Cambridge Pre-U

Cambridge Assessment International Education
Cambridge Pre-U Certificate

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6853364694

BIOLOGY (PRINCIPAL) **9790/04**

Paper 4 Practical **May/June 2019**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **19** printed pages and **1** blank page.

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Cambridge Assessment International Education

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Section A

Answer **all** the questions.

You are advised to spend no more than **90 minutes** on Question 1.

1 You are advised to read the whole of the question before starting the practical work, as you will need to make decisions about how to obtain high quality results using the apparatus and materials provided.

The exchange of water between plant tissues and their surroundings is partly determined by the water potential of the tissues.

Part 1

You are provided with a part of a red onion bulb and 1.0 mol dm^{-3} solution of potassium nitrate.

1. Label one microscope slide **A** and another slide **B**.

2. Place one drop of potassium nitrate solution on slide **A**.

3. Place one drop of distilled water on slide **B**.

4. The onion consists of several fleshy layers. Remove one of these layers and hold it with the coloured side facing upwards. Bend the edges upwards until it snaps and carefully pull the two sides apart to reveal a thin sheet of coloured epidermal cells.

5. Remove two small pieces from the thin sheet.

6. Place one piece of coloured epidermis into the potassium nitrate solution on slide **A**.

7. Place the other piece of coloured epidermis into the distilled water on slide **B**.

8. Add coverslips to slides **A** and **B**.

9. Observe the coloured cells on slides **A** and **B** under low power and high power of a microscope.

(a) Draw **one** cell from the piece of epidermis immersed in potassium nitrate solution (slide **A**).

Label and annotate your drawing to describe how this cell differs in appearance from a cell immersed in distilled water (slide **B**).

[6]

Follow the procedure shown in Fig. 1.1 to irrigate the piece of epidermis on slide **A** with several drops of distilled water.

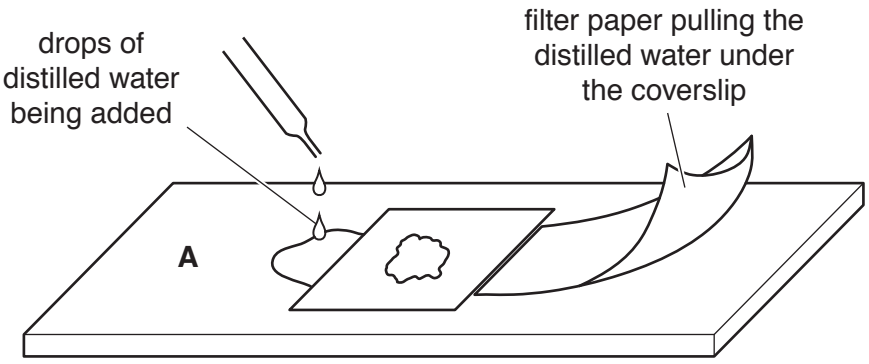

Fig. 1.1

Observe the cells with low and high power of a microscope.

(b) Describe the effect of irrigation with water on the epidermal cells **and** explain this effect.

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Part 2

In Part 2 you will estimate the water potential of potato tissue.

You are provided with some cylinders of potato tissue in Petri dishes and a stock solution of mannitol.

Mannitol is a sugar-like molecule which is not absorbed by cells.

The concentration of the stock solution is 1.0 mol dm^{-3}.

Use the materials and apparatus provided to prepare a range of concentrations of mannitol that you can use to find the water potential of the potato tissue.

You will need a minimum of 10 cm^3 of each concentration.

(c) Use the space below to draw a dilution table showing how you will prepare the mannitol concentrations.

[4]

1. Put 10 cm^3 of each of the solutions that you have prepared into labelled test-tubes.

2. Remove an appropriate number of cylinders of potato from the Petri dishes and trim each cylinder to a length of 50 mm.

3. Use a balance to measure the mass of each cylinder.
   Record the mass of each cylinder before placing it into a labelled test-tube.

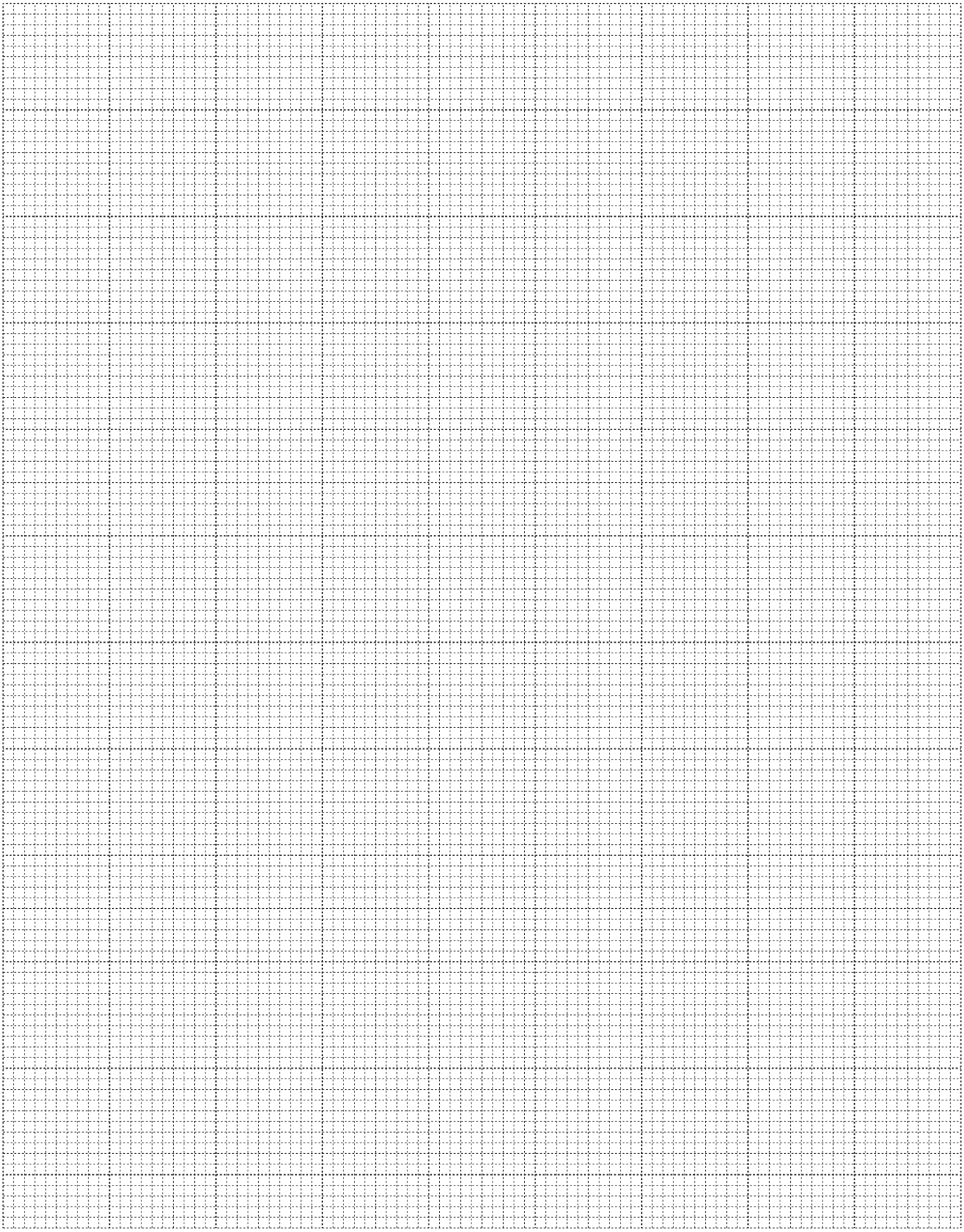
4. Leave the test-tubes for at least 15 minutes.

5. Remove the cylinders from the test-tubes and measure their mass.
   Record the mass of the cylinders.
   Carry out any processing of your results that you consider necessary.

(d) Record all of your results in the space below.

[7]

(e) Draw a graph of your results.



[5]

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(f) Describe the precautions that you have taken to ensure high quality results.

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(g) Use your graph to estimate the concentration of mannitol solution that has the same water potential as the potato tissue.

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Explain your reasoning in making this estimate.

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[3]

(h) Typical water potentials of potato tissue vary, but have been reported as being between –100 kPa (Meyer and Wallace (1941)) and –1000 kPa (O'Leary (1970)).

The water potential of the 1.0 mol dm^{-3} solution of mannitol is –3510 kPa at 20 °C.

(i) Calculate the water potential of the potato tissue that you used.

You should assume that there is a linear relationship between the molar concentration of mannitol and its water potential.

Show your working.

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(ii) Comment on how your calculated value compares with the water potentials reported by Meyer and Wallace and by O'Leary.

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Meyer, B S and Wallace, A M, 1941, 'A comparison of two methods of determining the diffusion pressure deficit of potato tuber tissues'. *American Journal of Botany 28: 838–843*.

O'Leary, J, 1970, 'A critical evaluation of tissue-immersion methods for measurement of plant water potential'. *The Ohio Journal of Science 70: (1) 34–38*.

(i) **(i)** List the random errors that may have affected your results in **Part 2**.

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(ii) Suggest ways in which you could improve the investigation to reduce the effect of some of the random errors that you have identified.

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[Total: 45]

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Section B

Answer **all** the questions.

You are advised to spend no more than **60 minutes** on Section B.

2 You should read through the whole of Question 2 carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

Slide **L1** is a section through a mammalian ovary with follicles at various stages of development.

Look carefully at the section with the low power of your microscope.

(a) (i) Make a large, labelled drawing of the section through the ovary in the space provided on the page opposite.

Include in your drawing the following structures:

- germinal epithelium
- some primary follicles
- a mature Graafian follicle.

[7]

(ii) Annotate your drawing to show the functions of the structures within the Graafian follicle. [4]

(iii) Calculate the magnification of your drawing.

Show your working.

..... [3]

Space for drawing

(b) Fig. 2.1 is an electron micrograph of a primary follicle from the ovary of a mammal.

Label the structures shown in Fig. 2.1.

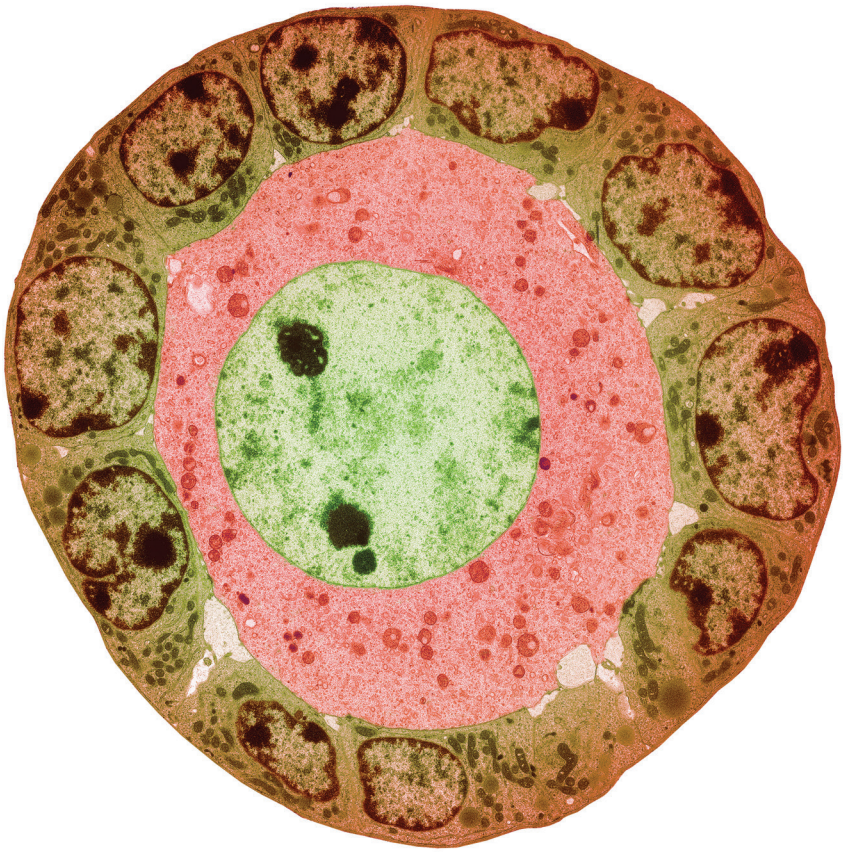


Fig. 2.1 magnification = ×3360

[5]

[Total: 19]

3 **(a)** Many external parasites of mammals feed on the blood of their hosts. Some of these parasites only attach to their host's body to feed. Other external parasites remain attached to their host almost permanently.

Many of the external parasites of mammals are arthropods.

Fig. 3.1 is a drawing of the mosquito, *Anopheles maculipennis*. Some of the features of arthropods are labelled.

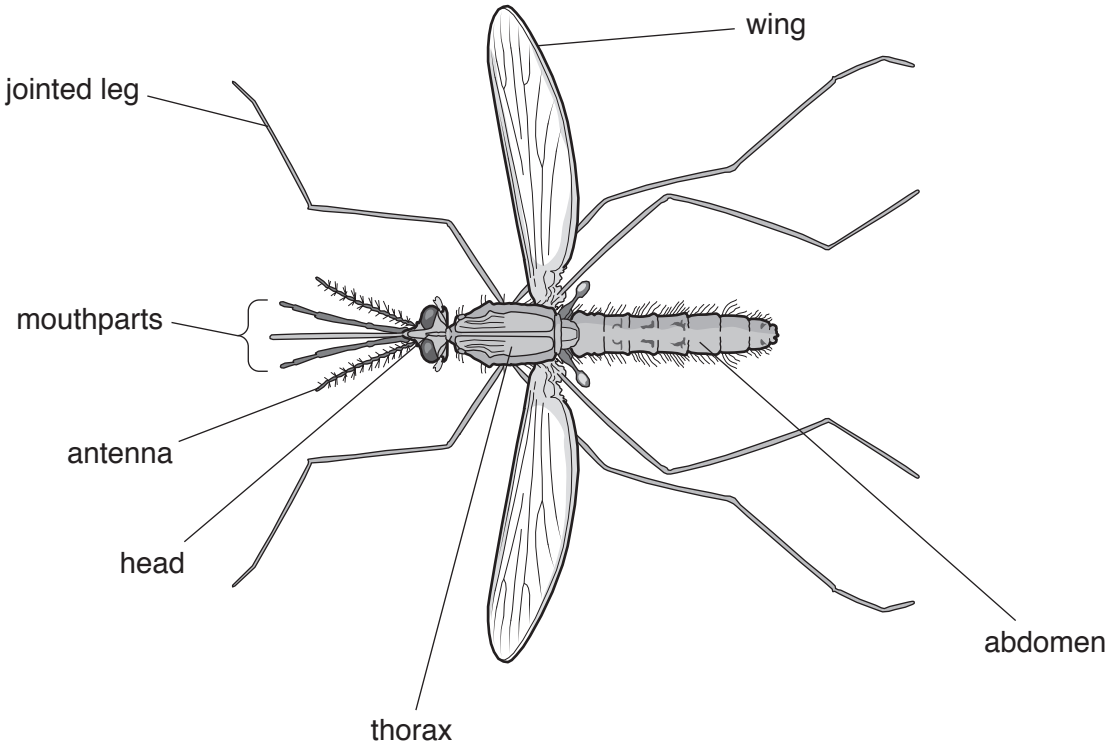


Fig. 3.1

Fig. 3.2 shows ten species of arthropod that are either temporary or permanent external parasites of mammals. All show dorsal (top) views unless otherwise stated.

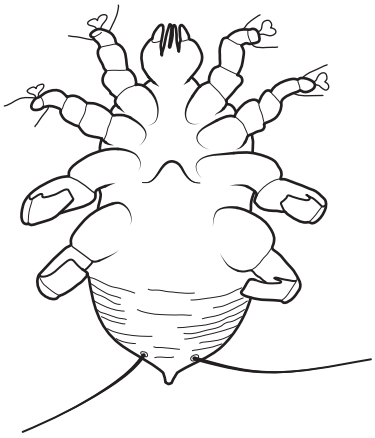
The drawings are **not** to the same scale.

Use the key to identify the ten species.

Write the appropriate letters from Fig. 3.2 in the last column of the key.

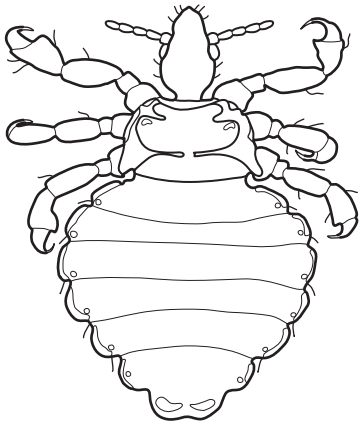
[Turn over

A

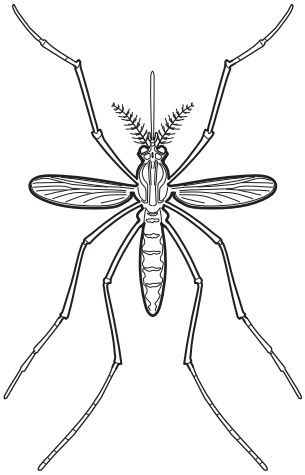


view of underside

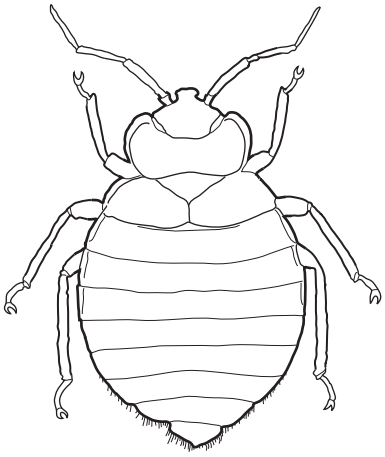
B



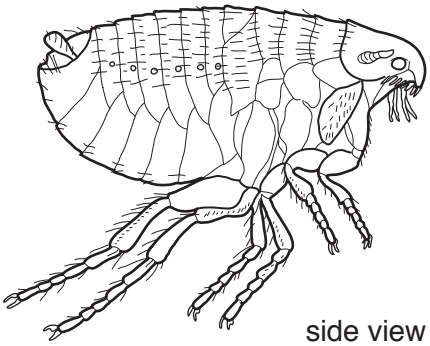
C



D

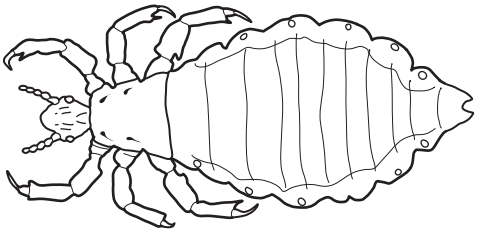


E

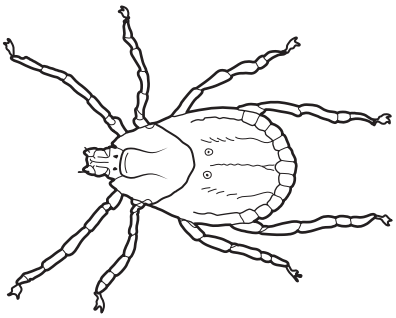


side view

F

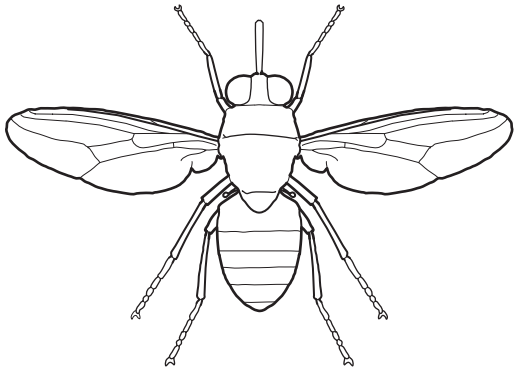


G



H

J



K

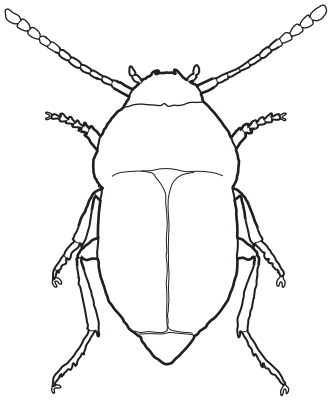


Fig. 3.2

1	(a)	Four pairs of legs	Go to 2	
	(b)	Three pairs of legs	Go to 3	
2	(a)	Abdomen with a pair of long hairs	*Myocoptes musculinus*	
	(b)	Abdomen with no long hairs	*Dermacentor variabilis*	
3	(a)	Wings held at right angles to the thorax	Go to 4	
	(b)	No wings OR wings covering part of body	Go to 6	
4	(a)	Abdomen longer than thorax	*Aedes aegypti*	
	(b)	Abdomen about the same length as the thorax	Go to 5	
5	(a)	Eyes a triangular shape	*Tabanus par*	
	(b)	Eyes rounded	*Glossina morsitans*	
6	(a)	Segments of the abdomen are clearly visible	Go to 7	
	(b)	Segments of the abdomen are not clearly visible on the dorsal surface	*Leptinus testaceus*	
7	(a)	Each leg ends in a single large hook	Go to 8	
	(b)	Each leg ends in a pair of small hooks	Go to 9	
8	(a)	Abdomen three times as long as the thorax	*Haematopinus suis*	
	(b)	Abdomen four times as long as the thorax	*Pediculus humanus*	
9	(a)	Antennae are longer than the head and thorax	*Cimex lectularius*	
	(b)	Antennae are very short	*Ctenocephalides canis*	

[5]

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(b) *Anopheles maculipennis*, shown in Fig. 3.1, is a temporary external parasite of mammals. It is also one of the vectors of malaria, caused by *Plasmodium falciparum*.

Researchers investigated the effect of altitude on the percentage of people infected with *P. falciparum* in villages in north-eastern Tanzania.

The results are shown in Table 3.1.

Table 3.1

village	altitude/m	percentage of the population infected with *P. falciparum*
Emmao	1845	0
Funta	1279	17
Handei	1425	17
Kwadoe	1523	4
Kwemasimba	662	25
Mgamba	1685	0
Mgila	432	34
Mgome	196	61
Mn'galo	416	55
Tamota	1176	19
Tewe	1049	22
Ubiri	1216	12

The data can be analysed with the Spearman's Rank Correlation Test.

(i) State the null hypothesis for this investigation.

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(ii) The formula to calculate Spearman's rank correlation coefficient (r_s) is:

$$r_s = 1 - \left(\frac{6 \times \Sigma D^2}{n^3 - n} \right)$$

n = the number of pairs of items in the sample
D = the difference between each pair of ranked measurements
Σ = the sum of

Use Table 3.2 to calculate the value of r_s for the data in Table 3.1.

Express your value of r_s to three decimal places.

Table 3.2

village	altitude/m	altitude rank	percentage *P. falciparum*	percentage rank	*D*	D^2
Emmao	1845		0			
Funta	1279		17			
Handei	1425		17			
Kwadoe	1523		4			
Kwemasimba	662		25			
Mgamba	1685		0			
Mgila	432		34			
Mgome	196		61			
Mn'galo	416		55			
Tamota	1176		19			
Tewe	1049		22			
Ubiri	1216		12			
					ΣD^2 =	

r_s = ... [5]

(iii) Table 3.3 shows the information required to interpret your calculated value of r_s.

Table 3.3

number of pairs of measurements	critical values	
	$p = 0.05$ (5%)	$p = 0.01$ (1%)
10	0.648	0.794
11	0.618	0.755
12	0.587	0.727
13	0.560	0.703
14	0.538	0.679

Use Table 3.3 and the value for r_s that you have calculated to state and explain the conclusions that can be made from the results.

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[Total: 16]