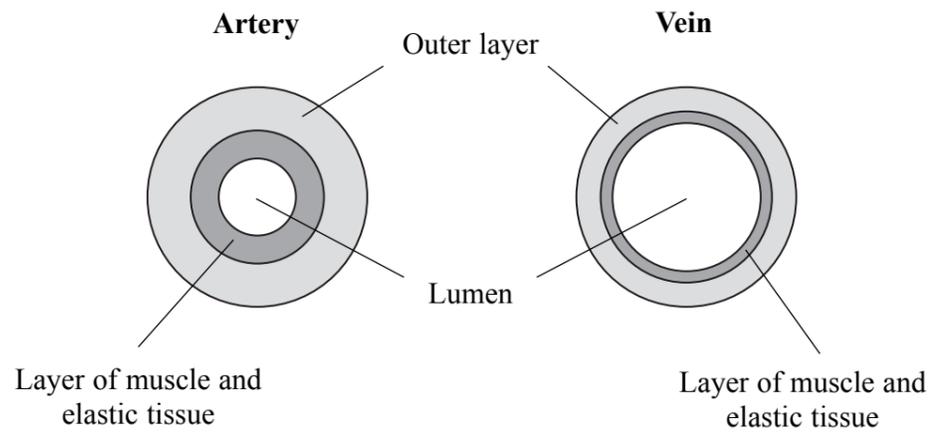




**Answer ALL the questions.**

1. The diagram below shows two types of blood vessels found in the body.



(a) Give **three** ways **shown in the diagram** that the artery differs from the vein.

- 1 .....
- .....
- 2 .....
- .....
- 3 .....
- .....

**(3)**



Leave blank

(b) Identify the blood vessels that do each of the following.

(i) Carries blood from the lungs to the heart

..... (1)

(ii) Carries blood away from the kidney

..... (1)

(iii) Carries blood with the highest oxygen content

..... (1)

(iv) Carries blood with the highest carbon dioxide content

..... (1)

(v) Carries blood with the lowest urea content

..... (1)

(c) The capillaries are the blood vessels in which most exchange of materials takes place. Describe how the capillaries are adapted for this role.

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.....  
.....  
.....  
.....  
.....  
..... (2)

(Total 10 marks)

Q1

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2. *Drosophila* (the fruit fly) is often used in genetic investigations. One strain of *Drosophila* has very small wings and these are called 'vestigial'. Normal flies have long wings. *Drosophila* with vestigial wings are unable to fly.



*Drosophila* with vestigial wings



*Drosophila* with normal wings

A scientist carried out a series of genetic crosses to investigate the inheritance of wing length.

Cross 1 was between 10 female flies with vestigial wings and 10 male flies with normal wings. She counted the offspring and recorded their phenotypes in the table below.

Number of flies	Sex of flies	Phenotype
160	female	normal wings
151	male	normal wings

(a) (i) Calculate the ratio of female to male flies in the offspring of cross 1.

..... (1)

(ii) What is the expected ratio?

..... (1)

(b) The scientist thought that the gene controlling wing length has two alleles, one for normal wings and one for vestigial wings.

Which allele is dominant? Explain your answer.

.....  
 .....  
 .....  
 ..... (2)



(c) She then carried out a second cross (cross 2). She took 10 female flies with normal wings and 10 male flies with normal wings from cross 1 and mated them together.

She counted the offspring and recorded the phenotypes in the table below.

Number of flies	Phenotype
68	vestigial wings
241	normal wings

(i) Complete the genetic diagram below to show this cross.

Parents

Gametes

Genotypes of offspring

Phenotypes of offspring

(4)

(ii) The actual numbers of each type of fly differed from what she was expecting.

Using her results, calculate the observed ratio of flies with normal wings to flies with vestigial wings.

..... (1)

(iii) Suggest **one** reason why there were fewer flies with vestigial wings than expected in the offspring.

.....  
 .....  
 ..... (1)



(d) During mating, the *Drosophila* males court the females by vibrating their wings to produce a 'courtship song'. Suggest why males with vestigial wings would be less successful in courtship.

.....  
.....  
.....

(2)

(Total 12 marks)

Leave  
blank

Q2



3. Living organisms can be placed into one of five major groups according to their characteristics. Complete the table below by inserting either a group or an example.

Group	Example
Plants	
	Housefly
Bacteria	
	Mucor
Virus	HIV

(Total 4 marks)

Leave blank

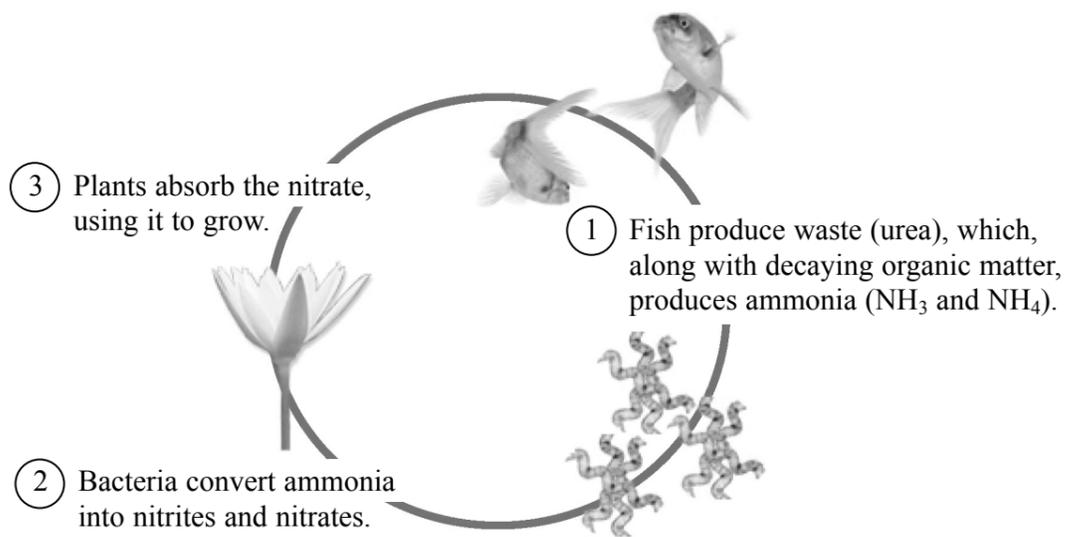
Q3

7

Turn over



4. The diagram below comes from a guide to keeping fish. It shows part of the nitrogen cycle and how this can affect the water in an aquarium used to keep fish.



(a) (i) Name the process shown as 2 on the diagram.

..... (1)

(ii) Explain how the plants use nitrate for growth.

.....  
.....  
.....  
..... (2)





Leave  
blank

(b) The guide suggests that there are two situations that should be avoided. The first is too many fish and the second is too few plants.

(i) Suggest how too many fish could lead to problems in the aquarium.

.....  
.....  
.....  
.....  
.....  
.....

(3)

(ii) Suggest how too few plants could lead to problems in the aquarium.

.....  
.....  
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.....  
.....  
.....

(3)

Q4

(Total 9 marks)



5. Different species of plants have different numbers of chromosomes.

Small Cord-grass (*Spartina maritima*) is a native plant of the saltmarshes and mud flats found along the Atlantic coast of Europe and Africa. It has a diploid number  $2n = 60$ .



Common Cord-grass, *Spartina anglica*

Smooth Cord-grass (*S. alterniflora*) is found in similar habitats on the Atlantic coast of North America. It has a diploid number  $2n = 62$ . This species was introduced into southern England in the 1800s.

By 1870, botanists had found a new type of Cord-grass with the diploid number  $2n = 61$ . This was the offspring of a cross (hybrid) between *S. maritima* and *S. alterniflora*. They called this *S. townsendii*. This hybrid was sterile.

Then in the 1890s a new fertile species called Common Cord-grass (*S. anglica*) was observed, with a diploid number  $2n = 122$ . This quickly spread around British and European coasts. The plant grows quickly and stops the mud from being washed away so its spread was encouraged. However, this has had a severe impact on the invertebrates and birds that live on the bare mud.

(a) Explain what is meant by diploid number.

.....  
..... (1)

(b) After meiosis, how many chromosomes would there be in the gametes of *S. maritima*?

..... (1)



Leave  
blank

(c) What is meant by the term sterile?

.....  
.....  
(1)

(d) Suggest why the hybrid species *S. townsendii* does not undergo meiosis successfully.

.....  
.....  
.....  
.....  
(2)

(e) (i) Suggest how *S. anglica* stops mud from being washed away.

.....  
.....  
(1)

(ii) Suggest why people may want to stabilise mud along the coast.

.....  
.....  
(1)

(f) Suggest how reduction of bare mud might affect populations of invertebrates and birds.

.....  
.....  
.....  
.....  
.....  
.....  
(3)

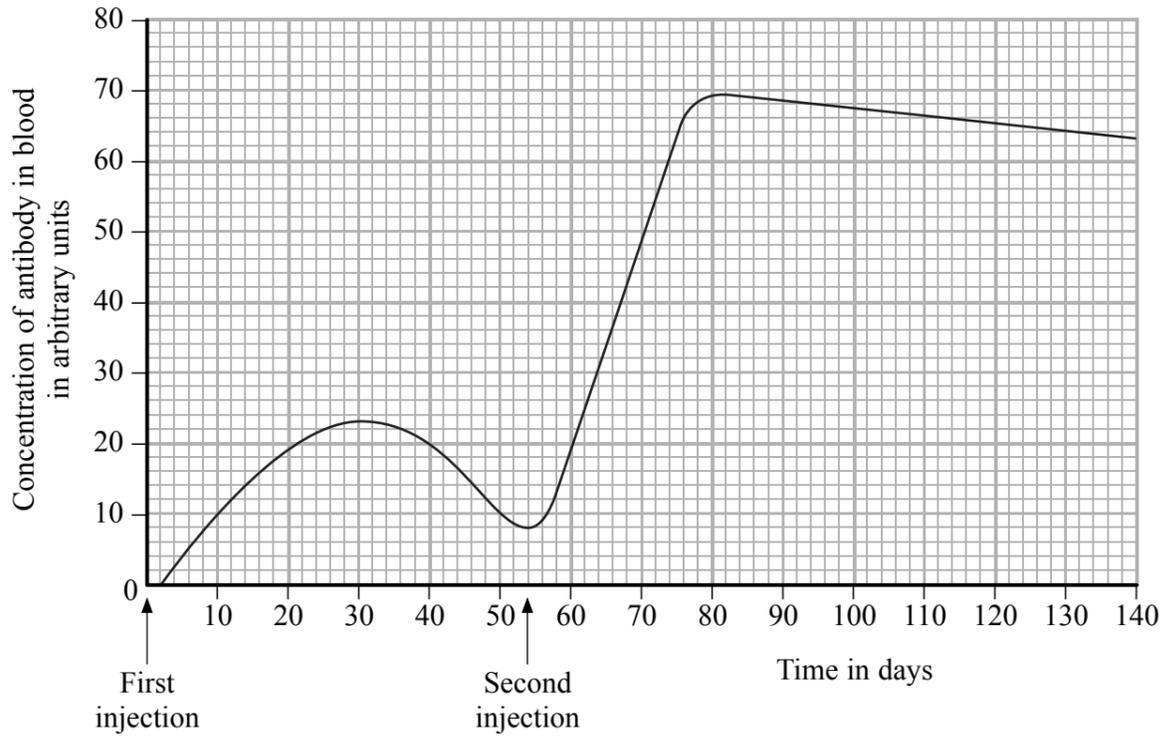
(Total 10 marks)

Q5



Leave blank

6. The graph below shows the concentration of an antibody in the blood of a person over a period of 140 days. The person was injected with an antigen at the beginning of the period and was injected again with the same antigen 54 days later.



- (a) Give **three** ways in which the pattern of antibody produced in the person's blood after the second injection of the antigen differs from the results after the first injection.

1 .....

.....

2 .....

.....

3 .....

.....

(3)

- (b) After 100 days the person was injected with a different antigen. On the graph, draw a line to show the concentration of the new antibody you would expect to find as a result of this injection.

(2)

Q6

(Total 5 marks)



Leave blank

7. Read the following passage and answer the questions below.

Predators are wild animals that hunt other animals for food. Wolves, mountain lions, hawks and ferrets are predators. Because these animals are meat eaters, they are also called carnivores. Some predators, such as coyotes and bears, are also scavengers, meaning they eat the dead bodies of animals that they did not hunt themselves.

In an area of the Rocky mountains in the USA, 143 cows and 356 sheep were eaten by wolves from January 1987 to December 1999. Predation accounts for only a small fraction of the loss of these farm animals, and most deaths were due to other factors.

(a) How many different species of predators are named in the passage?

.....  
(1)

(b) Using the information in the passage, calculate the number of cows eaten by wolves per year in the Rocky mountains. Show your working.

Answer ..... per year  
(2)

(c) Suggest **two** factors, other than predation, that might be responsible for the deaths of the farm animals.

1 .....

2 .....

(2)

(d) In the space below, draw a food chain involving wolves.

(2)

Q7

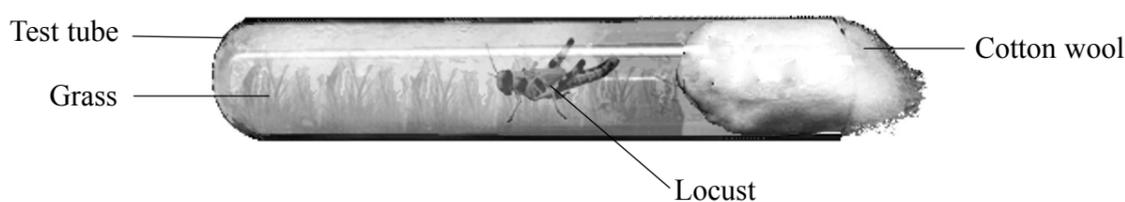
(Total 7 marks)



8. The diagram below shows a locust. Locusts eat vast amounts of crop plants every year. This is why locusts are major insect pests.



A student wanted to find out if air temperature affected the mass of plant material eaten by locusts. The student put locusts into test tubes as shown in the diagram.



At the start of the investigation, 2 g of grass were put into each test tube. Different locusts were used at each air temperature. After 6 hours, the mass of the grass left in the test tube was weighed. The mass of grass eaten was then calculated. The table below shows the results.

Locust	Mass of grass in g eaten during 6 hours			
	10 °C	20 °C	30 °C	40 °C
1	0.13	0.40	0.71	0.76
2	0.09	0.38	0.74	0.82
3	0.10	0.42	0.77	0.84
4	0.12	0.45	0.75	0.81
5	0.08	0.34	0.75	0.82
6	0.11	0.49	0.76	0.80
7	0.09	0.43	0.70	0.82
8	0.12	0.41	0.68	0.83
9	0.09	0.40	0.73	0.78
10	0.11	0.42	0.70	0.75
<b>Mean mass</b>	0.10	0.41	?	0.80

- (a) (i) What was the total number of locusts used in the investigation?

.....  
(1)

- (ii) Calculate the mean mass of grass in g eaten at 30 °C.

.....  
(1)



Leave  
blank

(b) (i) The student wanted to measure the amount of grass eaten per hour. Suggest why it was better to calculate the mass of grass eaten in 6 hours rather than the mass of grass eaten in 24 hours.

.....  
.....  
.....  
.....

(2)

(ii) Suggest why the student used the cotton wool in each test tube.

.....  
.....  
.....  
.....

(2)

(iii) The student did the investigation at different temperatures. Other variables that could have changed the mass of the grass eaten should have been kept the same. Name **three** of these variables.

1 .....  
2 .....  
3 .....

(3)

(c) (i) How does temperature affect the mass of grass eaten?

.....  
.....

(1)

(ii) Suggest **one** explanation for the results of the investigation.

.....  
.....

(1)

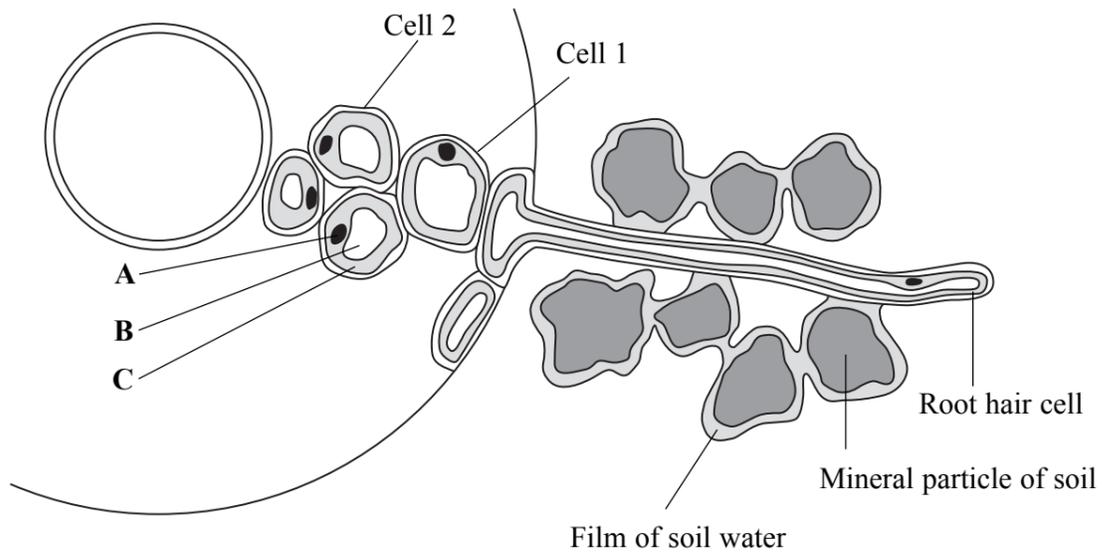
(Total 11 marks)

Q8

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9. The diagram below shows some of the cells found in the root of a plant.



(a) Name the structures labelled A, B and C.

A .....

B .....

C .....

(3)

(b) (i) The water moves from the soil into the root hair cell by osmosis. Explain what is meant by osmosis.

.....  
.....  
.....  
.....

(2)

(ii) Explain how the root hair cells are adapted to increase uptake of water from the soil.

.....  
.....  
.....  
.....

(2)





Leave blank

(c) Complete the table below using a tick (✓) to indicate which cell is described by each statement.

Statement	Root hair cell	Cell 1	Cell 2
The cell with the highest concentration of solution			
The cell with the lowest solute concentration			
The cell nearest to the xylem vessels			
The cell with the highest availability of water			

(4)

Q9

(Total 11 marks)



Leave blank

10. The table shows the mean (average) heart rate for small men and for large men when doing different activities. It also shows the mean volume of blood pumped out of the heart with each beat.

Activity	Small men		Large men	
	Heart rate in beats per minute	Volume pumped per beat in cm <sup>3</sup>	Heart rate in beats per minute	Volume pumped per beat in cm <sup>3</sup>
Resting	68	82	62	134
Walking	91	108	76	179
Jogging	140	127	117	221

(a) Describe how body size affects heart rate.

.....  
.....

(1)

(b) (i) For small men, calculate the percentage increase in heart rate between resting and jogging. Show your working.

Answer..... % per minute  
(2)

(ii) Explain why there is a change in heart rate during jogging compared to resting.

.....  
.....  
.....  
.....  
.....  
.....

(3)



Leave  
blank

- (c) (i) Cardiac output gives a measure of the volume of blood leaving the heart each minute. The formula below shows how to calculate cardiac output.

**Cardiac output = Heart beats per minute × Volume pumped per beat**

Use this formula to calculate the cardiac output of large men when jogging.

Answer.....cm<sup>3</sup>  
(2)

- (ii) Suggest why smaller men have a lower cardiac output than larger men.

.....  
.....  
.....  
.....  
.....  
.....

(3)

Q10

(Total 11 marks)



Leave blank

11. The poster below is designed for sports players to use to prevent them dehydrating during a swimming competition.



ARNOLD SWIMMING CLUB

---

### Dehydration Chart

	Urine Colour	Percentage of Dehydration
1	almost colourless	0%
2	very pale yellow	20%
3	pale yellow	30%
4	yellow	40%
5	dark yellow	50%
6	very dark yellow	60%
7	yellow – orange	70%
8	orange	80%

1% dehydration decreases performance by 10%  
1 hour of hard exercise requires 1 litre of fluid

Please remember to take on fluids when you are training.

(a) Describe how the colour of urine changes as the athlete becomes dehydrated.

.....  
.....

(1)



Leave blank

(b) Explain why the colour of urine changes following exercise.

.....  
.....  
.....  
.....  
.....  
.....

(3)

(c) Suggest why swimmers might be more at risk of overheating than other athletes. Explain your answer.

.....  
.....  
.....  
.....

(2)

(d) Apart from drinking water, name **one** other substance that a long distance swimmer should consume before a race. Give a reason for your answer.

.....  
.....  
.....  
.....

(2)

(e) Urea is a waste product found in urine. Name **one** other waste product that is excreted from the body during exercise, and state the organ it is released from.

.....  
.....

(2)

Q11

(Total 10 marks)

**TOTAL FOR PAPER: 100 MARKS**

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