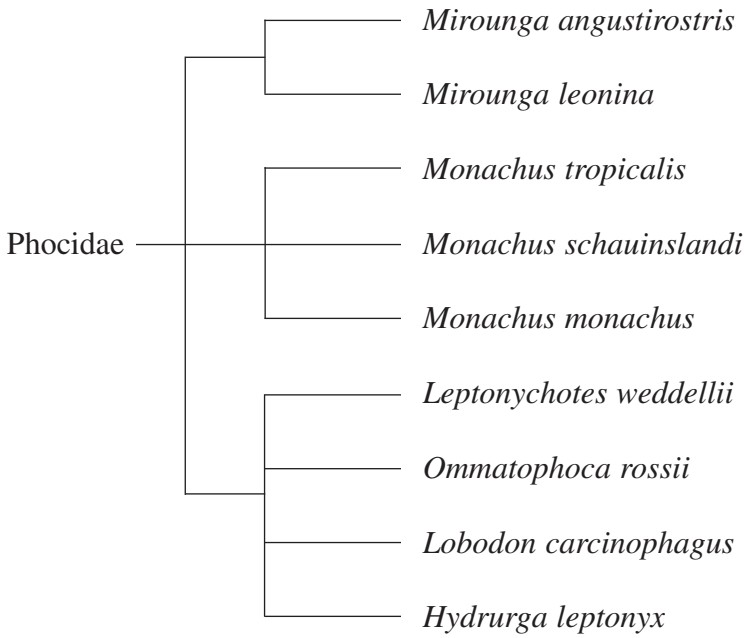
7

6 (a) An order is a taxonomic group. All seals belong to the same order. Name **one** other taxonomic group to which all seals belong.

.....

(1 mark)

6 (b) The diagram shows how some species of seal are classified.



6 (b) (i) How many different genera are shown in this diagram?

(1 mark)

6 (b) (ii) All the seals shown in the diagram are members of the Phocidae. Phocidae is an example of a taxonomic group. Of which taxonomic group is it an example?

.....

(1 mark)

6 (b) (iii) The diagram is based on the evolutionary history of the seals. What does the information in the diagram suggest about the common ancestors of *Mirounga angustirostris*, *Mirounga leonina* and *Monachus tropicalis*?

.....

.....

.....

(1 mark)

6 (c) A species of seal shows genetic diversity. Explain what is meant by genetic diversity.

.....

.....

(1 mark)

6 (d) In the late 18th century, the population of northern elephant seals was estimated to be about 150 000. These seals lived in different colonies in different places. The seals were then hunted. By 1910, the total population had fallen to under 100. All these seals lived in a single colony on one island. Hunting then stopped. Numbers increased and there are now approximately 150 000 seals living in many different colonies.

Use this information to explain

6 (d) (i) what is meant by a genetic bottleneck

.....

.....

.....

.....

(2 marks)

(Extra space) .....

.....

6 (d) (ii) how you would expect the founder effect to have influenced the genetic diversity of northern elephant seals after 1910.

.....

.....

.....

.....

(2 marks)

(Extra space) .....

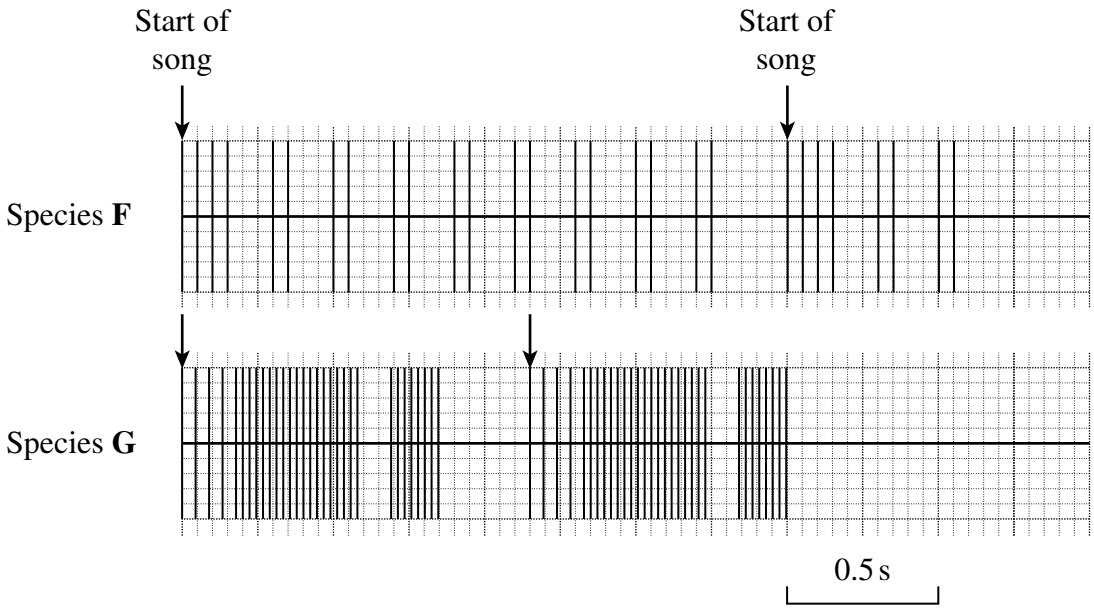
.....

9

7 Mole crickets are insects that live underground. At night, a male cricket produces a courtship song. A female cricket is attracted by this song and mates with the male.

Scientists investigated courtship in two species of mole cricket. They found that female mole crickets were only attracted to the song produced by a male of the same species.

The charts show recordings of typical songs of two species of mole cricket.



7 (a) The song of species **F** is repeated at regular intervals. The arrows on the chart show the beginning of each song.

7 (a) (i) Calculate the time taken for one complete song.

Answer.....seconds *(1 mark)*

7 (a) (ii) Calculate the rate of singing in songs per minute.

Answer.....songs per minute *(1 mark)*

7 (b) Explain why courtship song is an important part of species recognition in mole crickets.

.....

.....

.....

.....

(2 marks)

(Extra space).....

.....

7 (c) The scientists produced hybrids between the two crickets by fertilising eggs from one species with sperms from the other. The male hybrids had songs that had some features of one parent species and some features of the other. Suggest why the male hybrids were not able to reproduce.

.....

.....

.....

.....

(2 marks)

(Extra space).....

.....

6

Turn over for the next question

8 (a) A fish uses its gills to absorb oxygen from water. Explain how the gills of a fish are adapted for efficient gas exchange.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

(Extra space).....

.....

.....

Mackerel live in the surface waters of the sea. Toadfish live on the seabed in deep water.

8 (b) The concentration of oxygen is higher in the surface waters than it is in water close to the seabed. Suggest why.

.....

.....

.....

.....

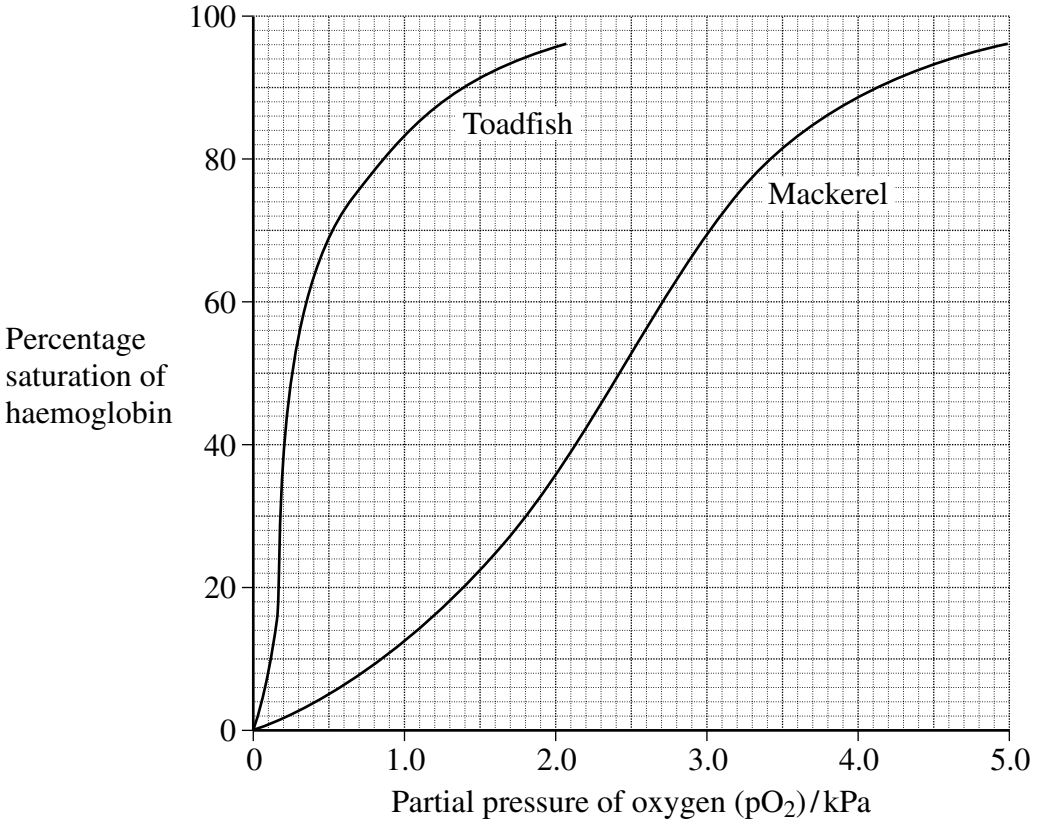
(2 marks)

(Extra space).....

.....

Question 8 continues on the next page

8 (c) The graph shows oxygen dissociation curves for toadfish haemoglobin and for mackerel haemoglobin.



Explain how the shape of the curve for toadfish haemoglobin is related to where the toadfish is normally found.

.....

.....

.....

.....

(2 marks)

(Extra space).....

.....

8 (d) Scientists analysed the sequence of amino acids in one polypeptide chain in the haemoglobin of four different species of ape. The only difference they found affected the amino acids at three positions in the polypeptide chain. Their results are shown in the table. The letters are abbreviations for particular amino acids.

Species	Position 87	Position 104	Position 125
Chimpanzee	T	R	P
Bonobo	T	R	P
Gorilla	T	K	P
Orang utan	K	R	Q

8 (d) (i) What information do the data in the table suggest about the relationships between the chimpanzee, the bonobo and the gorilla? Explain your answer.

.....

.....

.....

.....

(2 marks)

8 (d) (ii) Hybrid DNA was made from the gene for chimpanzee haemoglobin and the genes for the haemoglobin of the other three species of ape. Which of the three samples of hybrid DNA would separate into two strands at the lowest temperature?
Explain your answer.

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

15

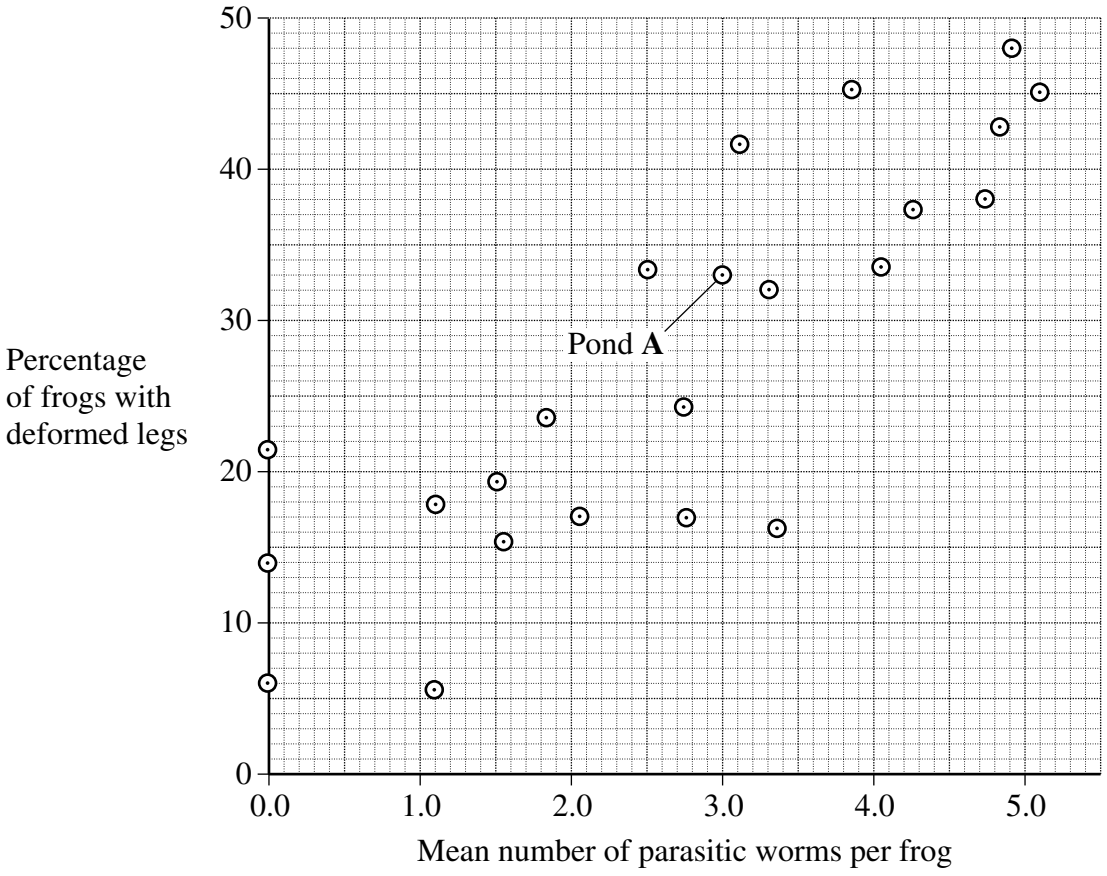
9 (a) In the USA, members of the public found many frogs with deformed legs. Scientists investigated this. They collected samples of the frogs. They wanted to get reliable data. Give **one** feature of the sample, other than a large sample size, that would help to make sure that their data were reliable.

.....

.....

(1 mark)

The team of scientists then investigated frogs in ponds. The team measured many different factors and then analysed their results. The graph shows the relationship between the percentage of frogs with deformed legs and the mean number of parasitic worms found in the frogs.



9 (b) The scientists collected a sample of three frogs from pond **A**. What was the total number of parastic worms found in these three frogs?

(1 mark)

9 (c) One scientist suggested that the parasites caused the deformed legs found in frogs. Does the graph support this suggestion? Explain your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(Extra space).....

.....

.....

9 (d) The scientists wrote a paper. In their discussion they wrote that they found very few ponds that were free from human influence. The few that they did find were only in mountainous areas.

The scientists could not draw any reliable conclusions about whether human influence contributed to the frogs' deformed legs. Explain why each of the following meant that they could not draw reliable conclusions.

9 (d) (i) There were very few ponds free from human influence.

.....

.....

(1 mark)

Question 9 continues on the next page

9 (d) (ii) The ponds free from human influence were found only in mountainous areas.

.....

.....

.....

.....

(2 marks)

(Extra space) .....

.....

In a second investigation, another research team investigated deformed legs in frogs in a different way.

- They chose six ponds, all of which contained parasitic worms. Three of the ponds were close to fields and received agricultural run-off from these fields. The other three ponds did not receive agricultural run-off.
- They built two cages in each of the six ponds. One cage in each pond allowed parasitic worms to enter and one cage did not.
- They put frogs that were not infected with parasitic worms into all twelve cages.

The table shows the results of this second investigation.

	Percentage of frogs with deformed limbs					
	Ponds with agricultural run-off			Ponds with no agricultural run-off		
Pond number	1	2	3	4	5	6
Cage with mean mesh diameter of 500 µm	22	27	24	3	4	7
Cage with mean mesh diameter of 75 µm	0	0	0	0	0	0

9 (e) One of the boxes in the table has been shaded. Describe the information given in the shaded box.

.....

.....

.....

.....

(2 marks)

(Extra space).....

.....

9 (f) What conclusions can you draw from the data in the table about the factors causing deformed leg in frogs? Explain your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(Extra space).....

.....

.....

.....

15

END OF QUESTIONS

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

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)

Turn over ▶

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 .....

.....

.....

.....

.....

.....

Risk .....

.....

.....

.....

.....

.....

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

(2)

.....

.....

.....

.....

.....

.....

.....

(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.

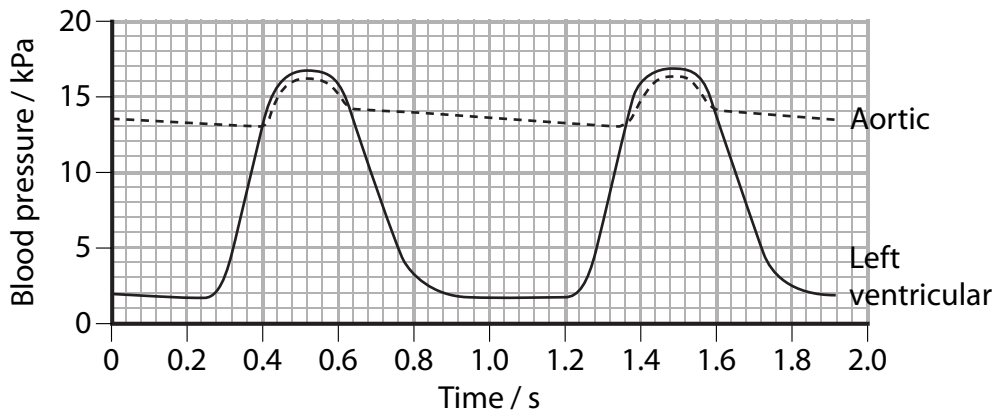
(3)

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)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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)

.....

.....

.....

.....

(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)

.....

.....

.....

.....

.....

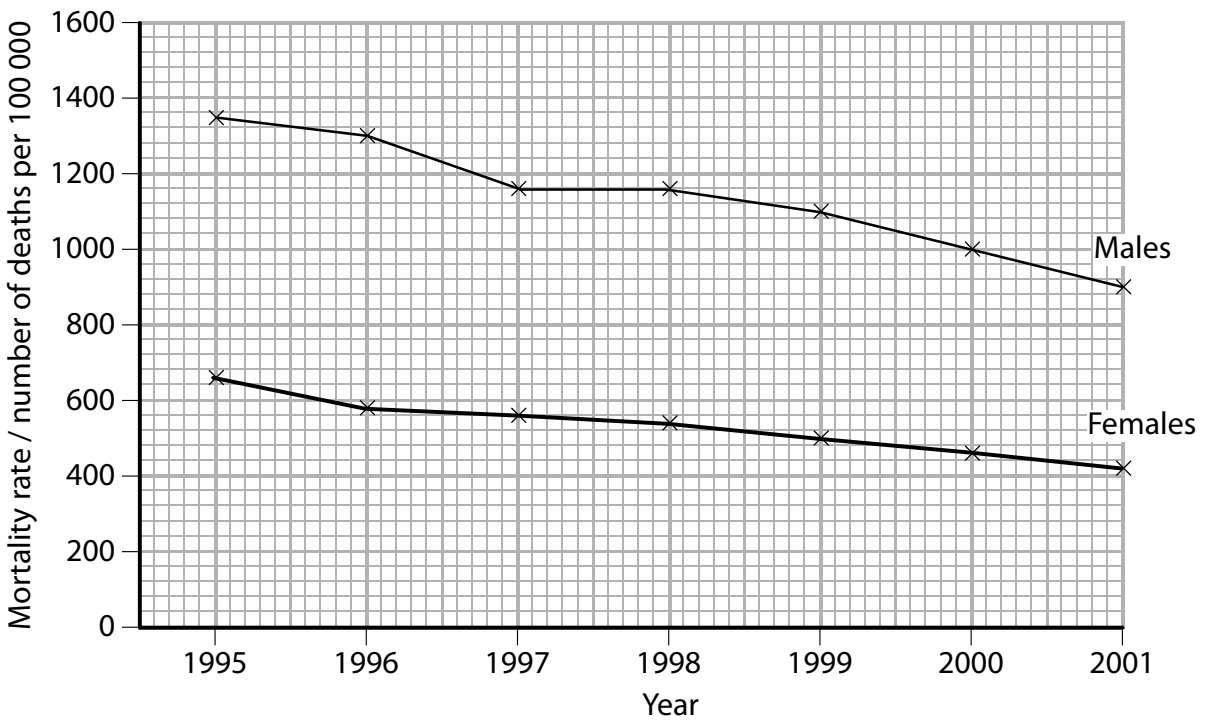
.....

.....

.....

(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 .....

.....

2 .....

.....

3 .....

.....

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

(4)

.....

.....

.....

.....

.....

.....

.....

.....

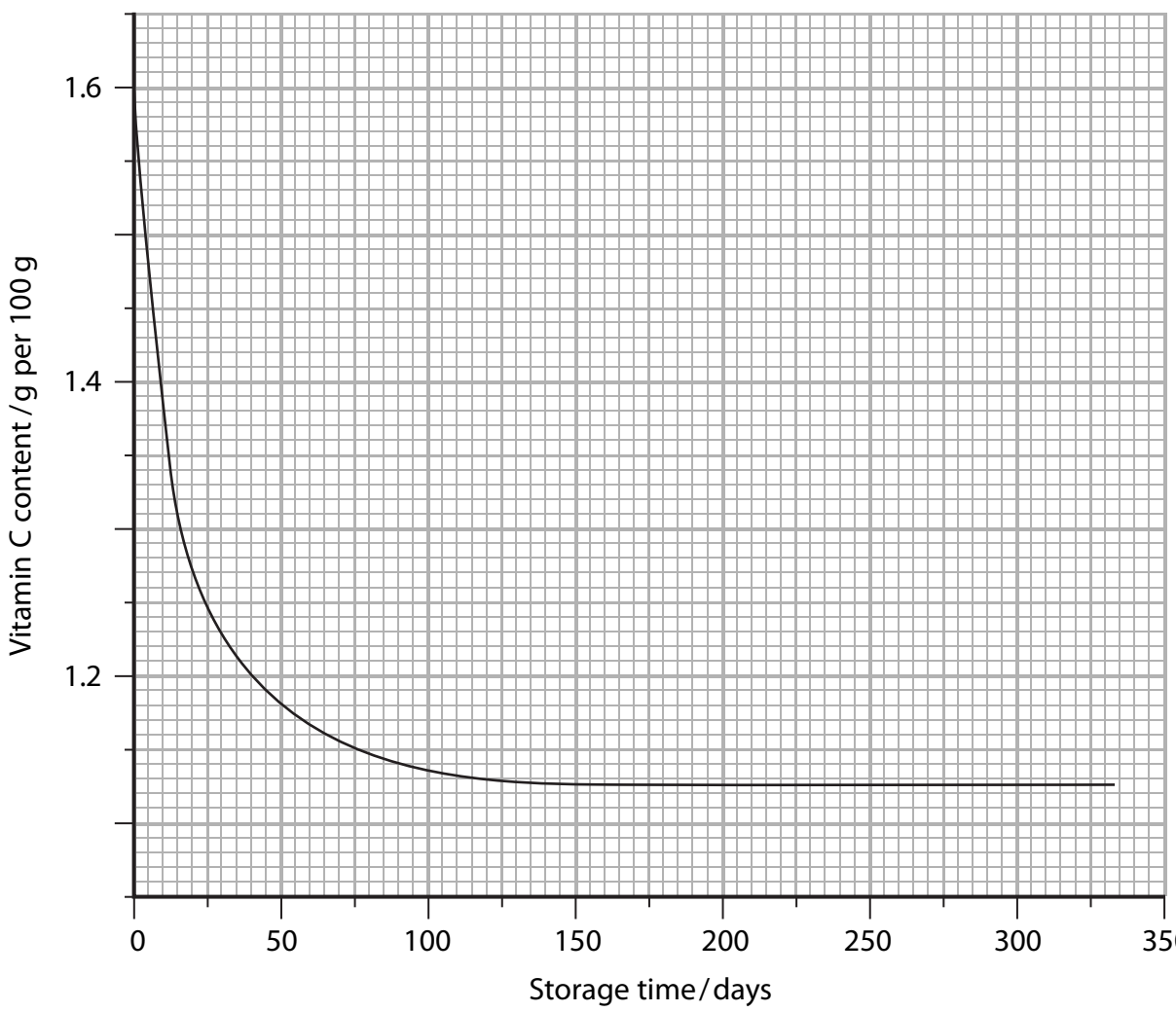
.....

.....

(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)

BLANK PAGE

Turn over ▶

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

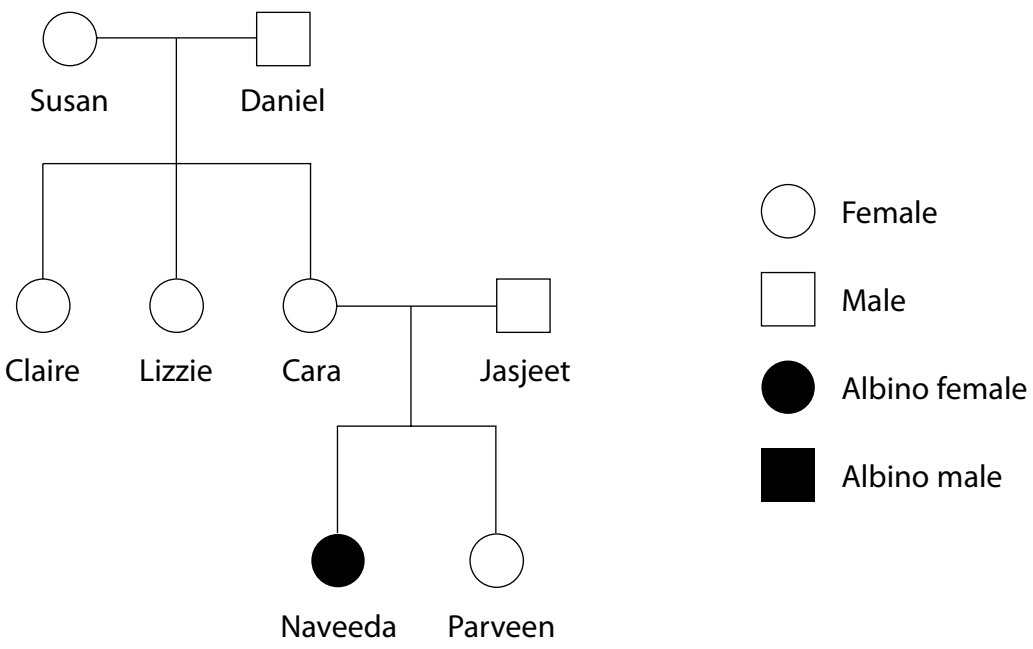
(a) (i) Distinguish between the terms **allele** and **gene**.

(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)

.....

.....

.....

.....

.....

.....

(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)

.....

.....

.....

.....

.....

.....

.....

(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