Science Department

1.Cell Biology Mastery Booklet (Biology Paper 1)

2.Organisation Mastery Booklet (Biology Paper 1)

3.Infection & Response Mastery Booklet (Biology Paper 1)

4.Bioenergetics Mastery Booklet (Biology Paper 1)

5.Homeostatsis & Response Mastery Booklet (Biology Paper 2)

6.Inheritance/Inheritance/Evolution Mastery Booklet (Biology Paper 2)

7.Ecology Mastery Booklet (Biology Paper 2)

Name : _____

Teacher : _____

Date Given : _____

These booklets are a consolidation of your learning from year 11, to help prepare you for the A Level Biology course. You should attempt the questions. You will need to bring the completed booklet to Miss Ward at the start of the new academic year. You will then mark your questions with **green pen** and add any marks you missed.

Year 11 pre-A-level Biology work

In preparation for your A-level Biology course, there are three tasks to compete. The first task requires revision of key GCSE topics and will also check your GCSE exam technique and Maths skills. The second task involves working through a 'transition guide' prepared by AQA that will help you to understand what the A-level course will involve and will develop some key skills that will be required over the next two years. The third task is a project that will get you started on your A-level studies.

Bring your work with you to your first Biology lesson.

Task 1: GCSE revision, exam technique and Maths skills

Work through the GCSE exam questions. You may need to do some revision in order to complete this work. The questions will test your exam technique (e.g., your knowledge of command words) and also your Maths skills. When you have completed the questions, mark your work using the mark scheme. Think about any areas of weakness you might have and how you might improve these before you start the A-level course.
This task should take around 5-6 hours.

Task 2: Complete the activities in the AQA transition guide

There are 11 activities to complete. This should take around 3-4 hours.

Task 3: Project
At A-level you will study the sub-cellular contents (also called organelles) in more detail than you did at GCSE.

i) Choose two organelles from this list:

Nucleus	Lysosomes
Mitochondrion	Ribosomes
Chloroplast	Cell wall
Endoplasmic reticulum	Vacuole
Golgi apparatus	

ii) Using the internet to help you, produce an information poster (or make a model and photograph it) about each of your chosen organelles. Your poster/photos of your model should provide the following information:

- The function of the organelle
- Labels showing its key features
- Explanations as to how its features adapt it for the job it does
- Suggest which types of cells might have particularly high numbers of your chosen organelles and explain way

Each poster (or model) should take you around 2-3 hours.

These resources provide the kind of level of detail you need at A-level and could be a starting point:
https://www.youtube.com/watch?v=cj8dDTHGJBY
https://sciencing.com/prokaryotic-cells-definition-structure-function-with-examples-13717657.html
https://biologydictionary.net/mitochondria/

1.Cell Biology Mastery Booklet (Biology Paper 1)

Q1.

Living organisms are made of cells.

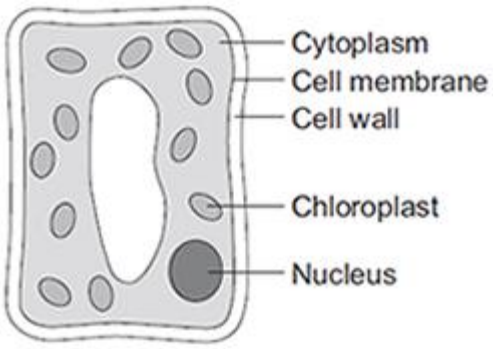
(a) Animal and plant cells have several parts. Each part has a different function.

Draw **one** line from each cell part to the correct function of that part.

Cell part	Function
Cell membrane	Where most energy is released in respiration
Mitochondria	Controls the movement of substances into and out of the cell
Nucleus	Controls the activities of the cell
	Where proteins are made

(3)

(b) The diagram below shows a cell from a plant leaf.



Which **two** parts in the diagram above are **not** found in an animal cell?

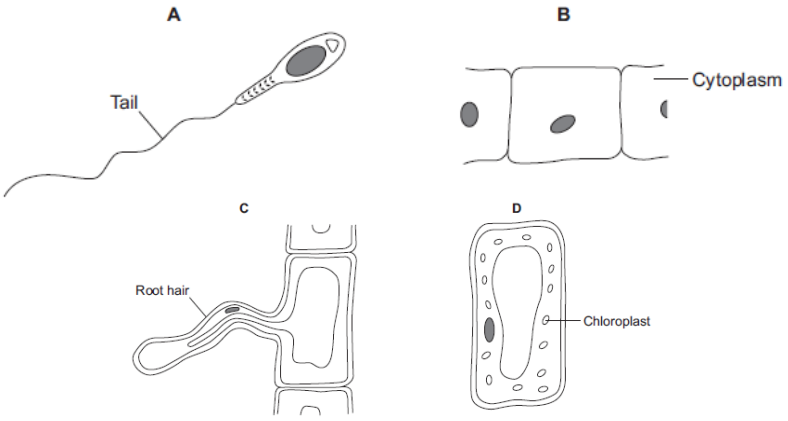
1. _____

2. _____

(2)

(Total 5 marks)

Q2. The diagrams show four types of cell, **A**, **B**, **C** and **D**. Two of the cells are plant cells and two are animal cells.



(a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and **B** ☐

A and **D** ☐

C and **D** ☐

(1)

(ii) Give **one** reason for your answer.

_____

_____

(1)

(b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming? ☐

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis? ☐

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

osmosis **photosynthesis** **respiration**

(1)

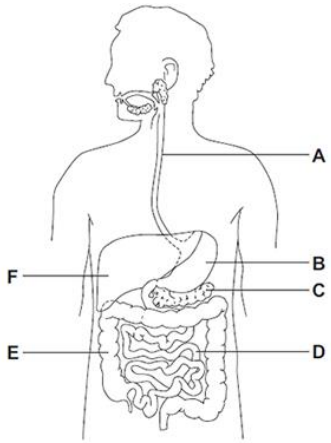
(Total 5 marks)

Q3.

The digestive system breaks down food into small molecules.

The small molecules can be absorbed into the blood.

The diagram below shows the human digestive system.



(a) (i) Which letter, **A**, **B**, **C**, **D**, **E** or **F**, shows each of the following organs?

Write **one** letter in each box.

large intestine

small intestine

stomach

(3)

(ii) Different organs in the digestive system have different functions.

Draw **one** line from each function to the organ with that function.

Function	Organ
Digestion of fat	Large intestine
Absorption of water into the blood	Liver
Production of hydrochloric acid	Small intestine
	Stomach

(3)

(b) Glucose is absorbed into the blood in the small intestine.

Most of the glucose is absorbed by diffusion.

How does the glucose concentration in the blood compare to the glucose concentration in the small intestine?

Tick (✔) **one** box.

The concentration in the blood is higher. ☐

The concentration in the blood is lower. ☐

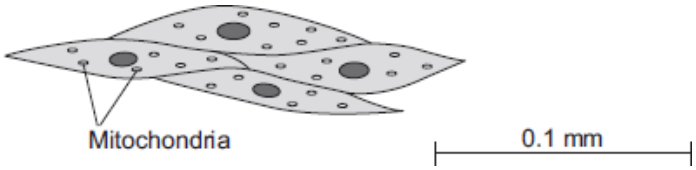
The concentration in the blood is the same. ☐

(1)

(Total 7 marks)

Q4.

The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.



(a) Describe the function of muscle cells in the wall of the stomach.

_____

_____

_____ **(2)**

(b) **Figure above** is highly magnified.

The scale bar in **Figure above** represents 0.1 mm.

Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure above**.

_____

_____

_____

_____

Magnification = _____ times

(2)

(c) The muscle cells in **Figure above** contain many mitochondria.

What is the function of mitochondria?

_____

_____

_____

_____

(2)

(d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure above**.

(i) What is the function of a ribosome?

_____

_____

(1)

(ii) Suggest why the ribosomes **cannot** be seen through a light microscope.

_____

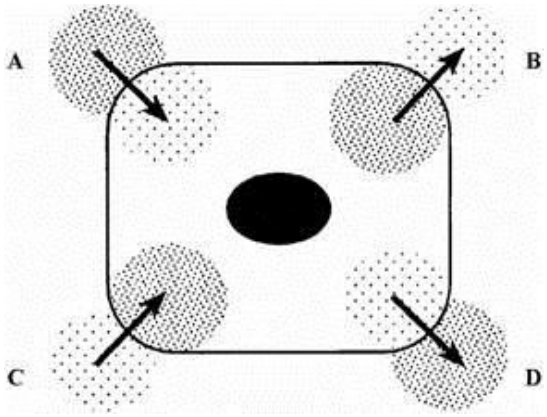
_____

(1)

(Total 8 marks)

Q5. (a) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the

concentration of molecules.



The cell is respiring aerobically.
Which arrow, **A**, **B**, **C** or **D**, represents:

(i) movement of oxygen molecules; _____

(ii) movement of carbon dioxide molecules? _____

(2)

(b) Name the process by which these gases move into and out of the cell.

_____

(1)

(c) Which arrow, **A**, **B**, **C** or **D**, represents the active uptake of sugar molecules by the cell?

_____

Explain the reason for your answer.

_____

_____

_____

(2)

(Total 5 marks)

Q6.

Explain how the human circulatory system is adapted to:

- supply oxygen to the tissues
- remove waste products from tissues.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q7.

A student investigated the effect of different sugar solutions on potato tissue.

This is the method used.

1. Add 30 cm^3 of 0.8 mol dm^{-3} sugar solution to a boiling tube.
2. Repeat step **1** with equal volumes of 0.6, 0.4 and 0.2 mol dm^{-3} sugar solutions.
3. Use water to give a concentration of 0.0 mol dm^{-3}.
4. Cut five cylinders of potato of equal size using a cork borer.
5. Weigh each potato cylinder and place one in each tube.
6. Remove the potato cylinders from the solutions after 24 hours.
7. Dry each potato cylinder with a paper towel.
8. Reweigh the potato cylinders.

The table below shows the results.

Concentration of sugar solution in mol dm^{-3}	**Starting mass in g**	**Final mass in g**	**Change of mass in g**	**Percentage (%) change**
0.0	1.30	1.51	0.21	16.2
0.2	1.35	1.50	0.15	**X**
0.4	1.30	1.35	0.05	3.8
0.6	1.34	1.28	−0.06	−4.5
0.8	1.22	1.11	−0.11	−9.0

(a) Calculate the value of **X** in the table above.

_____

_____

Percentage change in mass = _____ %

(2)

(b) Why did the student calculate the percentage change in mass as well as the change in grams?

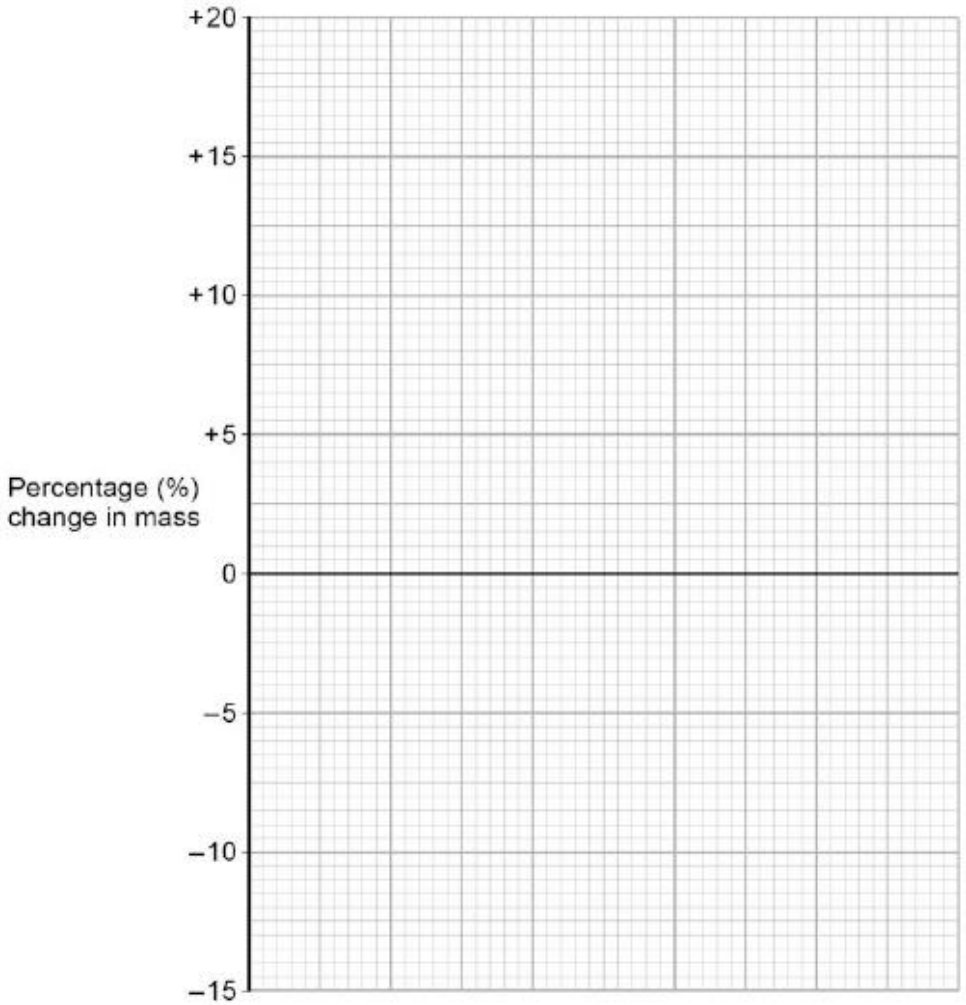
_____

_____

(1)

(c) Complete the graph using data from the table above.

- Choose a suitable scale and label for the *x*-axis.
- Plot the percentage (%) change in mass.
- Draw a line of best fit.



(4)

(d) Use your graph to estimate the concentration of the solution inside the potato cells.

Concentration = _____ mol dm^{-3}

(1)

(e) The results in the table above show the percentage change in mass of the potato cylinders.

Explain why the percentage change results are positive **and** negative.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(f) Suggest **two** possible sources of error in the method given above.

1. _____

_____

2. _____

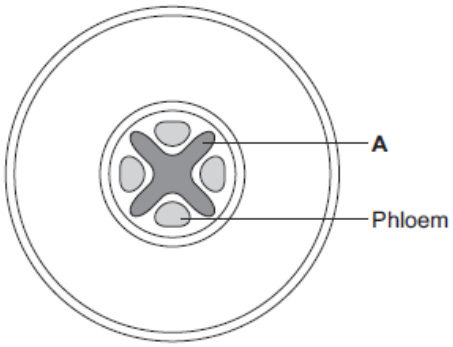
_____

(2)

(Total 13 marks)

Q8.

The diagram below shows a cross-section of a plant root. The transport tissues are labelled.



(a) (i) What is tissue **A**?

Draw a ring around the correct answer.

cuticle **epidermis** **xylem**

(1)

(ii) Name **two** substances transported by tissue **A**.

1. _____

2. _____ **(2)**

(b) Phloem is involved in a process called translocation.

(i) What is translocation?

_____

_____

_____

(1)

(ii) Explain why translocation is important to plants.

_____

_____

_____

_____

(2)

(c) Plants must use active transport to move some substances from the soil into root hair cells.

(i) Active transport needs energy.

Which part of the cell releases most of this energy?

Tick (✓) **one** box.

mitochondria ☐

nucleus ☐

ribosome ☐

(1)

(ii) Explain why active transport is necessary in root hair cells.

_____

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

Q9.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Diffusion is an important process in animals and plants.

The movement of many substances into and out of cells occurs by diffusion.

Describe why diffusion is important to animals and plants.

In your answer you should refer to:

- animals
- plants
- examples of the diffusion of named substances.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

_____

_____

_____

_____

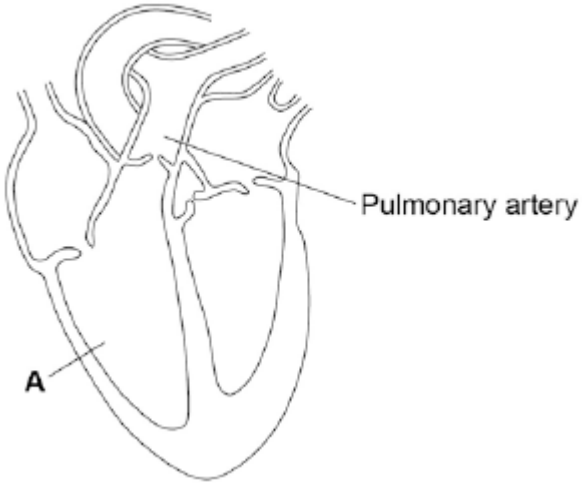
_____

(Total 6 marks)

2.Organisation Mastery Booklet (Biology Paper 1)

Q1. **Figure 1** shows a diagram of the human heart.

Figure 1



(a) What part of the heart is labelled **A**?

Tick **one** box.

Aorta ☐

Atrium ☐

Valve ☐

Ventricle ☐

(1)

(b) Where does the pulmonary artery take blood to?

Tick **one** box.

Brain ☐

Liver ☐

Lungs ☐

Stomach ☐

(1)

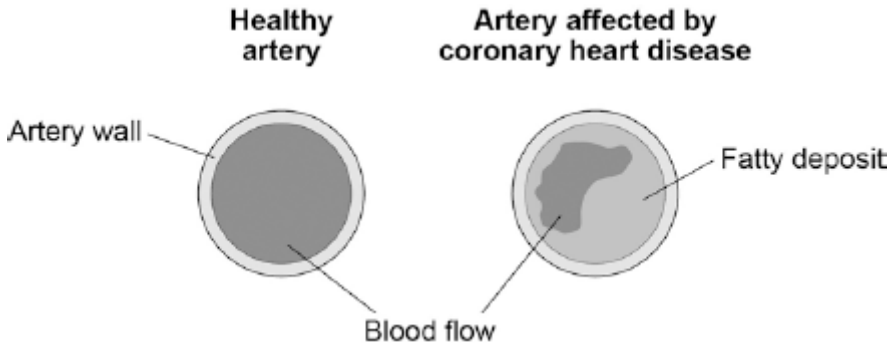
(c) Circle a valve on **Figure 1**.

(1)

(d) The coronary arteries supply blood to the heart.

Figure 2 shows two coronary arteries.

Figure 2



Describe **two** ways the healthy artery is different from the artery affected by coronary heart disease.

1. _____

_____

2. _____

_____

(2)

(e) What can be used to treat people with coronary heart disease?

Tick **two** boxes.

Antibiotics	☐
Hormones	☐
Statins	☐
Stent	☐
Vaccination	☐

(2)

(f) Suggest **two** risk factors for coronary heart disease.

1. _____

_____

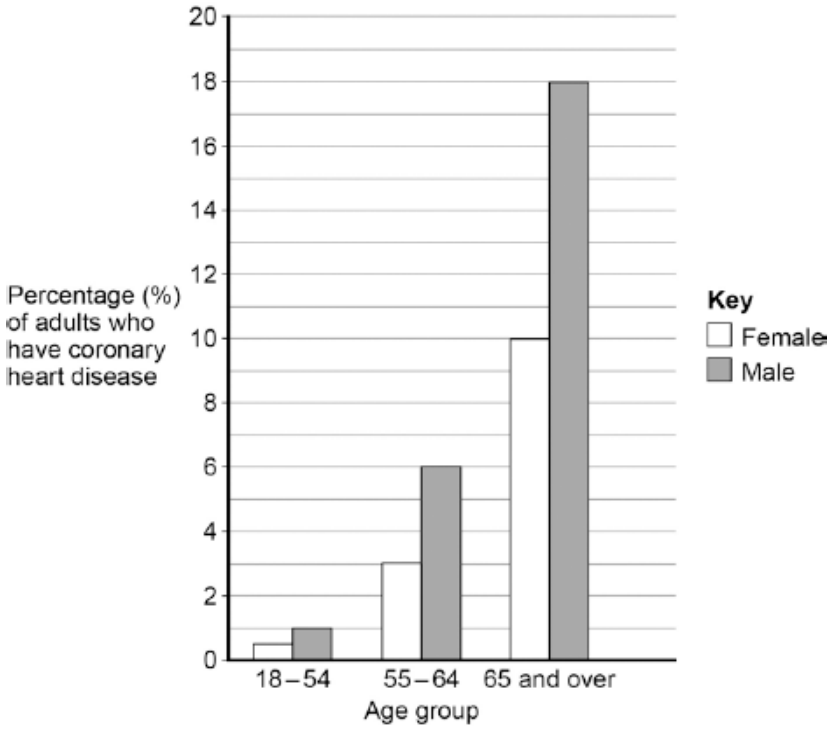
2. _____

_____

(2)

(g) **Figure 3** shows the percentages of adults in the UK who have coronary heart disease.

Figure 3



Calculate the difference in the percentage of male and female adults aged 65 and over who have coronary heart disease.

_____ %

(1)

(h) Which is the correct conclusion for the data in **Figure 3**?

Tick **one** box.

Children do **not** suffer from coronary heart disease ☐

More males suffer from coronary heart disease than females ☐

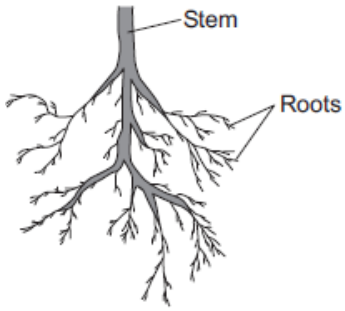
More younger people suffer from coronary heart disease than older people ☐

(1)

(Total 11 marks)

Q2. Plants need different substances to survive. **Figure 1** shows the roots of a plant.

Figure 1



(a) (i) Mineral ions are absorbed through the roots.

Name **one** other substance absorbed through the roots.

_____

(1)

(ii) The plant in **Figure 1** has a higher concentration of mineral ions in the cells of its roots than the concentration of mineral ions in the soil.

Which **two** statements correctly describe the absorption of mineral ions into the plant's roots?

Tick (✓) **two** boxes.

The mineral ions are absorbed by active transport. ☐

The mineral ions are absorbed by diffusion. ☐

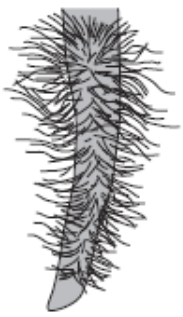
The mineral ions are absorbed down the concentration gradient. ☐

The absorption of mineral ions needs energy. ☐

(2)

(iii) The plant in **Figure 1** has roots adapted for absorption. **Figure 2** shows a magnified part of a root from **Figure 1.**

Figure 2



Describe how the root in **Figure 2** is adapted for absorption.

_____

_____

_____

_____

(2)

(b) The leaves of plants have stomata.

What is the function of the stomata?

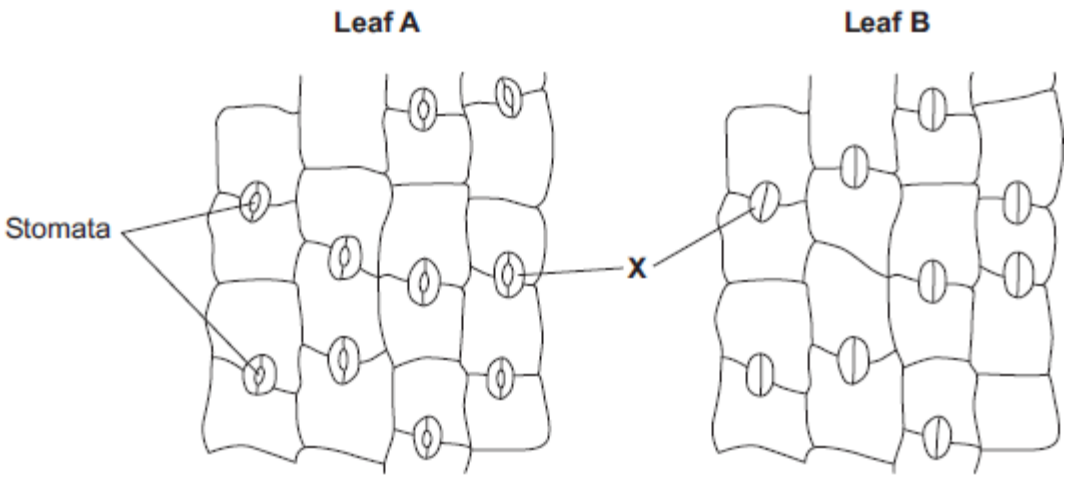
_____

_____

(1)

(c) **Figure 3** shows the underside of two leaves, **A** and **B**, taken from a plant in a man's house.

Figure 3



(i) In **Figure 3**, the cells labelled **X** control the size of the stomata.

What is the name of the cells labelled **X**?

Tick (✓) **one** box.

Guard cells ☐

Phloem cells ☐

Xylem cells ☐

(1)

(ii) Describe how the appearance of the stomata in leaf **B** is different from the appearance of the stomata in leaf **A**.

_____

_____

(1)

(iii) The man forgets to water the plant.

What might happen to the plant in the next few days if the stomata stay the same as shown in leaf **A** in **Figure 3**?

_____

_____

(1)

(Total 9 marks)

Q3. (a) **List A** gives four structures in the human body. **List B** gives the functions of some structures in the body.

Draw a straight line from each structure in **List A** to the correct function in **List B**.

List A – Structure	**List B – Function**
	Surround and protect the lungs
Alveoli	
	Filter the blood
Veins	
	Carry blood towards the heart
Villi	
	Absorb digested food
Ribs	
	Allow oxygen to enter the blood

(4)

(b) Draw a ring around the correct answer to complete the sentence.

In the lungs, oxygen enters the blood from the air by

diffusion.

filtration.

respiration.

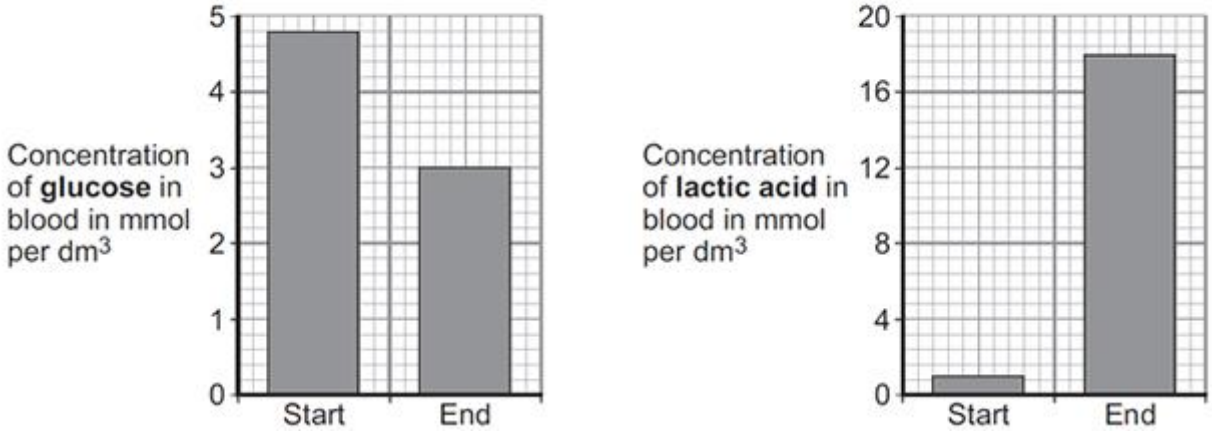
(1)

(Total 5 marks)

Q4. An athlete ran as fast as he could until he was exhausted.

(a) **Figure 1** shows the concentrations of glucose and of lactic acid in the athlete's blood at the start and at the end of the run.

Figure 1



(i) Lactic acid is made during anaerobic respiration.

What does anaerobic mean?

_____

_____

(1)

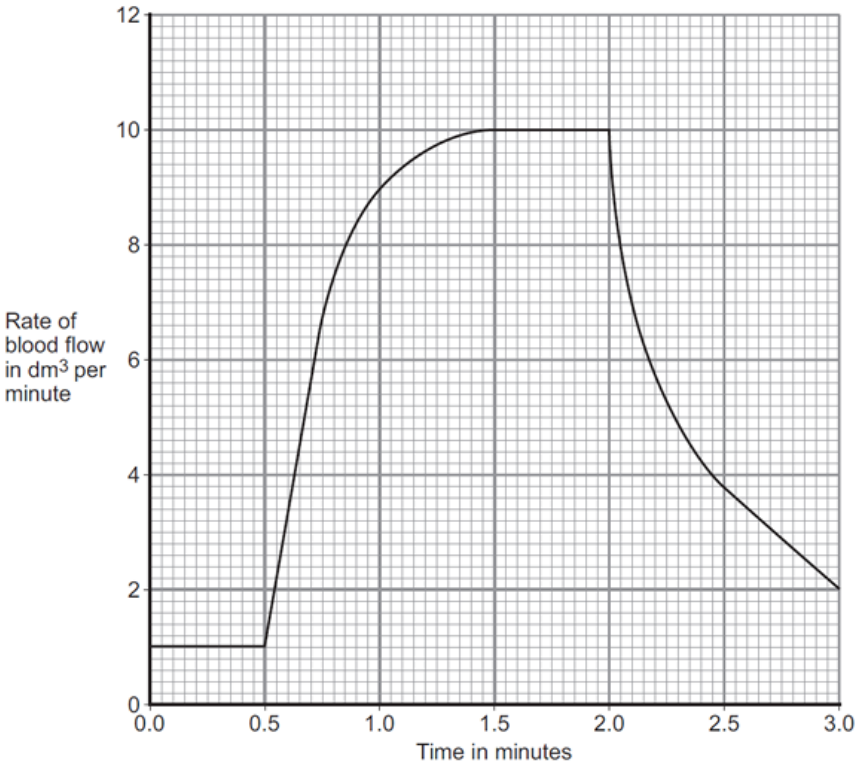
(ii) Give evidence from **Figure 1** that the athlete respired anaerobically during the run.

_____

_____ **(1)**

(b) **Figure 2** shows the effect of running on the rate of blood flow through the athlete's muscles.

Figure 2



(i) For how many minutes did the athlete run?

Time = _____ minutes

(1)

(ii) Describe what happens to the rate of blood flow through the athlete's muscles during the run.

Use data from **Figure 2** in your answer.

_____

_____

_____

(2)

(iii) Explain how the change in blood flow to the athlete's muscles helps him to run.

_____

_____

_____

_____

_____

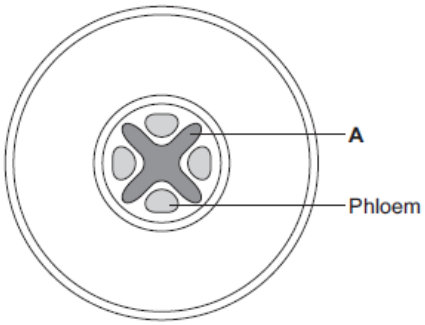
_____

_____

_____ **(4)**

(Total 9 marks)

Q5. The diagram below shows a cross-section of a plant root. The transport tissues are labelled.



(a) (i) What is tissue **A**? Draw a ring around the correct answer.

cuticle **epidermis** **xylem**

(1)

(ii) Name **two** substances transported by tissue **A**.

1. _____

2. _____

(2)

(b) Phloem is involved in a process called translocation.

(i) What is translocation?

_____

_____ **(1)**

(ii) Explain why translocation is important to plants.

_____

_____

(2)

(c) Plants must use active transport to move some substances from the soil into root hair cells.

(i) Active transport needs energy.

Which part of the cell releases most of this energy?

Tick (✓) **one** box.

mitochondria ☐

nucleus ☐

ribosome ☐

(1)

(ii) Explain why active transport is necessary in root hair cells.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q6. (a) A food contains protein. Describe, in as much detail as you can, what happens to this protein after the food is swallowed.

_____

_____

_____

_____

_____

_____ **(4)**

(b) The table shows the activity of lipase on fat in three different conditions.

CONDITION	UNITS OF LIPASE ACTIVITY PER MINUTE
Lipase + acid solution	3.3
Lipase + weak alkaline solution	15.3
Lipase + bile	14.5

Explain, as fully as you can, the results shown in the table.

_____

_____

_____

_____

_____

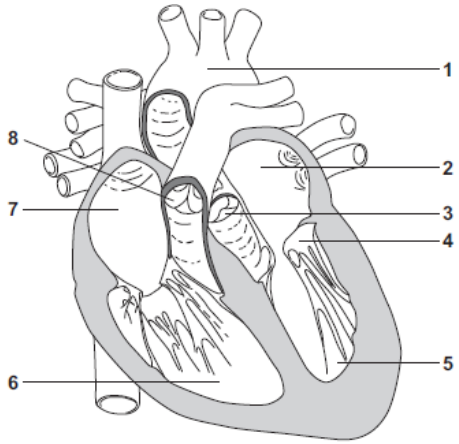
_____

(3)

(Total 7 marks)

Q7. The diagram in **Figure 1** shows a section through the human heart, seen from the front.

Figure 1



(a) Draw a ring around the correct answer to complete each sentence.

(i) The wall of the heart is made mostly of

epithelial
glandular
muscular

tissue.

(1)

(ii) The resting heart rate is controlled by the pacemaker.

The pacemaker is located at position

1.
6.
7.

(1)

(iii) If a person's heart rate is irregular, the person may be fitted with an artificial pacemaker.

The artificial pacemaker is

an electrical device.
a pump.
a valve.

(1)

(b) (i) Write a number, **2**, **5**, **6** or **7**, in **each** of the three boxes to answer this question.

Which chamber of the heart:

pumps oxygenated blood to the head and body ☐

receives deoxygenated blood from the head and body ☐

receives oxygenated blood from the lungs? ☐

(3)

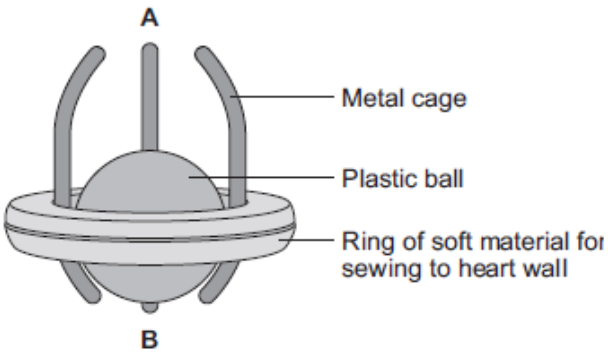
(ii) Give the number, **3**, 4 or **8**, of the valve that closes when the blood pressure in the aorta is greater than the blood pressure in the left ventricle.

Write the correct answer in the box. ☐

(1)

(c) The diagram in **Figure 2** shows one type of artificial heart valve. The plastic ball is in the closed position.

Figure 2



This type of artificial valve could be used to replace a faulty valve in the heart.

(i) What is the function of valves in the heart?

_____

_____

(1)

(ii) The artificial valve could be used to replace valve **4** shown in **Figure 1**.

The artificial valve opens to let blood through when the ball is moved towards **A**.

Which end of the valve, **A** or **B**, should point towards chamber **5**?

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

(3)

(d) (i) The artificial heart valve may cause blood clots to form on its surface.

Describe what happens during blood clotting.

_____

_____

_____

_____

(2)

(ii) Read the information in the passage.

> Replacing a damaged heart valve can dramatically improve the blood circulation and the supply of oxygen to the body's tissues. The operation to replace a heart valve is a long one during which the patient's blood goes through a bypass machine.
> Sometimes the artificial valve can fail to work. If the surface of the valve becomes rough, small blood clots can form on its surface then break away and be carried around the body by the blood.

Evaluate the advantages and disadvantages of artificial heart valves.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

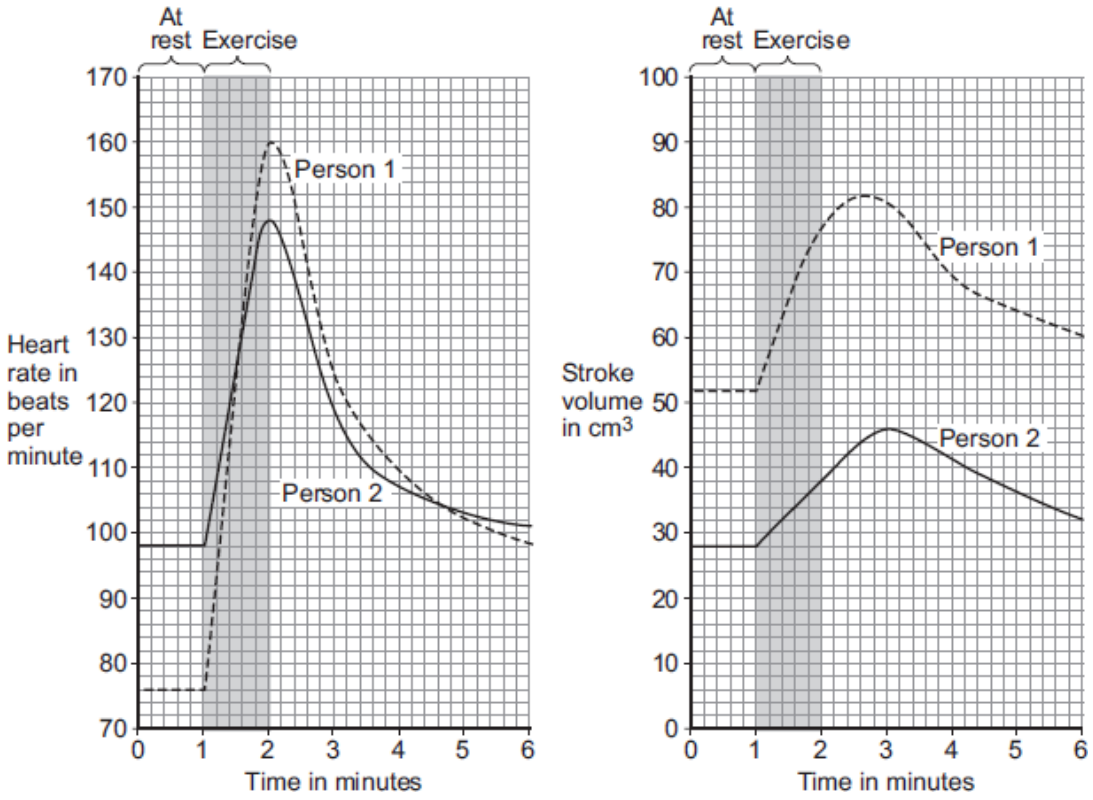
(Total 17 marks)

Q8. During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute.The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

The graph below shows the scientists' results.



(a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

Cardiac output = Heart rate × Stroke volume

At the end of the exercise, **Person 1**'s cardiac output = 160 × 77 = 12 320 cm^3 per minute.

Use information from **Figure above** to complete the following calculation of **Person 2**'s cardiac output at the end of the exercise.

At the end of the exercise:

Person 2's heart rate = _____ beats per minute

Person 2's stroke volume = _____ cm^3

Person 2's cardiac output = _____ cm^3 per minute

(3)

(b) **Person 2** had a much lower cardiac output than **Person 1.**

(i) Use information from **Figure above** to suggest the **main** reason for the lower cardiac output of **Person 2**.

_____

_____ **(1)**

(ii) **Person 1** was able to run much faster than **Person 2**.

Use information from **Figure above** and your own knowledge to explain why.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 9 marks)

Q9.

(a) Complete the table to give one site where digestive substances are made.

Digestive substance	One site of production
bile	
amylase	
lipase	
protease	

(4)

(b) Describe **two** ways that the mouth can break down starchy foods.

_____

_____

_____

(2)

(c) Describe how the liver helps to digest fats.

_____

_____

_____

(2)

(Total 8 marks)

Q10.

A group of pupils investigated the digestion of fat by the enzyme lipase.

(a) What **two** substances are produced when fats are digested?

Tick (✓) **two** box.

Glucose ☐

Fatty acids ☐

Glycerol ☐

Amino acids ☐

(2)

In the investigation:

- the pupils set up five test tubes
- each tube contained 1 cm^3 of fat and 10 cm^3 of lipase solution
- each tube was kept at a different temperature for 24 hours.

(b) (i) Give **one** control variable in this investigation.

_____

(1)

(ii) What was the independent variable being investigated?

_____

(1)

(c) The pH of the solution in each tube was tested at the beginning of the investigation and after 24 hours.

The results of the pupils' investigation are shown in the table.

Tube	**Temperature in °C**	**pH at the beginning**	**pH after 24 hours**
1	0	Neutral	Neutral
2	20	Neutral	'Weak' acid
3	40	Neutral	'Strong' acid
4	60	Neutral	'Weak' acid
5	80	Neutral	Neutral

One pupil said, "We might **not** have found the best temperature for the lipase to work".

What more could they do to find the best temperature?

_____

_____

_____

_____

(2)

(d) The pupils then placed **Tube 1** into a water-bath kept at 40 °C. The tube was left in the water-bath for 24 hours.

(i) What pH would you expect the contents of the tube to be after the extra 24 hours?

Tick (✓) **one** box.

Neutral ☐

'Strong' acid ☐

'Weak' acid ☐

(1)

(ii) Give the reason for your answer.

_____

_____

(1)

(Total 8 marks)

Q11. After a meal rich in carbohydrates, the concentration of glucose in the small intestine changes.

The table below shows the concentration of glucose at different distances along the small intestine.

Distance along the small intestine in cm	Concentration of glucose in mol dm^{-3}
100	50
300	500
500	250
700	0

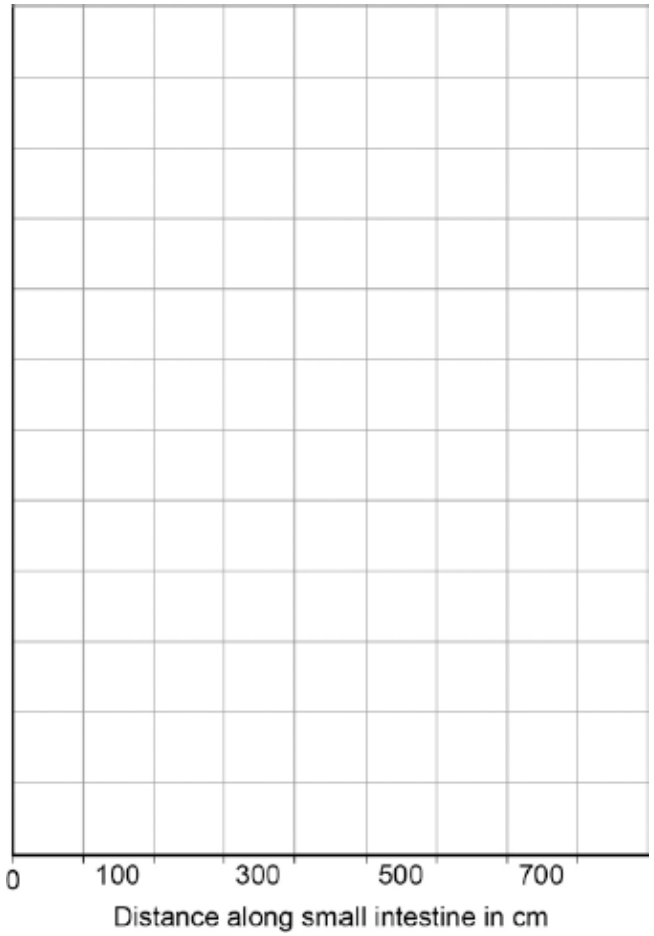
(a) At what distance along the small intestine is the glucose concentration highest?

_____ cm

(1)

(b) Use the data in the table to plot a bar chart on the graph below.

- Label the *y*-axis.
- Choose a suitable scale.



(4)

(c) Look at the graph on the previous page.

Describe how the concentration of glucose changes as distance increases along the small intestine.

_____

_____

_____

_____

(2)

(d) Explain why the concentration of glucose in the small intestine changes between 100 cm and 300 cm.

_____

_____

_____

_____

_____

(2)

(e) Explain why the concentration of glucose in the small intestine changes between 300 cm and 700 cm.

_____

_____

_____

_____

_____

_____

_____

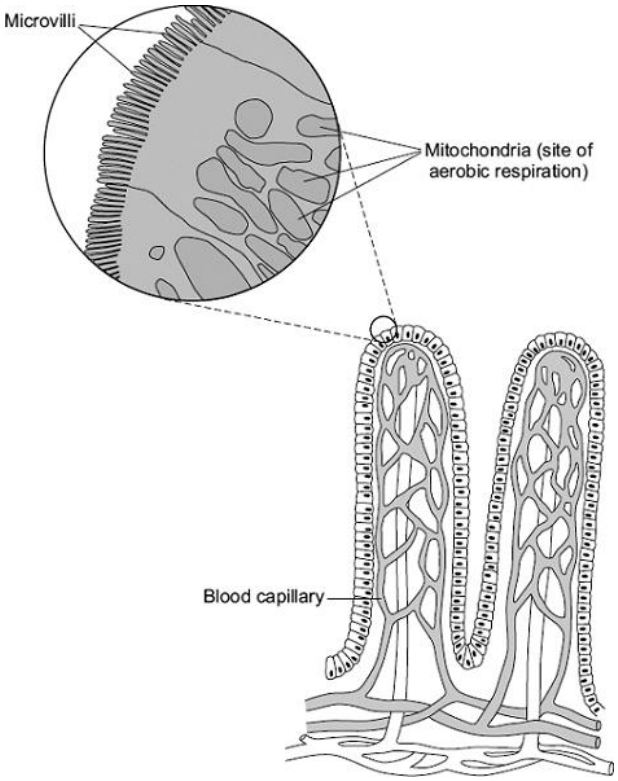
_____

(3)

(Total 12 marks)

Q12. The villi of the small intestine absorb the products of digestion.

The diagram shows two villi. It also shows parts of some of the surface cells of a villus, as seen with an electron microscope.



Describe and explain how the villi are adapted to maximise the rate of absorption of the products of digestion.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 5

3.Infection & Response Mastery Booklet (Biology Paper 1)

Q1. Microorganisms cause infections.

The human body has many ways of defending itself against microorganisms.

(a) Describe **two** ways the body prevents the entry of microorganisms.

1. _____

_____

2. _____

_____

(2)

(b) In 2014 the Ebola virus killed almost 8000 people in Africa.

Drug companies have developed a new drug to treat Ebola.

Explain what testing must be done before this new drug can be used to treat people.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 8 marks)

Q2. The MMR vaccine is used to protect against measles.

(a) Apart from measles, which **two** other diseases does the MMR vaccine protect against?

_____ and _____

(1)

(b) Read the information.

> Measles is a dangerous disease caused by a virus. Normally, MMR vaccinations are given at 1 year old and again at 4 years old. Each vaccination is 90% effective in protecting against the measles virus.
>
> In April 2013, there were 630 cases of measles in children aged 4 and over in a small area of the UK. Of these cases, 504 children had not been vaccinated against MMR at all and only a few had been given a second vaccination.

(i) Calculate the percentage of the children who caught measles in April 2013 who had **not** been vaccinated against MMR.

_____

_____

_____

Percentage = _____

(2)

(ii) Suggest **one** advantage to the population as a whole of children having the second MMR vaccination.

_____

(1)

(c) (i) What does a vaccine contain?

_____

_____

(1)

(ii) Explain how a vaccination prevents infection.

_____

_____

_____

_____

_____

_____

_____

(3)

(d) (i) Antibiotics can only be used to treat some infections.

Explain why antibiotics **cannot** be used to treat measles.

_____

_____

_____

_____

(2)

(ii) Why do antibiotics become less useful at treating an infection if the antibiotic is overused?

_____

_____

(1)

(Total 11 marks)

Q3. Microorganisms can cause disease.

(a) Draw **one** line from each disease to the correct description.

	Can be spread by not washing hands thoroughly.
HIV	Can increase the chance of infection such as pneumonia.
	Part of the life cycle includes an insect.
Malaria	spread by cough and sneezes.
	Treated with stem cell.
Salmonella	Treated with fungicides.

(3)

(b) Gonorrhoea is a sexually transmitted disease. A bacterium causes gonorrhoea.

What are the symptoms of gonorrhoea?

Tick **two** boxes.

Headache ☐

Pain when urinating ☐

Rash ☐

Vomiting ☐

Yellow discharge ☐

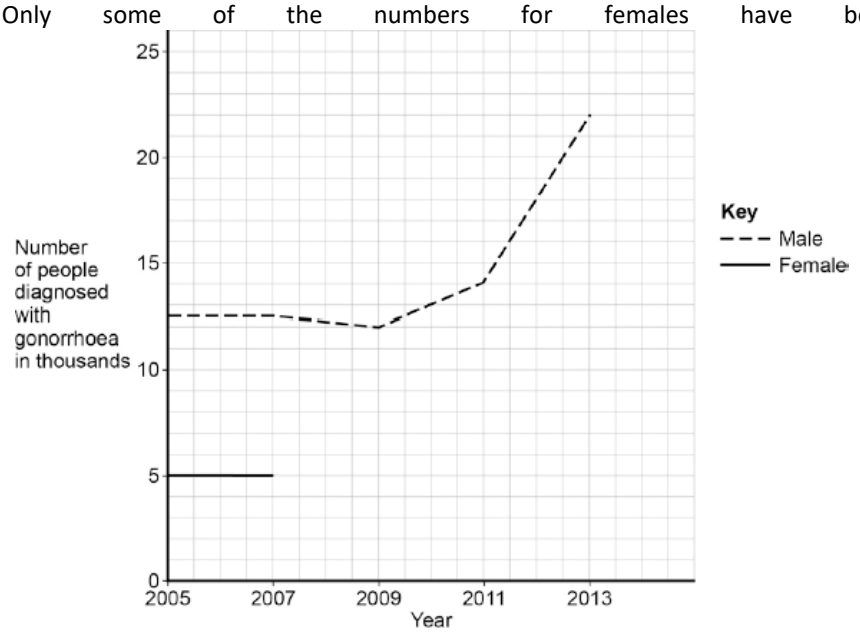
(2)

(c) The table below shows the number of people in the UK diagnosed with gonorrhoea in different years.

	Number of people diagnosed with gonorrhoea in thousands	
Year	**Female**	**Male**
2005	5.0	12.5
2007	5.0	12.5
2009	5.5	12.0
2011	6.0	14.0
2013	7.5	22.0

Use the data in the table to complete the graph below.

- The numbers for males have already been plotted.
- Only some of the numbers for females have been plotted.



(3)

(d) Describe the patterns in the numbers of males and females with gonorrhoea from 2005 to 2013.

Use the data in the graph.

_____

_____

_____

_____

(3)

(e) Gonorrhoea is treated with an antibiotic.

HIV is another sexually transmitted disease.

Explain why prescribing an antibiotic will **not** cure HIV.

_____

_____

_____

(2)

(Total 13 marks)

Q4.

Hepatitis B is a liver disease caused by a virus. The virus is found in body fluids such as blood, saliva and urine. Diagram **1** shows the structure of the virus in cross section.

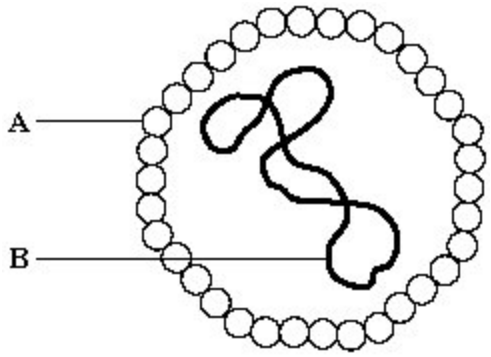
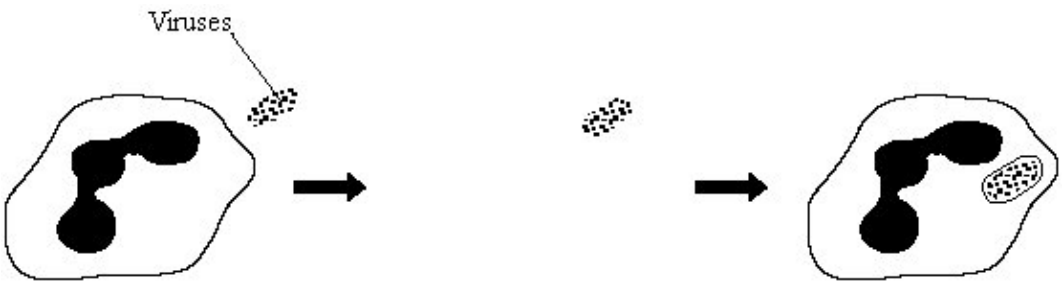


Diagram 1

(a) The human body has several natural defences against viruses. Some of these prevent viruses from entering the body. Others act once the viruses have entered.

(i) Diagram **2** shows a white blood cell attacking a group of viruses.

Complete diagram **2** by drawing the 2nd stage.



1st stage **2nd stage** **3rd Stage**

Diagram 2

(1)

(ii) What type of chemical is released by some white blood cells to attack viruses?

_____

(1)

(b) Hepatitis B is more likely to be spread among people who share needles when they inject drugs. Use information given at the beginning of this question to explain why this is so.

_____

_____

(2)

(Total 4 marks)

Q5. Viruses and bacteria cause diseases in humans.

(a) Draw a ring around the correct word to complete the sentence.

Organisms that cause disease are called

algae.
pathogens.
vaccines.

(1)

(b) In August 2011 the United Nations gave a warning that there was a new strain of the bird flu virus in China. Bird flu may kill humans. The new strain of the bird flu virus could cause a *pandemic* very quickly.

(i) What is a *pandemic*? Tick (✓) **one** box.

A disease affecting the people all over one country. ☐

A disease affecting hundreds of people ☐

A disease affecting people in many countries. ☐

(1)

(ii) The swine flu virus is carried by pigs.

The bird flu virus is likely to spread much more quickly than the swine flu virus.

Suggest **one** reason why.

_____

_____

(1)

This notice is from a doctor's surgery.

Unfortunately, antibiotics will NOT get rid of your flu.

(c) (i) Why will antibiotics **not** get rid of flu?

_____

_____

(1)

(ii) The symptoms of flu include a sore throat and aching muscles.

What would a doctor give to a patient to relieve the symptoms of flu?

_____

(1)

(iii) It is important that antibiotics are **not** overused.

Explain why.

Use words from the box to complete the sentence.

antibody	**bacteria**	**immune**	**resistant**	**viruses**

Overuse of antibiotics might speed up the development

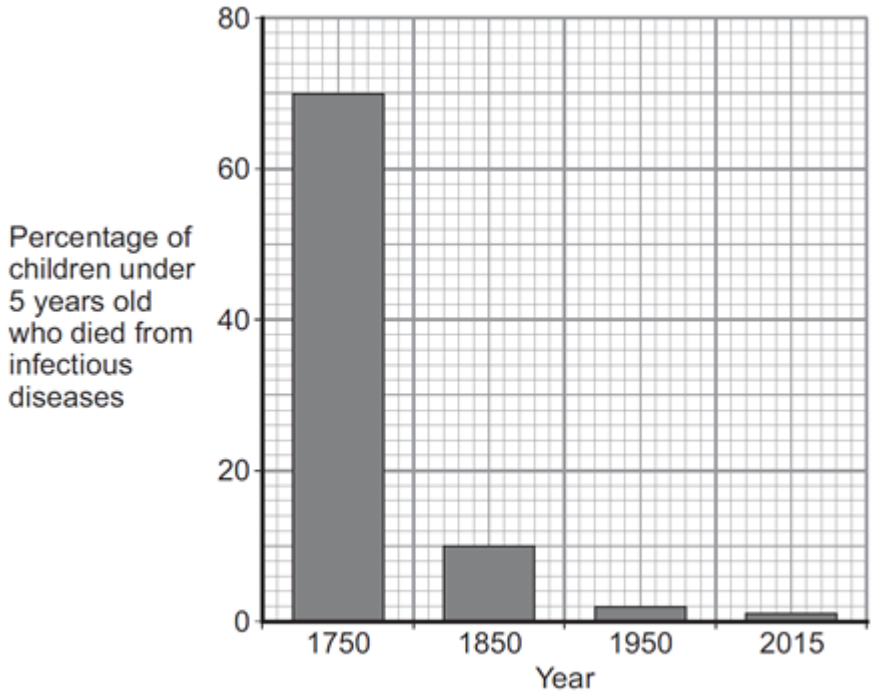
of _____ strains of _____ .

(2)

(Total 7 marks)

Q6. Pathogens are microorganisms that cause infectious diseases.

(a) The graph shows the percentage of children under 5 years old who died from infectious diseases, in the UK, in four different years.



(i) Between 1750 and 1850 vaccinations were also developed.
What is in a vaccine?

Tick (✔) **one** box.

large amounts of dead pathogens ☐

large amounts of live pathogens ☐

small amounts of dead pathogens ☐

(1)

(ii) The advances in medicine had an effect on death rate.

Describe the effect these advances had between 1750 and 1850.

To gain full marks you should include data from the graph above.

_____

_____

_____

_____

(2)

(b) Antibiotics were developed in the 1940s. Antibiotics kill bacteria.

(i) Which **one** of the following is an antibiotic?

Draw a ring around the correct answer.

cholesterol **penicillin** **thalidomide**

(1)

(ii) The use of antibiotics has **not** reduced the death rate due to all diseases to zero.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(c) In school laboratories, bacteria should be grown at a maximum temperature of 25 °C.

Give **one** reason why companies testing new antibiotics grow bacteria at 37 °C.

_____

_____

(1)

(Total 7 marks)

Q7.

The influenza virus damages the cells lining the respiratory tract causing sore throats.

Coughing and sneezing spread the virus.

(a) Give the correct term for this method of spreading an infection.

_____

(1)

(b) In an immunisation programme such as that for MMR (Measles, Mumps and Rubella), suggest why it is essential for a large proportion of the child population to be vaccinated in order to protect the few individuals who are unable to be vaccinated.

_____

_____

(1)

(c) In some modern influenza vaccines the protein surface sub-units are separated from the virus coat and used for the vaccine. This stimulates an effective immune response in the same way as inactive

pathogens.

(i) Explain how this immunity is produced in the body following vaccination, and how further illness from the same virus is prevented.

_____

_____

_____

_____

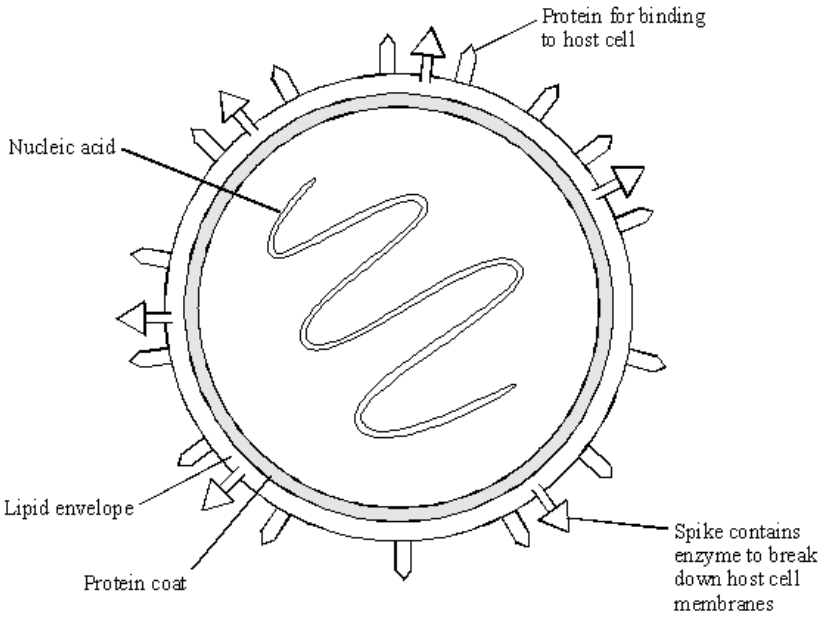
(4)

(ii) This type of immunity resulting from an influenza injection is described

as _____ immunity.

(1)

(d) The diagram shows the structure of an influenza virus.



Influenza epidemics can arise because the nucleic acid of the virus frequently changes. This results in changes in the virus structure and so a new strain of the virus is formed. A person who has had influenza or who has been vaccinated may not be immune to the new strain.

Explain why this is so, using the diagram of the influenza virus structure and your knowledge of immunity.

_____

_____

_____

_____

(3)

(Total 10 marks)

Q8. Antibiotics can be used to protect our bodies from pathogens.

(a) What is a pathogen?

_____

_____

(1)

(b) Bacteria may become resistant to antibiotics.

How can doctors reduce the number of bacteria that become resistant to antibiotics?

_____

_____

_____

_____

(2)

(c) Scientists grow microorganisms in industrial conditions at a higher temperature than is used in school laboratories.

(i) Which temperature would be most suitable for growing bacteria in industrial conditions?

Draw a ring around the correct answer.

25 °C **40 °C** **100 °C**

(1)

(ii) What is the advantage of using the temperature you gave in part (c)(i)?

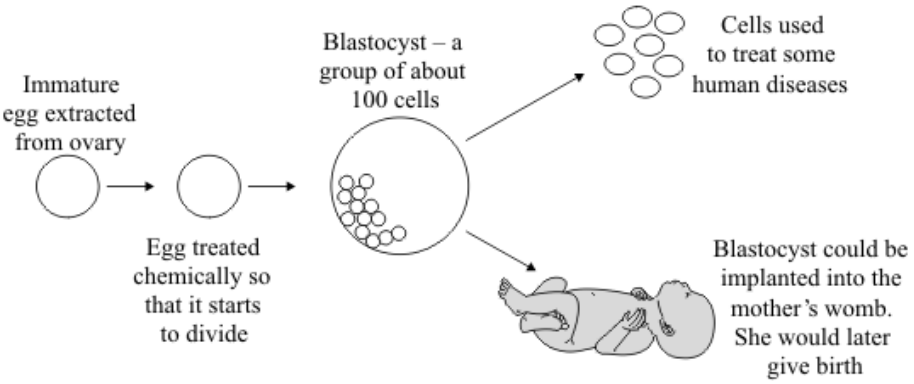
_____

_____

(1)

(Total 5 marks)

Q9. The diagram shows how an immature egg could be used either to produce cells to treat some human diseases or to produce a baby.



Scientists may be allowed to use this technique to produce cells to treat some human diseases, but not to

produce babies.

Using information from the diagram, suggest an explanation for this.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q10. Stem cells can be collected from human embryos and from adult bone marrow. Stem cells can develop into different types of cell.

The table gives information about using these two types of stem cell to treat patients.

Stem cells from human embryos	**Stem cells from adult bone marrow**
It costs £5000 to collect a few cells.	It costs £1000 to collect many cells.
There are ethical issues in using embryo stem cells.	Adults give permission for their own bone marrow to be collected.
The stem cells can develop into most other types of cell.	The stem cells can develop into only a few types of cell.
Each stem cell divides every 30 minutes.	Each stem cell divides every four hours.
There is a low chance of a patient's immune system rejecting the cells.	There is a high chance of a patient's immune system rejecting the cells.
More research is needed into the use of these stem cells.	Use of these stem cells is considered to be a safe procedure.

Scientists are planning a new way of treating a disease, using stem cells.

Use **only** the information above to answer these questions.

(a) Give **three** advantages of using stem cells from embryos instead of from adult bone marrow.

1. _____

2. _____

3. _____

(3)

(b) Give **three** advantages of using stem cells from adult bone marrow instead of from embryos.

1. _____

2. _____

3. _____

(3)

(Total 6 marks)

Q11.

Read the information about stem cells.

> Stem cells are used to treat some human diseases.
>
> Stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now.
>
> Stem cells can also be collected from adult bone marrow. The operation is simple but may be painful. Stem cells in bone marrow mainly differentiate to form blood cells. These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases.

You should give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 5 marks)

Q12. (a) How many pairs of chromosomes are there in a body cell of a human baby?

_____

(1)

(b) Place the following in order of size, **starting with the smallest,** by writing numbers **1** – **4** in the boxes underneath the words.

chromosome	nucleus	gene	cell
☐	☐	☐	☐

(1)

(c) For a baby to grow, its cells must develop in a number of ways.

Explain how each of the following is part of the growth process of a baby.

(i) Cell enlargement

_____

(1)

(ii) The process of cell division by mitosis

_____

_____

_____

_____

(3)

(d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

_____

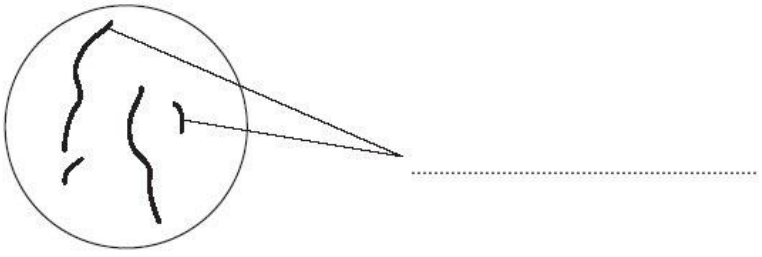
_____

(2)

(Total 8 marks)

Q13. **Diagram 1** shows the nucleus of a body cell as it begins to divide by mitosis.

Diagram 1



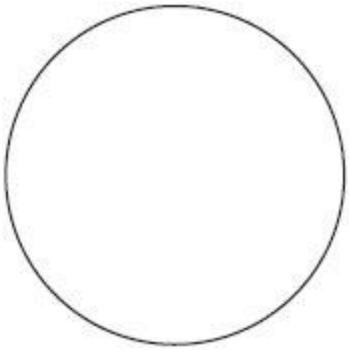
(a) Use a word from the box to label **Diagram 1**.

alleles	**chromosomes**	**gametes**

(1)

(b) Complete **Diagram 2** to show what the nucleus of one of the cells produced by this mitosis would look like.

Diagram 2



(1)

(c) Stem cells from a recently dead embryo can be grown in special solutions.

Some facts about stem cells are given below.

- Stem cells from an embryo can grow into any type of tissue.
- Stem cells may grow out of control, to form cancers.
- Large numbers of stem cells can be grown in the laboratory.
- Stem cells may be used in medical research or to treat some human diseases.
- Patients treated with stem cells need to take drugs for the rest of their life to prevent rejection.
- Collecting and growing stem cells is expensive.

Use **only** the information above to answer these questions.

(i) Give **two** advantages of using stem cells.

1. _____

_____

2. _____

_____

(2)

(ii) Give **two** disadvantages of using stem cells.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

Q14. (a) A healthy diet should be balanced. What is meant by a balanced diet?

_____

_____

_____

_____

(2)

(b) Cholesterol has important functions in the body. Some cholesterol is produced by the liver. Cholesterol is needed in the body to make the hormone oestrogen.

(i) Name the organ in the body which produces oestrogen.

_____

(1)

(ii) What effect does oestrogen have on the female reproductive cycle?

_____

_____

(1)

(iii) Oestrogen is a naturally occurring steroid hormone.

Give **one** artificial use of a steroid hormone in the body.

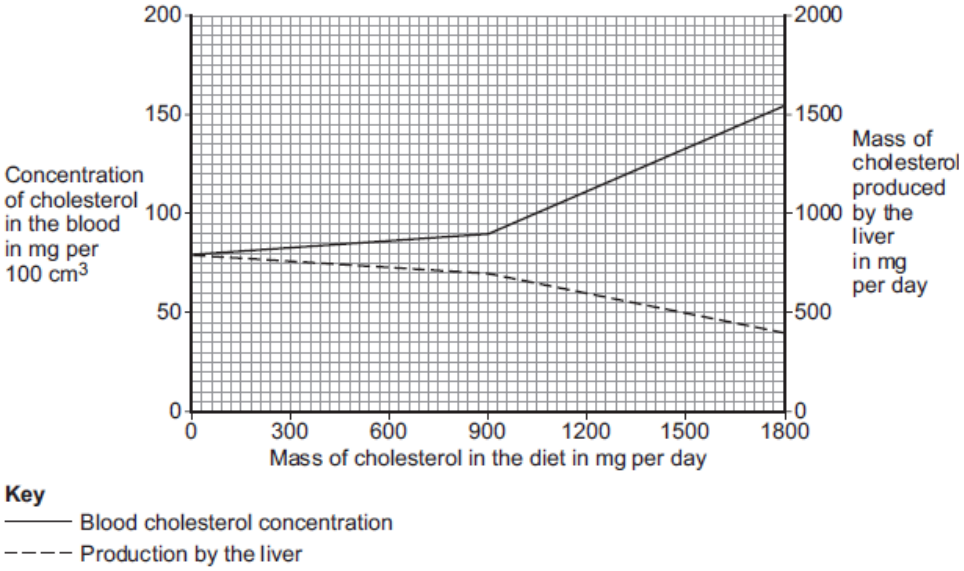
_____

_____

(1)

(c) The graph below shows the effect of the mass of cholesterol in the diet on:

- the concentration of cholesterol in the blood
- the mass of cholesterol produced by the liver.



Describe the effect of increasing the mass of cholesterol in the diet on the mass of cholesterol produced by the liver. To gain full marks you should include data from the graph in your answer.

_____

_____

_____

_____

_____

_____

(2)

(d) Large amounts of cholesterol in the diet switch off the production of an enzyme called reductase, in the liver.

An increase of the enzyme reductase increases the production of cholesterol by the liver.

(i) Which part of a liver cell is responsible for controlling the production of reductase?

_____

_____

(1)

(ii) High blood cholesterol concentrations increase the likelihood of heart and circulatory diseases.

Doctors can prescribe statins to control the concentration of cholesterol in the blood.

Suggest how statins work.

_____

_____

(1)

(Total 9 marks)

.Bioenergetics Mastery Booklet (Biology Paper 1)

Q1.

Anaerobic respiration happens in muscle cells and yeast cells.

The equation describes anaerobic respiration in muscle cells.

glucose ⟶ **lactic acid**

(a) How can you tell from the equation that this process is anaerobic?

_____

_____

(1)

(b) Exercise **cannot** be sustained when anaerobic respiration takes place in muscle cells.

Explain why.

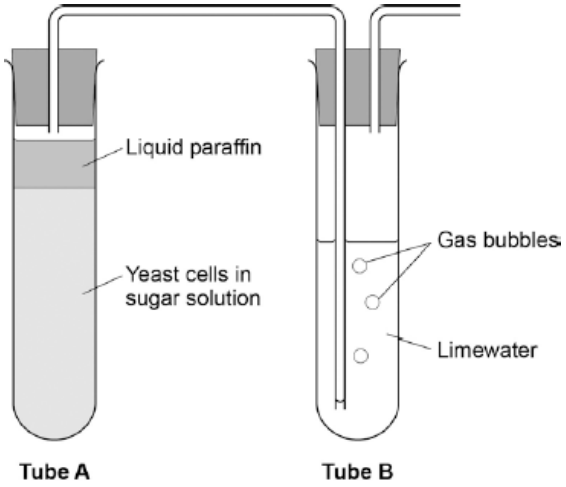
_____

_____

_____

(2)

(c) The diagram below shows an experiment to investigate **anaerobic** respiration in yeast cells.



What gas will bubble into Tube **B**?

Tick **one** box.

Carbon dioxide ☐

Nitrogen ☐

Oxygen ☐

Water vapour ☐

(1)

(d) Describe how you could use tube **B** to measure the rate of the reaction in tube **A**.

_____

_____

_____

(2)

(e) Anaerobic respiration in yeast is also called fermentation.

Fermentation produces ethanol.

Give **one** use of fermentation in the food industry.

_____

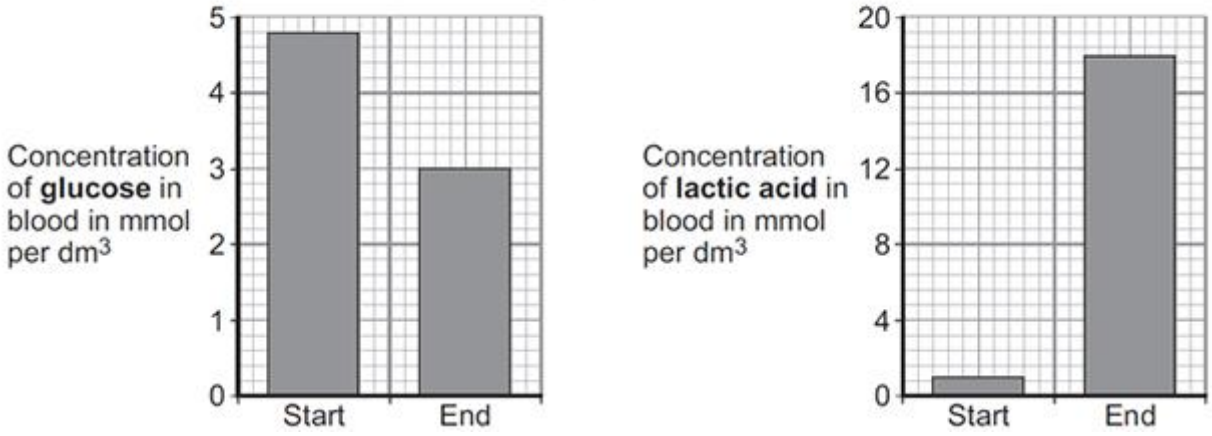
(1)

(Total 7 marks)

Q2. An athlete ran as fast as he could until he was exhausted.

(a) **Figure 1** shows the concentrations of glucose and of lactic acid in the athlete's blood at the start and at the end of the run.

Figure 1



(i) Lactic acid is made during anaerobic respiration.

What does anaerobic mean?

_____

_____

(1)

(ii) Give evidence from **Figure 1** that the athlete respired anaerobically during the run.

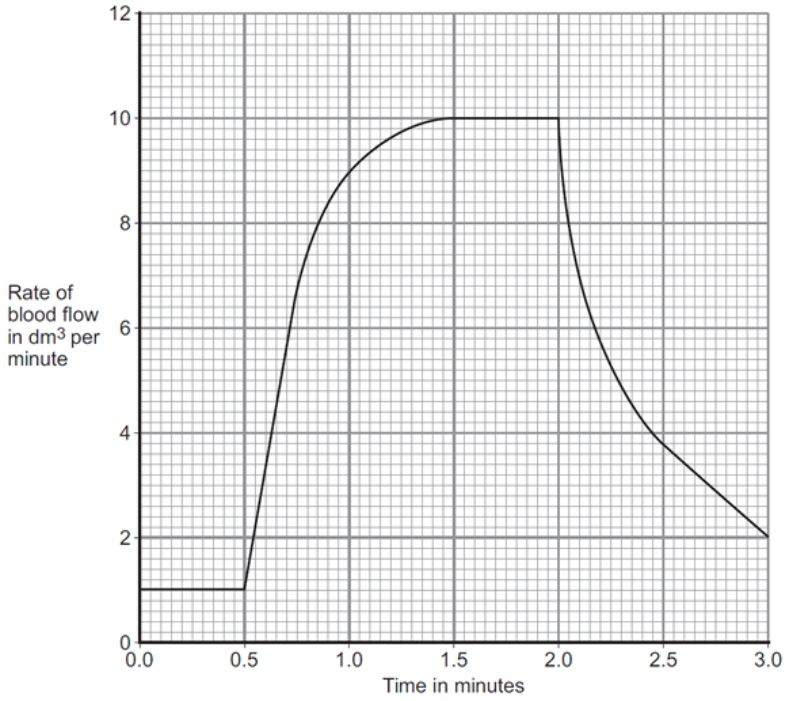
_____

_____

(1)

(b) **Figure 2** shows the effect of running on the rate of blood flow through the athlete's muscles.

Figure 2



(i) For how many minutes did the athlete run?

Time = _____ minutes

(1)

(ii) Describe what happens to the rate of blood flow through the athlete's muscles during the run.

Use data from **Figure 2** in your answer.

_____

_____

_____

(2)

(iii) Explain how the change in blood flow to the athlete's muscles helps him to run.

_____

_____

_____

_____

_____

_____

_____

_____

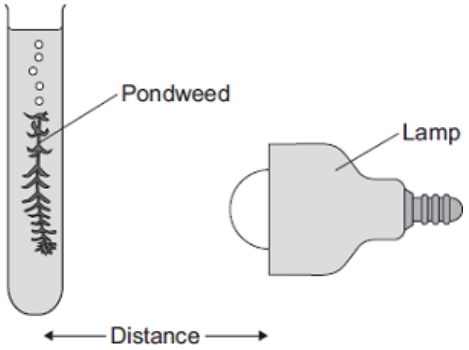
(4)

(Total 9 marks)

Q3. Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

(a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

_____

_____

(1)

(b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

(i) At distances between 15 cm and 50 cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

_____

_____

(1)

(ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10 cm and 15 cm.

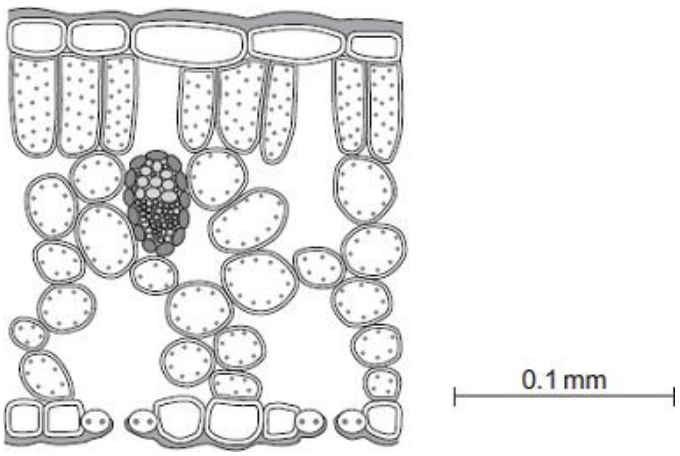
_____

(1)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2



Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 9 marks)

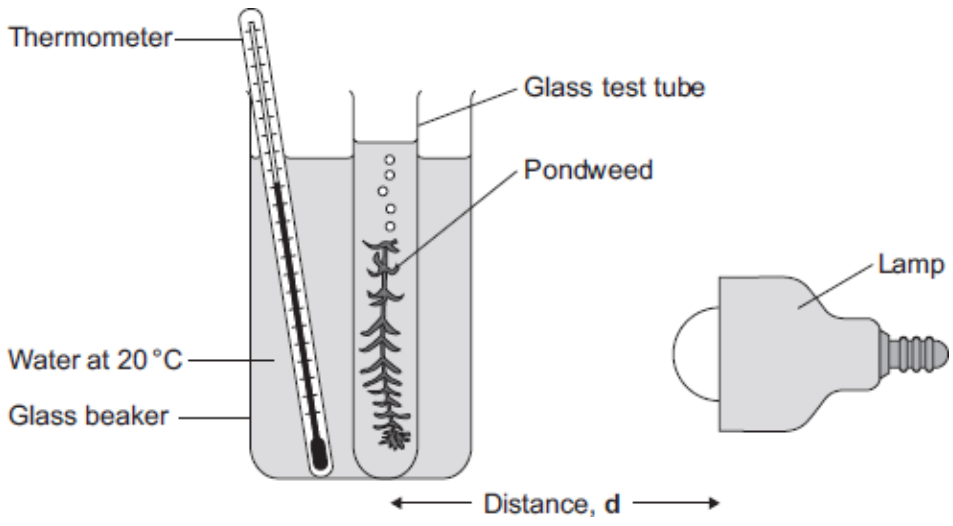
Q4. (a) Complete the equation for photosynthesis. Draw a ring around each correct answer.

Carbon dioxide + (hydrogen / nitrogen / water) → light energy → (alcohol / glucose / methane) + oxygen

(2)

Some students investigated the effect of light intensity on the rate of photosynthesis in pondweed.

The diagram shows the apparatus the students used.



The closer the lamp is to the pondweed, the more light the pondweed receives.

The students placed the lamp at different distances, **d**, from the pondweed.

They counted the number of bubbles of gas released from the pondweed in 1 minute for each distance.

(b) A thermometer was placed in the glass beaker.

Why was it important to use a thermometer in this investigation?

_____

_____

_____

_____

_____

_____

(3)

(c) The students counted the bubbles four times at each distance and calculated the correct mean value of their results.

The table shows the students' results.

Distance d in cm	**Number of bubbles per minute**				
	1	**2**	**3**	**4**	**Mean**
10	52	52	54	54	53
20	49	51	48	52	50
30	32	30	27	31	30
40	30	10	9	11	

(i) Calculate the mean number of bubbles released per minute when the lamp was 40 cm from the pondweed.

_____

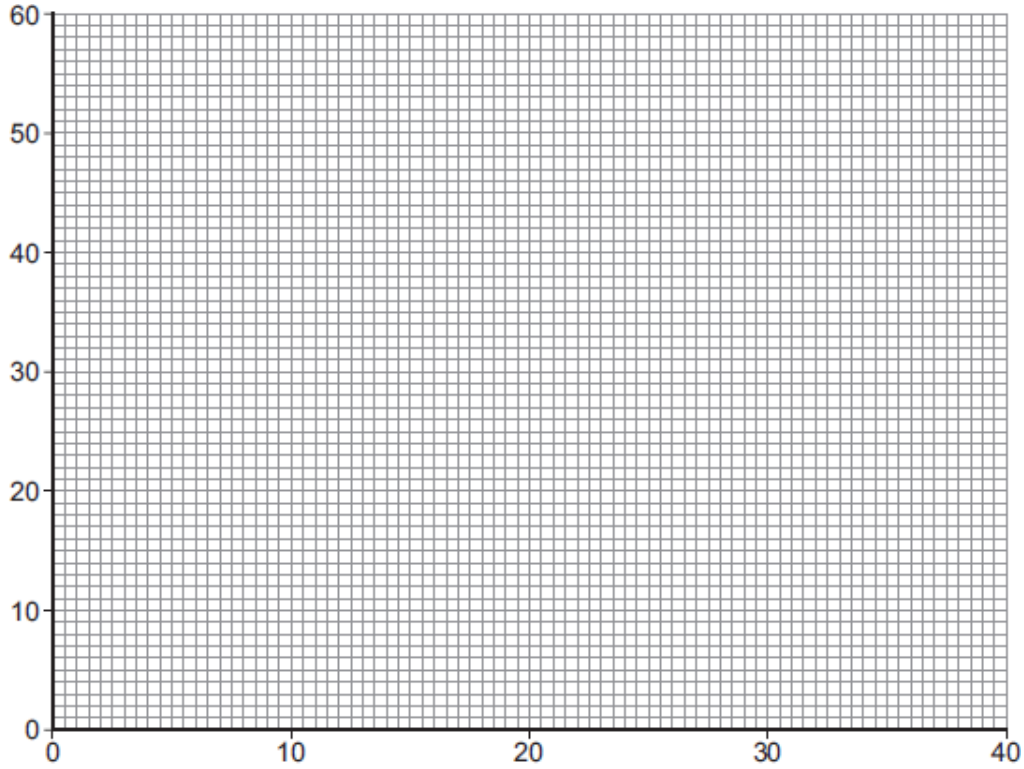
_____

Mean number of bubbles at 40 cm = _____

(2)

(ii) On the graph paper below, draw a graph to show the students' results:

- add a label to the vertical axis
- plot the **mean values** of the number of bubbles
- draw a line of best fit.



(4)

(iii) One student concluded that the rate of photosynthesis was inversely proportional to the distance of the lamp from the plant.

Does the data support this conclusion? Explain your answer.

_____

_____

_____

_____

_____

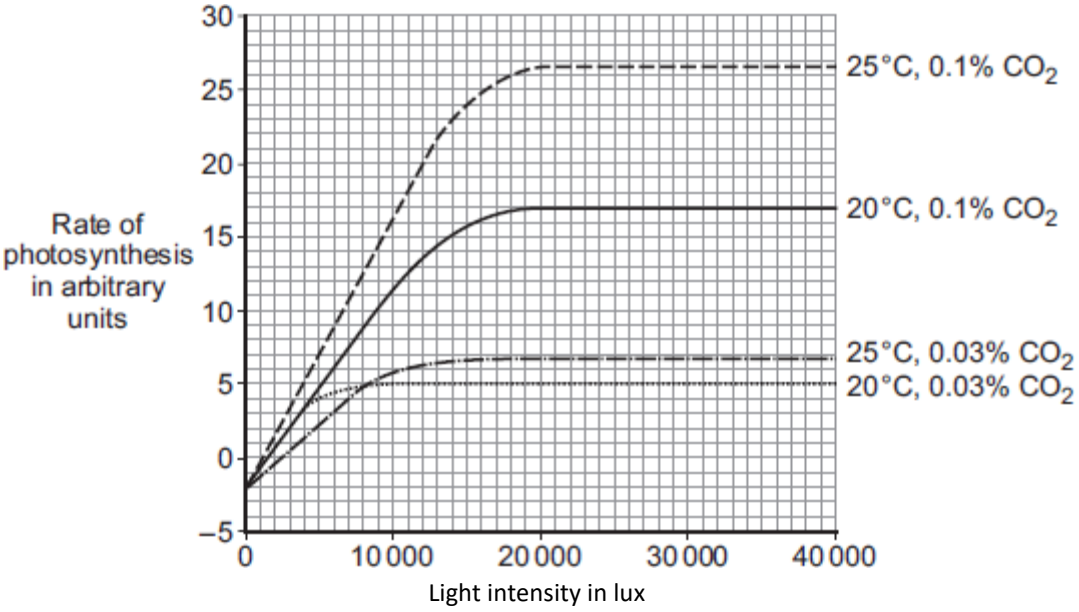
_____

(2)

(d) Light intensity, temperature and concentration of carbon dioxide are factors that affect the rate of photosynthesis.

Scientists investigated the effects of these three factors on the rate of photosynthesis in tomato plants growing in a greenhouse.

The graph below shows the scientists' results.



A farmer in the UK wants to grow tomatoes commercially in a greenhouse.

The farmer read about the scientists' investigation.

During the growing season for tomatoes in the UK, natural daylight has an intensity higher than 30 000 lux.

The farmer therefore decided to use the following conditions in his greenhouse during the day:

- 20°C
- 0.1% CO_2
- no extra lighting.

Suggest why the farmer decided to use these conditions for growing the tomatoes.

You should use information from the scientists' graph in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

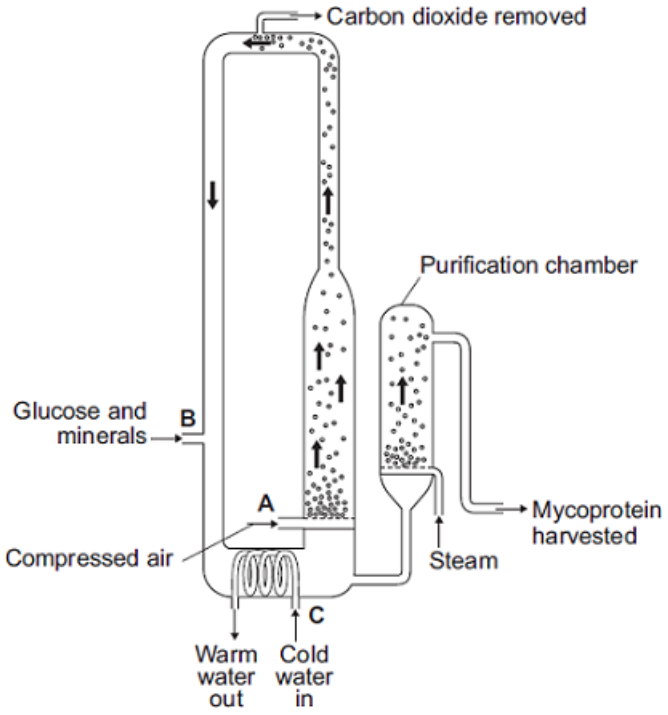
_____

_____

(4)

(Total 17 marks)

Q5. The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*. *Fusarium* is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A**. Give **two** functions of the air bubbles.

1. _____

_____

2. _____

_____ **(2)**

(b) Why is glucose added to the fermenter?

_____

_____

(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

_____

(1)

(d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

(i) Why is this important?

_____

_____

(1)

(ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

_____

_____

(1)

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement. Remember to include a conclusion in your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q6. One factor that may affect body mass is *metabolic rate*.

(a) (i) What is meant by *metabolic rate* ?

_____

_____

(1)

(ii) Metabolic rate is affected by the amount of activity a person does.

Give **two** other factors that may affect a person's metabolic rate.

1. _____

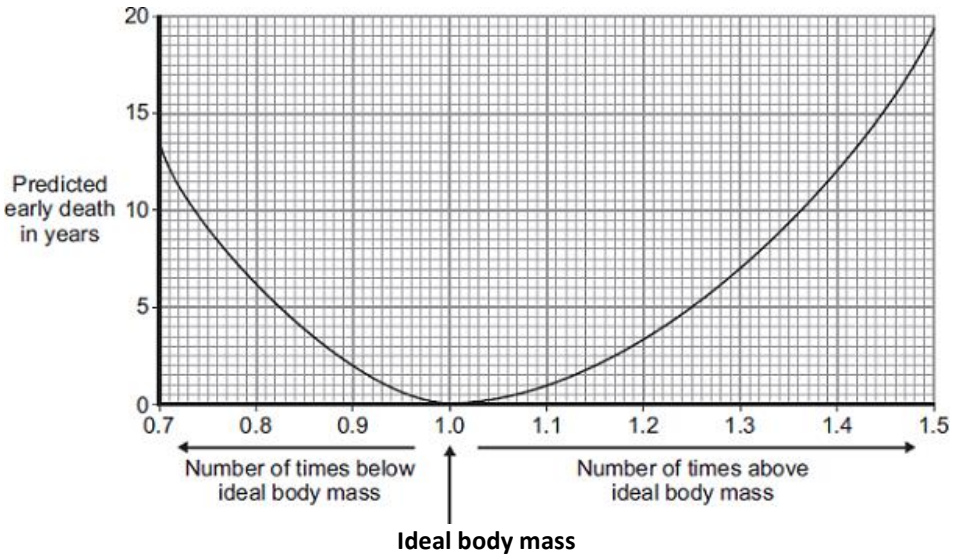
2. _____

(2)

(b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass.

Scientists have calculated the effect of body mass on predicted early death.

The graph shows the results of the scientists' calculations.



The number of times above or below ideal body mass is given by the equation:

$$\frac{\text{Actual body mass}}{\text{Ideal body mass}}$$

In the UK the mean age of death for women is 82.

A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg.

(i) Use the information from the graph to predict the age of this woman when she dies.

_____

Age at death = _____ years **(2)**

(ii) The woman could live longer by changing her lifestyle.

Give **two** changes she should make.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Q7. (a) Complete the equation for photosynthesis.

_____ + water $\xrightarrow{\text{light energy}}$ _____ + _____

(3)

(b) The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____ **(5)**

(Total 8 marks)

Q8. **Figure 1** shows an athlete running on a treadmill.

Figure 1

After running for several minutes, the athlete's leg muscles began to ache. This ache was caused by a high concentration of lactic acid in the muscles.

(a) The equation shows how lactic acid is made.

glucose $\longrightarrow$ lactic acid (+ energy)

Name the process that makes lactic acid in the athlete's muscles.

_____

(1)

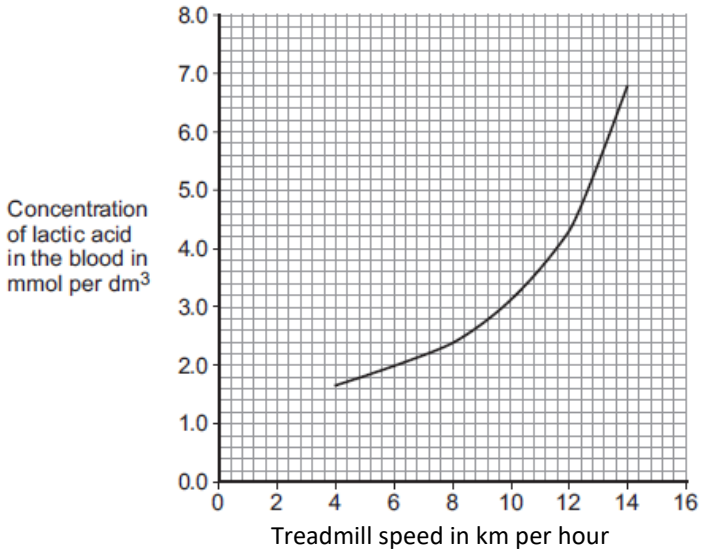
(b) Scientists investigated the production of lactic acid by an athlete running at different speeds.

In the investigation:

- the athlete ran on the treadmill at 4 km per hour
- the scientists measured the concentration of lactic acid in the athlete's blood after 2 minutes of running.

The investigation was repeated for different running speeds. **Figure 2** shows the scientists' results.

Figure 2



(i) How much more lactic acid was there in the athlete's blood when he ran at 14 km per hour than when he ran at 8 km per hour?

_____

_____

_____

Answer = _____ mmol per dm^3

(2)

(ii) Why is more lactic acid made in the muscles when running at 14 km per hour than when running at 8 km per hour?

_____

_____

_____

_____

_____

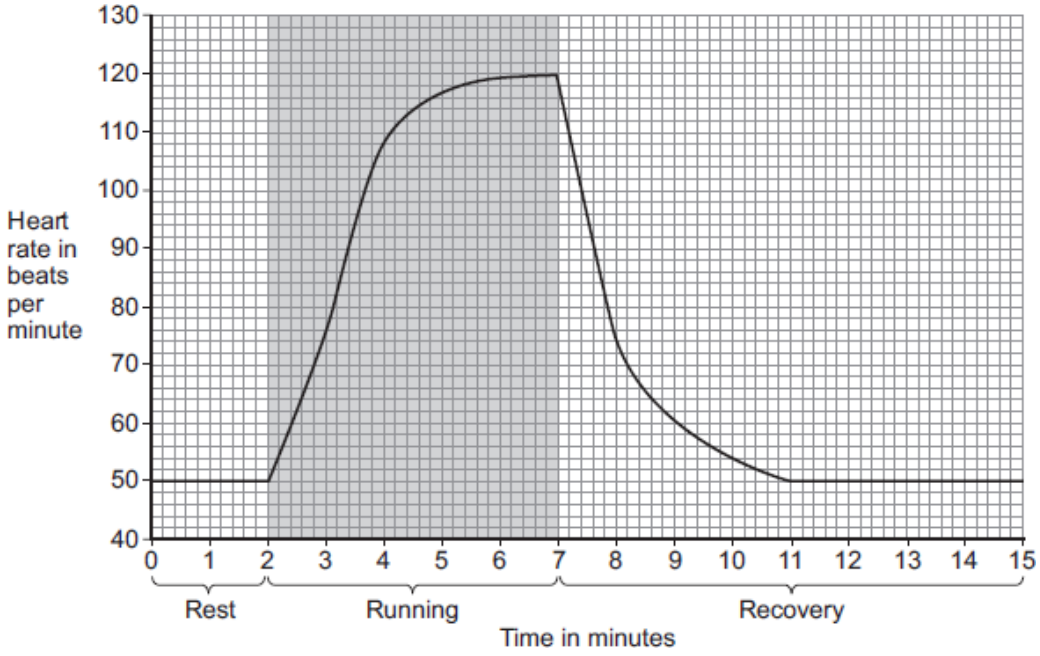
_____

(3)

(Total 6 marks)

Q9. A student ran on a treadmill for 5 minutes.The speed of the treadmill was set at 12 km per hour.

The graph below shows the effect of the run on the student's heart rate.



(a) (i) What was the student's heart rate at rest?

_____ beats per minute

(1)

(ii) After the end of the run, how long did it take for the student's heart rate to return to the resting heart rate?

_____ minutes

(1)

(b) During the run, the student's muscles needed larger amounts of some substances than they needed at rest.

(i) Which **two** of the following substances were needed in larger amounts during the run?

Tick (✓) **two** boxes.

carbon dioxide ☐

glucose ☐

lactic acid ☐

oxygen ☐

protein ☐

(2)

(ii) Why are the two substances you chose in part **(b)(i)** needed in larger amounts during the run?

Tick (✓) **one** box.

To help make more muscle fibres ☐

To release more energy ☐

To help the muscles to cool down ☐

(1)

(c) After exercise, a fit person recovers faster than an unfit person.

Let the student's heart rate at the end of exercise = **a**.

Let the student's heart rate after 2 minutes of recovery = **b**.

The table below shows how the difference between **a** and **b**, (**a** − **b**), is related to a person's level of fitness.

(a – b)	**Level of fitness**
< 22	Unfit
22 to 52	Normal fitness
53 to 58	Fit
59 to 65	Very fit
> 65	Top athlete

What is the student's level of fitness?

Use information from the graph and the table.

a = _____ beats per minute

b = _____ beats per minute

(**a – b**) = _____ beats per minute

Level of fitness = _____

(3)

(d) The student repeated the run with the treadmill set at 16 km per hour.

The student's heart rate took 3 minutes longer to return to the normal resting rate than when running at 12 km per hour.

Give reasons why it took longer to recover after running faster.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

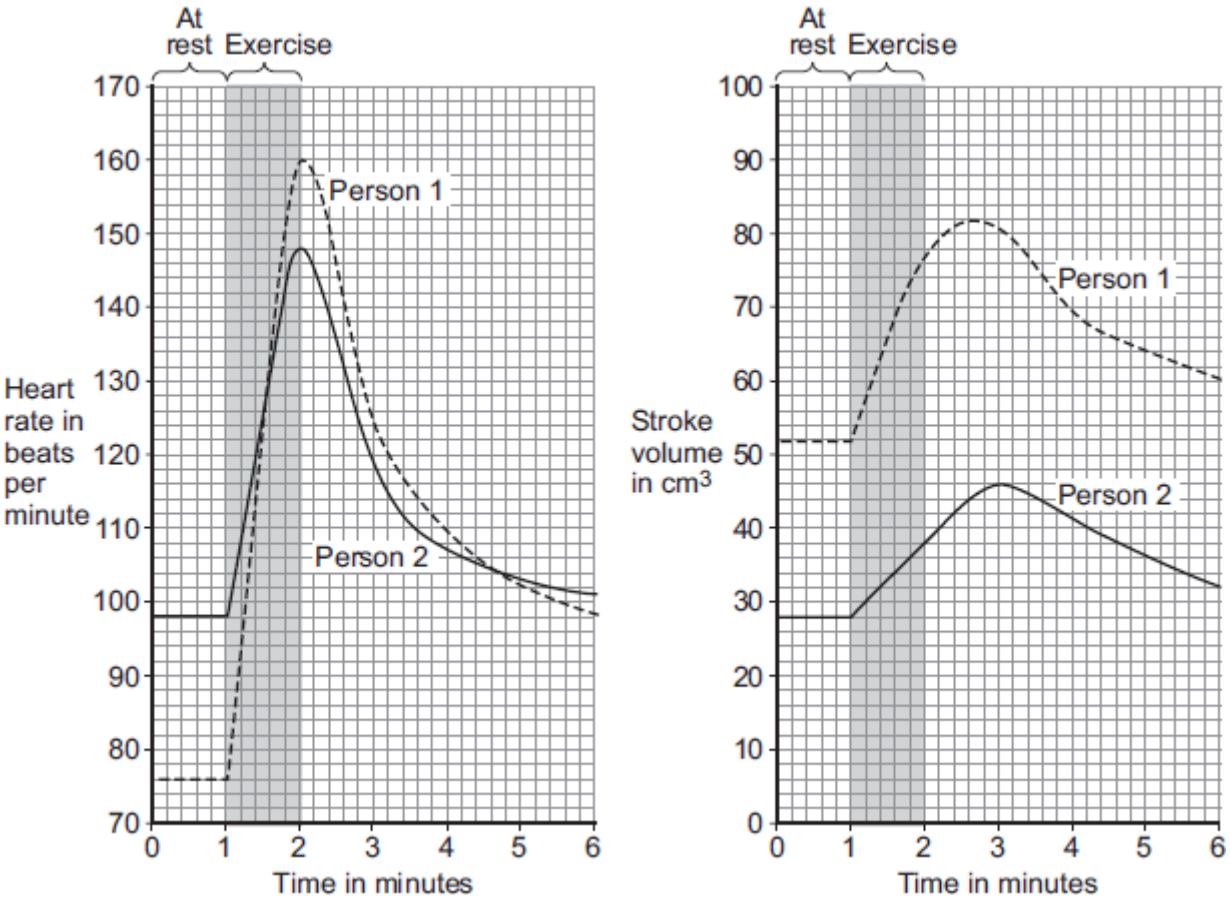
(Total 12 marks)

Q10. During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute.The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

The graph below shows the scientists' results.



(a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

Cardiac output = Heart rate × Stroke volume

At the end of the exercise, **Person 1**'s cardiac output = 160 × 77 = 12 320 cm^3 per minute.

Use information from **Figure above** to complete the following calculation of **Person 2**'s cardiac output at the end of the exercise.

At the end of the exercise:

Person 2's heart rate = _____ beats per minute

Person 2's stroke volume = _____ cm^3

Person 2's cardiac output = _____ cm^3 per minute

(3)

(b) **Person 2** had a much lower cardiac output than **Person 1.**

(i) Use information from **Figure above** to suggest the **main** reason for the lower cardiac output of **Person 2**.

_____

_____

(1)

(ii) **Person 1** was able to run much faster than **Person 2**.

Use information from **Figure above** and your own knowledge to explain why.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 9 marks)

Q11. Photosynthesis uses carbon dioxide to make glucose.

(a) (i) Complete the equation for photosynthesis.

carbon dioxide + _____ $\xrightarrow{\text{energy}}$ glucose + _____

(2)

(ii) What type of energy does a plant use in photosynthesis?

_____

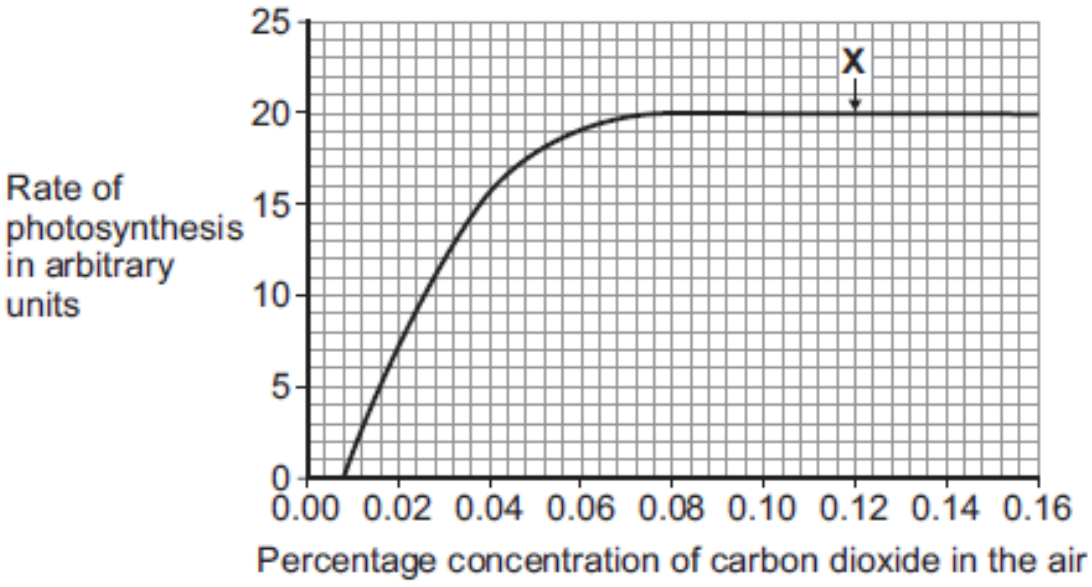
(1)

(iii) Which part of a plant cell absorbs the energy needed for photosynthesis?

_____

(1)

(b) The graph shows the effect of the concentration of carbon dioxide on the rate of photosynthesis in tomato plants at 20 °C.



(i) What is the maximum rate of photosynthesis of the tomato plants shown in the graph?

_____ arbitrary units

(1)

(ii) At point **X**, carbon dioxide is **not** a limiting factor of photosynthesis.

Suggest **one** factor that is limiting the rate of photosynthesis at point **X**.

_____

(1)

(c) A farmer plans to grow tomatoes in a large greenhouse.

The concentration of carbon dioxide in the atmosphere is 0.04%. The farmer adds carbon dioxide to the greenhouse so that its concentration is 0.08%.

(i) Why does the farmer use 0.08% carbon dioxide?

Tick (✓) **one** box.

To increase the rate of growth of the tomato plants ☐

To increase the rate of respiration of the tomato plants ☐

To increase water uptake by the tomato plants ☐

(1)

(ii) Why does the farmer **not** use a concentration of carbon dioxide higher than 0.08%?

Tick (✓) **two** boxes.

Because it would cost more money than using 0.08% ☐

Because it would decrease the temperature of the greenhouse ☐

Because it would not increase the rate of photosynthesis of the tomato plants any further ☐

Because it would increase water loss from the tomato plants ☐

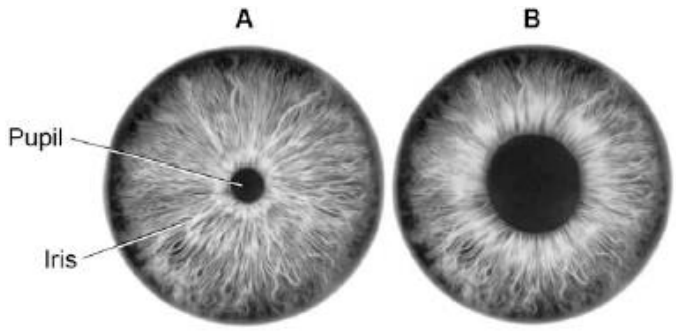
(2)

(Total 9 marks)

5.Homeostatsis & Response Mastery Booklet (Biology Paper 2)

Q1. **Figure 1** shows a reflex in the iris of the human eye in response to changes in light levels.

Figure 1



@ Gandee Vasan/Stone/Getty Images

(a) Describe the changes in the pupil and iris going from **A** to **B** in **Figure 1**.

Explain how these changes occur.

Refer to the changes in light level in your answer.

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Some people wear glasses to improve their vision.

Figure 2 shows light entering the eye in a person with blurred vision.

Figure 3 shows how this condition is corrected with glasses.

Figure 2

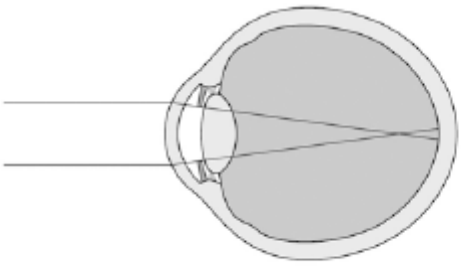
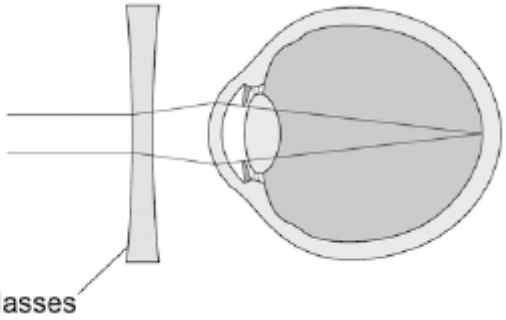


Figure 3



Compare **Figure 2** and **Figure 3**.

Explain how the blurred vision is corrected.

_____

_____

_____

_____

_____

_____

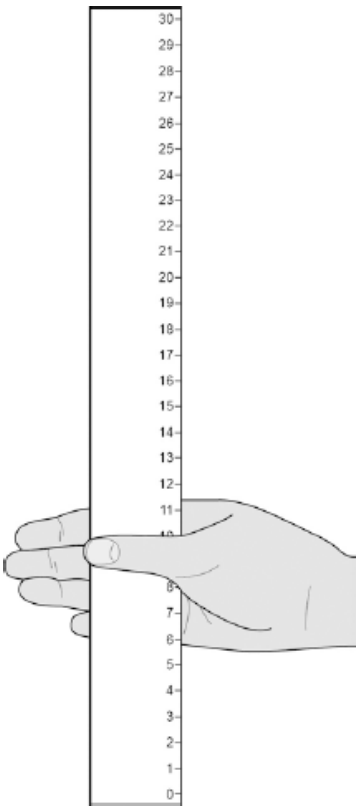
(2)

(Total 6 marks)

Q2. Two students investigated reflex action times.

This is the method used.

1. Student **A** sits with her elbow resting on the edge of a table.
2. Student **B** holds a ruler with the bottom of the ruler level with the thumb of Student **A**.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler and records the distance, as shown in the diagram below.
5. Steps **1** to **4** were then repeated.



(a) Suggest **two** ways the students could improve the method to make sure the test would give valid results.

1. _____

_____

2. _____

_____

(2)

(b) The table below shows Student **A**'s results.

Test Number	Distance ruler dropped in mm
1	117
2	120
3	115
4	106
5	123
6	125
7	106

What is the **median** result?

Tick **one** box.

106 ☐

115 ☐

116 ☐

117 ☐

123 ☐

(1)

(c) The mean distance the ruler was dropped is 116 mm.

Calculate the mean reaction time.

Use the equation:

reaction time in s = $\sqrt{\frac{\text{mean drop distance in cm}}{490}}$

Give your answer to 3 significant figures

_____

_____

Mean reaction time = _____ s

(3)

(d) The students then measured Student **A**'s reaction time using a computer program.

This is the method used.

1. The computer shows a red box at the start.

2. As soon as the box turns green the student has to press a key on the keyboard as fast as possible.

3. The test is repeated five times and a mean reaction time is displayed.

Student **A**'s mean reaction time was 110 ms.

Using a computer program to measure reaction times is likely to be more valid than the method using a dropped ruler.

Give **two** reasons why.

1. _____

_____

2. _____

_____ **(2)**

(e) A woman has a head injury.

Her symptoms include:

- finding it difficult to name familiar objects
- not being able to remember recent events.

Suggest which part of her brain has been damaged.

_____

(1)

(f) A man has a head injury.

He staggers and sways as he walks.

Suggest which part of his brain has been damaged.

_____

(1)

(Total 10 marks)

Q3. Two students investigated reflex action times.

This is the method used.

1. Student **A** sits with his elbow resting on the edge of a table.
2. Student **B** holds a ruler with the bottom of the ruler level with the thumb of Student **A**.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler and records the distance.
5. Steps **1** to **4** are then repeated.

The same method was also used with Student **A** dropping the ruler and Student **B** catching the ruler.

(a) Give **two** variables the students controlled in their investigation.

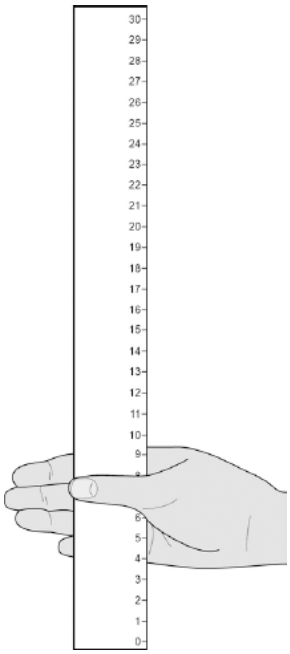
1. _____

2. _____

(2)

(b) **Figure 1** shows one of the results for the Student **A**.

Figure 1



What is the reading shown in **Figure 1**? Reading on ruler = _____ cm

(1)

(c) **Table 1** shows the students' results.

Table 1

Test number	Distance ruler dropped in cm	
	Student A	**Student B**
1	9	12
2	2	13
3	6	13
4	7	9
5	7	8
Mean	**7**	**X**

Circle the anomalous result in **Table 1** for Student **A**.

(1)

(d) What is the **median** result for Student **B**?

Tick **one** box.

8 ☐

11 ☐

12 ☐

13 ☐

(1)

(e) Calculate the value of **X** in **Table 1**.

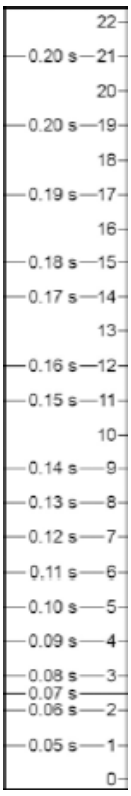
_____

Mean distance ruler dropped = _____ cm

(1)

(f) **Figure 2** shows the scale used to convert distance of the ruler drop to reaction time.

Figure 2



Calculate how much faster the reaction time of Student **A** was compared to Student **B**.

Use **Figure 2** and **Table 1**.

_____

Answer = _____ s

(2)

(g) What improvement could the students make to the method so the results are more valid?

Tick **one** box.

Use alternate hands when catching the ruler ☐

Carry out more repeats ☐

Use a longer ruler for catching ☐

Use more than two students to collect results ☐

(1)

(h) Student **A** carried out a second investigation to see the effect of caffeine on the reflex action.

Table 2 shows his results.

Table 2

Test number	Distance ruler dropped in cm	
	Without caffeine	**With caffeine**
1	9	5
2	6	5
3	9	4
4	6	7
5	10	4
Mean	**8**	**5**

Give **one** conclusion about the effect of caffeine on reflex actions.

_____

_____

(1)

(Total 10 marks)

Q4. Homeostasis controls the internal conditions of the body.

(a) Explain how blood glucose levels are controlled in the body of someone who does **not** have diabetes.

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Compare how each type of diabetes is caused.

Suggest how each type of diabetes can be treated.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Look at the table below.

Population of UK in 2015	6.5×10^7
Number of people diagnosed with diabetes	3.45×10^6
Estimated number of people with undiagnosed diabetes	5.49×10^5

Calculate the percentage (%) of the UK population estimated to have diabetes.

You should include both diagnosed and undiagnosed people in your calculation.

Give your answer to 2 significant figures.

_____

_____

_____

_____

_____

Estimated percentage of population with diabetes = ___ %

(3)

(d) A urine test can be used to check for the presence of glucose in the urine.

Diabetes can also be diagnosed with a blood test to measure the concentration of blood glucose.

Suggest why a blood test is more reliable than a urine test.

_____

_____

(1)

(e) A blood test called the glucose tolerance test checks how well the body processes glucose.

Concentrations of glucose in the blood are measured before and after drinking a glucose drink.

Patients are not allowed to eat food for 8 hours before the glucose tolerance test.

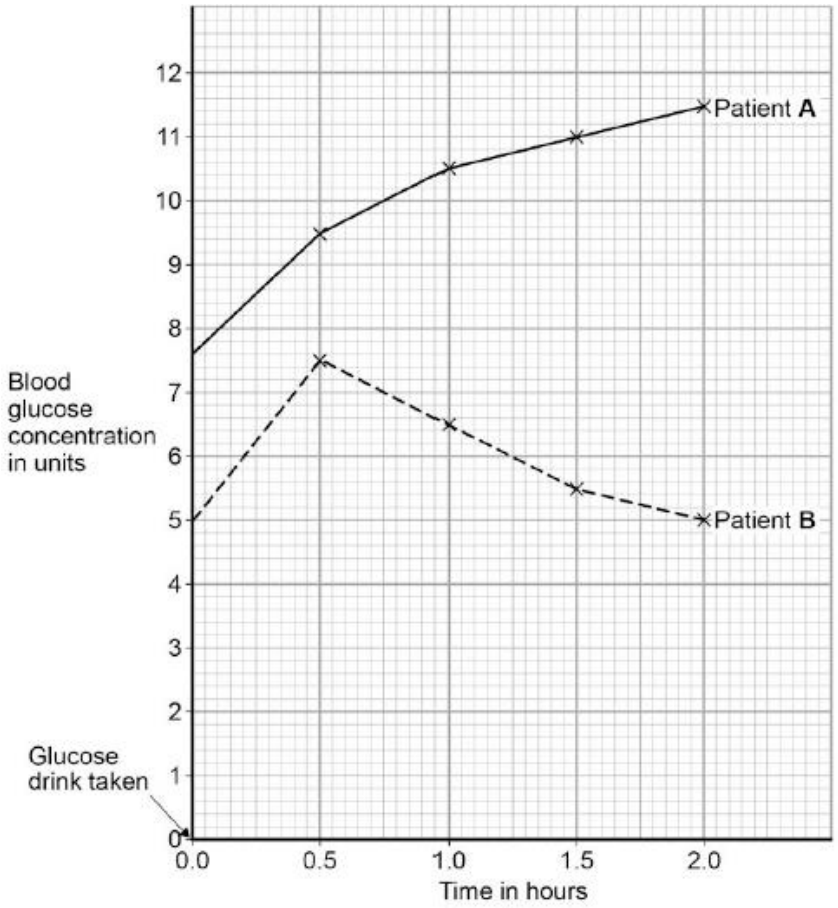
Suggest why patients are **not** allowed to eat for 8 hours before the test.

_____

_____

(1)

(f) The diagram below shows the results of a glucose tolerance test for two patients, **A** and **B**.



Which patient has diabetes?

Justify your answer.

Patient _____

Justification _____

_____

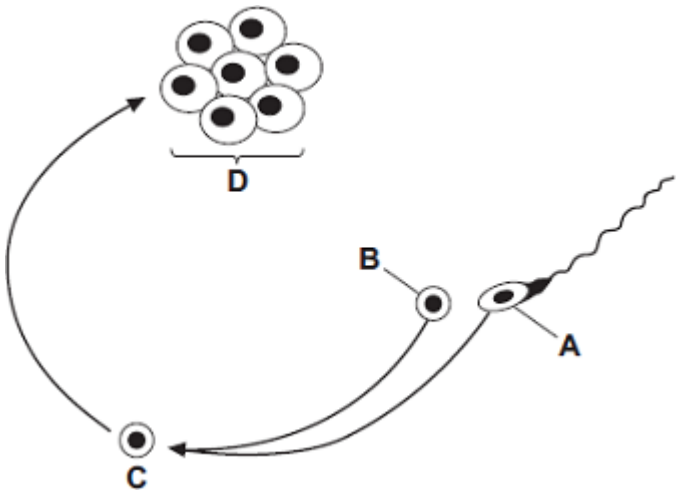
_____

_____

(2)

(Total 15 marks)

Q5. The diagram shows some of the stages in IVF (in vitro fertilisation).



(a) Use words from the box to name structures **A**, **B**, **C** and **D**.

egg	**embryo**	**fertilised egg**	**ovary**	**sperm**

Structure **A** _____

Structure **B** _____

Structure **C** _____

Structure **D** _____

(4)

(b) What do doctors do next with structure **D**?

_____

_____

_____

_____

(2)

(c) The table gives statistics for an IVF clinic.

	Age of women treated			
	Below 35 years	**35 – 37 years**	**38 – 39 years**	**40 – 42 years**
Number of women treated	414	207	106	53
Number of women who produced one baby	90	43	17	1
Number of women who produced twins	24	8	4	1
Number of women who produced triplets	1	0	0	0

(i) About what proportion of the treated women aged 35 – 37 years produced one or more babies?

Draw a ring around your answer.

one quarter **one third** **half**

(1)

(ii) This clinic does **not** give IVF treatment to women over 42 years of age.

Use data from the table to explain why.

_____

_____

_____

_____

(2)

(iii) The committee which regulates IVF treatment now advises that only one embryo is used in each treatment.

Suggest **one** reason for this.

_____

_____

(1)

(Total 10 marks)

Q6.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The human body is kept at a constant internal temperature of about 37 °C.

Body temperature is monitored and controlled by the thermoregulatory centre in the brain.

Describe what happens in the body to keep the body temperature constant.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

_____

_____

_____

_____

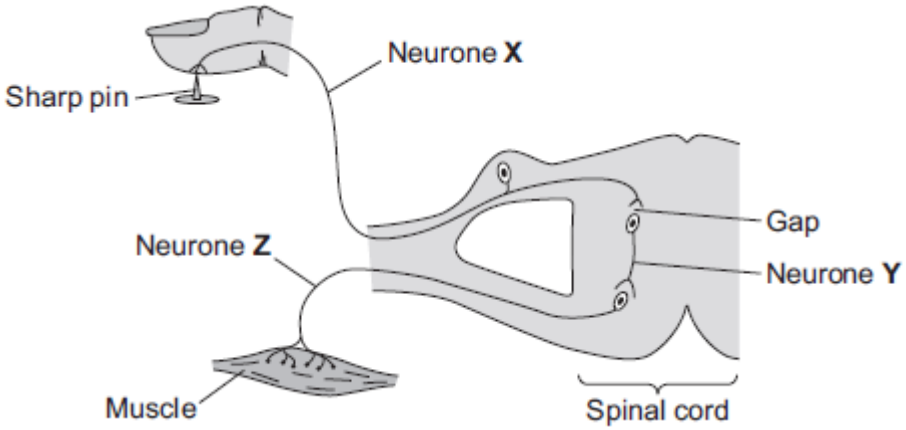
_____

_____

_____

(Total 6 marks)

Q7. The diagram below shows the pathway for a simple reflex action.



(a) What type of neurone is neurone **X**?

Draw a ring around the correct answer.

motor neurone **relay neurone** **sensory neurone**

(1)

(b) There is a gap between neurone **X** and neurone **Y**.

(i) What word is used to describe a gap between two neurones?

Draw a ring around the correct answer.

effector **receptor** **synapse**

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

Information passes across the gap as

a chemical.
an electrical impulse.
pressure.

(1)

(c) Describe what happens to the muscle when it receives an impulse from neurone **Z**. How does this reflex action help the body?

What happens to the muscle _____

_____

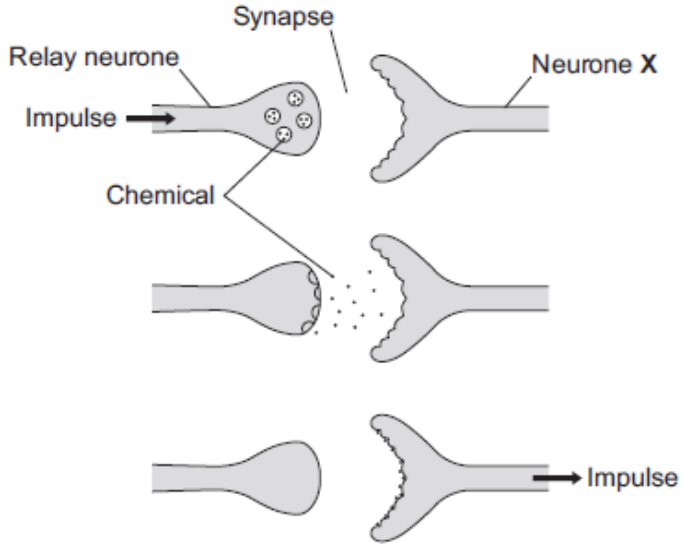
How this helps the body _____

_____

(2)

(Total 5 marks)

Q8. The diagram below shows how a nerve impulse passing along a relay neurone causes an impulse to be sent along another type of neurone, neurone **X**.



(a) What type of neurone is neurone **X**?

_____

(1)

(b) Describe how information passes from the relay neurone to neurone **X**. Use the diagram to help you.

_____

_____

_____

_____

_____

_____

(3)

(c) Scientists investigated the effect of two toxins on the way in which information passes across synapses. The table below shows the results.

Toxin	**Effect at the synapse**
Curare	Decreases the effect of the chemical on neurone **X**
Strychnine	Increases the amount of the chemical made in the relay neurone

Describe the effect of each of the toxins on the response by muscles.

Curare _____

_____

_____

Strychnine _____

_____

_____

(2)

(Total 6 marks)

Q9. This question is about the nervous system.

(a) Describe the difference between the function of a receptor and the function of an effector.

In your answer you should give **one** example of a receptor and **one** example of an effector.

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Synapses are important in the nervous system.

(i) What is a synapse?

_____

_____

_____

_____

(2)

(ii) Describe how information passes across a synapse.

_____

_____

_____

_____

(2)

(c) Reflexes may be co-ordinated by the brain or by the spinal cord.

(i) The reflexes from sense organs in the head are co-ordinated by the brain.

Name a sense organ involved in a reflex co-ordinated by the spinal cord.

_____

(1)

(ii) The table shows information about reflexes co-ordinated by the brain and reflexes co-ordinated by the spinal cord.

Organ co-ordinating the reflex	Mean length of neurones involved in cm	Mean time taken for reflex in milliseconds	Mean speed of impulse in cm per millisecond
Brain	12	4	3
Spinal cord	80	50	

Calculate the mean speed of the impulse for the reflex co-ordinated by the spinal cord.

_____

_____

Mean speed = _____ cm per millisecond

(1)

(iii) In reflexes co-ordinated by the brain there are **no** relay neurones.

Suggest why there is a difference in the mean speed of the impulse for the two reflexes.

_____

_____

_____

(2)

(Total 12 marks)

Q10.

Endocrine glands produce hormones.

(a) Hyperthyroidism is caused by an overactive thyroid gland.

Suggest what would happen in the body of a person with hyperthyroidism.

_____

_____

_____

_____

_____

(3)

(b) Describe the roles of FSH and LH in the menstrual cycle.

_____

_____

(2)

(c) The combined pill is a contraceptive that contains progesterone **and** oestrogen.

The 'mini-pill':

- is a contraceptive that **only contains** the progesterone hormone
- has to be taken at the same time each day to prevent pregnancy.

The success rate of the mini-pill in preventing pregnancy is lower than that of the combined pill.

Explain why missing a dose of the mini-pill would reduce the success rate of the mini-pill.

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

Q11. Humans use the nervous system to react to changes in the environment.

(a) (i) Which word means a change in the environment?

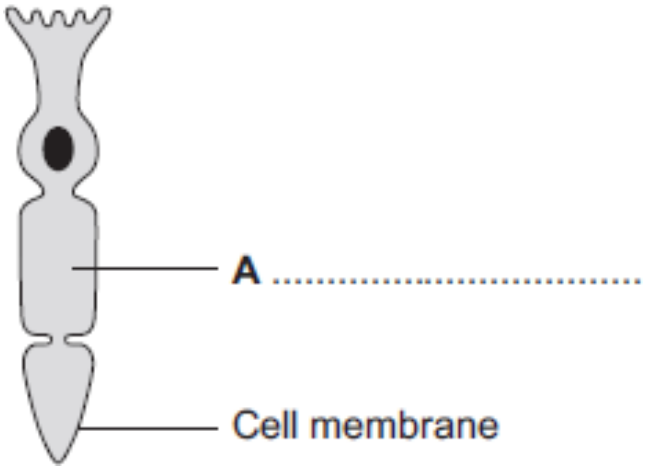
Draw a ring around the correct answer.

neurone **reflex** **stimulus**

(1)

(ii) **Figure 1** shows a light receptor cell.

Figure 1



Use the correct answer from the box to label part **A** on **Figure 1**.

chloroplast	**cytoplasm**	**vacuole**

(1)

(b) **Figure 2** shows a boy riding a bicycle on a sunny day.

Figure 2

(i) Receptors in the boy's body detect changes in the environment.

Complete the table to show which organ of the body contains the receptors for each change in the environment.

Change in the environment	**Organ that contains the receptors**
Sound of traffic from behind him	
Flashing blue lights of a police car	
Cooler air temperature in the shadows	

(3)

(ii) The boy's response to danger is to pull on the bicycle brakes.

Which type of effector causes this response?

Tick (✓) **one** box.

A gland ☐

A muscle ☐

A synapse ☐

(1)

(Total 6 marks)

Q12. This question is about hormones.

(a) (i) Hormones carry messages.

What type of messenger is a hormone?

Draw a ring around the correct answer.

chemical **electrical** **environmental**

(1)

(ii) Which part of the brain secretes hormones?

Draw a ring around the correct answer.

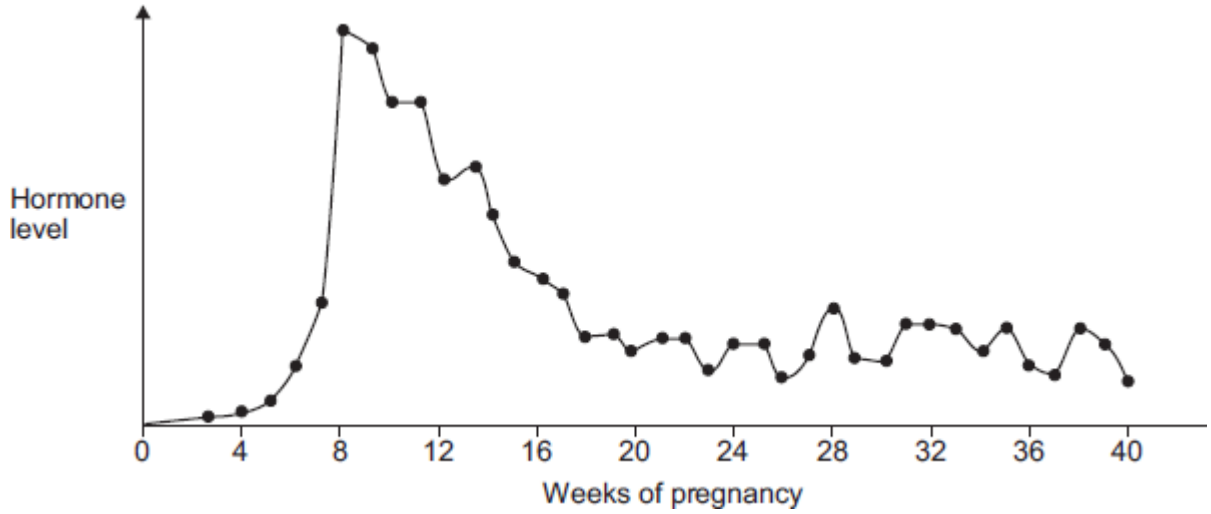
cerebellum **medulla** **pituitary gland**

(1)

(b) **Figure 1** shows the level of a pregnancy hormone over a 40-week pregnancy.

This hormone can be detected in a pregnancy test.

Figure 1



A woman takes a pregnancy test.

In which week of pregnancy is the test most likely to give a positive result?

Use information from **Figure 1**.

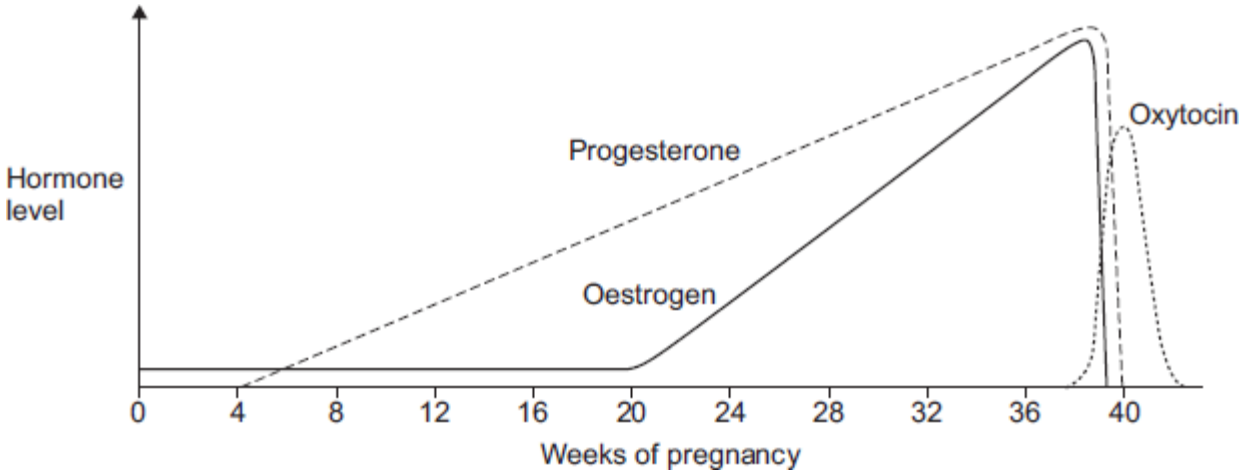
Write the correct answer in the box.

(1)

(c) **Figure 2** shows the levels of three other hormones during pregnancy.

The baby is usually born at about 40 weeks.

Figure 2



Adaptation by kind permission of Biozone International

(i) Describe the patterns in the levels of oestrogen and progesterone from 0 to 36 weeks.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(ii) Which hormone is likely to stimulate contractions of the uterus (womb) when the baby is born?

Use information from **Figure 2** to give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q13. Hormones are involved in controlling the menstrual cycle and fertility.

(a) (i) Use the correct answer from the box to complete the sentence.

auxin	**follicle stimulating hormone (FSH)**	**thalidomide**

A hormone produced by the pituitary gland is _____

(1)

(ii) Use the correct answer from the box to complete the sentence.

luteinising hormone (LH)	**oestrogen**	**statin**

A hormone produced by the ovaries is _____

(1)

(b) (i) Why are fertility drugs given to some women?

_____

(1)

(ii) A doctor injects fertility drugs into a woman. After the injection, the hormones travel to the woman's ovaries.

How do the hormones travel to the ovaries?

Draw a ring around the correct answer.

through the bloodstream **through the neurones** **through the skin**

(1)

(c) Which **two** hormones are used in contraceptive pills?

Tick (✔) **two** boxes.

FSH	☐	oestrogen	☐
LH	☐	progesterone	☐

(2)

(Total 6 marks)

Q14.

(a) Which organ of the human body produces egg cells?

Draw a ring around the correct answer.

liver **ovary** **testis**

(1)

(b) An egg joins with a sperm and develops into an embryo.

How many chromosomes are there in each cell of a human embryo?

Draw a ring around the correct answer.

23 **46** **48** **(1)**

(c) Some women find it difficult to have a baby. A doctor may suggest that these women should use In Vitro Fertilisation (IVF) to help them have a baby.

Table 1 shows how successful IVF was for women of different ages at one clinic.

Table 1

Age of women in years	Percentage of women who had a baby
<35	35
35–37	31
38–39	25
40–42	32
43–44	7
>44	0

(i) A student thought that the result for women aged 40–42 was anomalous.

Suggest why the student thought this result was anomalous.

_____

_____

(1)

(ii) Describe the general trend in the results in **Table 1**.

You should ignore the anomalous result.

_____

_____

(1)

(d) Some babies are born with a faulty chromosome.

Scientists investigated whether the chance of having a baby with a faulty chromosome is also related to the age of the woman.

Table 2 shows the scientists' results.

Table 2

Age of women in years	Number of women per 1000 who had a baby with a faulty chromosome
25	2.0
30	2.6
35	6.1
40	19.6
45	66.0

(i) A 45-year-old woman is more likely than a 25-year-old woman to have a baby with a faulty chromosome.

How many times more likely?

_____

_____

Answer = _____ times

(2)

(ii) Suggest **two** reasons why many fertility clinics will **not** accept women over 40 years of age for IVF treatment.

Use information from **Table 1** and **Table 2** in your answer.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

6.Inheritance/Inheritance/Evolution Mastery Booklet (Biology Paper 2)

Q1.

Figure 1 shows an image of a small section of DNA.

Figure 2 shows the structure of a small section of DNA.

Figure 1

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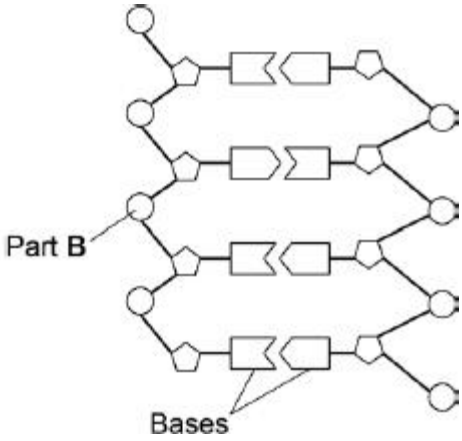
Figure 2



(a) What is Part **B**?

_____

_____

(1)

(b) In **Figure 1** the structure of DNA shows four different bases.

There are four different bases and they always pair up in the same pairs.

Which bases pair up together?

_____

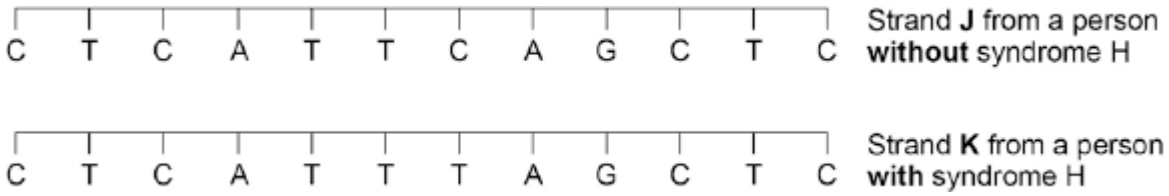
(1)

(c) Syndrome H is an inherited condition.

People with syndrome H do **not** produce the enzyme IDUA.

Figure 3 shows part of the gene coding for the enzyme IDUA.

Figure 3



Strand **K** shows a mutation in the DNA which has caused syndrome H.

The enzyme IDUA helps to break down a carbohydrate in the human body.

The enzyme IDUA produced from Strand **K** will not work.

Explain how the mutation could cause the enzyme **not** to work.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(d) A recessive allele causes syndrome H. A heterozygous woman and a homozygous recessive man want to have a child. Draw a Punnett square diagram to determine the probability of the child having syndrome H. Identify any children with syndrome H. Use the following symbols:

A = dominant allele **a** = recessive allele

Probability = _____ %

(5)

(Total 12 marks)

Q2. Polydactyly is an inherited condition caused by a dominant allele.

(a) The figure below shows the hand of a man with polydactyly. The man has an extra finger on each hand.

The man's mother also has polydactyly but his father does not.

© Ifness/iStock

(i) The man is **heterozygous** for polydactyly.

Explain how the information given above shows that the man is **heterozygous** for polydactyly.

_____

_____

_____

_____

_____

_____

(3)

(ii) The man marries a woman who does **not** have polydactyly.

What is the probability that their first child will have polydactyly?

_____

(1)

(b) The man has red hair. His sister has brown hair. Both of their parents have brown hair.

Brown hair is caused by the dominant allele, **B**. Red hair is caused by a recessive allele, **b**.

Complete the genetic diagram below to show how the man's parents were able to have some children with red hair and some with brown hair.

	Father	**Mother**
Parental phenotypes	_____	_____
Parental Genotypes	_____	_____
Gametes	_____ _____	_____ _____

Offspring genotypes: _____

Offspring phenotypes: _____

(5)

(Total 9 marks)

Q3. In humans, hair colour is an inherited characteristic.

Red hair is caused by a recessive allele.

(a) When does a recessive allele control the development of a characteristic?

Tick (✔) **one** box.

When the allele is present on only one of the chromosomes. ☐

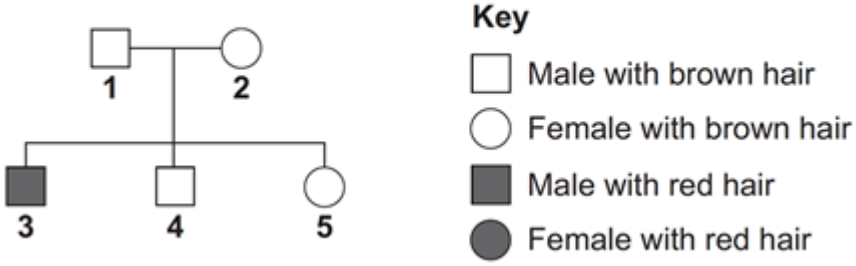
When the dominant allele is not present. ☐

When the allele is inherited from the female parent. ☐

(1)

(b) **Figure 1** shows the inheritance of hair colour in one family.

Figure 1



(i) Brown hair is caused by a dominant allele, **B**.

Red hair is caused by the recessive allele, **b**.

What combination of alleles does person **1** have?

Tick (✔) **one** box.

BB ☐

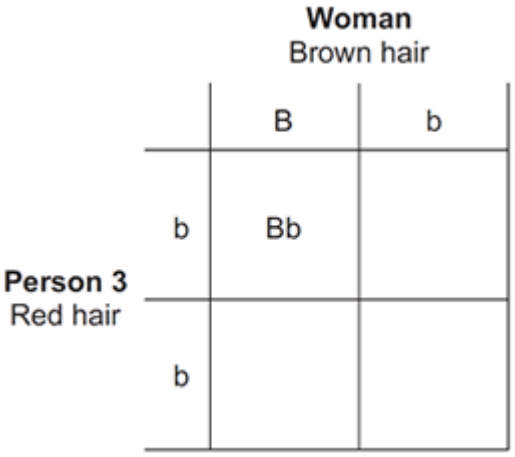
Bb ☐

bb ☐

(1)

(ii) Person **3** married a woman with brown hair. **Figure 2** shows how hair colour could be inherited by their children.

Figure 2



Complete **Figure 2** to show the combination of alleles that the children would inherit.
One has been done for you.

(2)

(iii) What is the probability that one of the children would have red hair?

Tick (✔) **one** box.

1 in 2 ☐

1 in 3 ☐

1 in 4 ☐

(1)

(Total 5 marks)

Q4. Our understanding of genetics and inheritance has improved due to the work of many scientists.

(a) Draw **one** line from each scientist to the description of their significant work.

Scientist	**Description of significant work**
	Carried out breeding experiments on pea plants.
Charles Darwin	
	Wrote 'On the origin of species'.
Alfred Russel Wallance	
	Worked on plant defence systems.
Gregor Mendel	
	Worked on warning colouration in animals.

(3)

(b) In the mid-20th century the structure of DNA was discovered.

What is a section of DNA which codes for one specific protein called?

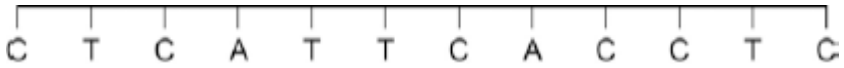
_____

(1)

(c) **Figure 1** shows one strand of DNA.

The strand has a sequence of bases (A, C, G and T).

Figure 1



How many amino acids does the strand of DNA in **Figure 1** code for?

Tick **one** box.

2 ☐

3 ☐

4 ☐

6 ☐

(1)

(d) Mutations of DNA cause some inherited disorders. One inherited disorder is cystic fibrosis (CF). A recessive allele causes CF.

Complete the genetic diagram in **Figure 2**.

- Identify any children with CF.
- Give the probability of any children having CF.

Each parent does not have CF.

The following symbols have been used:

D = dominant allele for **not** having CF **d** = recessive allele for having CF

Figure 2

		Mother	
		D	d
Father	D	DD	
	d		

Probability of a child with CF = _____

(3)

(e) What is the genotype of the mother shown in **Figure 2**?

Tick **one** box.

Heterozygous ☐

Homozygous dominant ☐

Homozygous recessive ☐

(1)

(Total 9 marks)

Q5. Humans reproduce sexually.

(a) Draw a ring around the correct answer to complete each sentence.

(i) At fertilisation | chromosomes / genes / gametes | join together.

(1)

(ii) At fertilisation a single cell forms. The cell has new pairs of | chromosomes. / nuclei. / gametes.

(1)

(b) A child inherits cystic fibrosis. The child's parents do **not** have cystic fibrosis.

(i) What does this information tell us about the cystic fibrosis allele?

Tick (✓) **one** box.

The allele is dominant. ☐

The allele is recessive. ☐

The allele is strong. ☐

(1)

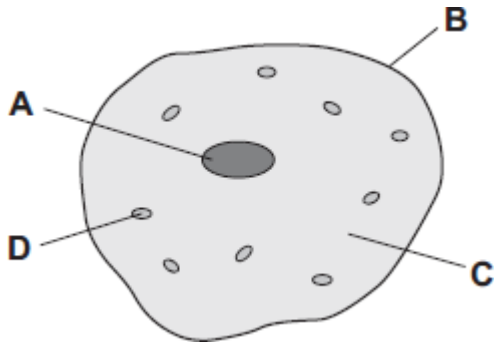
(ii) How many copies of the cystic fibrosis allele does the child have?

Draw a ring around your answer.

one **two** **four**

(1)

(c) The diagram shows a human body cell.



Which part of the cell, **A**, **B**, **C** or **D**:

(i) contains the allele for cystic fibrosis ☐

(1)

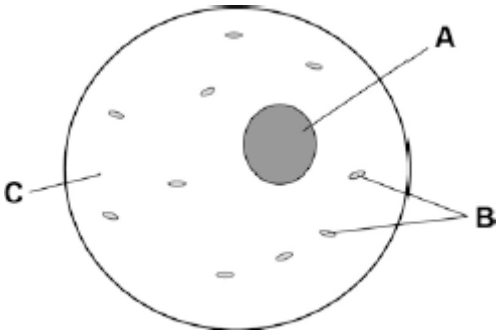
(ii) is affected by cystic fibrosis? ☐

(1)

(Total 6 marks)

Q6. **Figure 1** shows a human body cell.

Figure 1



(a) Which part in **Figure 1** contains chromosomes?

Tick **one** box.

A ☐ **B** ☐ **C** ☐

(1)

(b) Humans have pairs of chromosomes in their body cells.

Draw **one** line from each type of cell to the number of chromosomes it contains.

Type of cell	Number of Chromosomes
	10
Human body cell	23
	46
Sperm cell	60
	92

(2)

(c) Humans have two different sex chromosomes, **X** and **Y**.

Figure 2 shows the inheritance of sex in humans.

Figure 2

		Mother	
		X	X
Father	X	XX	XX
	Y	XY	XY

Circle a part of **Figure 2** that shows an egg cell.

(1)

(d) Give the genotype of male offspring.

_____

(1)

(e) A man and a woman have two sons. The woman is pregnant with a third child.

What is the chance that this child will also be a boy?

Tick **one** box.

0% ☐

25% ☐

50% ☐

100% ☐

(1)

(Total 6 marks)

Q7. (a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.
Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

_____

_____

(1)

(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

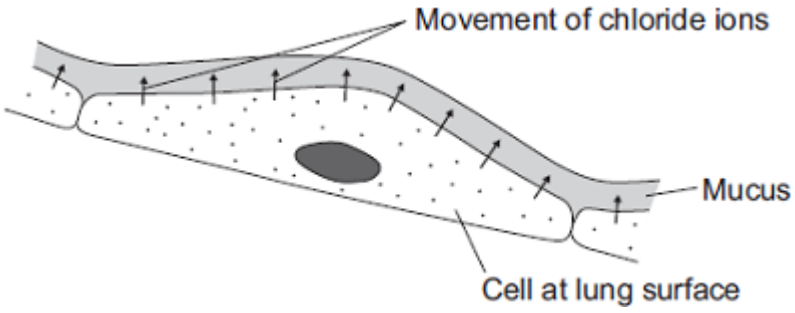
_____

_____

(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q8. When humans reproduce, chromosomes and genes are passed on to the next generation.

In each of the following questions, draw a ring around the correct answer to complete the sentence.

(a) A gene is a small section of

- cellulose.
- DNA.
- protein.

(1)

(b) The sex chromosomes in the human male are

- X and X.
- X and Y.
- Y and Y.

(1)

(c) (i) Most human body cells contain

- 23 chromosomes.
- 46 chromosomes.
- 92 chromosomes.

(1)

(ii) The number of chromosomes in a human gamete (sex cell)

is | the same number as / half the number / twice the number | in body cells.

(1)

(d) Gametes are produced by | fertilisation. / meiosis. / mitosis. |

(1)

(Total 5 marks)

Q9. DNA is the genetic material of human cells.

Figure 1 shows the structure of part of a DNA molecule.

Figure 1

(a) (i) Describe where DNA is found in a human cell.

_____

_____

_____

(2)

(ii) When a cell divides by mitosis the new cells are genetically identical.

What causes the cells to be genetically identical?

_____

_____

(1)

(b) Many genes have different forms called alleles.

(i) A person has polydactyly (extra fingers or toes). Polydactyly is caused by a dominant allele. What is the smallest number of copies of the dominant allele for polydactyly that could be found in a body cell of this person?

_____

(1)

(ii) Another person has cystic fibrosis. Cystic fibrosis (CF) is caused by a recessive allele. How many copies of the recessive CF allele are there in a body cell of this person?

_____

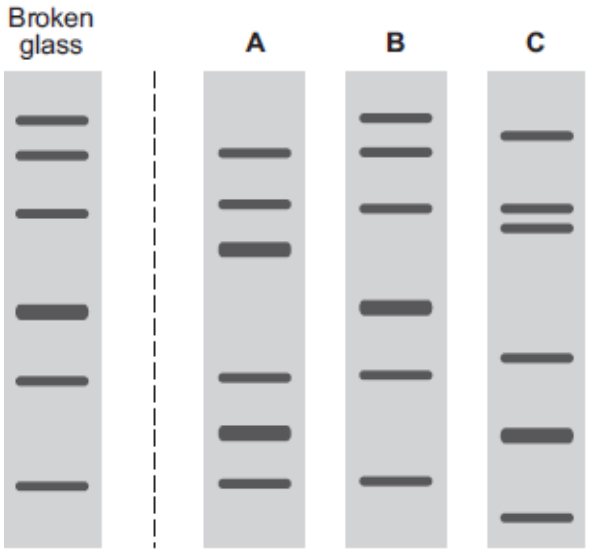
(1)

(c) A burglar broke into a house. The burglar cut his hand on some broken glass. Scientists extracted DNA from the blood on the broken glass.

The scientists analysed the DNA from the glass and DNA from three suspects, **A**, **B** and **C**. The scientists used a method called DNA fingerprinting.

Figure 2 shows the scientists' results.

Figure 2



Which suspect, **A**, **B** or **C**, is most likely to have been the burglar?

Tick (✓) **one** box.

A ☐

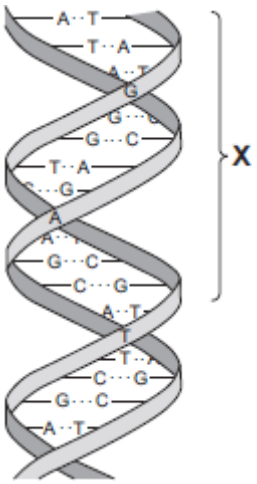
B ☐

C ☐

(1)

(Total 6 marks)

Q10. The diagram shows part of a DNA molecule.



(a) (i) In which part of an animal cell is DNA found?

_____

(1)

(ii) Complete the following sentence.

The letters **A**, **C**, **G** and **T** in the diagram represent four different compounds

called _____ .

(1)

(iii) One strand of the DNA, in the section labelled **X**, contains the following sequence of these compounds:

T A T G G G T C T T C G

How many amino acids would this section of the DNA code for? ☐

(1)

(iv) The section of DNA described in part **(a) (iii)** is a small part of a gene.

The sequence of compounds **A**, **C**, **G** and **T** in the gene is important.

Explain why.

_____

_____

_____

_____

(2)

(b) *Read the following information about genetic engineering.*

The caterpillar of the European Corn Borer moth feeds on the fruits of maize (sweet corn). There is a chemical called Bt-toxin which is poisonous to the corn borer caterpillar but not to humans.

Scientists carried out the following steps.

1. The Scientists made a bacterial plasmid to which they added two genes:
   - **Bt** gene, which coded for production of the Bt-toxin
   - **kan^r** gene, which coded for resistance to an antibiotic called kanamycin.

2. They used this plasmid to produce genetically modified bacteria which could invade plant cells.

3. They mixed these genetically modified bacteria with pieces cut from maize leaves.

4. They placed the pieces of maize leaf on agar jelly in a Petri dish. The agar jelly contained the antibiotic, kanamycin. The kanamycin killed most of the pieces of maize leaf, but a few survived.

5. They took some cells from the surviving pieces of maize leaf and grew them in tissue culture.

The result was maize plants that now contained the **Bt** gene, as well as the **kan^r** gene, in all of their cells.

(i) What is a **plasmid** (Step 1)?

_____

_____

_____

_____

(2)

(ii) Why did the scientists add **kanamycin** to the agar jelly (Step 4)?

_____

_____

_____

_____

(2)

(iii) The scientists grew each Bt-maize plant from a single cell which contained the **Bt** gene.

Explain why **all** the cells in the Bt-maize plant contained the **Bt** gene.

_____

_____

_____

_____

(2)

(iv) Kanamycin is an antibiotic.

Some scientists are concerned that the gene for kanamycin resistance has been put into maize.

Suggest why.

_____

_____

_____

_____

_____

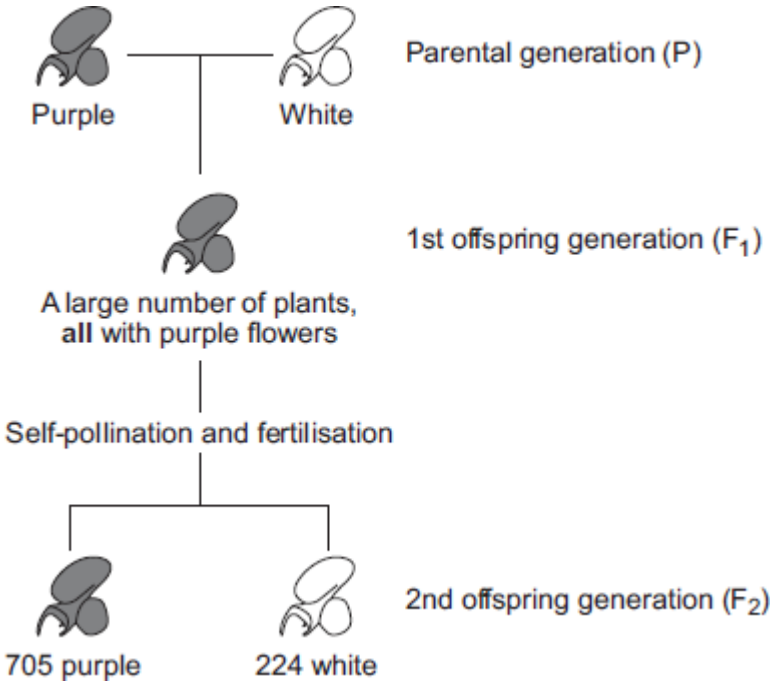
_____

(2)

(Total 13 marks)

Q11. In 1866, Gregor Mendel published the results of his investigations into inheritance in garden pea plants.

The diagram below shows the results Mendel obtained in one investigation with purple-flowered and white-flowered pea plants.



(a) (i) Calculate the ratio of purple-flowered plants to white-flowered plants in the F_2 generation.

Ratio of purple : white = _____

(1)

(ii) There was a total of 929 plants in the F_2 generation.

Mendel thought that the production of a large number of offspring plants improved the investigation.

Explain why.

_____

_____

_____

_____

(2)

(b) (i) Some of the plants in the diagram are homozygous for flower colour and some are heterozygous.

Complete the table to show whether each of the plants is homozygous or heterozygous. For each plant, tick (✓) **one** box.

	Homozygous	**Heterozygous**
Purple-flowered plant in the P generation		
White-flowered plant in the P generation		
Purple-flowered plant in the F_1 generation		

(2)

(ii) Draw a genetic diagram to show how self-pollination of the F_1 purple-flowered plants produced mainly purple-flowered offspring in the F_2 generation together with some white-flowered offspring.

Use the following symbols:

N = allele for purple flower colour
n = allele for white flower colour

(3)

(c) When Mendel published his work on genetics, other scientists at the time did not realise how important it was.

Suggest **two** reasons why.

1. _____

_____

2. _____

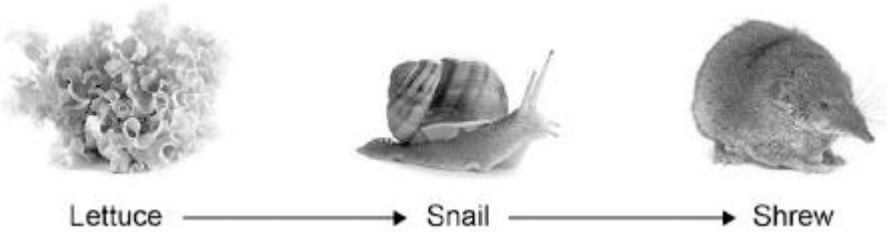
_____

(2)

(Total 10 marks)

7.Ecology Mastery Booklet (Biology Paper 2)

1 The diagram below shows a food chain in a garden.



(a) Name **one consumer** shown in the diagram above.

_____

(1)

(b) Name **one carnivore** shown in the diagram above.

_____

(1)

(c) A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

_____

_____

(1)

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community ☐

Ecosystem ☐

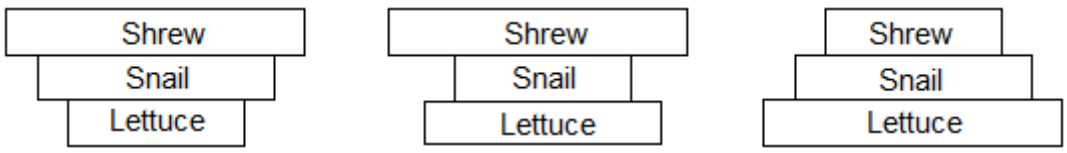
Population ☐

Territory ☐

(1)

(e) Which pyramid of biomass is correct for the food chain shown in the diagram above?

Tick **one** box.



(1)

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

Only 10% of this energy was transferred to the snails.

Calculate the energy transferred to the snails from the lettuces.

_____

Energy = _____ kJ

(1)

(g) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails.

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

(1)

(h) **Abiotic** factors can affect the food chain.

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

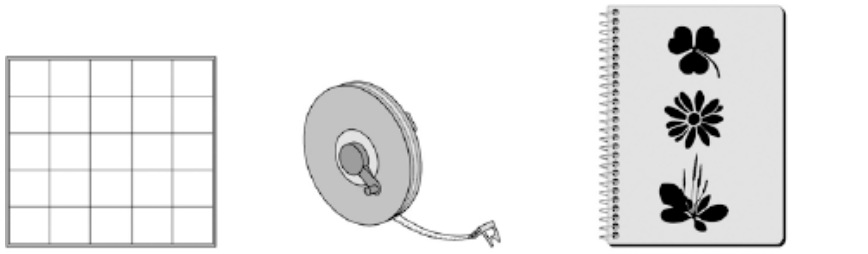
_____

(1)

(Total 8 marks)

Q2. A student was asked to estimate how many clover plants there are in the school field.

The image below shows the equipment used.



Not drawn to scale

This is the method used.

1. Throw a quadrat over your shoulder.
2. Count the number of clover plants inside the quadrat.
3. Repeat step **1** and step **2** four more times.
4. Estimate the number of clover plants in the whole field.

(a) What is the tape in the image above used for in this investigation?

_____

_____

(1)

(b) The teacher told the student that throwing the quadrat over his shoulder was **not** random.

The method could be improved to make sure the quadrats were placed randomly.

Suggest **one** change the student could make to ensure the quadrats were placed randomly.

_____

_____

(1)

(c) How could the student improve the investigation so that a valid estimate can be made?

Tick **two** boxes.

Weigh the clover plants	☐
Compare their results with another student's results	☐
Count the leaves of the clover plants	☐
Place more quadrats	☐
Place the quadrats in a line across the field	☐

(2)

(d) The table below shows the student's results.

Quadrat number	Number of clover plants counted
1	11
2	8
3	11
4	9
5	1
Total	40

The area of the school field was 500 m^2.

The quadrat used in the table above had an area of 0.25 m^2.

Calculate the estimated number of clover plants in the school field.

_____

_____

Estimated number of clover plants = _____

(3)

(e) What was the mode for the results in the table above?

Tick **one** box.

1 ☐

8 ☐

11 ☐

40 ☐

(1)

(f) Suggest which quadrat could have been placed under the shade of a large tree.

Give **one** reason for your answer.

Quadrat number _____

Reason _____

_____

(1)

(Total 9 marks)

Q3. A student plans an investigation using mould.

(a) Mould spores are hazardous.

Give **one** safety precaution the student should take when doing this investigation.

_____

_____

(1)

(b) A student made the following hypothesis about the growth of mould:

'The higher the temperature, the faster the growth of mould'.

The student planned to measure the amount of mould growing on bread.

The student used the following materials and equipment:

- slices of bread
- sealable plastic bags
- a knife
- a chopping board
- mould spores.

Describe how the materials and equipment could be used to test the hypothesis.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

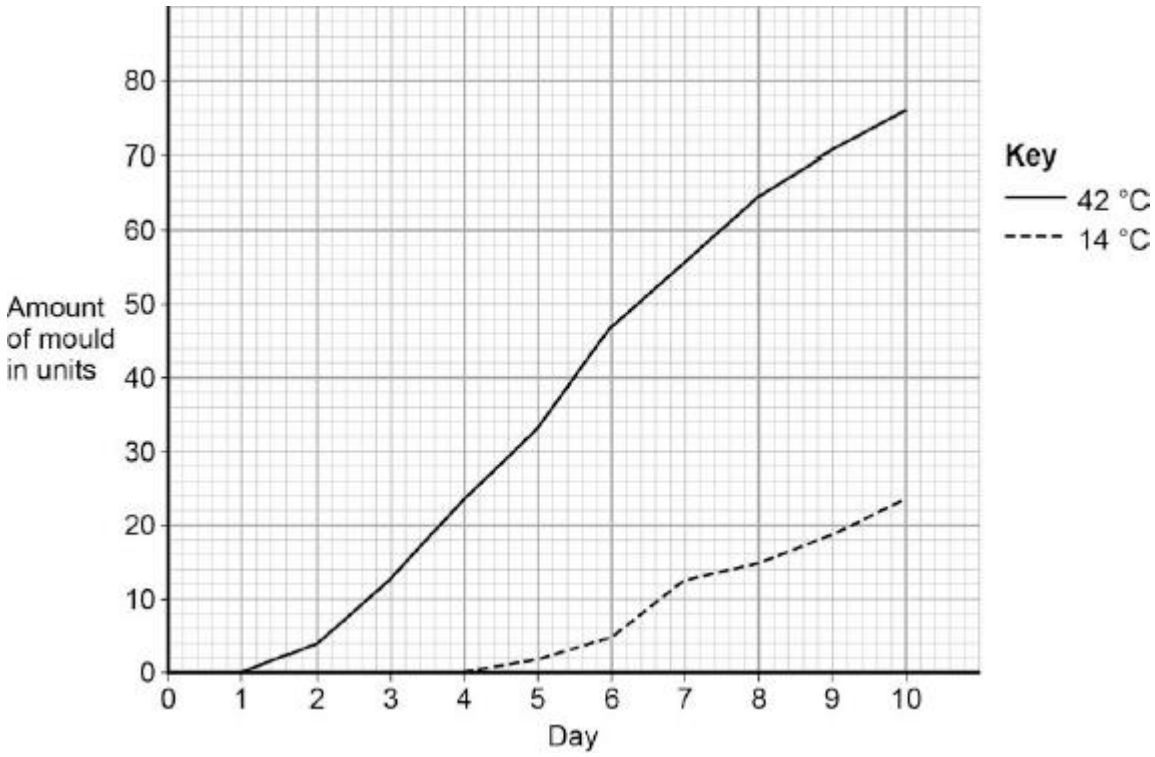
(c) Give **one** variable the student should control in the investigation.

_____

(1)

(d) Another student did a similar investigation.

The diagram below shows the results.



Determine the rate of mould growth at 42 °C between day 2 and day 7.

_____

_____

Rate of mould growth = _____ units per day

(2)

(e) The growth of mould shows decomposition of the bread.

Give a conclusion about decomposition from the results in the diagram above.

_____

_____

(1)

(Total 9 marks)

Q4.

Students investigated a food chain in a garden.

lettuce → snail → thrush (bird)

The students:

- estimated the number of lettuce plants in the garden
- estimated the number of snails feeding on the lettuces
- counted two thrushes in the garden in 5 hours.

The table below shows the students' results and calculations.

Organism	Population size	Mean mass of each organism in g	Biomass of population in g	Biomass from previous organism that is lost in g	Percentage of biomass lost
Lettuce	50	120.0	6000		
Snail	200	2.5	500	5500	91
Thrush	2	85.0	170	330	66

(a) (i) Give **two** ways that biomass is lost along a food chain.

_____

_____

_____

_____

(2)

(ii) Scientists estimate that about 90% of the biomass in food is lost at each step in a food chain.

Suggest **one** reason why the students' value for the percentage of biomass lost between the snails and the thrushes is only 66%.

_____

_____

(1)

(b) European banded snails have shells with different colours (light or dark) and with stripes or with no stripes.

Figure 1 shows two examples of European banded snails.

Figure 1

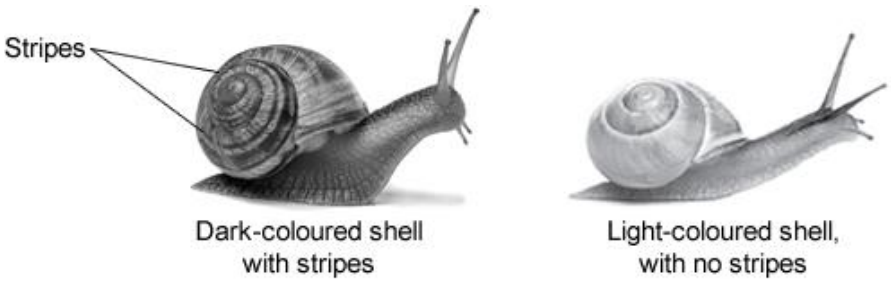
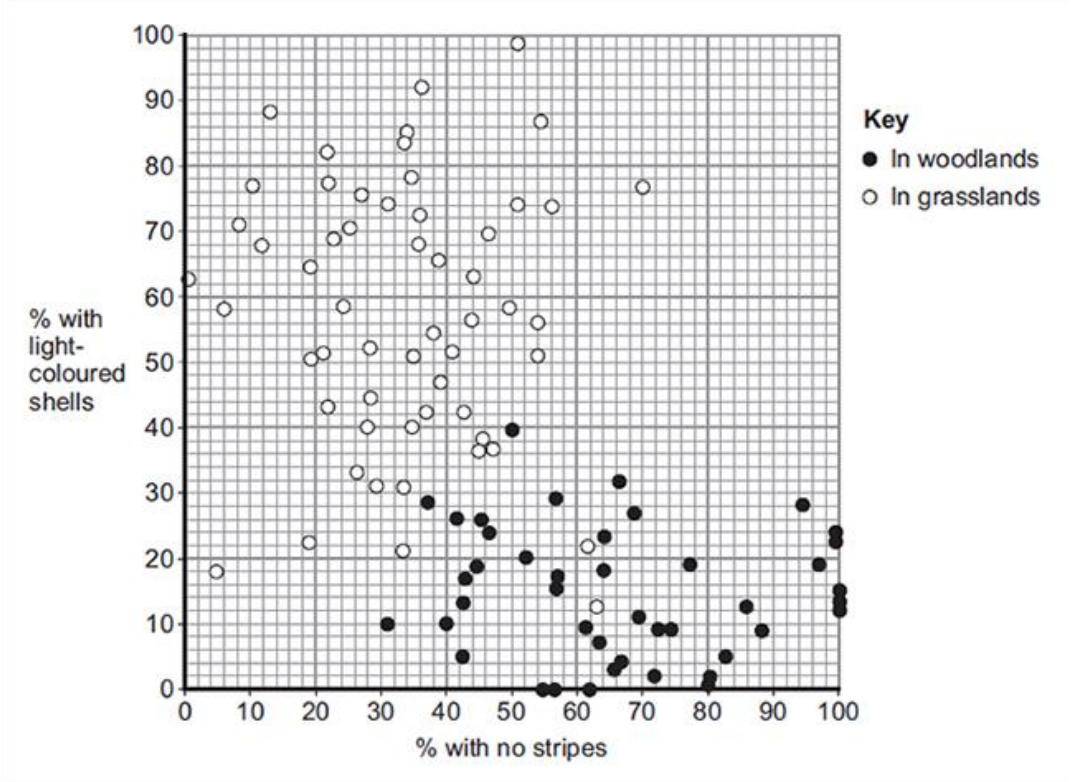


Figure 2 shows results from surveys in woodlands and in grasslands of the percentage of snails with light-coloured shells and the percentage of snails with no stripes.

Each point on the graph represents the results of one survey in one habitat.

Figure 2



(i) **Figure 2** is a scatter graph.

Why is a scatter graph used for this data?

_____

_____

(1)

(ii) Compare the general appearance of snails that live in woodlands with the general appearance of snails that live in grasslands.

_____

_____

_____

_____

(2)

(iii) Suggest a reason for the general appearance of snails that live in woodlands.

_____

_____

(1)

(Total 7 marks)

Q5.

Freshwater streams may have different levels of pollution. The level of pollution affects which species of invertebrate will live in the water.

Table 1 shows the biomass of different invertebrate species found in two different streams, **X** and **Y**.

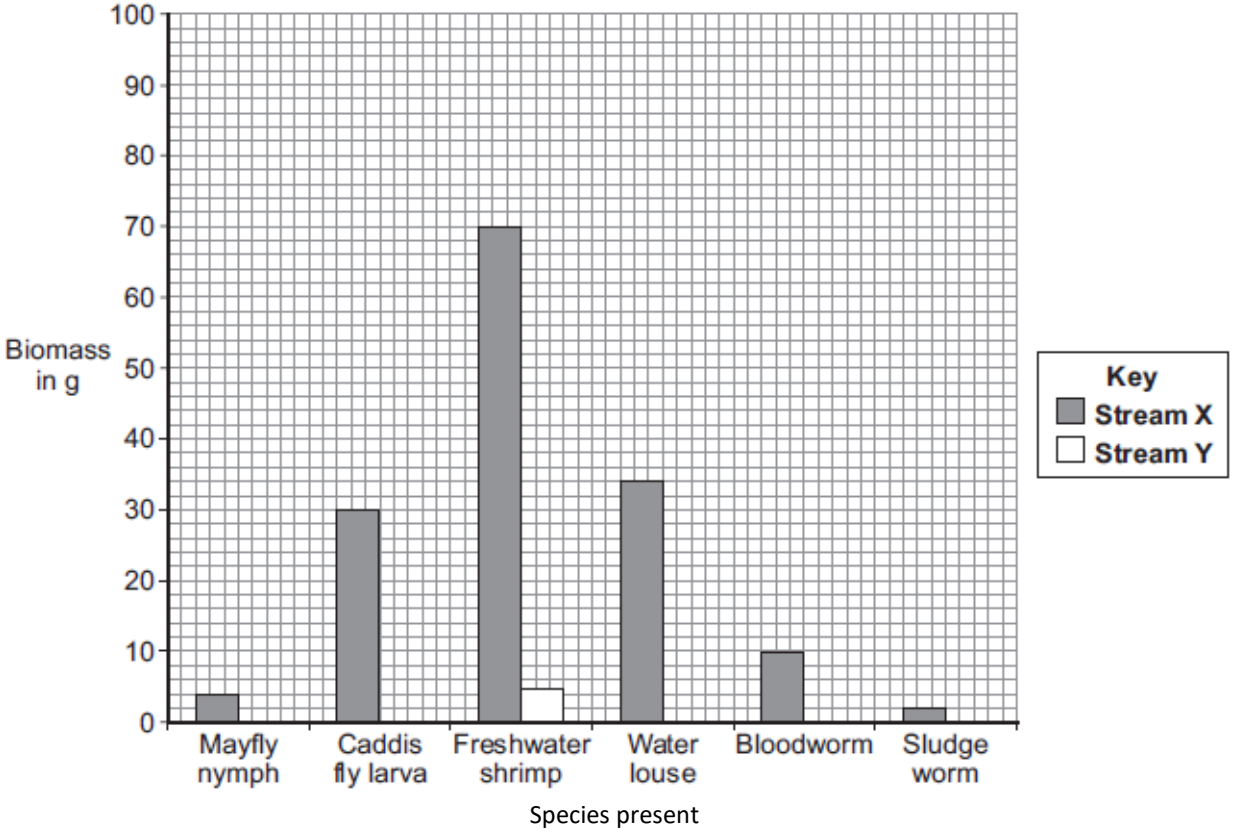
Table 1

	Biomass in g	
Invertebrate species	**Stream X**	**Stream Y**
Mayfly nymph	4	0
Caddis fly larva	30	0
Freshwater shrimp	70	5
Water louse	34	10
Bloodworm	10	45
Sludge worm	2	90
Total	**150**	**150**

(a) The bar chart below shows the biomass of invertebrate species found in **Stream X**.

(i) Complete the bar chart by drawing the bars for water louse, bloodworm and sludge worm in **Stream Y**.

Use the data in **Table 1**.



(2)

(ii) **Table 2** shows which invertebrates can live in different levels of water pollution.

Table 2

Pollution level	Invertebrate species likely to be present
Clean water	Mayfly nymph
Low pollution	Caddis fly larva, Freshwater shrimp
Medium pollution	Water louse, Bloodworm
High pollution	Sludge worm

Which stream, **X** or **Y**, is more polluted?
Use the information from **Table 1** and **Table 2** to justify your answer.

_____

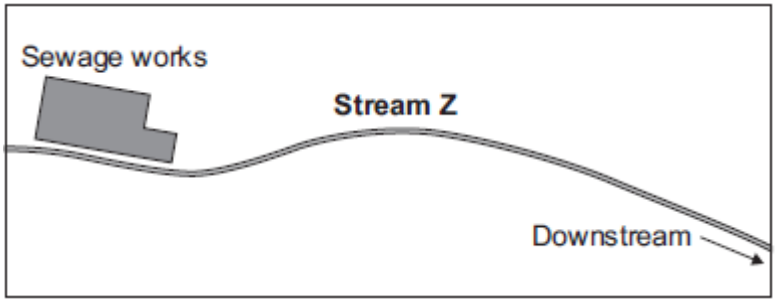
_____

_____

_____

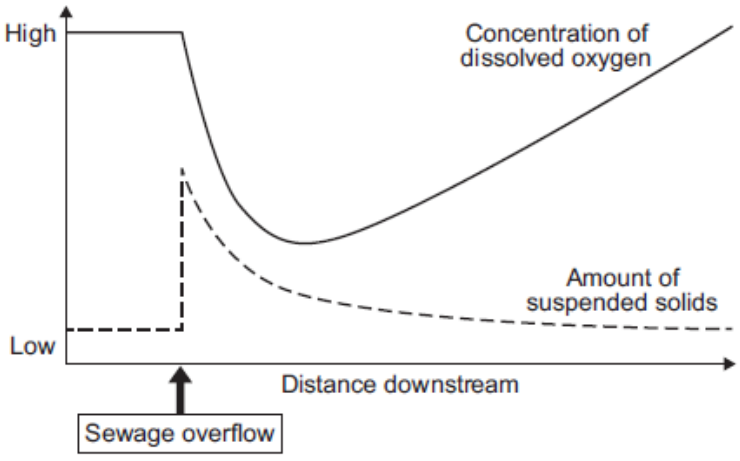
(2)

(b) There is a sewage works near another stream, **Z**.

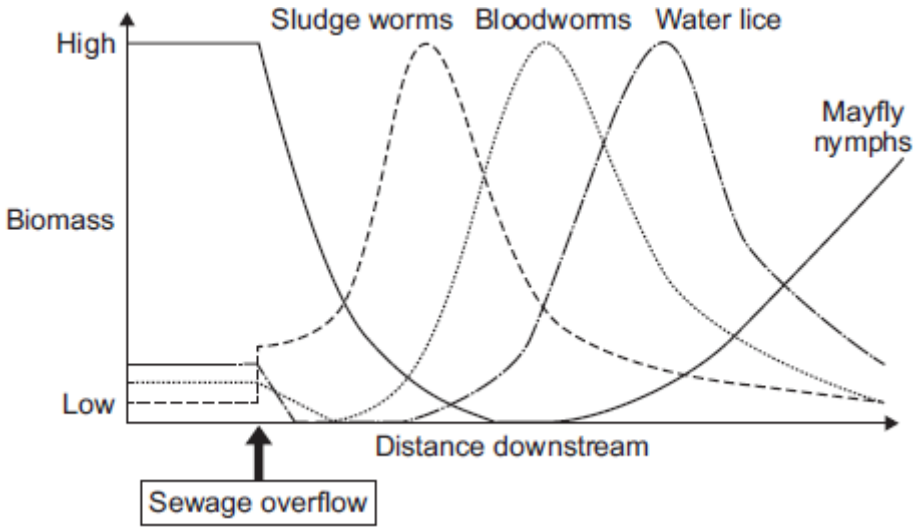


An accident caused sewage to overflow into **Stream Z**. Two weeks later scientists took samples of water and invertebrates from the stream. They took samples at different distances downstream from where the sewage overflowed. The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow



(i) Describe the patterns shown in **Graph P**.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(ii) Describe the relationship between dissolved oxygen and the survival of mayfly nymphs in **Stream Z**. Suggest a reason for the pattern you have described.

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Many microorganisms are present in the sewage overflow.

Explain why microorganisms cause the level of oxygen in the water to decrease.

_____

_____

_____

_____

(2)

(Total 13 marks)

Q6. In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Animals and plants have features (adaptations) that allow them to survive in the conditions in which they normally live.

Describe how animals and plants are adapted to survive in dry conditions such as deserts.

For each adaptation that you give, describe how the adaptation helps the animal or plant to survive in dry conditions.

To obtain full marks you should refer to **both** animals and plants.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

_____

_____

(Total 6 marks)

Q7. The table shows energy transfers in a large insect and a small mammal.

Both animals feed mainly on grass.

Energy transfer	Amount of energy in kJ.	
	Large insect	**Small mammal**
Eaten as grass	4.00	25.00
Absorbed into body	1.60	12.50
Leaves body as faeces	2.40	12.50
Production of new tissue	0.64	0.25
Transferred by respiration	0.96	12.25

(a) What percentage of the energy in food is transferred into new tissue in the large insect?

Show clearly how you work out your answer.

_____

_____

_____

Answer = _____ %

(2)

(b) The proportion of energy in the food transferred into new tissue is much greater in the large insect than in the small mammal.

Explain why as fully as you can.

You should include references to the data in your answer.

_____

_____

_____

_____

_____

_____

_____

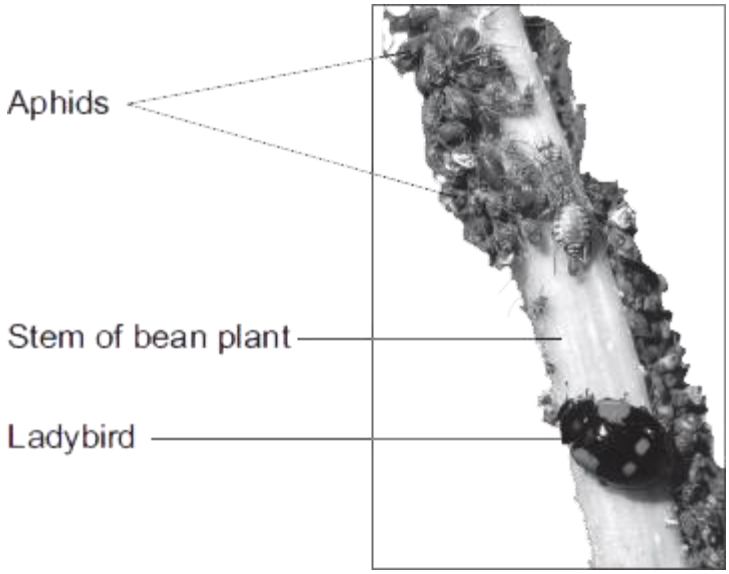
_____

(3)

(Total 5 marks)

Q8. Students investigated a food chain in a garden.

The students found 650 aphids feeding on one bean plant.
Five ladybirds were feeding on the aphids.



Photograph supplied by Hemera/Thinkstock

(a) (i) Draw a pyramid of biomass for this food chain. Label the pyramid.

(2)

(ii) The biomass in the five ladybirds is less than the biomass in the bean plant.

Give **two** reasons why.

_____

_____

_____

(2)

(b) The carbon in dead bean plants is returned to the atmosphere via the carbon cycle.

Describe this part of the carbon cycle.

_____

_____

_____

_____

_____

(4)

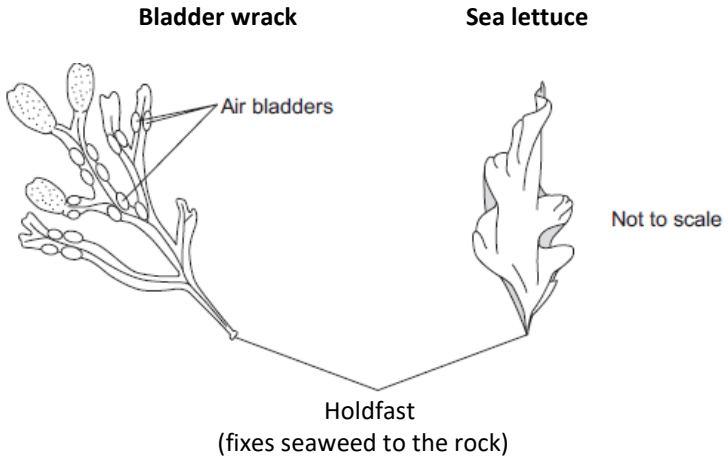
(Total 8 marks)

Q9. At the seashore, the tide comes in and goes out twice each day.

Some students investigated whether two different species of seaweed could live only at certain positions on a rocky shore.
Seaweeds are plant-like organisms that make their food by photosynthesis.

Figure 1 shows the two species of seaweed that the students investigated.

Figure 1



(a) The students:

1 placed a 50-metre tape measure on the rocks at right angles to the sea

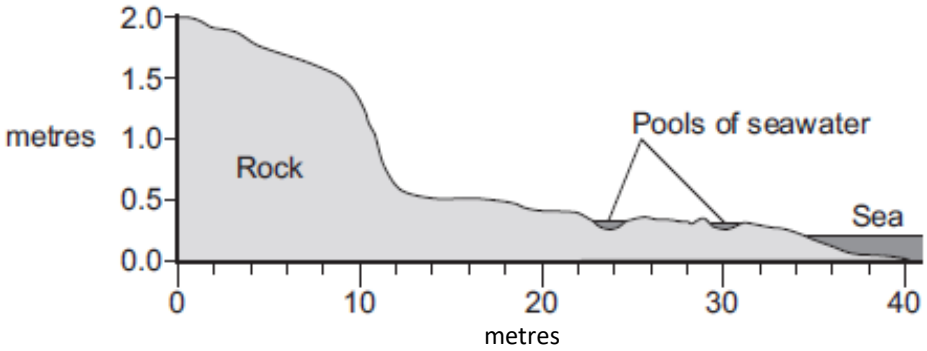
2 placed a quadrat next to the tape measure

3 recorded whether each species was present or not.

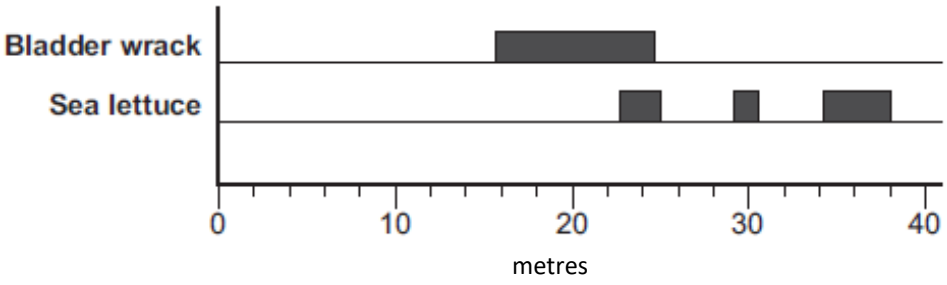
The students repeated steps 2 and 3 every metre down the shore.

Figure 2 shows a section of the seashore and the students' results.

Figure 2 Section of the seashore



Students' results



(i) The students placed the quadrat at regular intervals along a transect line rather than placing the quadrat at random positions anywhere on the rocky shore.

Explain why.

_____

_____

_____

_____

(2)

(ii) How could the students have improved their investigation to ensure that they produced valid data?

_____

_____

_____

_____

(2)

(iii) The students concluded that bladder wrack is better adapted than sea lettuce to survive in dry conditions.

What is the evidence for this conclusion?

Use information from **Figure 2**.

_____

_____

_____

_____

(2)

(b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

_____

_____

_____

_____

(2)

(Total 8 marks)

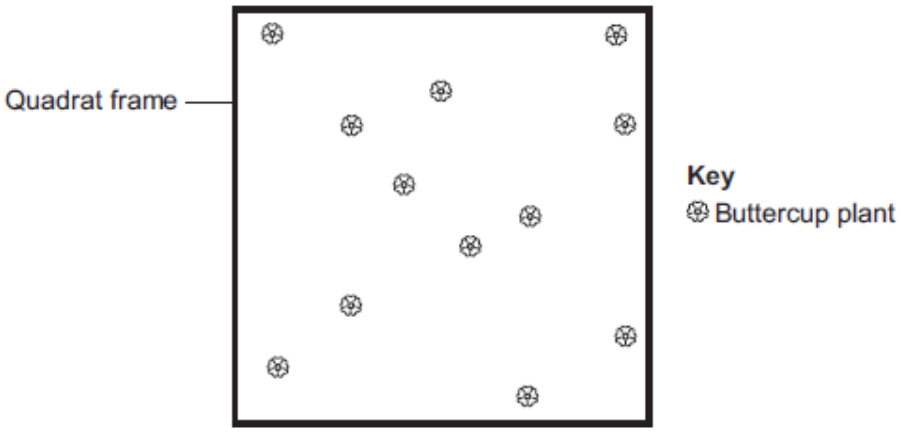
Q10. A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

Figure 1 shows the buttercup plants in the quadrat.

Figure 1



The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

_____

_____

_____

(2)

(ii) The student's estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

_____

_____

_____

_____

(2)

(b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1. _____

2. _____

3. _____

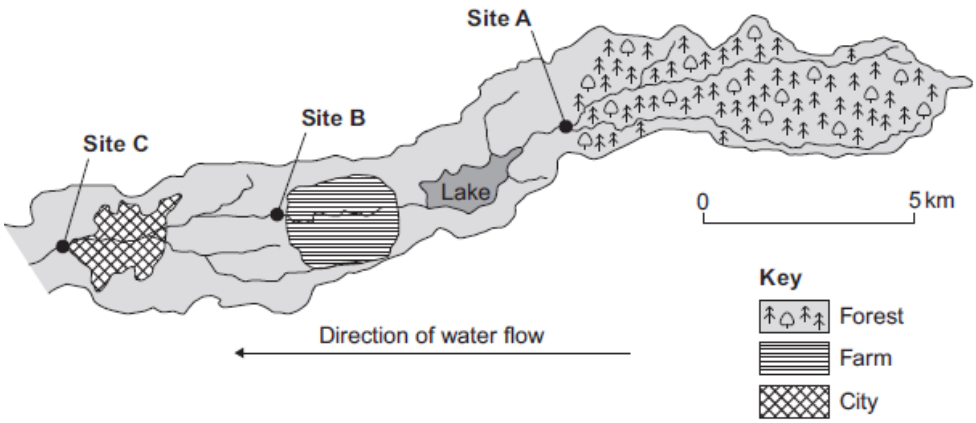
(3)

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

(3)

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.

Figure 2



Every year, the farmer puts fertiliser containing mineral ions on some of his fields.When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

_____

(1)

(d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

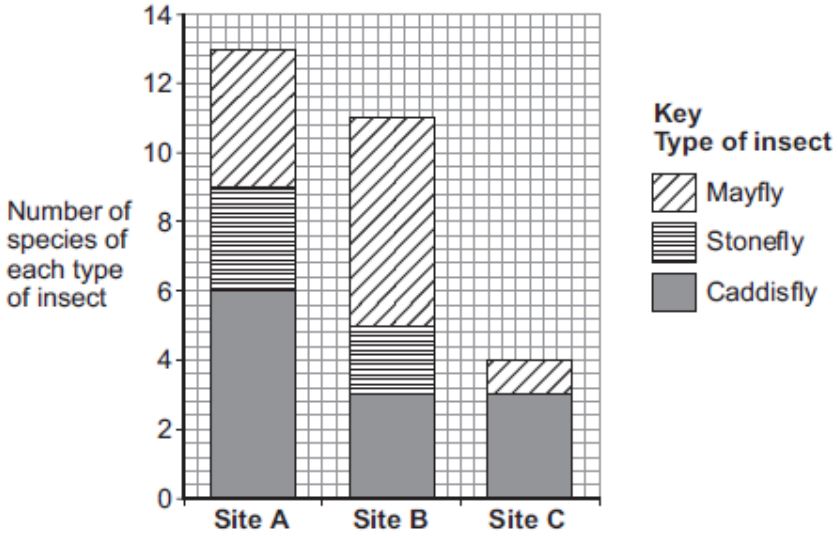
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

Figure 3 shows the scientists' results.

Figure 3



(i) How many more species of mayfly were there at Site **B** than at Site **A**?

_____

(1)

(ii) Suggest what caused this increase in the number of species of mayfly.

_____

_____

(1)

(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

(1)

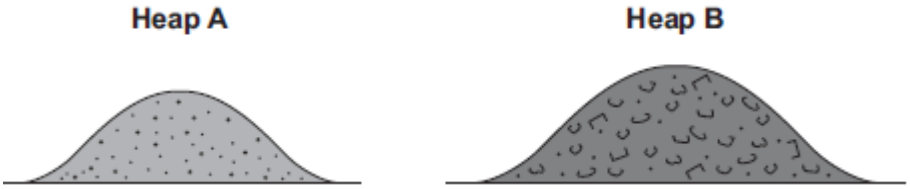
(Total 19 marks)

Q11. A gardener investigates if turning over the waste in a compost heap makes the waste decay more quickly.

The gardener:

- makes two separate heaps of garden waste, heap **A** and heap **B**
- turns over the material in heap **A** every 2 weeks
- does **not** turn over the material in heap **B**
- estimates the amount of decay in the two heaps after 6 months.

The diagram shows the two heaps of garden waste at the beginning of the investigation.



(a) Suggest **two** factors, other than time, the gardener should control to make the investigation fair.

1. _____

_____

2. _____

_____

(2)

(b) Name **one** type of living thing that causes decay.

_____

(1)

(c) The gardener's results are shown in the table.

Compost heap	Estimated amount of decay
A	A lot
B	Very little

(i) Why does turning over the material in heap **A** make the material decay more quickly?

_____

_____

(1)

(ii) The gardener puts decayed material around his plants to help them grow.

Suggest why the plants in a woodland grow well each year **without** material from compost heaps being added.

_____

_____

_____

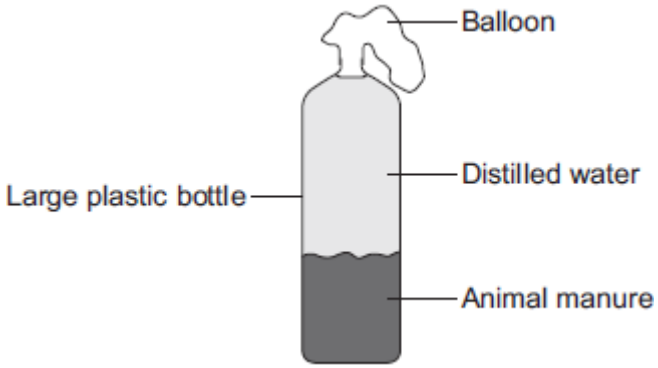
_____

(2)

(Total 6 marks)

Q12. Some students set up biogas generators to find out which type of animal manure produced the most biogas.

The diagram shows the apparatus they used.



The students:
Step 1: Put some cow manure into the plastic bottle
Step 2: Filled the bottle with distilled water
Step 3: Attached a balloon over the top of the bottle
Step 4: Put the bottle in a warm room for 10 days
Step 5: Measured the diameter of the balloon on day 10
Step 6: Repeated steps 1 to 5 using each type of animal manure.

The students' results are shown in the table.

Type of animal manure	**Diameter of balloon on day 10 in cm**
Cow	29
Horse	26
Sheep	34
Pig	32

(a) What is the main gas found in biogas?

_____

(1)

(b) The students concluded that sheep manure is the best type of manure to use in a biogas generator.

A teacher told the students that the design of their investigation meant that their conclusion might **not** be correct.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(c) Another student suggested that adding potato to the manure would increase the amount of biogas produced.

Why would adding potato increase the amount of biogas produced?

Tick (✓) **one** box.

The potato contains a lot of carbohydrate. ☐

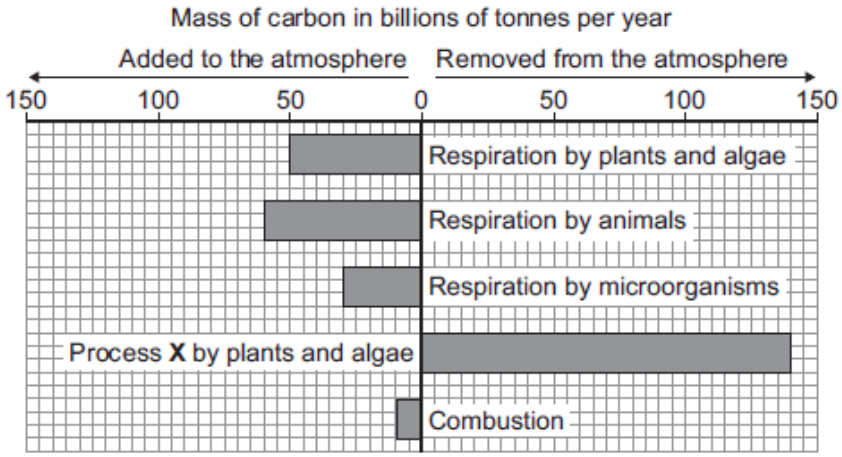
The potato contains a lot of protein. ☐

The potato contains a lot of water. ☐

(1)

(Total 4 marks)

Q13. This question is about carbon. The graph shows the mass of carbon added to and removed from the atmosphere each year.



(a) Name process **X**.

_____

(1)

(b) (i) Calculate the mass of carbon added to the atmosphere by respiration per year.

Answer = _____ billion tonnes

(1)

(ii) Some scientists are concerned that the mass of carbon in the atmosphere is changing.

How does the data in the graph support this idea?

_____

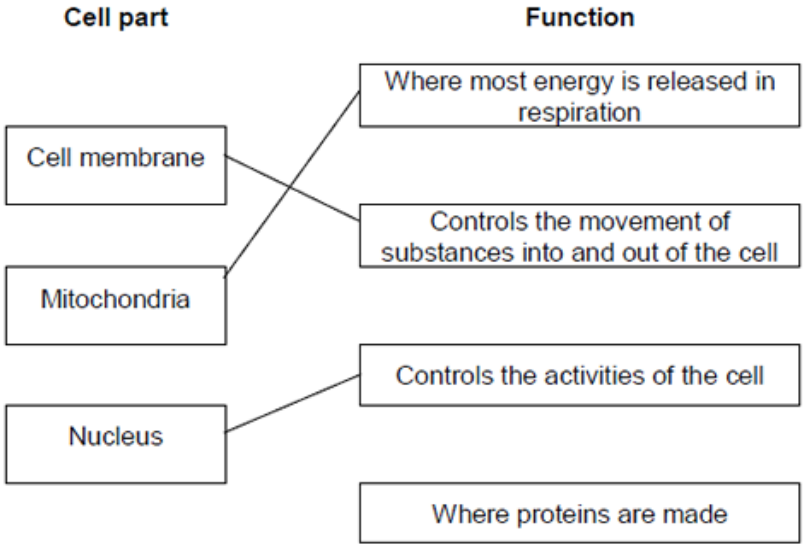
_____

(1)

(Total 3 marks)

Mark scheme 1.Cell Biology Mastery Booklet (Biology Paper 1)

Q1.



(a)

extra lines cancel

3

(b) Cell wall

in either order

1

Chloroplast

allow (permanent) vacuole

1

[5]

Q2.

(a) (i) **C** and **D**

no mark if more than one box is ticked

1

(ii) any **one** from:

*do **not** allow if other cell parts are given in a list*

- (have) cell wall(s)
- (have) vacuole(s)

1

(b) (i) **A**

apply list principle

1

(ii) **D**

apply list principle

1

(c) respiration

apply list principle

1

[5]

Q3.

(a) (i) large intestine = **E**

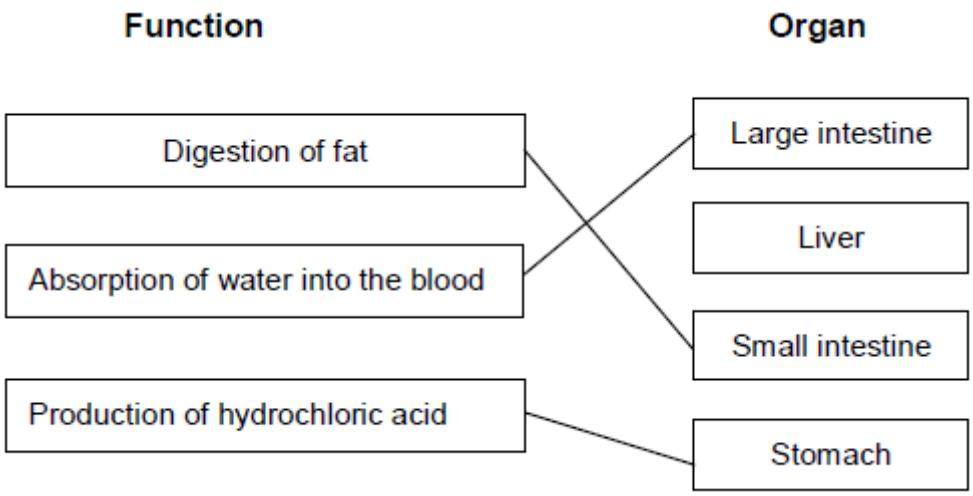
1

small intestine = **D**

1

stomach = **B**

1



(ii)

extra lines cancel

3

(b) The concentration in the blood is lower.

1

[7]

Q4.

(a) contract / shorten

ignore relax

*do **not** allow expand*

1

to churn / move / mix food

accept peristalsis / mechanical digestion

ignore movement unqualified

1

(b) 400

acceptable range 390-410

allow 1 mark for answer in range of 39 to 41

allow 1 mark for answer in range of 3900 to 4100

2

(c) to transfer energy for use

allow to release / give / supply / provide energy

*do **not** allow to 'make' / 'produce' / 'create' energy*

allow to make ATP

ignore to store energy

1

by (aerobic) respiration **or** from glucose

*do **not** allow anaerobic*

*energy released **for** respiration = max 1 mark*

1

(d) (i) to make protein / enzyme

ignore 'antibody' or other named protein

1

(ii) too small / very small

allow light microscope does not have sufficient magnification / resolution

allow ribosomes are smaller than mitochondria

ignore not sensitive enough

ignore ribosomes are transparent

1

[8]

Q5.

(a) (i) A

(ii) B

for 1 mark each

2

(b) diffusion

(reject osmosis)
for one mark

1

(c) C
because uptake against a concentration / diffusion gradient
(*reject* osmosis)
(if C not given, then idea of <u>movement</u> essential)

for 1 mark each

2

[5]

Q6.

Level 3 (5–6 marks):

A detailed and coherent explanation is provided with most of the relevant content, which demonstrates a comprehensive understanding of the human circulatory system . The response makes logical links between content points.

Level 2 (3–4 marks):

The response is mostly relevant and with some logical explanation. Gives a broad understanding of the human circulatory system. The response makes some logical links between the content points.

Level 1 (1–2 marks):

Simple descriptions are made of the roles of some of the following: heart function, gas exchange, named blood vessels, named blood cells. The response demonstrates limited logical linking of points.

0 marks:

No relevant content.

Indicative content

- dual / double circulatory system which means that it has higher blood pressure and a greater flow of blood to the tissues
- heart made of specialised (cardiac) muscle cells which have long protein filaments that can slide past each other to shorten the cell to bring about contraction for pumping blood
- heart pumps blood to lungs in pulmonary artery so that oxygen can diffuse into blood from air in alveoli
- blood returns to heart via pulmonary vein where muscles pump blood to the body via aorta
- oxygen carried by specialised cells / RBCs which contain haemoglobin to bind oxygen and have no nucleus so there is more space available to carry oxygen
- arteries carry oxygenated blood to tissues where capillaries deliver oxygen to cells for respiration and energy release
- thin walls allow for easy diffusion to cells
- large surface area of capillaries to maximise exchange
- waste products removed eg CO_2 diffuse from cells into the blood plasma
- blood goes back to the heart in veins which have valves to prevent backflow
- cardiac output can vary according to demand / is affected by adrenaline

accept annotated diagrams

[6]

Q7.

(a) (0.15 / 1.35) × 100

1

11.1 (%)

*allow 11.1 (%) with no working shown for **2** marks*

1

(b) to allow results to be compared

or

they had different masses at the start

1

(c) axis correct scale and labelled

1

5 points correctly plotted

*allow ecf from **05.1***

*allow **1** mark for 4 points correctly plotted*

2

line of best fit

1

(d) 0.5

allow 0.45–0.55

1

(e) (0.0 to 0.4) water moves into cells

1

(0.6 to 0.8) water leaves cells

1

by osmosis

1

(f) any **two** from:

- concentration of solutions
- drying of chips
- accuracy of balance
- evaporation from tubes

2

[13]

Q8.

(a) (i) xylem

1

(ii) water

1

minerals / ions / named example(s)

ignore nutrients

1

(b) (i) movement of (dissolved) sugar

allow additional substances, eg amino acids / correct named sugar (allow sucrose / glucose)

allow nutrients / substances / food molecules if sufficiently qualified

ignore food alone

1

(ii) sugars are made in the leaves

1

so they need to be moved to other parts of the plant for respiration / growth / storage

1

(c) (i) mitochondria

1

(ii) for movement of minerals / ions

Do not accept 'water'

1

against their concentration gradient

1

[9]

Q9.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1 – 2 marks)

An example is given of a named substance
or
a process
or
there is an idea of why diffusion is important eg definition.

Level 2 (3 – 4 marks)

At least one example of a substance is given
and
correctly linked to a process in either animals or plants.

Level 3 (5 – 6 marks)

There is a description of a process occurring in either animals or plants that is correctly linked to a substance
and
a process occurring in the other type of organism that is correctly linked to a substance.

examples of points made in the response

Importance of diffusion:

- to take in substances for use in cell processes
- products from cell processes removed

Examples of processes and substances:

- for gas exchange / respiration: O_2 in / CO_2 out
- for gas exchange / photosynthesis: CO_2 in / O_2 out
- food molecules absorbed: glucose, amino acids, etc
- water absorption in the large intestine
- water lost from leaves / transpiration
- water absorption by roots
- mineral ions absorbed by roots

extra information

Description of processes might include:

- *movement of particles / molecules / ions*
- *through a partially permeable membrane*
- *(movement of substance) down a concentration gradient*
- *osmosis: turgor / support / stomatal movements*

[6]

Mark Scheme 2.Organisation Mastery Booklet (Biology Paper 1)

Mark schemes

Q1.

(a) ventricle

1

(b) lungs

1

(c) valve circled on heart

1

(d) no fatty deposit

1

healthy artery is wider / bigger hole / has more blood flow

1

(e) statins

1

stent

1

(f) any **two** from:

- smoking
- high-fat diet
- lack of exercise

allow:

- *overweight / obese*
- *having high blood pressure*
- *having high cholesterol*

2

(g) 8 (%)

1

(h) more males have coronary heart disease than females

1

[11]

Q2.

(a) (i) water / H_2O

accept oxygen

allow H_2O

*do **not** allow H^2O or H2O*

1

(ii) the mineral ions are absorbed by active transport

1

the absorption of mineral ions needs energy

1

(iii) have (many root) <u>hairs</u>

1

(which) give a large surface area (for absorption)

1

(b) carbon dioxide in

or

oxygen out

or

control water loss

accept gas exchange

ignore gases in and out

ignore gain / lose water

1

(c) (i) guard cells

1

(ii) (stomata are) closed

allow there is no gap / space

1

(iii) plant will wilt / droop

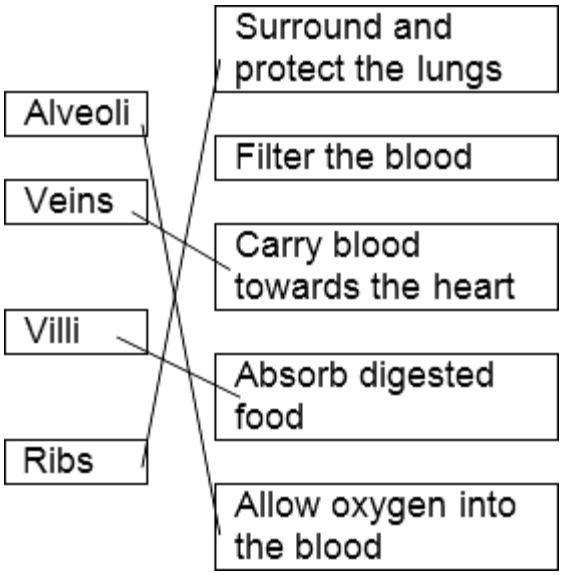
ignore die

1

[9]

Q3.

(a)



*4 correct = **4** marks*

*3 correct = **3** marks*

*2 correct = **2** marks*

*1 correct = **1** mark*

extra line from a structure cancels the mark

4

(b) diffusion

1

[5]

Q4.

(a) (i) without <u>oxygen</u>

allow not enough oxygen

ignore air

ignore production of CO_2

ignore energy

1

(ii) more / high / increased lactic acid (at end)

allow approximate figures (to show increase)

ignore reference to glucose

1

(b) (i) 1.5

allow only 1.5 / 1½ / one and a half

1

(ii) increases at first **and** levels off

ignore subsequent decrease

1

suitable use of numbers eg

rises to 10 / by 9 (dm^3 per min)

or

increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale)

allow answer in range 1.4 to 1.5

or

after the first minute (of the run)

1

(iii) supplies (more) oxygen

1

supplies (more) glucose

1

need 'more/faster' once only for full marks

*allow removes (more) CO_2 / lactic acid / heat as an alternative for either marking point one **or** two, **once** only*

for (more) respiration

1

releases (more) energy (for muscle contraction)

*do **not** allow energy production or for respiration*

1

[9]

Q5.

(a) (i) xylem

1

(ii) water

1

minerals / ions / named example(s)

ignore nutrients

1

(b) (i) movement of (dissolved) sugar

allow additional substances, eg amino acids / correct named sugar (allow sucrose / glucose)

allow nutrients / substances / food molecules if sufficiently qualified

ignore food alone

1

(ii) sugars are made in the leaves

1

so they need to be moved to other parts of the plant for respiration / growth / storage

1

(c) (i) mitochondria

1

(ii) for movement of minerals / ions

Do not accept 'water'

1

against their concentration gradient

1

[9]

Q6.

(a) digested / broken down / made soluble by protease enzyme
in stomach in small intestine / from stomach / from pancreas
into amino acids
amino acids / small molecules absorbed into blood

any four for 1 mark each

4

(b) *ideas that*
lipase / enzyme works best in alkaline / neutral conditions
acid denatures or inactivates enzyme / inhibits enzyme activity
bile emulsifies fat / bile produces larger surface area of fats / bile alkaline
for enzyme to work on / which increase activity of enzymes

any three for 1 mark each

3

[7]

Q7.

(a) (i) muscular

1

(ii) **7**

1

(iii) an electrical device

1

(b) (i) in sequence:

5

1

7

1

2

1

(ii) **3**

1

(c) (i) prevent backflow (of blood) / allow flow in only one direction / in the correct direction

1

(ii) **A**

*no mark, but max **2** marks if incorrect*

2 / atrium contracts / pressure in **2** increases

1

<u>blood</u> <u>pushes</u> ball (down / towards ventricle / towards **5**)

allow this point even if valve in wrong part of heart

1

(opens valve which) allows blood into **5** / ventricle

***or** converse points re closing the valve*

1

(d) (i) involvement of <u>platelets</u> / eg <u>platelets</u> 'trigger' clotting process / release enzyme(s) / release 'clotting factors'

1

fibrinogen to fibrin
or
meshwork formed (which traps blood cells)

1

(ii) any **four** from:

*to gain **4** marks candidates should include at least:*

***one** advantage and **one** disadvantage*

Advantages

(improved circulation / O_2 supply) provides:

- <u>more</u> cell respiration
- <u>more</u> energy released
- (more) active life / not so tired / more physical activity

Disadvantages

- danger of surgery / operation
- infection from surgery / operation
- valve may need replacing

- clots may form and block blood vessels

  may need to take anti-coagulants – eg warfarin

- clots may cause heart attacks / strokes

4

[17]

Q8.

(a) 5624

allow 2 marks *for:*

- *correct HR = 148* ***and*** *correct SV = 38 plus wrong answer / no answer*

or

- *only one value correct* ***and*** *ecf for answer*

allow 1 mark *for:*

- *incorrect values* ***and*** *ecf for answer*

or

- *only one value correct*

3

(b) (i) **Person 2** has low(er) stroke volume / SV / described

eg ***Person 2*** *pumps out smaller volume each beat*

do ***not*** *allow* ***Person 2*** *has lower heart rate*

1

(ii) **Person 1** sends <u>more blood</u> (to muscles / body / lungs)

1

(which) supplies (more) oxygen

1

(and) supplies (more) glucose

1

(faster rate of) respiration **or** transfers (more) energy for use

ignore aerobic / anaerobic

allow (more) energy release

allow aerobic respiration transfers / releases more energy (than anaerobic)

do ***not*** *allow makes (more) energy*

1

removes (more) CO2 / lactic acid / heat

allow less oxygen debt

or less lactic acid made
or (more) muscle contraction / less muscle fatigue

if no other mark awarded,

allow person 1 is fitter (than person 2) for max 1 mark

1

[9]

Q9.

(a) liver

1

mouth or salivary glands **or** duodenum **or** small intestine **or** pancreas

1

pancreas

*accept duodenum **or** ileum **or** small intestine*

*do **not** accept stomach*

1

stomach **or** duodenum **or** ileum **or** small intestine **or** pancreas

1

(b) teeth breakdown food

accept chewing

1

amylase **or** saliva (breaks down starch)

1

(c) produces bile (salts)

1

emulsifies (fat) **or** produces droplets **or** disperses fat)

1

[8]

Q10.

(a) fatty acids

1

glycerol

1

(b) (i) any **one** from:

- (same) amount / $1cm^{3}$ fat
- (same) amount / $10cm^{3}$ lipase / enzyme
- (kept for) 24 hours **or** (same length of) time

1

(ii) temperature

allow heat / warmth

1

(c) (carry out experiments) using more temperatures / smaller intervals

ignore repeat unqualified

do not accept longer time

1

between 20 and 60 °C / around 40 °C

accept extra single temperature in range 20 °C – 60 °C but cannot be 20 °C, 40 °C or 60 °C

1

(d) (i) 'strong' acid

1

(ii) enzyme works / not destroyed / not denatured / not damaged

*do **not** accept enzyme not killed*

accept any indication that the fat is digested

accept same as tube 3 / tube at 40 °C

accept optimum temperature / at or near body temperature

1

[8]

Q11.

(a) 300

1

(b) suitable scale on *y*-axis

1

label *y*-axis

1

4 bars drawn correctly

*allow **1** mark for 3 correct bars*

2

(c) increases from 50 to 500

1

then decreases from 500 to 0

1

(d) carbohydrates broken down / digested into sugars

1

broken down by carbohydrase or amylase

1

(e) absorption of glucose

1

into blood

1

by active transport

allow diffusion

1

[12]

Q12.

D – *many* microvilli (1)
Ex – provide large surface area (1)

***five** points made*

*max **3** descriptions*

*max **3** explanations*

D – *many* capillaries / *good* blood supply (1)
Ex – maintain concentration / diffusion gradient **or** quickly removes food (1)

D – thin wall / one cell thick surface / capillaries near surface (1)

allow villi are thin

ignore villi are one cell thick

Ex – short distance for food to travel (1)

D – *many* *mitochondria* *(1)*
Ex – provide energy / ATP for active uptake / transport (1)

[5]

Mark scheme 3. Infection and response

Q1.

(a) any **two** from:

- acid in the stomach kills pathogens in food
- skin forms a barrier / produces antimicrobial secretions
- hairs in the nose trap (particles which may contain) pathogens
- trachea / bronchi has mucus which traps pathogens

or

bronchi have cilia which waft mucus to throat to be swallowed

2

(b) **Level 3 (5–6 marks):**

A clear, logical and coherent answer, with no significant redundancy. The student understands the process and links this to reasons for clinical trials.

Level 2 (3–4 marks):

A partial answer with errors and ineffective reasoning or linkage.

Level 1 (1–2 marks):

One or two relevant points but little linkage of points or logical reasoning.

0 marks:

No relevant content.

Indicative content

- pre-clinical trials of the new drug on cells / tissues / live animals
- to test toxicity, dosage and efficacy
- clinical trials / test on healthy volunteers and Ebola patients at very low doses
- so that you can monitor for safety / side effects
- and only then do trials to find the optimum dosage and test for efficacy
- double blind trial / use of placebo
- which does not contain the new drug

- random allocation of Ebola patients to groups
- so no one knows who has placebo / the new drug
- peer review of data
- to help prevent false claims

6

[8]

Q2.

(a) mumps

in either order rubella / German measles

both needed for the mark

ignore measles unqualified

1

(b) (i) 80(.0)

*allow **1** mark for* $\frac{504}{630}$ ***or** 0.8*

2

(ii) less chance of epidemic / pandemic

or

less chance of spread of disease / measles / mumps / rubella

allow idea of herd immunity (increased protection for those who are not vaccinated)

*ignore less chance of getting the disease **or** to eradicate the disease*

1

(c) (i) dead / inactive pathogens / viruses / bacteria

allow antigens / proteins from pathogens / viruses / bacteria

ignore microorganisms

1

(ii) white blood cells produce <u>antibodies</u>

1

antibodies produced rapidly (on re-infection) **or** response rapid (on re-infection)

allow ecf if antibodies incorrectly identified in first marking point

1

these antibodies kill pathogens / viruses / bacteria

*do **not** accept idea that original antibodies remain in blood and kill pathogens*

1

(d) (i) antibiotics don't kill viruses

allow antibiotics only kill bacteria

1

(because measles) virus / pathogen lives inside cells

*allow antibiotics do not work inside cells **or** killing virus / pathogen would kill / damage cell*

1

(ii) (bacteria / pathogens) develop resistance (to antibiotic)

ignore reference to immunity

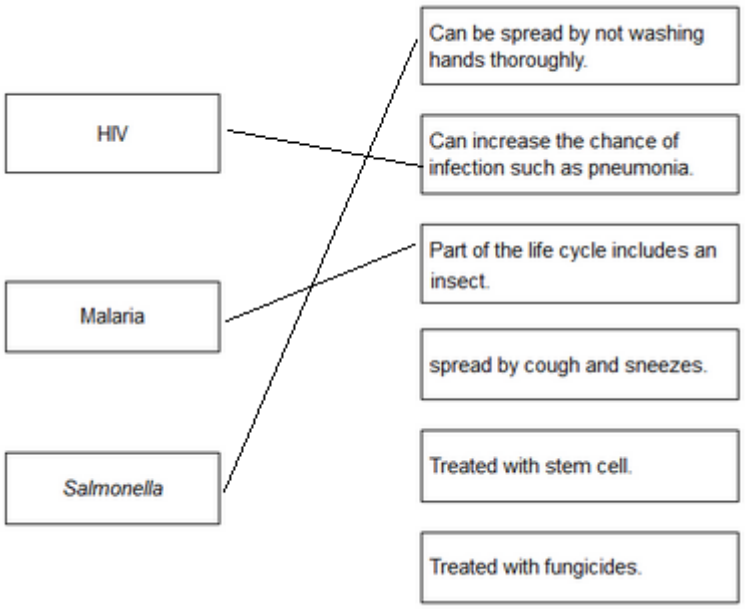
ignore viruses develop resistance

1

[11]

Q3.

(a)



each extra line negates a mark

4

(b) pain when urinating

1

yellow discharge

1

(c) three correct plots

*allow **1** mark for two correct plots*

2

correctly drawn line

1

(d) any **three** from:

- (fairly) level / steady up to 2009

  *allow numbers of males fall (slightly) **and** females rise (slightly) up to 2009*

- (there is a) rise after 2009
- males are (always) higher than females
- males rising faster than females

  allow overall increase (from 2005 to 2013)

3

(e) HIV is a virus

1

(and) antibiotics are only effective against bacteria

or

antibiotics do not kill viruses

allow viruses live inside cells

1

[13]

Q4.

(a) (i) diagram shows extensions of intact cell membrane around viruses

1

(ii) antibodies

allow enzymes re (ii)
allow interferon
ignore antitoxins / proteins

1

(b) virus is transferred

1

(virus in) blood / body fluids – transfer (via needles)

1

[4]

Q5.

(a) pathogens

1

(b) (i) A disease affecting people in many countries

1

(ii) birds fly / migrate

accept converse

OR

human contact with birds more likely

birds not contained / difficult to control movement

OR

there are more birds (than pigs)

1

(c) (i) antibiotics (only) kill bacteria

ignore flu is caused by a virus unqualified

OR

antibiotics don't kill viruses

ignore virus resistant / immune

1

(ii) painkillers

accept any correct named painkiller, eg aspirin or paracetamol

allow antivirals / Tamiflu

ignore medicine / tablets

1

(iii) resistant

1

bacteria

1

in this order

[7]

Q6.

(a) (i) small amounts of dead pathogens

1

(ii) decrease

1

by 60 (%)

allow from 70(%) to 10(%)

allow other correct data treatment

1

(b) (i) penicillin

1

(ii) any **two** from:

- antibiotics only kill bacteria

  allow antibiotics do not kill viruses
- some bacteria are resistant (to antibiotics)

  allow MRSA not killed by antibiotics
- (correct) antibiotics not always used

  allow course not completed
- deficiency disease(s) not caused by bacteria **or** cannot be treated by antibiotics
- inherited disease(s) not caused by bacteria **or** cannot be treated by antibiotics
- 'lifestyle' diseases not caused by bacteria **or** cannot be treated by antibiotics

  eg heart disease / cancer

  *if no other mark given allow **1** mark for not all diseases are caused by bacteria **or** some diseases are caused by viruses*

2

(c) bacteria grow faster

allow this is body temp (at which pathogens grow)

1

[7]

Q7.

(a) droplet infection **or** aerosol infection

*do **not** accept airborne*
accept airborne droplets

1

(b) so there is no large group which could catch the infection/pass on the infection

converse – if large numbers can't pass it on the virus is less likely to reach those few who are susceptible

1

(c) (i) any **four** of the following points:-

example of a 3 mark answer: Lymphocytes produce specific antibodies……

comment on specificity applied to antibodies or lymphocytes

(recognition by) lymphocytes;

(white cells) make antibodies;

antibodies destroy/neutralise the virus/antigen/protein subunit;

*do **not** accept antibodies KILL viruses*

accept white blood cells replicate

accept some white cells form memory cells/live a long time;

accept subsequent infection results in very rapid antibody production;

max 4

(ii) active;

1

(d) any **three** of the following points

Structure change in:
protein for binding to host cell;

accept changes in surface proteins (of protein coat)

spike containing enzyme;

changes in antigen

Fit: existing/circulating/old antibodies don't match new virus strain shape/new antigen/new binding protein;

Wrong antibodies: injection does not stimulate antibodies against all strains/different antigens;

accept wrong antibodies for 1 mark

max 3

[10]

Q8.

(a) microorganism / bacteria / virus / fungus that causes (infectious) disease

1

(b) reduce / stop use of (current) antibiotics

1

(reduce / stop use) for non-serious / mild / viral infections

allow ensure course is completed

allow use of variety of antibiotics

1

(c) (i) 40 °C

1

(ii) any **one** from:

- microorganisms grow / reproduce / work / act faster
- results / product acquired sooner

1

[5]

Q9.

any **four** from:

- cells used to treat diseases do not go on to produce a baby
- produces identical cells for research
- cells would not be rejected
- allow cells can form different types of cells
- (immature) egg contains only genetic information / DNA / genes / chromosomes from mother **or** there is only one parent
- asexual / no mixing of genetic material / no sperm involved / no fertilisation **or** chemical causes development
- baby is a clone
- reference to ethical / moral / religious issues

  allow ethically wrong
  NB *<u>cloning</u> is illegal gains **2** marks*
  ignore unnatural
- risk of damage to the baby

  in correct context

[4]

Q10.

(a) comparisons are **not** required but should be credited
accept a clear indication of the statement even if incomplete

can develop into most other types of cell

1

each cell divides every 30 minutes

1

low chance of rejection by the patient's immune system

1

(b) any **three** from:

- cheaper / <u>only</u> costs £1000

  *this **must** be comparative*

  ignore costs £1000
- can collect many (stem) cells
- adults give permission for their own bone marrow to be collected

  comparisons are not required but should be credited
- safe

3

[6]

Q11.

Marks should **not** be awarded for simply copying the information provided
A mark may be awarded for a <u>comparison</u> between treatments if the answer only involves copied information

any **four** from:

*For all **4** marks to be awarded, there must be at least 1 pro and 1 con*

<u>embryo stem cells – examples of</u>

pros

- can treat a wide variety / lots of diseases / problems
- many available / plentiful
- using them better than wasting them
- painless

cons

- (possible) harm / death to embryo
- (relatively) untested / unreliable / may not work

  allow long term effects not known
  ***or** may be more risky*
- embryo can't be 'asked' / 'embryo rights' idea

<u>adult bone marrow stem cells – examples of</u>

pros

- no ethical issues (in collection) **or** permission given
- quick recovery
- (relatively) safe

  allow does not kill (donor) / low risk
- well tried / tested / know they work

cons

- operation hazards eg infection
- few types of cell / tissue produced **or** few diseases / problems treated
- painful so may deter donors

4

Conclusion to evaluation:

A reasoned conclusion from the evidence

1

[5]

Q12.

(a) 23

1

(b) chromosome nucleus gene cell

2 3 1 4

1

(c) (i) any **one** from

(cells which are bigger) take up more space

(cells) have to get bigger **or** mature to divide

1

(ii) chromosomes duplicate **or** make exact copies of self

accept forms pairs of chromatids

1

nuclei divide

*accept chromatids **or** chromosomes separate*

1

identical (daughter) cells formed

*accept for example, skin cells make more skin cells **or** cells are clones*

1

(d) any **two** from

Differentiation *mark*

babies need **or** are made of different types of cells **or** cells that have different functions

accept different cells are needed for different organs

Division or specialisation *mark*

as fertilised egg starts to divide each cell specialises to form a part of the body

accept specialised cells make different parts of the body

Growth *mark*

specialised cells undergo mitosis to grow further cells

*accept cells divide **or** reproduce to form identical cells*

2

[8]

Q13.

(a) chromosomes

1

(b) diagram showing four separate chromosomes two long and two short (as in diagram 1)

allow each chromosome shown as two joined chromatids
*do **not** allow if chromosomes touching each other*

1

(c) (i) any **two** from:

- can grow into any type of tissue / named tissue
- used in medical research
- used to treat human diseases
- large numbers can be grown

2

(ii) any **two** from:

- expensive
- grow out of control / ref cancers
- may be rejected
- need for drugs (for rest of life)

2

[6]

Q14.

(a) any **two** from:

- right amount of nutrients **or** different / all foods
- right amount of energy
- for (individual) needs

'right amount' only needed once for both marks to be awarded

2

(b) (i) ovaries / ovary

allow placenta

1

(ii) any **one** from:

- inhibits follicle stimulating hormone / FSH production
- inhibits maturation of eggs

ignore ref to site of production of FSH

*allow stimulates LH production **or** stimulates preparation of womb lining*

1

(iii) any **one** from:

- stimulate muscle growth
- used in (oral) contraceptives

1

(c) small (rate of) decrease then bigger (rate of) decrease

1

idea that change of rate (of decrease) at 900 (mg per day)

*If no other mark awarded allow **1** mark for decrease*

1

(d) (i) gene(s) / nucleus / chromosome(s) / DNA

allow ribosome

1

(ii) reduces production of cholesterol (by liver)

allow idea of switching off gene for reductase (production)

allow switch off / reduce / inhibit reductase (production)

allow reduces absorption of cholesterol (by intestine)

allow statins (might) breakdown / destroy cholesterol

1

[9]

Mark schemes Bioenergetics

Q1.

(a) no oxygen (is used)

1

(b) muscles become fatigued / stop contracting

1

because not enough energy is transferred

1

(c) carbon dioxide

1

(d) count the bubbles

or

measure volume of gas

1

in a given time

1

(e) brewing / bread making

allow other suitable use of fermentation in food industry

1

[7]

Q2.

(a) (i) without <u>oxygen</u>

allow not enough oxygen

ignore air

ignore production of CO_2

ignore energy

1

(ii) more / high / increased lactic acid (at end)

allow approximate figures (to show increase)

ignore reference to glucose

1

(b) (i) 1.5

allow only 1.5 / 1½ / one and a half

1

(ii) increases at first **and** levels off

ignore subsequent decrease

1

suitable use of numbers eg

rises to 10 / by 9 (dm^3 per min)

or

increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale)

allow answer in range 1.4 to 1.5

or

after the first minute (of the run)

1

(iii) supplies (more) oxygen

1

supplies (more) glucose

1

need 'more/faster' once only for full marks

*allow removes (more) CO_2 / lactic acid / heat as an alternative for either marking point one **or** two, **once** only*

for (more) respiration

1

releases (more) energy (for muscle contraction)

*do **not** allow energy production or for respiration*

1

[9]

Q3.

(a) any **one** from:

ignore 'check temperature'

- add a water bath
- heat screen
- use LED
- low energy bulb / described

1

(b) (i) rate / number of bubbles decreases

*accept converse with reference to increasing light **or** shorter distance*

or

less oxygen / gas released

ignore reference to rate of photosynthesis

1

(ii) temperature / CO_2 (concentration)

*accept 'it was too cool' **or** not enough CO_2*

accept number of chloroplasts / amount of chlorophyll

allow heat

allow CO2

*do **not** allow CO^2*

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 **marks**

No relevant content.

Level 1 (1-2 marks)

There is a brief description of at least 1 tissue **or** at least 1 function of an indicated part of the leaf.

The account lacks clarity or detail.

Level 2 (3-4 marks)

There is a clear description which includes at least 1 named tissue and at least 1 correct function described for an indicated part of the leaf.

Level 3 (5-6 marks)
There is a detailed description of most of the structures and their functions.

Examples of responses:

- epidermis
- cover the plant
- mesophyll / palisade
- photosynthesises
- phloem
- xylem
- transport.

The following points are all acceptable but beyond the scope of the specification:

- (waxy) cuticle – reduce water loss
- epidermis – no chloroplasts so allows light to penetrate
- stomata / guard cells – allow CO_2 in (and O_2 out) **or** controls water loss
- palisade (mesophyll) – <u>many</u> chloroplasts to trap light
  – near top of leaf for receiving more light
- spongy (mesophyll) – air spaces for rapid movement of gases

6

[9]

Q4.

(a) LHS = water

1

RHS = glucose

1

(b) any **three** from:

- (measure) temperature
  ignore reference to fair test
- to check that the temperature isn't changing
- rate of reaction changes with temperature
- temperature is a variable that needs to be controlled
  allow lamp gives out heat

3

(c) (i) 10

*correct answer = **2** marks*

*allow **1** mark for:* $\frac{(10+9+11)}{3}$

*allow **1** mark for correct calculation without removal of anomalous result ie 15*

2

(ii) graph:

*allow ecf from **(c)(i)***

label on y-axis as 'number of bubbles per minute'

1

three points correct = **1** mark

allow ± 1 mm

four points correct = **2** marks

2

line of best fit = smooth curve

1

(iii) as distance increases, rate decreases – pro

allow yes between 20 – 40

1

but should be a straight line / but line curves – con / not quite pro

allow not between 10 – 20

if line of best fit is straight line, allow idea of poor fit

1

(d) any **four** from:

- make more profit / cost effective
- raising temp. to 25 °C makes very little difference at 0.03% CO_2
- (at 20 °C) with CO_2 at 0.1%, raises rate
- (at 20 °C with CO_2 at 0.1%) → >3x rate / rises from 5 to 17
- although 25 °C → higher rate, cost of heating not economical
- extra light does not increase rate / already max. rate with daylight

accept ref to profits c.f. costs must be favourable

4

[17]

Q5.

(a) circulating / mixing / described **or** temperature maintenance

1

supply oxygen
or for aerobic conditions
or for faster respiration

*do **not** allow oxygen for anaerobic respiration*

1

(b) energy supply / fuel / use in respiration

*do **not** allow just food / growth*

ignore reference to aerobic / anaerobic

or material for growth / to make mycoprotein

1

(c) respiration

allow exothermic reaction

allow catabolism

ignore metabolism

ignore aerobic / anaerobic

1

(d) (i) any **one** from:

- compete (with *Fusarium*) for food / oxygen **or** reduce yield of *Fusarium*
- make toxic waste products or they might cause disease / pathogenic **or** harmful to people / to *Fusarium*

*do **not** allow harmful unqualified*

1

(ii) steam / heat treat / sterilise fermenter (before use)

***not** just clean*

or
steam / heat treat / sterilise glucose / minerals / nutrients / water (before use)
or
filter / sterilise air intake
or
check there are no leaks

*allow sterilisation unqualified **not** just use pure glucose*

1

(e) any **three** from:

- beef is best or beef is better than mycoprotein
- mycoprotein <u>mainly</u> better than wheat
- more phenylalanine in wheat than in mycoprotein

allow equivalent numerical statements

- but no information given on other amino acids / costs / foods

3

<u>overall conclusion:</u>

statement is incorrect because
either
it would be the best source for vegetarians
or
for given amino acids, beef is the best source
or
three foods provide insufficient data to draw a valid conclusion

1

[10]

Q6.

(a) (i) <u>rate of</u> chemical reaction<u>s</u> (in the body)

1

(ii) any **two** from:

- heredity / inheritance / genetics
- proportion of muscle to fat **or** (body) mass

allow (body) weight / BMI

- age / growth rate

- gender

accept hormone balance or <u>environmental</u> temperature

ignore exercise / activity

2

(b) (i) 77

*correct answer with or without working gains **2** marks*

*allow **1** mark for 70 / 56 **or** 1.25 **or** 5*

2

(ii) increase exercise

accept a way of increasing exercise

1

reduce food intake

accept examples such as eat less fat / sugar

*allow go on a diet **or** take in fewer calories*

ignore lose weight

ignore medical treatments such as gastric band / liposuction

1

[7]

Q7.

(a) LHS – carbon dioxide / CO_2

allow CO2

ignore CO^2

1

RHS

in either order

glucose / carbohydrate / sugar

allow starch

allow $C_6H_{12}O_6$ / C6H12O6

ignore $C^6H^{12}O^6$

1

oxygen

allow O_2 / O2

ignore O^2 / O

1

(b) any **five** from:

- factor 1: CO^2 (concentration)
- effect - as CO_2 increases so does rate and then it levels off or shown in a graph
- explanation:
  (graph increases) because CO_2 is the raw material or <u>used</u> in photosynthesis / converted to organic substance / named eg
  or
  (graph levels off) when another factor limits the rate.

accept points made via an annotated / labelled graph

- factor 2: temperature

  allow warmth / heat

- effect – as temperature increases, so does the rate and then it decreases or shown in a graph

  allow 'it peaks' for description of both phases

- explanation:
  (rise in temp) increases rate of chemical reactions / more kinetic energy

  allow molecules move faster / more collisions

  or
  (decreases) because the enzyme is denatured.

  context must be clear = high temperature

  allow other factor plus effect plus explanation:

  eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves

  2nd or 3rd mark can be gained from correct description and explanation

5

[8]

Q8.

(a) anaerobic respiration

allow phonetic spelling

1

(b) (i) 4.4

4.2, 4.3, 4.5 or 4.6 with figures in tolerance (6.7 to 6.9 and 2.3 to 2.5) and correct working gains 2 marks

4.2, 4.3, 4.5 or 4.6 with no working shown or correct working with one reading out of tolerance gains 1 mark

correct readings from graph in the ranges of 6.7 to 6.9 ***and*** *2.3 to 2.5 but no answer / wrong answer gains 1 mark*

2

(ii) more energy is needed / used / released

do ***not*** *allow energy production*

(at 14 km per hour)

ignore work

1

not enough oxygen (can be taken in / can be supplied to muscles)

allow reference to oxygen debt

do ***not*** *allow less / no oxygen*

1

so more anaerobic respiration (to supply the extra energy) **or** more glucose changed to lactic acid

allow not enough aerobic respiration

1

[6]

Q9.

(a) (i) 50

1

(ii) 4

accept 3.9 – 4.0

1

(b) (i) glucose

1

oxygen

1

(ii) to release more energy

1

(c) correct readings from graph:

a = 120

b = 60

allow 60 - 61

1

calculation correct for candidate's figures:

e.g. a – b = 60

1

level of fitness correct for candidate's figures:

e.g. very fit

1

(d) any **four** from:

- higher heart rate (at 16 km / h) (so takes longer to slow to normal)
- more energy needed
- not enough O_2 supplied / more O_2 needed / reference to O_2-debt
- (more) anaerobic respiration
- (more) lactic acid made / to be broken down / to remove / to oxidise
- higher blood flow needed to deliver (the required amount of) oxygen.

'more' must be given at least once for full marks

do not allow more energy produced

allow higher blood flow to remove lactic acid / remove (additional) CO_2

4

[12]

Q10.

(a) 5624

***allow 2 marks** for:*

- *correct HR = 148 **and** correct SV = 38 plus wrong answer / no answer*

or

- *only one value correct **and** ecf for answer*

***allow 1 mark** for:*

- *incorrect values **and** ecf for answer*

or

- *only one value correct*

3

(b) (i) **Person 2** has low(er) stroke volume / SV / described

*eg **Person 2** pumps out smaller volume each beat*

*do **not** allow **Person 2** has lower heart rate*

1

(ii) **Person 1** sends <u>more blood</u> (to muscles / body / lungs)

1

(which) supplies (more) oxygen

1

(and) supplies (more) glucose

1

(faster rate of) respiration **or** transfers (more) energy for use

ignore aerobic / anaerobic

allow (more) energy release

allow aerobic respiration transfers / releases more energy (than anaerobic)

*do **not** allow makes (more) energy*

1

removes (more) CO2 / lactic acid / heat

allow less oxygen debt

or less lactic acid made
or (more) muscle contraction / less muscle fatigue

if no other mark awarded,

allow person 1 is fitter (than person 2) for max 1 mark

1

[9]

Q11.

(a) (i) LHS = water

accept H_2O

*do **not** accept H^2O / H2O*

1

RHS = oxygen

accept O_2

*do **not** accept O / O^2 / O2*

1

(ii) light / sunlight

ignore solar / sun / sunshine

*do **not** allow thermal / heat*

1

(iii) chloroplasts

allow chlorophyll

1

(b) (i) 20

1

(ii) any **one** from:

- light (intensity)
- temperature.

1

(c) (i) To increase the rate of growth of the tomato plants

1

(ii) Because it would cost more money than using 0.08%

1

Because it would not increase the rate of photosynthesis of the tomato plants any further

1

[9]

Mark scheme Homeostasis

Q1.

(a) pupils dilated (at **B**)

*allow converse for **A***

1

in dim light / low light levels

1

because circular muscles (in iris) relax

1

(and) radial muscles contract

1

(b) figure 2 shows myopia where light does not focus on the retina

allow refraction

1

in figure 3 the lens bends the light so that light focuses on the retina

1

[6]

Q2.

(a) any **two** from:

- drop the ruler from the same height each time
- let the ruler drop without using any force

- same type / weight of ruler
- thumb should be same distance from the ruler each time at the start
- use the same hand to catch the ruler each time
- carry out the experiment with the lower arm resting in the same way on the table

allow description of holding bottom edge of ruler opposite the catcher's thumb

2

(b) 117

1

(c) $\sqrt{\frac{11.6}{490}}$

1

0.1539

*allow 01539 with no working shown for **2** marks*

1

0.154

*allow 0.154 with no working shown for **3** marks*

1

allow ecf as appropriate

(d) no indication beforehand when the colour will change

or

you might be able to tell when the person is about to drop the ruler

1

measurement of time is more precise (than reading from a ruler)

or

resolution (of computer timer) is higher

1

(e) cerebral cortex

allow cerebrum

1

ignore identified lobes

(f) cerebellum

1

[10]

Q3.

(a) any **two** from:

- drop the ruler from the same height
- use the same / dominant hand each time
- thumb same distance from ruler at the start
- use same type / weight of ruler
- drop the ruler without any force each time
- keep arm resting on the edge of the table

2

(b) 8

allow 8.0

1

(c) 2 (in test number 2)

1

(d) 12

1

(e) (12 + 13 + 13 + 9 + 8 / 5 =) 11

1

(f) 0.15 − 0.12 (s)

1

0.03 (s)

*allow 0.03 (s) with no working shown for **2** marks*

1

(g) carry out more repeats

1

(h) caffeine speeds up reflex actions

or

reduces reaction time

1

[10]

Q4.

(a) if too high <u>insulin</u> released from pancreas

1

so glucose is moved into cells

allow glucose is stored

1

if too low, <u>glucagon</u> is released (from pancreas)

1

causes glycogen to be converted to glucose <u>and</u> released into the blood

1

(b) type 1 not enough / no insulin produced

1

whereas type 2 cells do not respond to insulin

1

type 1 is treated with injections of insulin

1

whereas type 2 is treated with diet and exercise

or

loss of weight

or

drugs

1

(c) $(3.45 \times 10^6) + (5.49 \times 10^5) = 3.999 \times 10^6$

or

3 450 000 + 549 000 = 3 999 000

*allow 3.999×10^6 **or** 3 999 000 with no working shown for **1** mark*

1

$$\frac{3.999 \times 10^6}{6.5 \times 10^7} \times 100$$

or

$$\frac{3\,999\,000}{65\,000\,000} \times 100$$

= 6.15

*allow 6.15 with no working shown for **2** marks*

*allow for **1** mark for a calculation using either:*

$$\frac{3.45 \times 10^6}{6.5 \times 10^7}$$

or

$$\frac{3\,450\,000}{65\,000\,000}$$

or

$$\frac{5.49 \times 10^6}{6.5 \times 10^7}$$

or

$$\frac{549\,000}{65\,000\,000}$$

1

6.2

*allow 6.2 with no working shown for **3** marks*

1

*allow ecf from second step correctly rounded for **1** mark*

(d) could be other reasons for glucose in urine

or

blood test gives current / immediate result, urine levels might be several hours old

or

not always glucose in urine

1

(e) results not affected by glucose from food

or

8 hours is sufficient time for insulin to have acted on any glucose from food eaten

or

so that there is a low starting point to show the effect

1

(f) (patient **A**)

*no mark for identifying **A***

glucose level much higher (than **B**)

1

and remains high / does not fall

1

[15]

Q5.

(a) **A** sperm

1

B egg

1

C fertilised egg

1

D embryo

1

(b) insert into mother

ignore fertilise / check fertilisation / check viability

1

womb / uterus

1

(c) (i) one quarter

1

(ii) no / little chance of success over 42

1

reference to table of only two women in the age bracket 40-42 years became pregnant

*the statement 'only 2 out of 53 40-42 year old women became pregnant / had babies' gains **2** marks*

1

(iii) so fewer twins / multiple births
or
multiple births more dangerous

1

[10]

Q6.

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1 – 2 marks)

There is a description of thermoregulation **or** at least one correct mechanism (skin, sweat glands or muscles) but roles may be confused.

Level 2 (3 – 4 marks)

There is a description of thermoregulation **or** some correct mechanisms (sweating, shivering, blood flow in the skin).

Level 3 (5 – 6 marks)

There is a clear description of thermoregulation by TC or skin **and** some correct control mechanisms.

examples of biology points made in the response:

full marks may be awarded for detailed description of what happens if the core temperature is <u>either</u> too high <u>or</u> too low

- temperature receptors in TC
- the TC detects (core) body / blood temperature
- temperature receptors in the skin send impulses to the TC, giving information about skin temperature
- if the core body temperature is too high: blood vessels / arterioles supplying the skin capillaries dilate / vasodilation

  ***do not** accept refs to veins instead of arterioles or answers that imply blood vessels have moved up / down through the skin.*
- so that more blood flows (through the skin) and more heat is lost
- sweat glands release more sweat to cool the body
- by evaporation
- if the core body temperature is too low: blood vessels supplying the skin capillaries constrict
- to reduce the flow of blood (through the skin) and less heat is lost

  allow idea of blood diverted to vital organs in extreme cold
- muscles may shiver to release (heat) energy
- from respiration, some of which is lost as heat

[6]

Q7.

(a) sensory neurone

1

(b) (i) synapse

1

(ii) a chemical

1

(c) (What happens to the muscle)

mark both parts of the question together

any **one** from:

- contraction / contracts

  ignore relaxation / relaxes / tenses

1

- gets shorter

(How this helps the body)

idea of protection for body (from damage / pain)

eg moves finger / arm away (from pin / stimulus / source of pain)

1

[5]

Q8.

(a) motor

allow efferent / postsynaptic

*allow **another** relay (neurone)*

1

(b) release of chemical (from relay neurone)

allow ecf for 'motor' neurone from (a)

allow release of neurotransmitter / named example

1

chemical crosses gap / junction / synapse

allow diffuses across

allow chemical moves to X

1

chemical attaches to X / motor / next neurone (causing impulse)

1

(c) (curare) decrease / no contraction

accept (muscle) relaxes

1

(strychnine) increase / more contraction

*if no other mark awarded allow 1 mark for (curare) decrease / no response **and** (strychnine) increase / more response*

1

[6]

Q9.

(a) receptors detect / sense stimuli / change in surroundings **or** convert stimulus into an impulse

ignore send impulses to brain / spinal cord

1

example of a receptor

allow any appropriate organ or part of an organ, eg eye / retina or named type of receptor eg light receptor

1

effectors allow / make response **or** convert an impulse to an action

ignore receive impulses from brain / spinal cord

1

(effector) muscle / gland

allow an example

ignore eg arm / leg

1

(b) (i) junction

allow idea of a (small) gap / space

*do **not** allow if implication is that the neurones move*

1

between neuron(e)s

allow named types of neurones

1

(ii) chemical

allow answers in terms of specific types of neurone

allow neurotransmitter / named neurotransmitter released

1

any **one** from:

- (chemical released) from one neurone

  ignore produced

- (chemical) passes (across synapse) to next neurone to stimulate / cause (electrical) impulse

  allow diffuses for passes (across)

1

(c) (i) skin

ignore hand / leg

1

(ii) 1.6 (cm per millisecond)

allow 2 if evidence of rounding up of 1.6

1

(iii) any **two** from:

ignore length of neurones

- synapses slow down transmission / impulse

  allow idea of movement of chemical being slower than electrical impulse

- fewer synapses (via brain)

  *allow one synapse compared to two **or** only one synapse*

- (therefore) fewer delays

  allow impulse travels more slowly in relay neurones

2

[12]

Q10.

(a) Too much thyroxine is released into the blood

1

which raises BMR

1

causing increase in formation of glycogen / lipids / proteins

or

increase in rate of respiration

or

increase in breakdown of excess proteins

1

(b) FSH causes eggs to mature and stimulate ovaries to produce oestrogen

1

LH stimulates the egg to be released

1

(c) (missing a dose causes a) dip / drop in progesterone levels

1

(therefore) FSH is not inhibited anymore

1

(therefore) LH is not inhibited anymore

1

(and consequently) an egg is matured and released

allow (and consequently) an egg is available to be fertilised

1

[9]

Q11.

(a) (i) stimulus

1

(ii) cytoplasm

1

(b) (i) ear(s)

in this order only

1

eye(s)

accept retina

1

skin

ignore extra detail

1

(ii) A muscle

1

[6]

Q12.

(a) (i) chemical

1

(ii) pituitary gland

1

(b) 8

allow 9 or 10

1

(c) (i) any **four** from:

- progesterone starts being produced at 4 weeks / no progesterone before 4

weeks

- and then / from 4 weeks increases
- oestrogen at constant / low level (from 0) to 20 weeks
- and then / from 20 weeks increases
- from 20 − 36 weeks level of O rises more steeply than that of P

or

- P is always higher than 0 from 6 to 36 weeks

*if no other marks awarded, allow progesterone and oestrogen both increase / rise for **1** mark.*

4

(ii) oxytocin

1

level of oxytocin increases just before birth

1

[9]

Q13.

(a) (i) follicle stimulating hormone / FSH

1

(ii) oestrogen

1

(b) (i) any **one** from:

- to help them have a baby / get pregnant

  ignore to make them fertile
- to stimulate egg production / release / maturation
- own levels of FSH / LH / hormone (too) low

  allow to increase hormone / FSH / LH levels

  do not allow to increase oestrogen levels

1

(ii) through the bloodstream

1

(c) oestrogen

1

progesterone

1

[6]

Q14.

(a) ovary

1

(b) 46

1

(c) (i) does not fit the pattern

or

it is higher than the 3rd value / it should be lower than the 3rd value / it should be between the 3rd and 5th values

*do **not** allow use of incorrect figures*

1

(ii) As age increases % of women (having a baby) decreases

1

(d) (i) 33

$$\frac{66}{2}$$

allow 1 mark for

if no answer / wrong answer

2

(ii) low success rate

1

more likely to have a baby with health problems / abnormalities / a faulty chromosome

1

[8]

Mark scheme Inheritance

Q1.

(a) phosphate

allow PO_4^{3-}

1

*do **not** allow P*

(b) A / adenine and T / thymine

and

C / cytosine and G / guanine

*do **not** allow U / uracil*

1

(c) (mutation) changes from C to T DNA code

or

there is a change in the three bases / triplet from CAG to TAG

1

(mutation) changes the amino acid

1

(this could) change the protein

1

(so it) forms a different shape / changed active site

accept different tertiary structure

1

(therefore) the enzyme no longer fits the substrate / carbohydrate

1

(d) mother / woman's gametes correct: A a

1

father / man's gametes correct: a a

1

correct derivation of offspring

ecf

1

identification of child with syndrome H or genotype aa

1

0.5

ecf

allow 50% / 1 / 2 / 1 in 2 / 1:1

1

*do **not** accept 1:2*

[12]

Q2.

(a) (i) man has (inherited) polydactyly (PD) allele (from mother)

1

man has (inherited) other / normal / recessive allele from father

1

because father does not have PD allele **or** if father had it father would have had PD **or** father only has normal allele **or** father is homozygous recessive

1

allow gene for allele

(ii) 0.5 / ½ / 1 in 2 / 1:1 / 50%

do not allow 1:2 or 50/50

allow 50:50

1

(b) parental phenotypes: both brown

1

parental genotypes: both **Bb**

1

gametes: **B b** and **B b**

1

allow only on gametes answer line

allow ecf from genotypes

offspring genotypes: **BB (2)Bb bb**

allow ecf from gametes

1

offspring phenotypes correctly assigned to genotypes:

BB & **Bb** = brown **bb** = red

do not penalise confusion of 'phenotypes' & 'genotypes' here

1

[9]

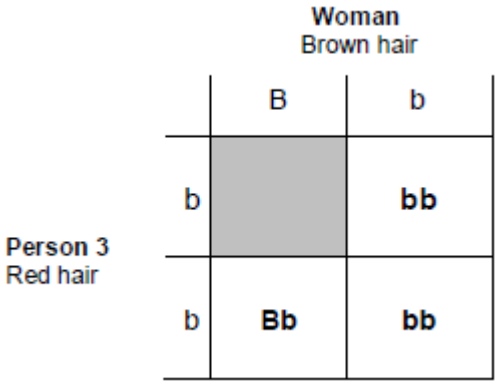
Q3.

(a) When the dominant allele is not present.

1

(b) (i) Bb

1



(ii)

3 correct = 2 marks

2 correct = 1 mark

1 or 0 correct = 0 marks

allow bB for Bb

2

(iii) 1 in 2

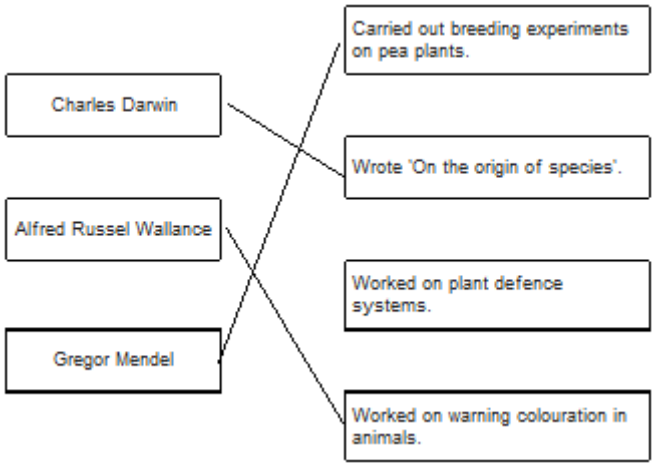
allow ecf from part ii

1

[5]

Q4.

(a)



3

(b) a gene

allow allele

1

(c) 4

1

(d) correct derivation of children's genotypes

1

identification of children with cystic fibrosis (dd)

1

0.25

allow ecf

allow ¼ / 25% / 1 in 4 / 1:3

1

*do **not** accept 1:4*

(e) heterozygous

1

[9]

Q5.

(a) (i) gametes

apply list principle

1

(ii) chromosomes

apply list principle

1

(b) (i) The allele is recessive

no mark if more than one box is ticked

1

(ii) two

apply list principle

1

(c) (i) **A**

apply list principle

1

(ii) **B**

apply list principle

1

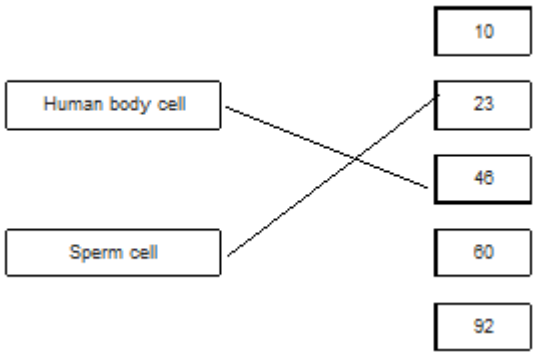
[6]

Q6.

(a) **A**

1

(b)



2

(c) one x circled under mother

accept if clearly indicated choice even if not circled

1

(d) XY

allow YX

1

(e) 50 (%)

1

[6]

Q7.

(a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols with a key*

allow as gametes shown in Punnett square

1

aa in offspring correctly derived from parents
or
aa correctly derived from the parents given

ignore other offspring / gametes

for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

accept converse if clear, eg if you (only) took one it might have cystic fibrosis / might not be fertilised

- (more) sure / greater chance of healthy / non-cystic fibrosis egg / embryo / child

  accept some may have the allele

  reference to 'suitable / good embryo' is insufficient

- greater chance of fertilisation

1

(ii) **advantages**

to gain 3 marks both advantage(s) <u>and</u> disadvantage(s) must be given

max 3

any **two** from:

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

disadvantages

any **two** from:

- operation dangers / named eg infection

  ignore risk unqualified

- ethical or religious issues linked with killing embryos

  accept wrong / cruel to embryos accept right to life argument

  ignore embryos are destroyed

- (high) cost of procedure
- possible damage to embryo (during testing for cystic fibrosis / operation)

plus

conclusion

a statement that implies a qualified value judgement
eg it is right because the child will (probably) not have cystic fibrosis even though it is expensive
or
eg it is wrong because embryos are killed despite a greater chance of having a healthy baby

***note**: the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage is made*

*do **not** award the mark if the conclusion only states that advantages outweigh the disadvantages*

1

(c) any **three** from:

- osmosis / diffusion

  *do **not** accept movement of ions / solution by osmosis / diffusion*

- more concentrated solution outside cell / in mucus

  assume concentration is concentration of solute unless answer indicates otherwise or accept correct description of 'water concentration'

- water moves from dilute to more concentrated solution

  allow correct references to movement of water in relation to concentration gradient

- partially permeable membrane (of cell)

  allow semi / selectively permeable

3

[11]

Q8.

(a) DNA

1

(b) X and Y

1

(c) (i) 46 chromosomes

1

(ii) half the number

1

(d) meiosis

1

[5]

Q9.

(a) (i) in the chromosome(s)

ignore genes / alleles

1

in the nucleus

allow nuclei

allow mitochondria

1

(ii) the DNA / chromosomes / genes are replicated / copied / multiplied / doubled / duplicated

allow DNA is cloned

ignore same DNA / chromosomes / genes if unqualified

1

(b) (i) 1 / one

1

(ii) 2 / two

1

(c) **B**

1

[6]

Q10.

(a) (i) nucleus

correct spelling only

accept mitochondrion

ignore genes / genetic material / chromosomes

1

(ii) base(s)

Accept all four correct names of bases

ignore nucleotides and refs to organic / N-containing

1

(iii) 4

1

(iv) codes for sequence / order of amino acids

ignore references to characteristics

1

codes for a (specific) protein / enzyme

or

the sequence / order of <u>three</u> bases / compounds / letters

codes for a specific amino acid

or

the sequence / order of 3 bases / compounds / letters

codes for the order / sequence of amino acids

1

(b) (i) DNA

1

circular / a ring **or** a vector / described

1

(ii) kills any cells not having **kan^r** gene / so only cells with **kan^r** gene survive

1

hence surviving cells will also contain **Bt** gene / plasmid

1

(iii) cells divide by <u>mitosis</u>

ignore ref to asexual reproduction

correct spelling only

1

genetic information is copied / each cell receives a copy of (all) the gene(s) / all cells produced are genetically identical / form a clone

1

(iv) any **two** from:

- gene may be passed to pathogenic bacteria
- cannot then kill these pathogens with kanamycin
  or
  cannot treat disease with kanamycin
- may need to develop new antibiotics
- gene may get into other organisms
- outcome unpredictable

2

[13]

Q11.

(a) (i) 3.15 : 1

accept 3.147:1 ***or*** *3.1 : 1* ***or*** *3 : 1*

do ***not*** *accept 3.14 : 1*

Ignore 705:224

1

(ii) any **two** from:

- fertilisation is random **or** ref. to chance combinations (of alleles / genes / chromosomes)
- more likely to get theoretical ratios **or** see (correct) pattern **or** get valid results if large number

  allow ref. to more representative / reliable

  *do **not** allow more accurate **or** precise*

  ignore fair / repeatable
- anomalies have limited effect / anomalies can be identified

  accept example of an anomaly

2

(b) (i) in sequence:

Homozygous
Homozygous
Heterozygous

All 3 correct = 2 marks

2 correct = 1 mark

1 or 0 correct = 0 marks

2

(ii) genetic diagram including:

Parental genotypes: **Nn** and **Nn**

allow other characters / symbols only if clearly defined

1

or

Gametes: **N** and **n + N** and **n** derivation of offspring genotypes: **NN Nn Nn nn**

allow genotypes correctly derived from candidate's P gametes

1

identification: **NN** and **Nn** as purple **and nn** as white

allow correct identification of candidate's offspring genotypes but only if some F_2 are purple and some are white

1

(c) any **two** from:

- did not know about chromosomes / genes / DNA **or** did not know chromosomes occurred in pairs

  ignore genetics
- had pre-conceived theories

  eg blending of inherited characters

  ignore religious ideas unless qualified
- Mendel's (mathematical) approach was novel concept

  allow his work was not understood or no other scientist had similar ideas
- Mendel was not part of academic establishment

  allow he was not considered to be a scientist / not well known / he was

only a monk

- work published in obscure journal / work lost for many years
- peas gave unusual results cf other species

  allow he only worked on pea plants

- Mendel's results were not corroborated until later / 1900

2

[10]

Mark scheme Ecology

Q1.

(a) snail

or

shrew

additional incorrect answer negates correct answer

1

(b) shrew

additional incorrect answer negates correct answer

1

(c) fewer shrews to eat them

1

(d) population

1

(e) **C**

1

(f) (11 000 × 0.1 =)

1 100 (kJ)

1

(g) the snails do not eat the roots of the lettuces

1

(h) any **one** from:

- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)
- wind intensity / speed

  ignore wind direction
- carbon dioxide (levels)
- oxygen (levels)

1

[8]

Q2.

(a) measure the length / area of the field

1

(b) use (a) random number(s) (generator)

or

use coordinates method explained

1

(c) compare their results with another student's results

1

place more quadrats

1

(d) 0.25 × 5 = 1.25

1

500 / 1.25 = 400

1

(40 × 400 =) 16 000

*allow 16 000 with no working shown for **3** marks*

1

(e) 11

1

(f) (quadrat) 5

*both quadrat number and correct reason must be given for **1** mark*

1

very few or only 2 growing (here)

[9]

Q3.

(a) wear a face mask

allow wear gloves

1

(b) **Level 2 (3–4 marks):**

A detailed and coherent plan covering all the major steps. It sets out the steps needed in a logical manner that could be followed by another person to produce an outcome which will address the hypothesis.

Level 1 (1–2 marks):

Simple statements relating to steps are made but they may not be in a logical order. The plan may not allow another person to produce an outcome which will address the hypothesis.

0 marks:

No relevant content.

Indicative content

Plan:

- cut a specified number of pieces of bread to the same size
- place mould spores on the bread
- the number of mould spores needs to be the same quantity of mould spores on each piece of bread
- place bread in different sealable plastic bags
- place in different temperatures (minimum of three) eg fridge, room, incubator
- leave each for the same amount of time eg four days
- measure the percentage cover of mould on each piece of bread
- repeat experiment

additional examiner guidance:

- good level 2 answer will describe how the growth of mould can be measured and

will give a range of different temperatures to be used

- allow equivalent levels of credit for alternative methodologies that would clearly produce a measurable outcome in terms of mould growth at various temperatures

4

(c) any **one** from:

- type of mould
- amount of mould (put on each piece of bread)
- amount of air in the plastic bags
- size of the pieces of bread
- type of bread
- amount of moisture / water added

1

(d) (56 − 4 = 52) / 5

1

10.4

*allow 10.4 with no working shown for **2** marks*

1

*ecf for incorrectly read figures for **1** mark*

(e) (decomposition occurs at a faster rate when the temperature is higher

or

amount of decomposition is higher when temperature is higher

1

[9]

Q4.

(a) (i) any **two** from:

- not all eaten

  allow eaten by other animals
- used for respiration

  ignore used / lost in heat / movement
- lost as CO_2 / water / urea
- lost as faeces **or** not all digested

  if neither mark awarded allow 1 mark for lost as waste

  ignore references to energy losses

  do not allow for growth / repair / reproduction

2

(ii) any **one** from:

- thrushes eat other things
- thrush numbers likely to vary (considerably)

  *allow it is only an estimate (of population size) **or** only counted thrushes for 5 hours*
- thrushes were not present all the time
- thrushes feed on a much bigger area

1

(b) (i) any **one** from:

- there are two dependent variables
- there is no independent variable
- to show the association / correlation / pattern (between the two variables)

1

(ii) (snails in woodlands)

more have dark(er) colour(ed shells) **or** fewer have light-coloured shells

allow converse for grassland, if clear

1

(shells have) no / fewer stripes or have no stripes

allow converse for grassland, if clear

1

(iii) less likely to be seen (by predators / birds / thrushes)

allow camouflaged (from predators / birds / thrushes)

allow light coloured shells with stripes would be more visible (to predators / birds / thrushes in woodland (than grassland)).

1

[7]

Q5.

(a) (i) correct bar heights

*three correct **2** marks*

*two correct **1** mark*

*one or none correct **0** marks*

ignore width

2

(ii) (Stream Y)

has many sludge worms / bloodworms

or

has no mayflies / caddis or few shrimp

*allow **1** mark if invertebrate not named but correct association given*

1

which indicate medium or high pollution

1

(b) (i) suspended solids increase (as a result of sewage overflow)

1

then decrease downstream / return to original levels

1

oxygen levels decrease (after sewage overflow)

1

and then rise again

1

(ii) any **three** from:

- mayflies decrease (to zero) near overflow

  accept 'have died out'
- because oxygen is low **or** mayflies have high oxygen demand
- mayflies repopulate / increase as oxygen increases again
- can't be sure if dissolved oxygen or suspended solids is the cause

3

(c) they respire / respiration

*aerobic respiration gains **2** marks*

1

this requires / uses up the oxygen

1

[13]

Q6.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1 – 2 marks)

At least **one** way in which animals **and / or** plants are adapted to survive.

Level 2 (3 – 4 marks)

A description of ways in which animals **and / or** plants are adapted **and** an attempt to link at least **one** adaptation to how it increases the chance of survival.

Level 3 (5 – 6 marks)

A description of ways in which animals **and** plants are adapted **and** a description of how at least **one** adaptation increases the chance of survival.

examples of biology points made in the response:

(animals)

(A) change / decrease in surface area / example

(decrease in surface area which) reduces area from which sweat / water may be lost

(A) hump with fat / fat stores

(fat in hump) to convert to water (via respiration)

(A) long eyelashes

(long eyelashes) to keep (wind-blown) dust out of eyes

(A) nocturnal / 'keep out of the sun'

reduce sweat loss (in heat of the day)

extra information

allow adaptations of specific animals to living in specified dry conditions, eg a desert

(A) change / increase in surface area / example

(increase in surface area which) increases area heat may be lost from (by radiation)

(A) changes to thickness of insulating coat

(thicker coat on upper surface) increases insulation from sun's heat

(A) thin (layer) / reduced amount of body fat

(reduced amount of body fat which) reduces insulating layer

(A) wide feet

(wide feet) to reduce pressure / spread weight / prevent sinking

(plants)

(A) decrease in surface area

(A) leaves are spikes

(reduced area / leaves are spikes) reduces water loss / transpiration / evaporation

(A) long / wide spread / extensive roots

(long / wide spread /extensive roots) to absorb (more) water

(A) fleshy / thick stem

(fleshy / thick stem) to store water

extra information

allow adaptations of specific plants to living in specified dry conditions, eg a desert

(A) thick wax

(thick wax) to reduce evaporation / water loss / transpiration

(A) few(er) stomata

(few stomata) to reduce evaporation / water loss / transpiration

[6]

Q7.

(a) 16

*accept correct answer for **2** marks, irrespective of working*

*if no answer **or** answer incorrect accept 0.64 x 100 / 4 (.0) **or** 0.16 for **1** mark*

2

(b) insect cold-blooded / not warm blooded **or** does not control body temperature

accept mammal warm-blooded / constant (high) body temperature / controls body temperature

1

reference to insect 0.96 (kJ) **and** mammal 12.25 (kJ) transferred by respiration **or** relevant calculation of this transfer

ignore references to other data

1

(less respiration) so more energy / biomass / food available (for growth of insect)

(more respiration) so less energy / biomass / food available (for growth

of mammal)

1

[5]

Q8.

(a) (i) triangular pyramid with 3 layers

may be as blocks or as triangle

ignore food chains and arrows

1

layers appropriately labelled:
bean / plant

aphid,

ladybird

*labelled in food chain order must **not** contradict correct pyramid*

*allow correctly labelled inverted pyramid for **2** marks*

1

(ii) any **two** from:
(for aphid / ladybird)

ignore energy

- not all digested / faeces
- loss in urine
- loss of CO_2

ignore loss of CO_2 from bean plant

- not all eaten

*if none of first 3 points given then allow waste (materials) / excretion for **1** mark*

2

(b) microorganisms / microbes / bacteria / fungi / decomposers / detritivores /named

*do **not** accept germs*

allow mould

ignore aphids

1

decay / breakdown / digest / decompose / rot (bean plant)

ignore eat

1

respiration (of microorganisms etc / aphids)

allow burning / combustion

1

carbon dioxide released (from respiration of microorganisms etc / aphids)

allow carbon dioxide released / produced (from burning / combustion)

ignore other parts of the carbon cycle
ignore formation of fossil fuels

1

[8]

Q9.

(a) (i) to get data re position of seaweed / of organism

1

in relation to distance from sea / distance down shore / how long each seaweed was exposed

1

(ii) repeat several times

minimum = 2 repeats

1

elsewhere along the shore

1

(iii) bladder wrack is further up the shore (than the sea lettuce) / exposed for longer

ignore found in dry areas / on bare rock

1

sea lettuce (only) in rock pools / in the sea / (only) in water

1

(b) gets more light / closer to light

allow better access to CO_2

1

(so) more photosynthesis

allow 1 mark for light for photosynthesis

allow 1 mark for CO_2 for photosynthesis

ignore reference to oxygen for respiration

'more' only needed once for 2 marks

1

[8]

Q10.

(a) (i) counts / 12

1

× 120 × 80 / × 9600

or

× area of field

1

(ii) (more) quadrats / repeats

1

placed randomly

ignore method of achieving randomness

1

(b) (i) any **three** from:

- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)

allow nutrients / fertiliser / soil fertility

ignore food

- pH (of soil)
- trampling
- herbivores

  ignore predators
- competition (with other species)
- pollution qualified e.g. SO_2 / herbicide
- wind (related to seed dispersal).

  ignore space / oxygen / CO_2 / soil unqualified

3

(ii) light needed for photosynthesis

1

for making food / sugar / etc.

1

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

1

(c) (i) fertiliser / ions / salts cause growth of algae / plants

1

(algae / plants) block light

1

(low light) causes algae / plants to die

1

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

1

(aerobic) <u>respiration</u> (by microbes) uses O_2

*do **not** allow anaerobic*

1

(ii) sewage / toxic chemicals / correct named example eg metals / bleach / disinfectant / detergent etc

allow suitable named examples eg metals such as Pb / Zn / Cr / oil / SO_2 / acid rain / pesticides / litter

ignore chemicals unqualified

ignore waste unqualified

ignore human waste / domestic waste / industrial waste unqualified

1

(d) (i) 2

1

(ii) more food

allow other sensible suggestion eg more species colonise from tributary streams after forest

1

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

allow fewer species in more polluted water

ignore none are found at site C

1

[19]

Q11.

(a) any **two** from:

- amount of waste on each heap

  allow size of heap

- (type of) materials on each heap

  *if neither marking points one or two awarded, allow **1** mark for same waste*

- put heaps in same (environmental) conditions.

  e.g. keep at same (outside) temperature

  allow put in same place

2

(b) microorganisms / microbes / bacteria / fungi / decomposers

ignore detritivores / examples (such as worms, maggots, insects)

ignore pathogens / germs

*do **not** allow viruses*

1

(c) (i) oxygen / air added (when turning over)

allow idea that decay will be aerobic

allow bacteria / microorganisms need oxygen / air

allow (microorganisms) respire faster

1

(ii) any **two** from:

- dead leaves / fruit / plants (fall off / onto the ground)
- (fallen dead leaves / fruit / plants) decay
- minerals / ions / nutrients are recycled / released.

ignore references to carbon dioxide

*allow animal waste **or** dead animals*

2

[6]

Q12.

(a) methane / CH_4

allow CH_4

*do **not** allow CH^4 **or** ch4 or CH4*

1

(b) any **two** from:

- didn’t carry out repeats
- only tested four types of manure
- don’t know the mass of manure was the same each time
- inaccuracies in measuring (diameter of) balloon
- bottles might have been different sizes
- temperature of the room may have been different.

2

(c) The potato contains a lot of carbohydrate

1

[4]

Q13.

(a) photosynthesis

1

(b) (i) 140

1

(ii) (10 billion tonnes) more added (to atmosphere) than removed

allow ecf from part (b)(i)

1

[3]