



GCE A LEVEL



A400U30 – 1

WEDNESDAY, 18 JUNE 2025 – MORNING

**BIOLOGY– A LEVEL COMPONENT 3
REQUIREMENTS FOR LIFE**

**2 hours plus your additional time
allowance**

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

	FOR EXAMINER’S USE ONLY		
	Question	Maximum Mark	Mark Awarded
SECTION A	1.	10	
	2.	12	
	3.	20	
	4.	14	
	5.	15	
	6.	9	
SECTION B	Option	20	
	Total	100	

ADDITIONAL MATERIALS

A calculator and a ruler.

ITEMS INCLUDED WITH QUESTION PAPER

A separate Diagram Booklet.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer ALL questions.

Write your answers in the spaces provided. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

(Turn over)

INFORMATION FOR CANDIDATES

This paper is in 2 sections, A and B.

Section A: 80 marks. Answer ALL questions. You are advised to spend about 1 hour 35 minutes on this section.

Section B: Options; 20 marks. Answer ONE OPTION ONLY. You are advised to spend about 25 minutes plus your additional time allowance on this section.

The number of marks is given in brackets at the end of each question or part – question.

The assessment of the quality of extended response (QER) will take place in Question 6

The quality of written communication will affect the awarding of marks.

(Turn over)

SECTION A

Answer ALL questions.

1. Refer to **IMAGE 1.1** in the separate Diagram Booket. The mammalian reflex arc consists of several components for sensing and responding to the environment. **IMAGE 1.1** shows the reflex arc involved when a heat source is touched by a finger.
- (a) Use letters **A** to **G** from **IMAGE 1.1** to complete the table below.

Component of reflex arc	Letter
Coordinator (spinal cord)	B
Effector	
Motor neurone	
Receptor	
Response	E
Sensory neurone	
Stimulus	A

[2 marks]

continued on the next page . . .

(Turn over)

Question 1 continued

(b) Impulses are transferred along both sensory and motor neurones as a wave of action potentials. Describe how the movement of ions generates an action potential.

[illegible]

[3 marks]

continued on the next page . . .

(Turn over)

Question 1 continued

1. (c) Refer to IMAGE 1.2 in the separate Diagram Booklet. Nerve nets are found in cnidarians (for example, HYDRA) and are different from the nervous systems of vertebrates. IMAGE 1.2 shows a nerve net in HYDRA and the nervous system of a human.
- (i) Use your own knowledge and the information provided in IMAGE 1.2 to give **THREE** differences between the nerve net of HYDRA and the nervous system in a human. Write your answers in the table below.

Hydra	Human

[3 marks]

continued on the next page . . .

(Turn over)

Question 1 (c) continued

- 1. (c) (ii) Refer to GRAPHS 1.3A and 1.3B in the separate Diagram Booklet. Both Hydra and humans generate action potentials in their neurones.**

GRAPHS 1.3A and 1.3B show a trace from each organism.

- (ii) Describe TWO ways in which the Hydra trace differs from that of the human.**

I. _____

II. _____

[2 marks]

(Total for Question 1 = 10 marks)

(Turn over)

2. (a) Refer to IMAGE 2.1 in the separate Diagram Booklet. IMAGE 2.1 shows three human erythrocytes.

(i) Human erythrocytes are biconcave in shape. Explain how this increases the efficiency of gas exchange by these cells.

[1 mark]

Two diameters of cells **A**, **B** and **C** have been marked on IMAGE 2.1. The length of the diameters for the cells were measured from the image and are shown in TABLE 2.2 provided separately in the Diagram Booklet.

continued on the next page . . .

(Turn over)

Question 2 (a) continued

2. (a) (ii) I. Use all the data in TABLE 2.2 to calculate the mean diameter of the human erythrocytes in IMAGE 2.1

Mean diameter of human erythrocytes in IMAGE 2.1

= _____ mm

[1 mark]

continued on the next page . . .

(Turn over)

Question 2 (a) (ii) continued

2. (a) (ii) II. **USE THE SCALE BAR in IMAGE 2.1 and your answer to (ii) I. to calculate the mean ACTUAL diameter of a human erythrocyte. GIVE YOUR ANSWER IN μm .**

Mean ACTUAL diameter of a human erythrocyte
= _____ μm

[2 marks]

continued on the next page . . .

(Turn over)

Question 2 (a) (ii) continued

- 2. (a) (ii) III. Use IMAGE 2.1 to suggest ONE reason why the erythrocytes have different measured diameters in TABLE 2.2**

[1 mark]

continued on the next page . . .

(Turn over)

Question 2 continued

- 2. (b) In the uterus, a developing foetus gains oxygen from maternal blood via the placenta. The foetal erythrocytes contain foetal haemoglobin (HbF) rather than adult haemoglobin (HbA).**

People with sickle cell anaemia have a gene mutation resulting in the production of sickle cell haemoglobin (HbS).

Refer to GRAPH 2.3 in the separate Diagram Booklet. GRAPH 2.3 shows the oxygen dissociation curves for HbF, HbA and HbS

continued on the next page . . .

Question 2 (b) continued

- 2. (b) (i) Use data from GRAPH 2.3 to explain the advantage to a foetus of having HbF rather than HbA.**

[3 marks]

continued on the next page . . .

(Turn over)

Question 2 (b) continued

- 2. (b) (ii) Use GRAPH 2.3 to explain how the positions of the curves for HbA and HbS affect oxygen saturation.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 2 (b) continued

- 2. (b) (iii) Use all the information provided to explain the effect of HbS on a person with sickle cell anaemia.**

[2 marks]

(Total for Question 2 = 12 marks)

(Turn over)

3. Sucrose and other carbohydrates, such as raffinose, are transported from mesophyll cells in leaves to other parts of a plant through the phloem.

(a) Sucrose is a disaccharide. Raffinose is a trisaccharide made up of galactose, glucose and fructose. Both sucrose and raffinose contain glycosidic bonds.

Raffinose is a non – reducing sugar.

Describe how you would show that raffinose is a **NON – REDUCING SUGAR** and not a reducing sugar.

(Turn over)

[4 marks]

- (b) Refer to IMAGE 3.1 in the separate Diagram Booklet. Carbohydrates move from leaf mesophyll cells into the sieve tube elements of plants via companion cells. There are several possible mechanisms involved. IMAGE 3.1 shows two of these mechanisms.

continued on the next page . . .

(Turn over)

Question 3 (b) continued

- 3. (b) (i) Refer to the table for Question 3 (b) in the separate Diagram Booklet, to identify how sucrose is transported FROM MESOPHYLL TO COMPANION CELLS in each mechanism shown in IMAGE 3.1**
- Explain the reason for your answer.**

[4 marks]

continued on the next page . . .

(Turn over)

Question 3 (b) continued

- 3. (b) (ii) A third mechanism involves sucrose being hydrolysed into its monosaccharides and used to synthesise raffinose in the companion cell.**

Suggest how this increases the rate of movement of sucrose from mesophyll into the companion cells.

[2 marks]

continued on the next page . . .

(Turn over)

Question 3 continued

- 3. (c) The mass flow hypothesis of movement of sugars in the phloem suggests there is a pressure gradient from source to sink. Explain how high pressure is generated in the phloem near the source cells.**

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[4 marks]

continued on the next page . . .

(Turn over)

Question 3 continued

3. (d) Refer to IMAGE 3.2 in the separate Diagram Booklet. The transport of sucrose in the phloem was investigated using radioactive carbon dioxide and ringing of the stem.

- **All leaves were removed apart from one midway down the stem.**
- **Radioactive carbon dioxide $^{14}\text{CO}_2$ was added to a chamber surrounding the leaf.**
- **The level of ^{14}C was then measured at the top of the stem, in the leaf and in the root.**
- **The experiment was then repeated on three more plants but with the stem being ringed to remove the phloem in a combination of locations. IMAGE 3.2 shows the setup up of the apparatus.**

TABLE 3.3 provided separately in the Diagram Booklet, shows the results of the investigation.

continued on the next page . . .

(Turn over)

Question 3 (d) continued

3. (d) (i) Suggest and explain the purpose of plant A.

[2 marks]

continued on the next page . . .

(Turn over)

Question 3 (d) continued

3. (d) (ii) Use the information from **IMAGE 3.2** and **TABLE 3.3** to make **TWO** conclusions about the transport of sucrose in plants. Justify each conclusion.

Conclusion 1

Conclusion 2

[4 marks]**(Total for Question 3 = 20 marks)****(Turn over)**

4. Refer to IMAGE 4.1 in the separate Diagram Booklet. Parasites are organisms which obtain nourishment at the expense of the host. Parasites of humans include TAENIA SOLIUM (pork tapeworm) and PEDICULUS CAPITUS (headlouse). These are shown in IMAGE 4.1

(a) TAENIA is an endoparasite and PEDICULUS is an ectoparasite.

Define each of these terms.

[1 mark]

continued on the next page . . .

(Turn over)

Question 4 continued

4. (b) Explain why TAENIA does not have a digestive system but PEDICULUS does have a digestive system.

[4 marks]

continued on the next page . . .

(Turn over)

Question 4 continued

- 4. (c) Refer to Graph 4.2 in the separate Diagram Booklet. Trypsin is an enzyme which digests proteins in the small intestine of humans. GRAPH 4.2 shows how trypsin is affected by pH.**

- (i) Describe the evidence in GRAPH 4.2 that suggests that trypsin is released into the duodenum.**

[1 mark]

- (ii) Trypsin is released in an inactive form called trypsinogen.**

Name the molecule that activates trypsinogen.

[1 mark]

continued on the next page . . .

(Turn over)

Question 4 (c) continued

- 4. (c) (iii) Refer to IMAGE 4.3 in the separate Diagram Booklet. IMAGE 4.3 shows a polypeptide containing three amino acids.**

Trypsin hydrolyses peptide bonds within polypeptides.

DRAW AN ARROW ON IMAGE 4.3 to identify ONE peptide bond.

[1 mark]

continued on the next page . . .

(Turn over)

Question 4 continued

4. (d) TAENIA is able to change the pH of its environment.

An investigation was carried out to determine the effect of TAENIA on the pH of its environment.

- Different saline (salt) solutions were prepared, each with a different initial pH (between 5.5 and 10.0).
- One TAENIA was added to each solution.
- Each solution was incubated for two hours at 37 °C.
- The pH of the solutions was measured after incubation.

- (i) Suggest why the TAENIA were placed in saline solution rather than distilled water.

[1 mark]

continued on the next page . . .

(Turn over)

Question 4 (d) continued

- 4. (d) (ii) The results of the experiment showed that the pH of ALL the saline solutions at the end of the two – hour period was pH 5•0**
- With reference to GRAPH 4.2 explain why it is of benefit to TAENIA to reduce the pH of its environment.**

[3 marks]

continued on the next page . . .

(Turn over)

Question 4 (d) continued

4. (d) (iii) Refer to GRAPH 4.4 in the separate Diagram Booklet. TAENIA also secretes a molecule called anti – trypsin which acts as an inhibitor of trypsin. GRAPH 4.4 shows the rates of reaction of trypsin with and without the anti – trypsin.

Use GRAPH 4.4 to identify which type of inhibition is shown by antitrypsin. Explain your answer.

[2 marks]

(Total for Question 4 = 14 marks)

(Turn over)

5. Bony fish have a specialised gas exchange surface. Smaller organisms, like the flatworm, do not need specialised surfaces for gas exchange.

(a) Explain why larger organisms require specialised gas exchange surfaces.

[2 marks]

continued on the next page . . .

(Turn over)

Question 5 continued

5. (b) Nitrogenous waste, in the form of ammonia, is released by the gills of bony fish directly into the water. Other organisms release different forms of nitrogenous waste.

(i) State the main form of nitrogenous waste excreted by:

Mammals _____

Birds _____

[1 mark]

Mammals have kidneys which can change the concentration of their urine. Urine concentration is measured in mOsm dm^{-3} and represents the number of particles dissolved in a dm^3 of solvent. Refer to TABLE 5.1 provided separately in the Diagram Booklet. TABLE 5.1 shows the water availability and the urine concentration of a range of organisms.

continued on the next page . . .

(Turn over)

Question 5 (b) continued

- 5. (b) (ii) I. Use the information in TABLE 5.1 to describe the relationship between the availability of water and the concentration of urine produced by different mammals.**

[1 mark]

- II. Explain the advantage of this relationship to the kangaroo rat.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 5 (b) continued

- 5. (b) (iii) Refer to GRAPH 5.2 in the separate Diagram Booklet. The medulla of the kidney contains the loop of Henle and the collecting ducts. GRAPH 5.2 shows the relative medullary thickness in a range of organisms from habitat types with different levels of water availability.**

Explain why GRAPH 5.2 uses a log scale for body mass.

[1 mark]

continued on the next page . . .

(Turn over)

Question 5 (b) continued

- 5. (b) (iv) Use GRAPH 5.2 and your own knowledge to suggest how mammals living in habitats with a low water availability produce more concentrated urine.**

No details of ADH are required.

[illegible]

(Turn over)

[4 marks]

continued on the next page . . .

(Turn over)

Question 5 continued

5. (c) (i) Toxic particles from plasma can be removed from the body in urine. Renal clearance is a measure of the volume of plasma that can be cleared of a particle by the kidneys per unit time.

Renal clearance can be calculated using the following equation:

$$CL_x = \frac{U_x \times V}{P_x}$$

Where

CL_x = renal clearance of particle X

U_x = urine concentration of particle X

P_x = plasma concentration of particle X

V = urine flow rate

continued on the next page . . .

(Turn over)

Question 5 (c) (i) continued

Use the equation on page 37 and the values below to calculate the renal clearance for particle **X** for a human.

GIVE YOUR ANSWER TO THE NEAREST WHOLE NUMBER.

$$U_x = 3.3 \text{ mg cm}^{-3}$$

$$P_x = 0.24 \text{ mg cm}^{-3}$$

$$V = 7 \text{ cm}^3 \text{ min}^{-1}$$

$$CL_x = \underline{\hspace{4cm}} \text{ cm}^3 \text{ min}^{-1}$$

[3 marks]

continued on the next page . . .

(Turn over)

Question 5 (c) continued

- 5. (c) (ii) If a human was dehydrated their urine flow rate would decrease.**

Suggest how this would affect renal clearance of particle X and the consequences of this to the person.

[2 marks]

(Total for Question 5 = 15 marks)

(Turn over)

6. Refer to IMAGE 6.1 and 6.2 in the separate Diagram Booklet. Mollusca is a phylum of invertebrate animals that have evolved different types of vascular systems. IMAGES 6.1 and 6.2 show the generalised circulatory systems of an aquatic snail and a squid (also aquatic). The circulatory system of aquatic snails includes a haemocoel. This is the main body cavity containing circulatory fluid which surrounds the internal organs.

Snails are slow – moving animals which feed mainly by grazing on algae and plants.

Squid are fast – moving predatory animals feeding on a wide variety of marine animals.

Describe the key features of the open circulatory system found in aquatic snails (IMAGE 6.1) and the closed circulatory system found in squid (IMAGE 6.2).

Explain how the circulatory systems of these organisms reflect their lifestyles.

(Total for Question 6 = 9 marks)

(Turn over)

SECTION B: OPTIONAL TOPICS

Option A: IMMUNOLOGY AND DISEASE

☐

Option B: HUMAN MUSCULOSKELETAL ANATOMY

☐

Option C: NEUROBIOLOGY AND BEHAVIOUR

☐

Answer the question on ONE TOPIC ONLY.

Place a tick (✓) in ONE of the boxes above, to show which topic you are answering.

YOU ARE ADVISED TO SPEND ABOUT 25 MINUTES PLUS YOUR ADDITIONAL TIME ALLOWANCE, ON THIS SECTION.

(Turn over)

OPTION A: IMMUNOLOGY AND DISEASE

- 7. Scarlet fever is an infectious disease of young children. The characteristic symptoms are sore throat, fever, and a red rash. The disease is caused by the bacterium *STREPTOCOCCUS PYOGENES* which produces a toxin that causes the symptoms. Diagnosis of scarlet fever may be confirmed by a test that detects antigens of *S. PYOGENES*.**

(a) Define the following terms:

Infectious disease;

Toxin;

continued on the next page . . .

(Turn over)

Question 7 (a) continued**Antigen.**

7. (b) Refer to IMAGE 7.1 in the separate Diagram Booklet. IMAGE 7.1 shows the results of an experiment into the effect of an antibiotic on *S. PYOGENES*. This involved placing a disc soaked in the antibiotic on an agar plate spread with a culture of *S. PYOGENES*. The antibiotic diffuses through the agar and a clear zone is produced around the disc where bacterial growth has been inhibited.

- (i) Use the line on IMAGE 7.1 to calculate the actual diameter of the clear zone.

Actual diameter = _____ mm

[2 marks]

continued on the next page . . .

(Turn over)

Question 7 (b) continued

The experiment was then carried out for a range of antibiotics. The mean results are shown in **TABLE 7.2** provided separately in the Diagram Booklet.

- 7. (b) (ii) It was concluded that Penicillin G was the most effective antibiotic against *S. PYOGENES*.
Use the data in **TABLE 7.2** to evaluate this conclusion.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 7 (b) continued

- 7. (b) (iii) In this investigation, identical agar plates and discs were used for all antibiotics and the concentration of each of the antibiotics was kept the same.**

State TWO other variables which would need to be controlled during the investigation.

[2 marks]

continued on the next page . . .

(Turn over)

Question 7 continued

**7. (c) Tetracycline is a broad – spectrum antibiotic.
Some strains of *S. PYOGENES* have become
resistant to this antibiotic.**

**(i) Explain why tetracycline is effective against
a wide range of bacterial species.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 7 (c) continued

7. (c) (ii) S. PYOGENES is a Gram positive bacterium. Resistant strains of S. PYOGENES survive due to one of two different mechanisms:

- A transmembrane protein which pumps tetracycline out of the cell as fast as it enters.**
- A protein that protects the ribosome from the effects of tetracycline.**

Use the information given to explain why S. PYOGENES which are resistant to tetracycline can still be killed by penicillin.

(Turn over)

[3 marks]

continued on the next page . . .

(Turn over)

Question 7 (c) continued

- 7. (c) (iii) Scientists have concluded that resistance of *S. PYOGENES* to tetracycline has become a problem due to the extensive use of this antibiotic.**

Explain how the extensive use of this antibiotic might lead to an increased number of resistant strains of *S. PYOGENES*.

(Turn over)

[3 marks]

7. (d) Following infection by *S. PYOGENES*, the patient develops immunity to the bacterium. This immunity can last for several years.

(i) Describe how infection can lead to the development of a primary immune response against *S. PYOGENES*.

[3 marks]

continued on the next page . . .

(Turn over)

Question 7 (d) continued

- 7. (d) (ii) Scarlet fever caused by *S. PYOGENES* is very uncommon in children under 6 months old who are breastfed.**

State the type of immunity present in these children and suggest how this occurs.

[2 marks]

(Total for Question 7 = 20 marks)

(Turn over)

OPTION B: HUMAN MUSCULOSKELETAL ANATOMY

8. (a) The axial skeleton includes the vertebral column and rib cage.

(i) State ONE function of the axial skeleton.

[1 mark]

Refer to IMAGE 8.1 in the separate Diagram Booklet. IMAGE 8.1 shows an X – ray of part of the axial skeleton of a patient with a postural deformity.

(ii) Name the type of deformity shown in IMAGE 8.1 and identify the region of the spine which is most affected in this patient.

[2 marks]

continued on the next page . . .

(Turn over)

Question 8 (a) continued

- 8. (a) (iii) In addition to surgery, identify one type of treatment which might be used to correct the deformity shown in IMAGE 8.1**

[1 mark]

continued on the next page . . .

(Turn over)

Question 8 continued

- 8. (b) Muscle wasting involves both the breakdown of muscle tissue and increased muscle fatigue. This can occur as part of the aging process, prolonged inactivity or disease.**

Refer to IMAGE 8.2 in the separate Diagram Booklet. IMAGE 8.2 shows the appearance of a sarcomere in a person with wasted muscles.

- (i) Use your own knowledge of the sliding filament theory to describe the damage seen to the sarcomere in IMAGE 8.2**
Explain how this can lead to muscle weakness.

(Turn over)

[3 marks]

8. (b) (ii) Enzymes in lysosomes of muscle cells can lead to the breakdown of mitochondria in a process called autophagy.

Suggest how autophagy might affect muscle contraction.

[2 marks]

continued on the next page . . .

(Turn over)

Question 8 (b) continued

Refer to IMAGE 8.3 in the separate Diagram Booklet. IMAGE 8.3 shows the changes that occur in a sarcomere when skeletal muscle contracts, as seen through an electron microscope.

- (iii) Use the scale bar to determine the actual length of the CONTRACTED sarcomere in IMAGE 8.3**

Actual length = _____ μm

[2 marks]

continued on the next page . . .

(Turn over)

Question 8 continued

8. (c) Refer to TABLE 8.4 provided separately in the Diagram booklet. TABLE 8.4 shows data on the percentage of slow twitch (ST) and fast twitch (FT) muscle fibres from groups of athletes and non – athletes. It also shows the ratio of slow twitch to fast twitch muscles in each group of athletes.

- (i) The ratio of ST : FT muscle fibres in marathon runners was 4 • 6 : 1
Explain the advantage of this ratio to marathon runners.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 8 (c) continued

- 8. (c) (ii) The samples analysed were all obtained from the same muscle in all individuals in the study.**

Explain why it is important to obtain the samples from the same muscle in each individual.

[2 marks]

continued on the next page . . .

(Turn over)

Question 8 (c) continued

- 8. (c) (iii) State TWO factors that should have been controlled within each group to improve confidence in the conclusions.**

[2 marks]

- (d) Refer to IMAGE 8.5 in the separate Diagram Booklet. IMAGE 8.5 shows an X – ray of a patient who was suffering from osteoarthritis of the knee.**

- (i) Describe the evidence from IMAGE 8.5 that this patient had osteoarthritis.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 8 (d) continued

- 8. (d) (ii) The patient above was advised that they would be a suitable candidate for knee replacement surgery.**

State THREE DISADVANTAGES of this treatment.

I. _____

II. _____

III. _____

[3 marks]

(Total for Question 8 = 20 marks)

(Turn over)

OPTION C: NEUROBIOLOGY AND BEHAVIOUR

9. (a) Refer to IMAGE 9.1 in the separate Diagram Booklet. IMAGE 9.1 shows the brains of a mouse and a capuchin monkey.
- (i) The mouse brain in IMAGE 9.1 has been magnified to allow comparison with the monkey brain.
USE THE SCALE BAR to calculate the actual length of the mouse brain.
GIVE YOUR ANSWER TO THE NEAREST HALF – CENTIMETRE.

Actual length = _____ cm

[2 marks]

continued on the next page . . .

(Turn over)

Question 9 (a) continued

- 9. (a) (ii) The monkey has a larger brain than the mouse and is considered to be a more intelligent animal.**

Use IMAGE 9.1 to identify ONE other difference between the two brains that might account for this.

[1 mark]

- (iii) Refer to IMAGE 9.2A and IMAGE 9.2B in the separate Diagram Booklet. Homunculi are used to represent the sizes of the relevant parts of the cerebrum associated with receiving sensory information from different parts of the body and their motor control. IMAGE 9.2 shows sensory and motor homunculi.**

continued on the next page . . .

(Turn over)

Question 9 (a) (iii) continued

- 9. (a) (iii) I. Describe the relationship between the size of the body parts shown in IMAGE 9.2 and the degree of innervation of the cerebrum.**

[1 mark]

- II. Explain why the size of the fingers in both the sensory and motor homunculi are similar.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 9 continued

9. (b) Refer to IMAGE 9.3 in the separate Diagram Booklet. IMAGE 9.3 shows three types of scan which are used to visualise the brain.

(i) Describe TWO advantages of using scans to visualise the brain.

[2 marks]

continued on the next page . . .

(Turn over)

Question 9 (b) continued

- 9. (b) (ii) fMRI scanning is considered the best method for monitoring brain activity.
State the full name for this scanning method.**

[1 mark]

- (iii) The coloured areas on the fMRI scan correspond to increased flow of oxygenated blood in that region.
Explain how this can be used to monitor brain activity.**

[2 mark]

continued on the next page . . .

(Turn over)

Question 9 continued

9. (c) Refer to IMAGE 9.4 in the separate Diagram Booklet. Honeybees live in dense groups called colonies. The bees display a range of innate behaviour patterns which help them to communicate within the colony. On returning to their colonies, worker honeybees perform a waggle dance many times to communicate to other bees the distance and direction of a food source from the hive. The dance is made up of two phases, the waggle phase and the return phase. This is shown in IMAGE 9.4

Refer to GRAPH 9.5A and GRAPH 9.5B in the separate Diagram Booklet. A group of researchers studied the relationship between the duration of the two phases of the waggle dance to the distance of artificial feeders from the hive. The artificial feeders contained a sugar solution and were all the same colour. The results they obtained are shown in GRAPH 9.5A and GRAPH 9.5B.

continued on the next page . . .

(Turn over)

Question 9 (c) continued

- 9. (c) (i) Suggest TWO factors that could be controlled by using an artificial feeder for this experiment rather than relying on naturally occurring flowers.**

[2 marks]

- (ii) Identify which of GRAPHS 9.5A and B has the more reliable data.
Explain your choice.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 9 (c) continued

- 9. (c) (iii) Refer to GRAPH 9.6 in the separate Diagram Booklet. State the general relationship shown in GRAPH 9.6 and suggest the benefit of this relationship to the bee colony.**

[3 marks]

continued on the next page . . .

(Turn over)

Question 9 (c) continued

9. (c) (iv) The bee waggle dance is an example of innate behaviour in a social insect. Primates also live in close social groups and display both innate and learned behaviour within the social group.

I. Distinguish between innate and learned behaviour.

[1 mark]

continued on the next page . . .

(Turn over)

Question 9 (c) (iv) continued

- 9. (c) (iv) II. Give ONE example of each type of behaviour in primates.**

Innate

Learned

[2 marks]

(Total for Question 9 = 20 marks)

TOTAL FOR SECTION B = 20 MARKS

TOTAL FOR PAPER = 100 MARKS

END OF PAPER

(Turn over)

[illegible]

(Turn over)

[illegible]

(Turn over)

[illegible]



GCE A LEVEL



A400U30–1

WEDNESDAY, 18 JUNE 2025 – MORNING

**BIOLOGY – A LEVEL COMPONENT 3
REQUIREMENTS FOR LIFE**

**The Diagram Booklet MUST be handed in
to the invigilators and sent for marking.**

Diagram Booklet

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

IMAGE 1.1

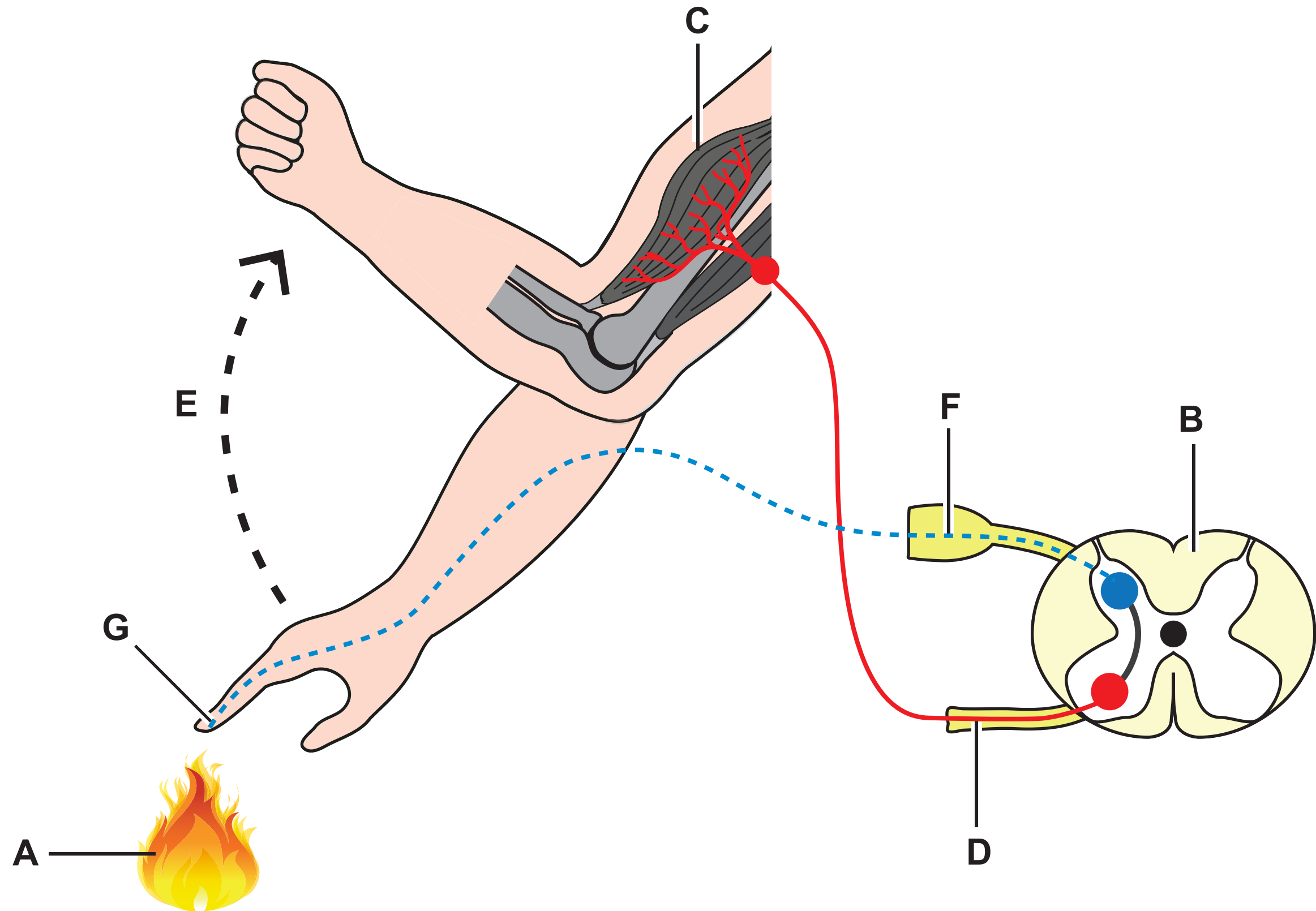
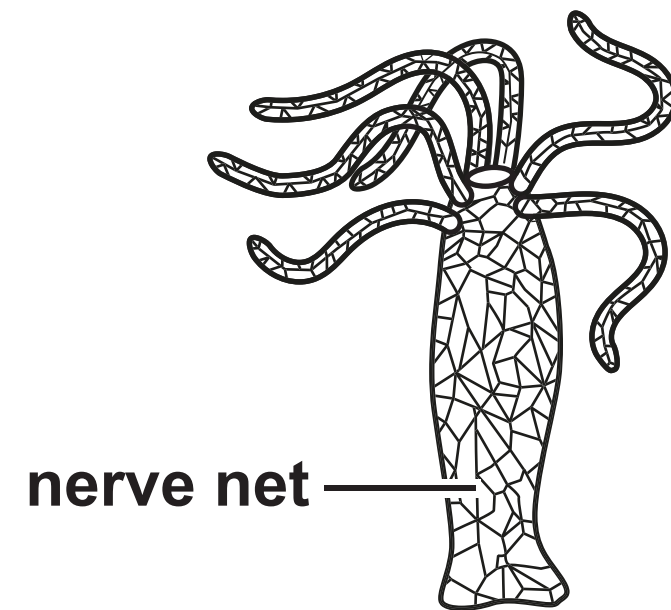


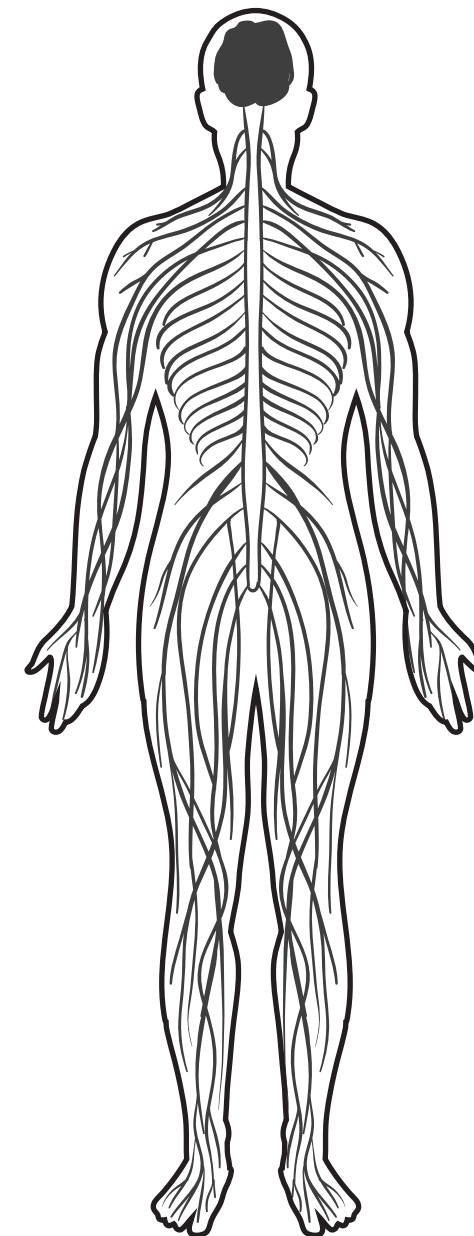
IMAGE 1.2

Diagrams NOT drawn to scale

HYDRA

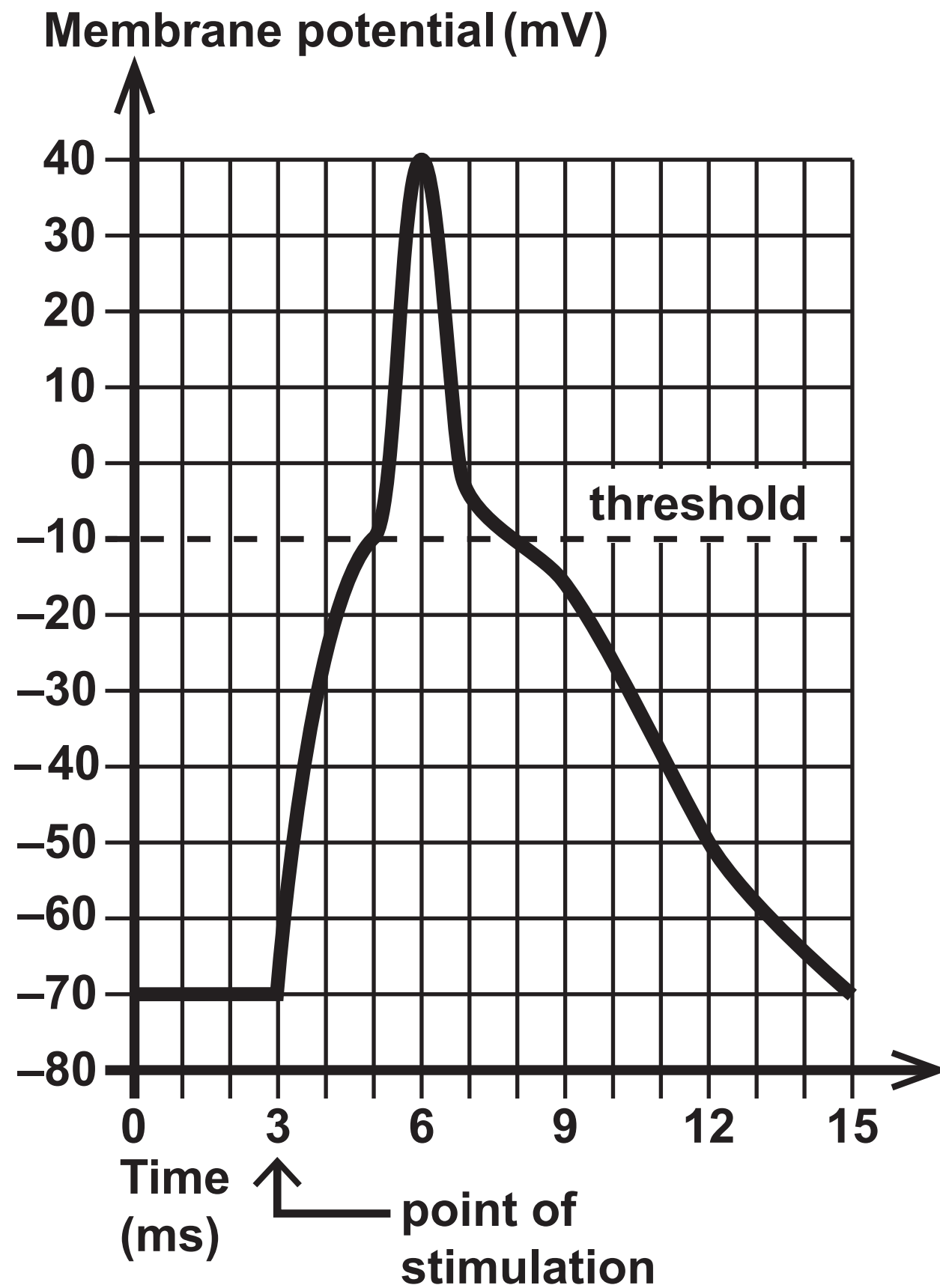


Human



GRAPH 1.3A and GRAPH 1.3B

GRAPH 1.3A HYDRA



GRAPH 1.3B HUMAN

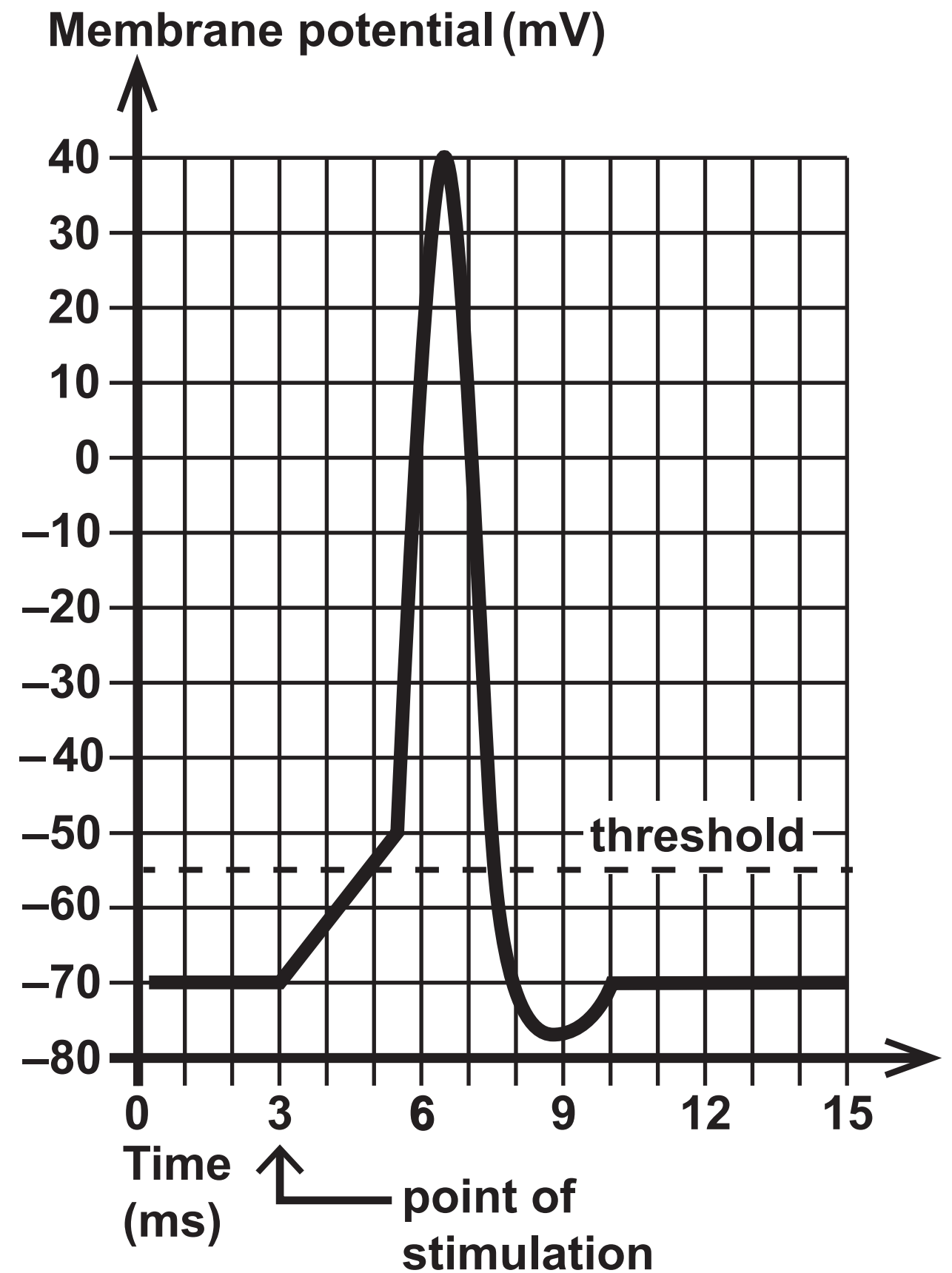
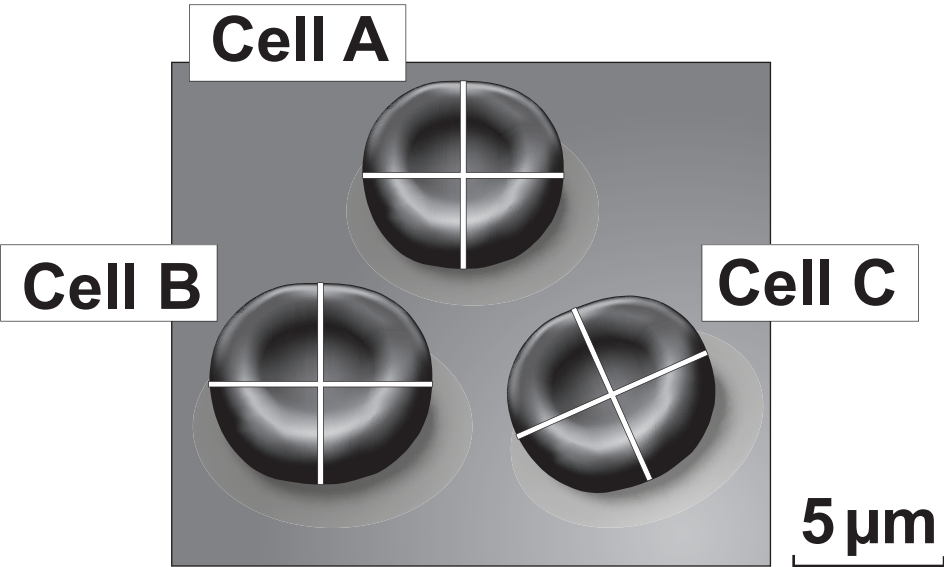


IMAGE 2.1



Question 2 (a)

TABLE 2.2

Cell	Diameter 1 (mm)	Diameter 2 (mm)
A	28	23
B	30	28
C	27	25

GRAPH 2.3

**Percentage saturation of haemoglobin
with oxygen (%)**

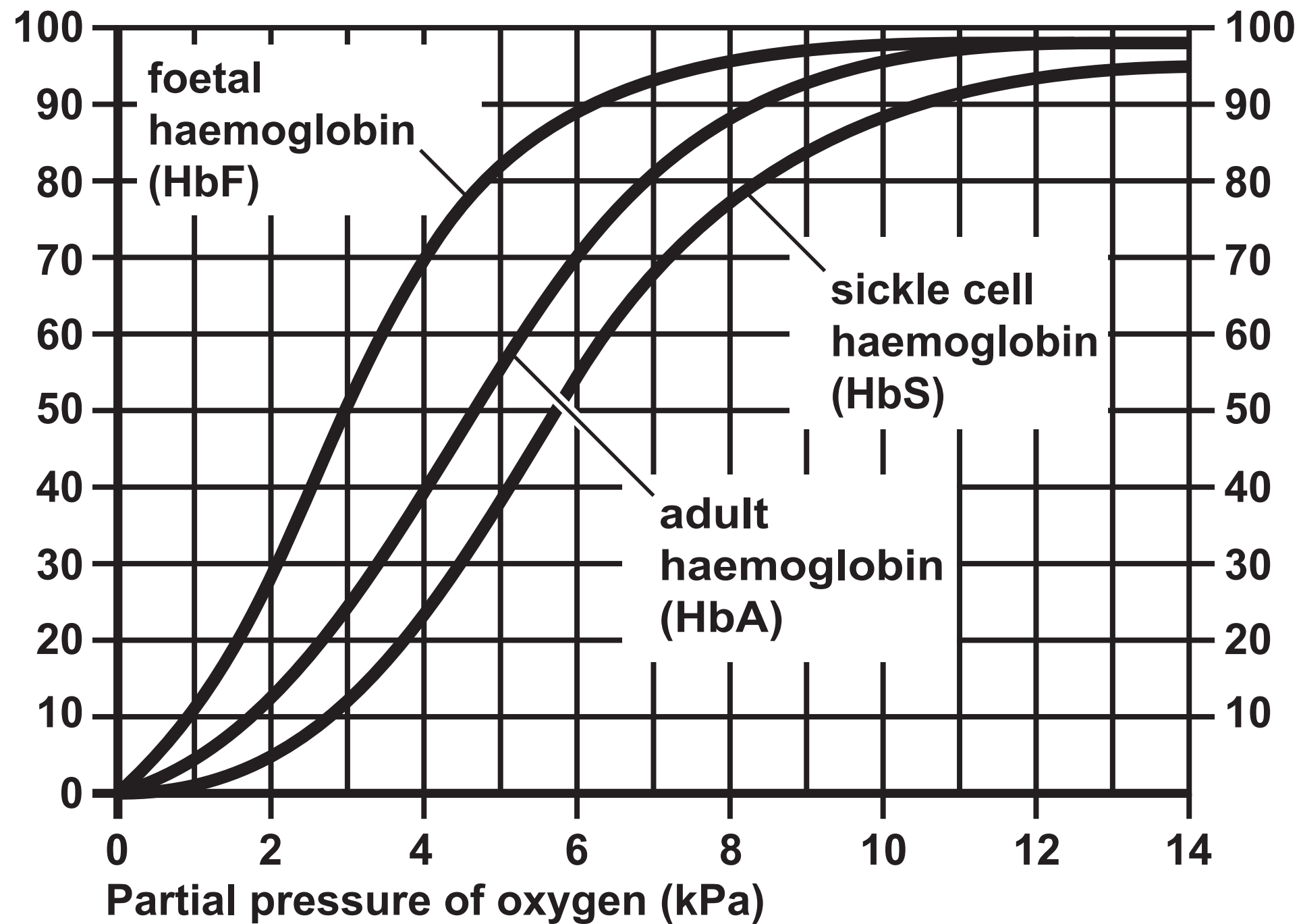
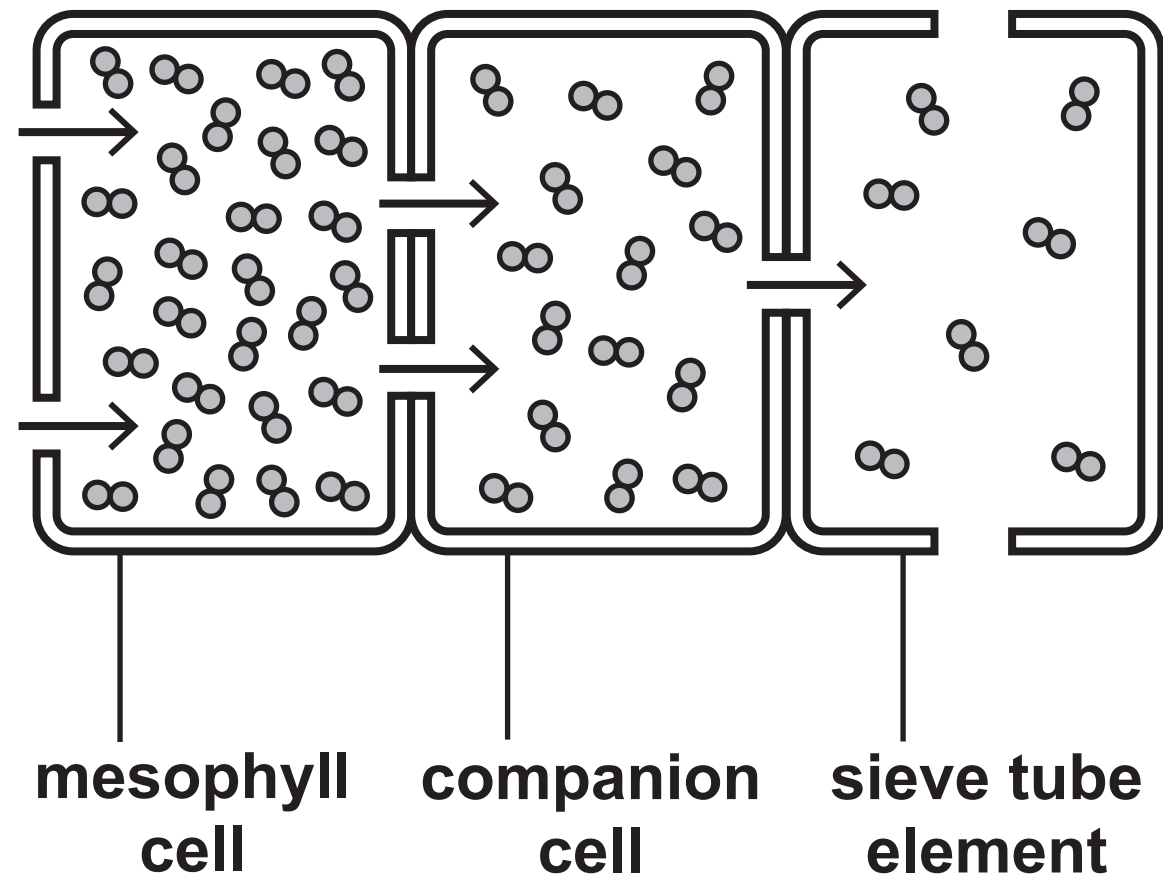
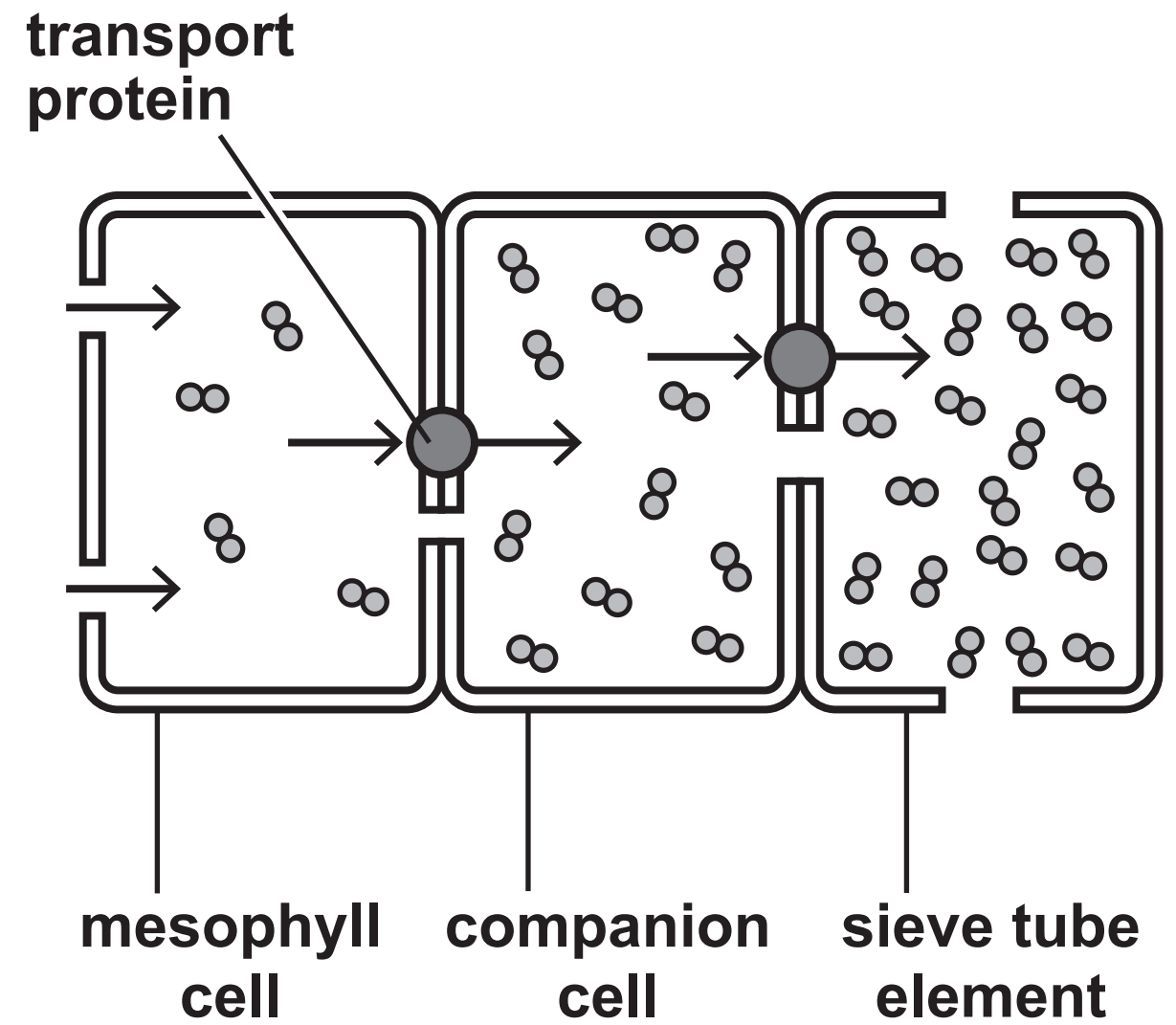


IMAGE 3.1

MECHANISM 1



MECHANISM 2



Question 3 (b)

Mechanism	Mode of transport	Explanation
1		
2		

IMAGE 3.2

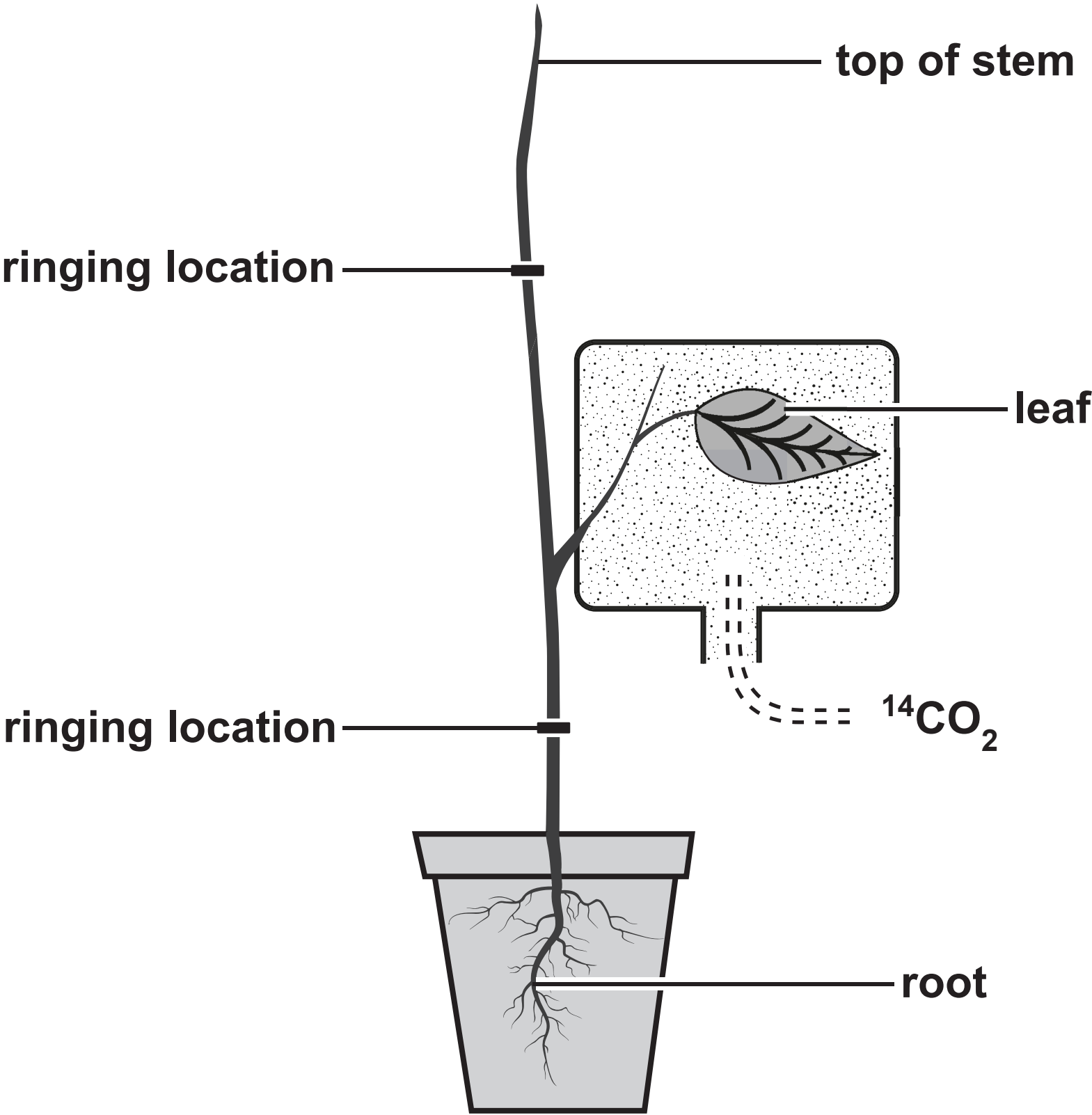


TABLE 3.3

Plant	Ringing location in relation to leaf	Level of ¹⁴C / au		
		Leaf	Top of stem	Root
A	none	2•5	3•3	0•9
B	above	2•3	0•0	1•7
C	below	2•1	4•1	0•0
D	above and below	2•1	0•0	0•0

IMAGE 4.1

TAENIA



PEDICULUS



GRAPH 4.2

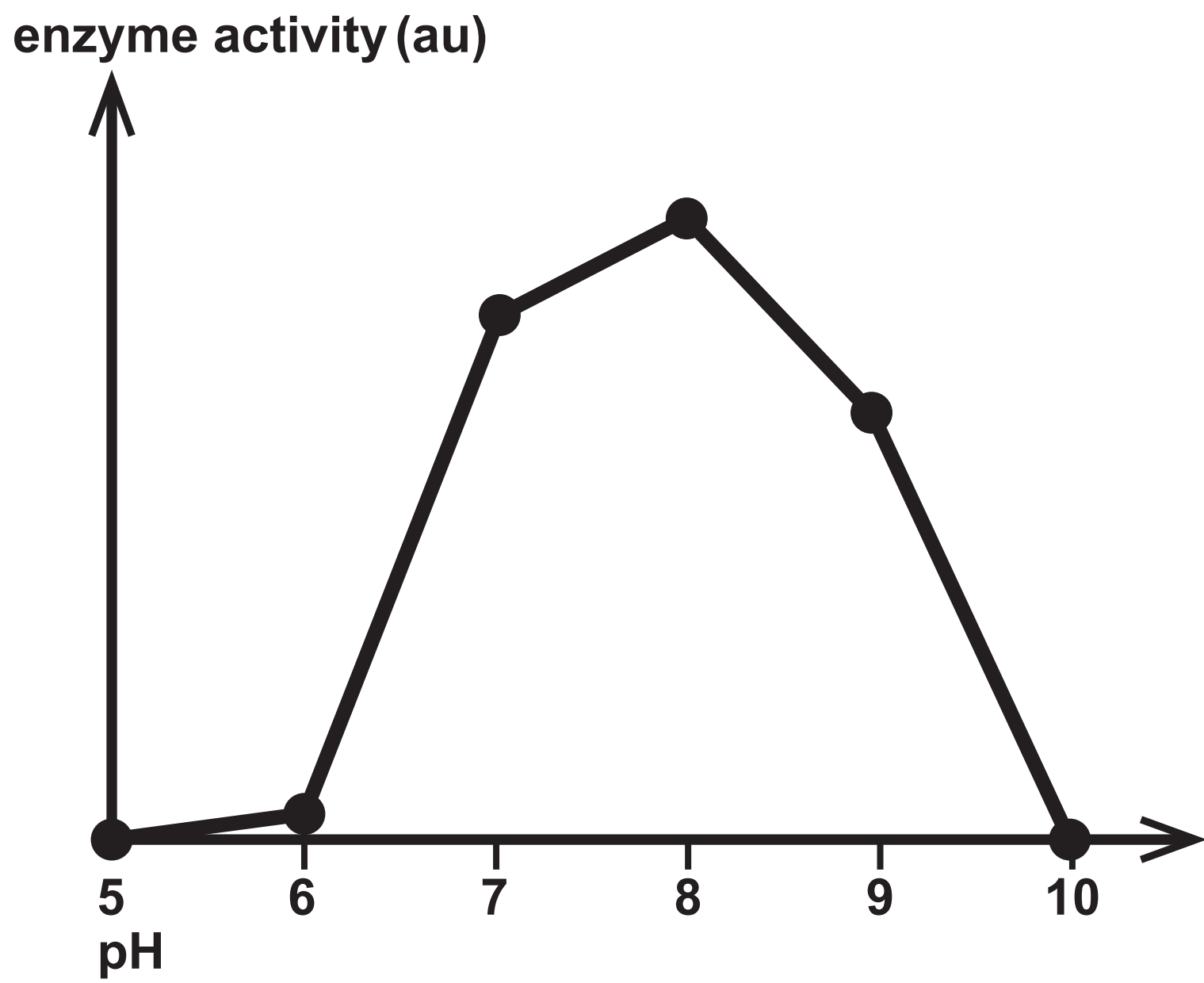


IMAGE 4.3

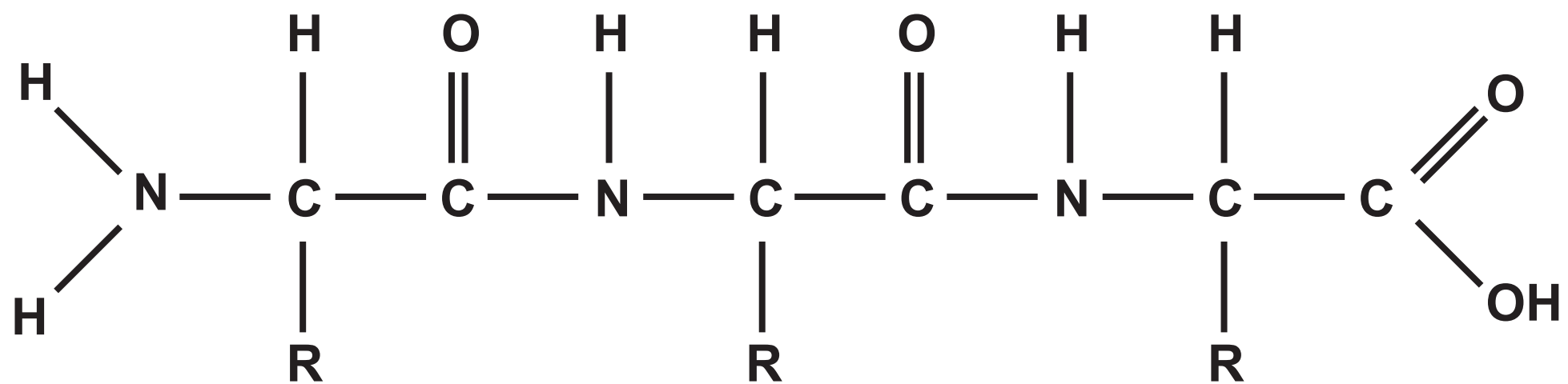
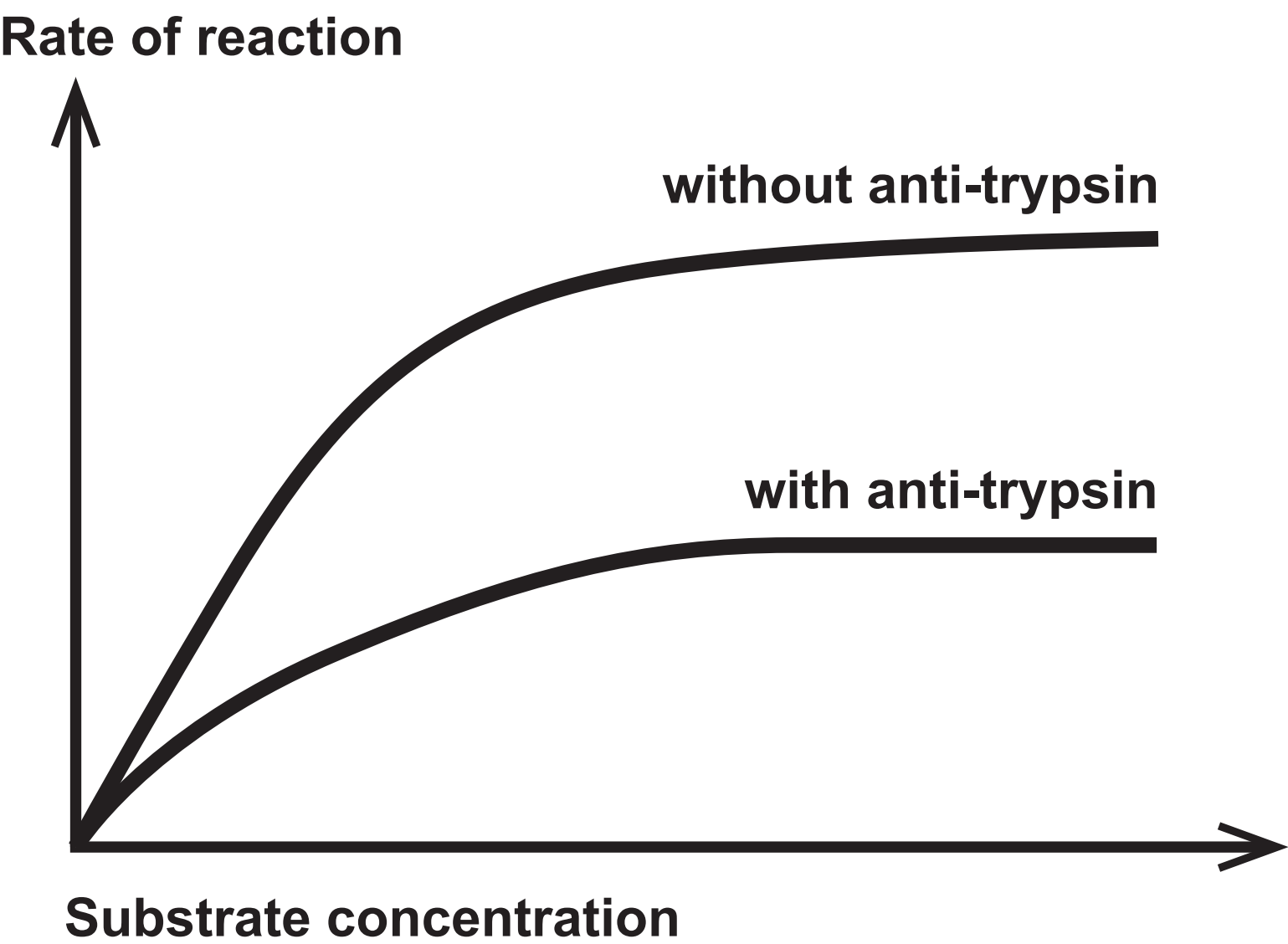


IMAGE 4.4



Question 5 (a)

TABLE 5.1

Organism	Water availability	Urine concentration / mOsm dm⁻³
domestic cat	medium	3100
kangaroo rat	low	5500
beaver	high	520
human	medium	1400
camel	low	2800

GRAPH 5.2

Key: — × — low water availability
— ● — medium water availability
·· ○ ·· high water availability

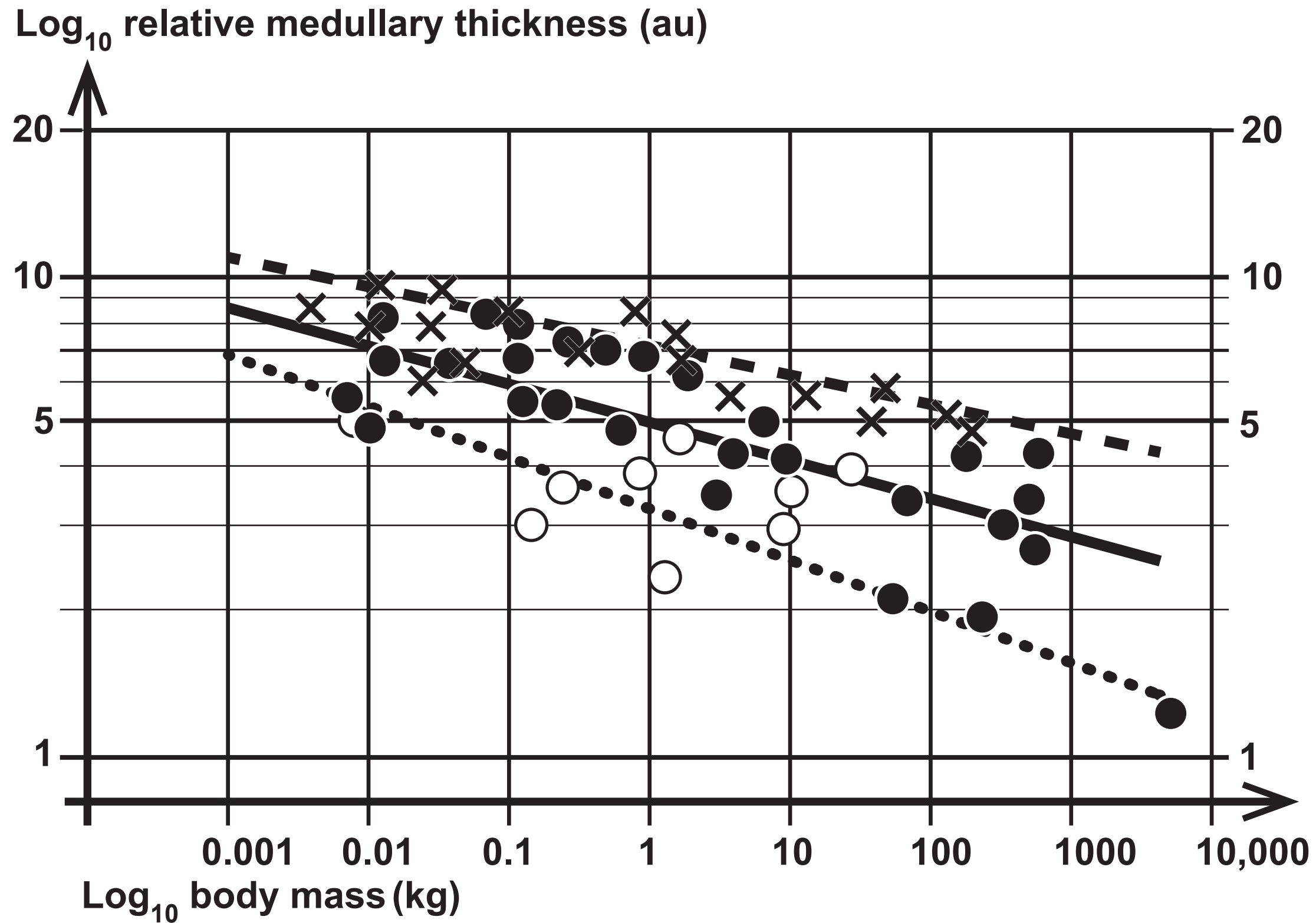


IMAGE 6.1

Circulatory system of an aquatic snail

an aquatic snail

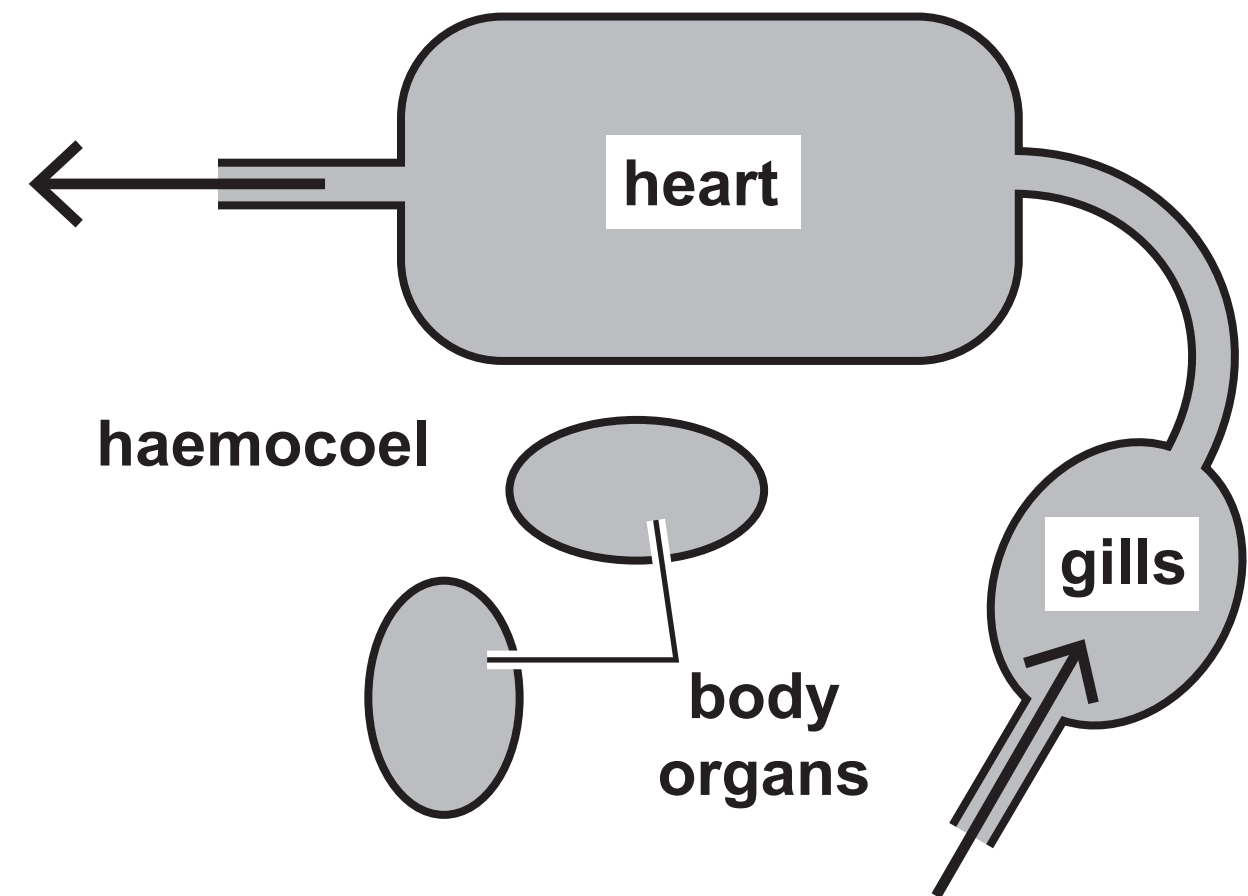


IMAGE 6.2

Circulatory system of a squid

A squid

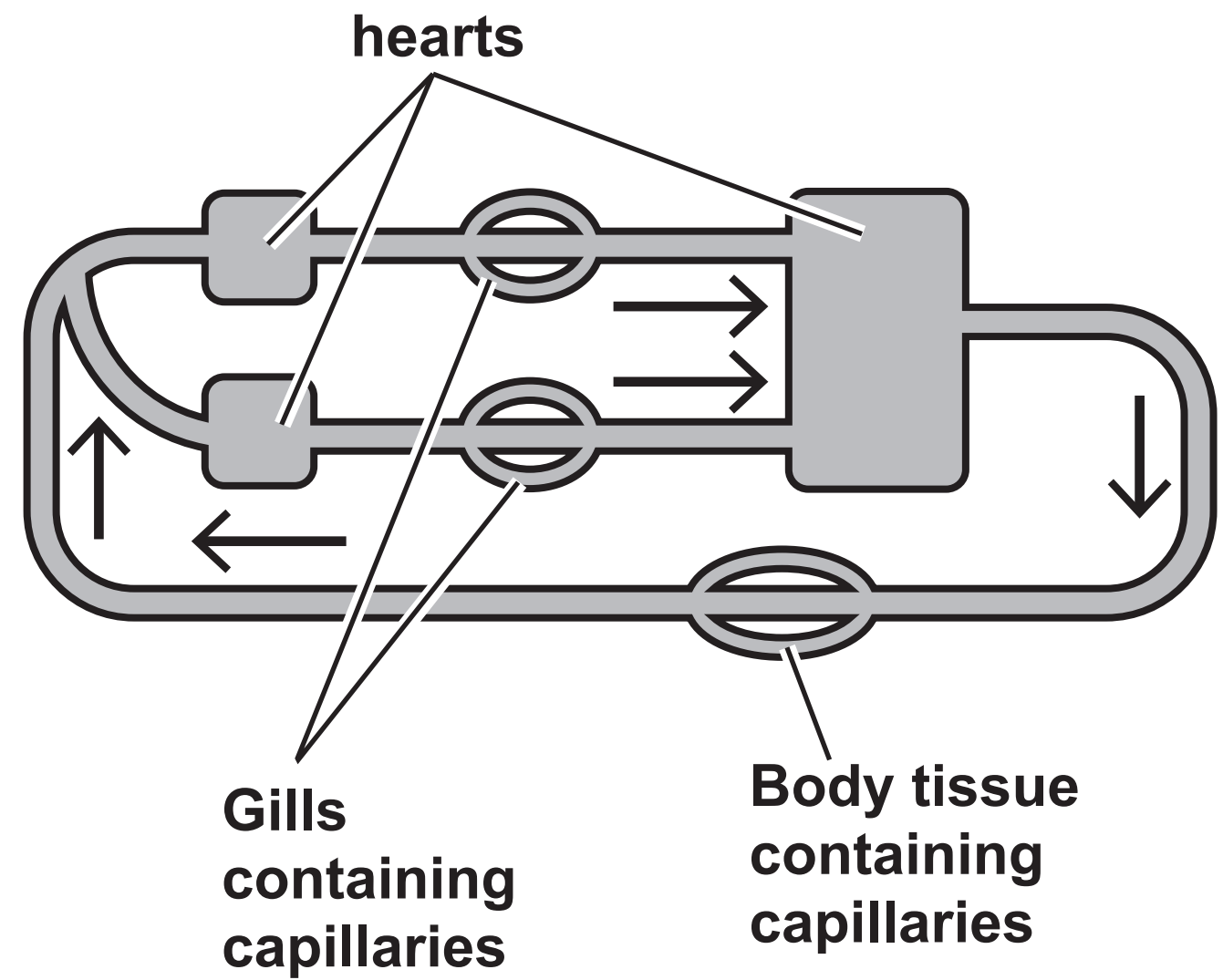
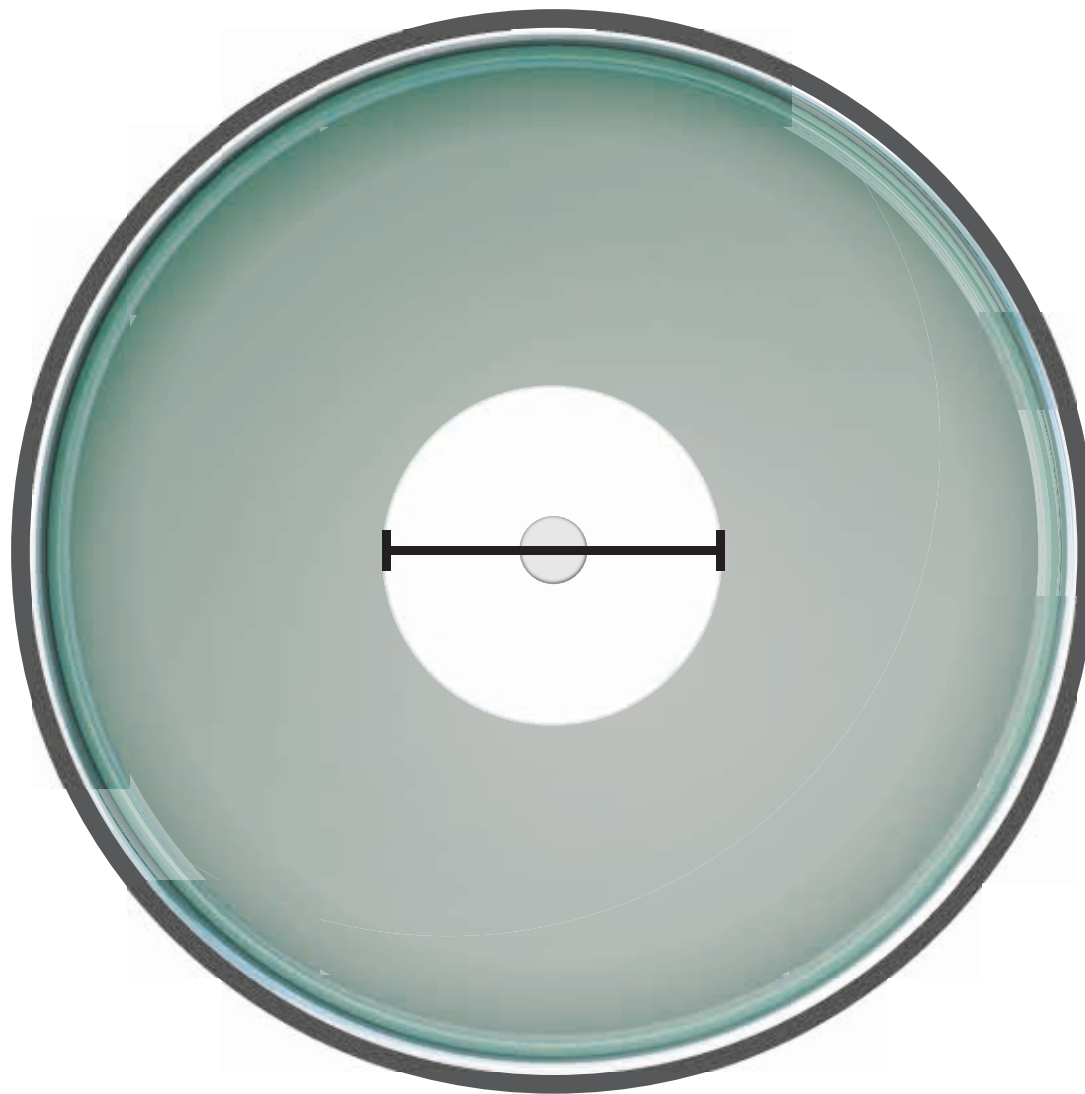


IMAGE 7.1



Magnification = $\times 1.2$

TABLE 7.2

Antibiotic	Mean diameter of clear zone / mm	Standard deviation / $\pm$
Penicillin G	30•4	2•7
Amoxycillin	27•8	2•9
Tetracycline	9•5	2•4
Control	0•0	0•0

IMAGE 8.1



IMAGE 8.2

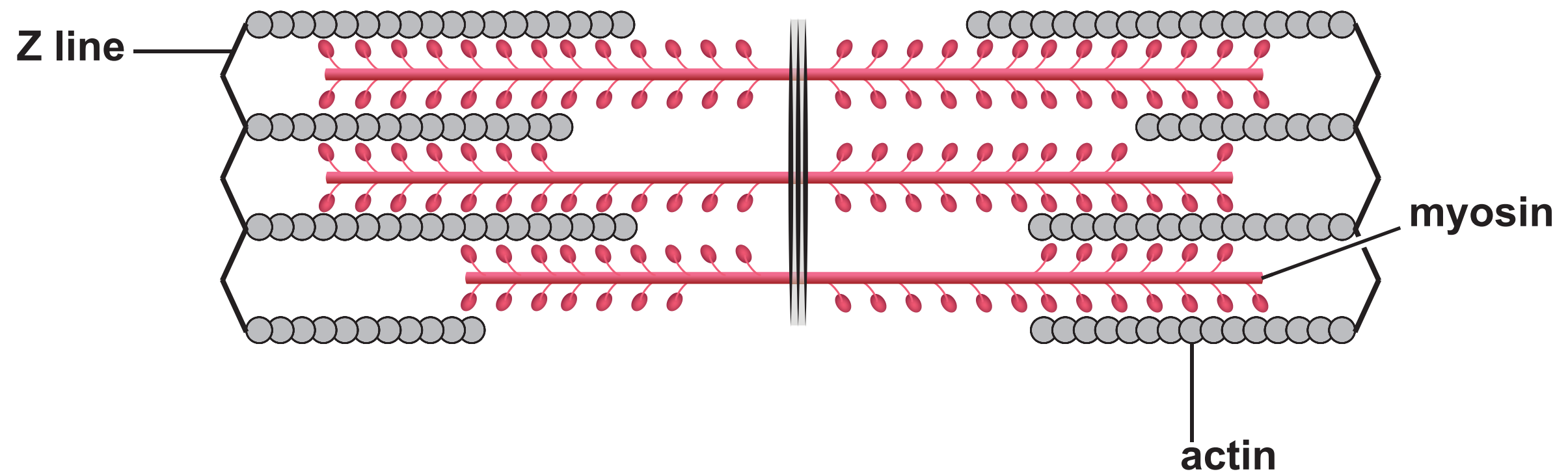
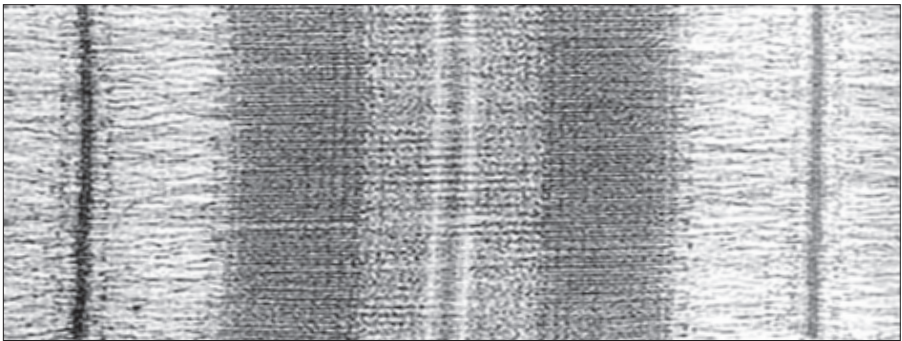
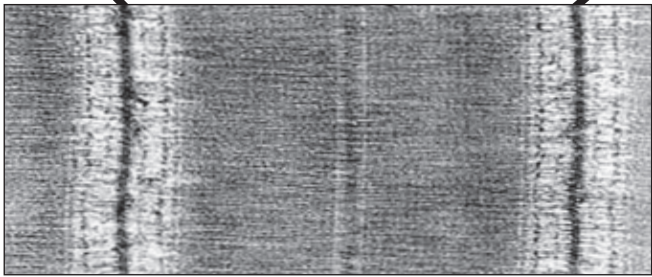


IMAGE 8.3

UNCONTRACTED



CONTRACTED



1 μ m



Question 8 (c)

TABLE 8.4

Group	Proportion of slow twitch and fast twitch muscle fibres		
	Slow Twitch / %	Fast Twitch / %	Ratio ST : FT
marathon runners	82	18	4•6 :1
swimmers	75	25	3•0 : 1
non – athlete	45	55	0•8 : 1
sprinters	37	63	0•6 : 1

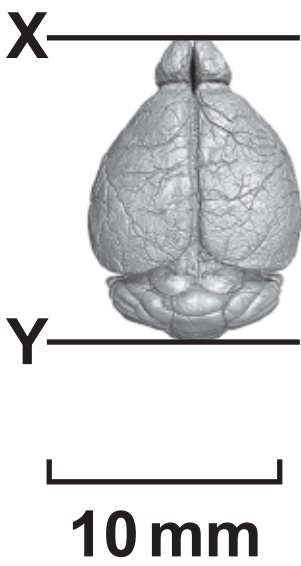
IMAGE 8.5

FRONT VIEW

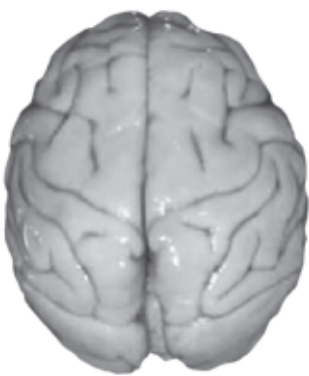


IMAGE 9.1

Mouse



Capuchin Monkey



2 × ACTUAL SIZE

IMAGE 9.2A

Sensory cortex in right cerebrum

Gen = genitals

To = toe

Fo = foot

Le = leg

Hi = hip

Tr = trunk

Ne = neck

He = head

Sh = shoulder

A = arm

Elb = elbow

Fo = forearm

Wr = wrist

Ha = hand

LF = little finger

RF = ring finger

MF = middle finger

IF = index finger

Th = thumb

Ey = eye

No = nose

Fa = face

ULi = upper lip

Li = lips

LLi = lower lip

**TG+J = teeth, gums
and jaw**

T = tongue

Ph = pharynx

I-A = Intra-abdominal

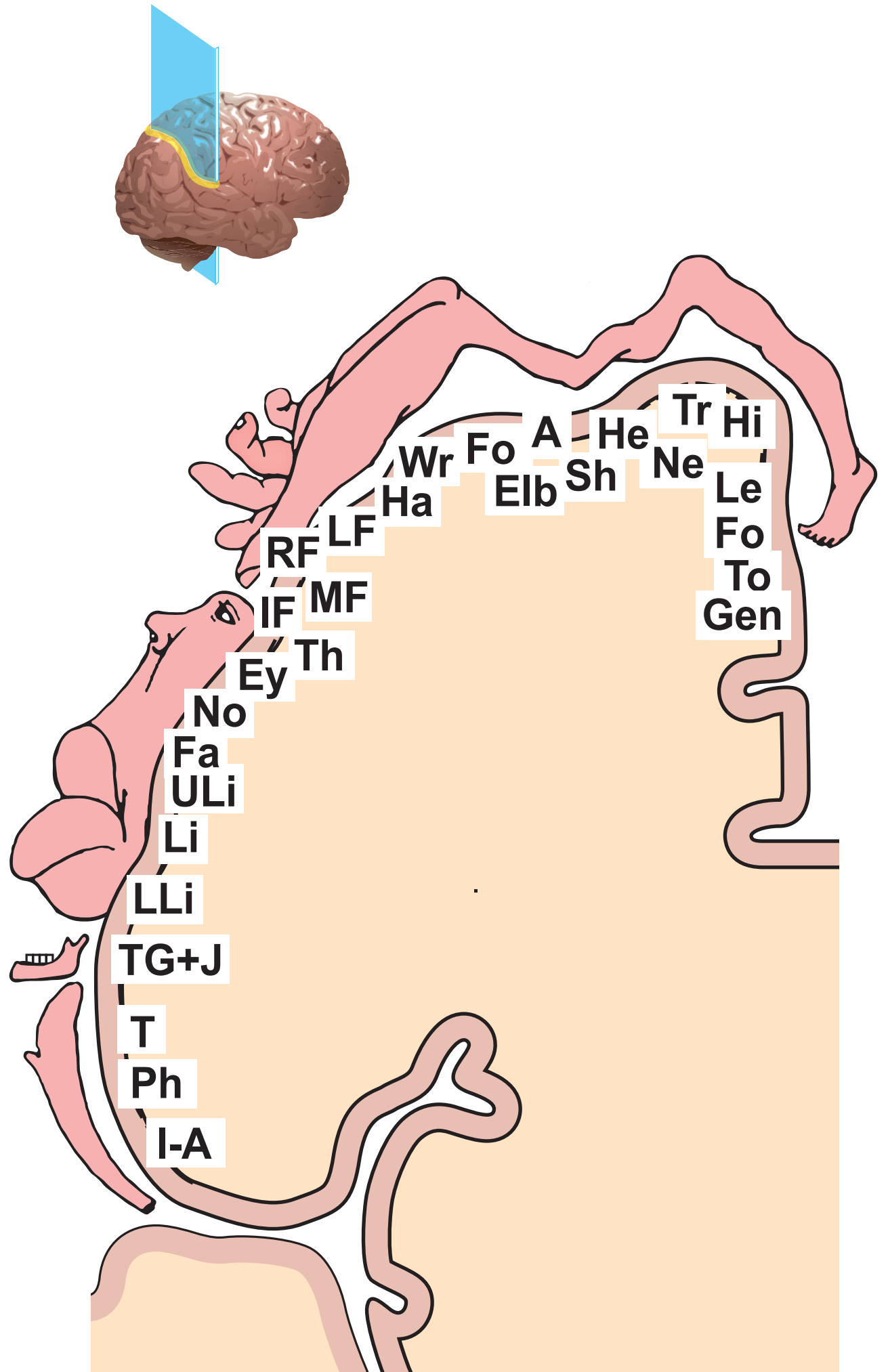


IMAGE 9.2B

Motor cortex in right cerebrum

To = toe

An = ankle

Kn = knee

Hi = hip

Tr = trunk

Sh = shoulder

Elb = elbow

Wr = wrist

Ha = hand

LF = little finger

RF = ring finger

MF = middle finger

IF = index finger

Th = thumb

Ne = neck

Br = brow

Ed+Eb = eyelid and
eyeball

Fa = face

Li = lips

Vocal. = vocalisation

Saliv. = salivation

Mast. = mastication

Sw = swallowing

T = tongue

J = jaw

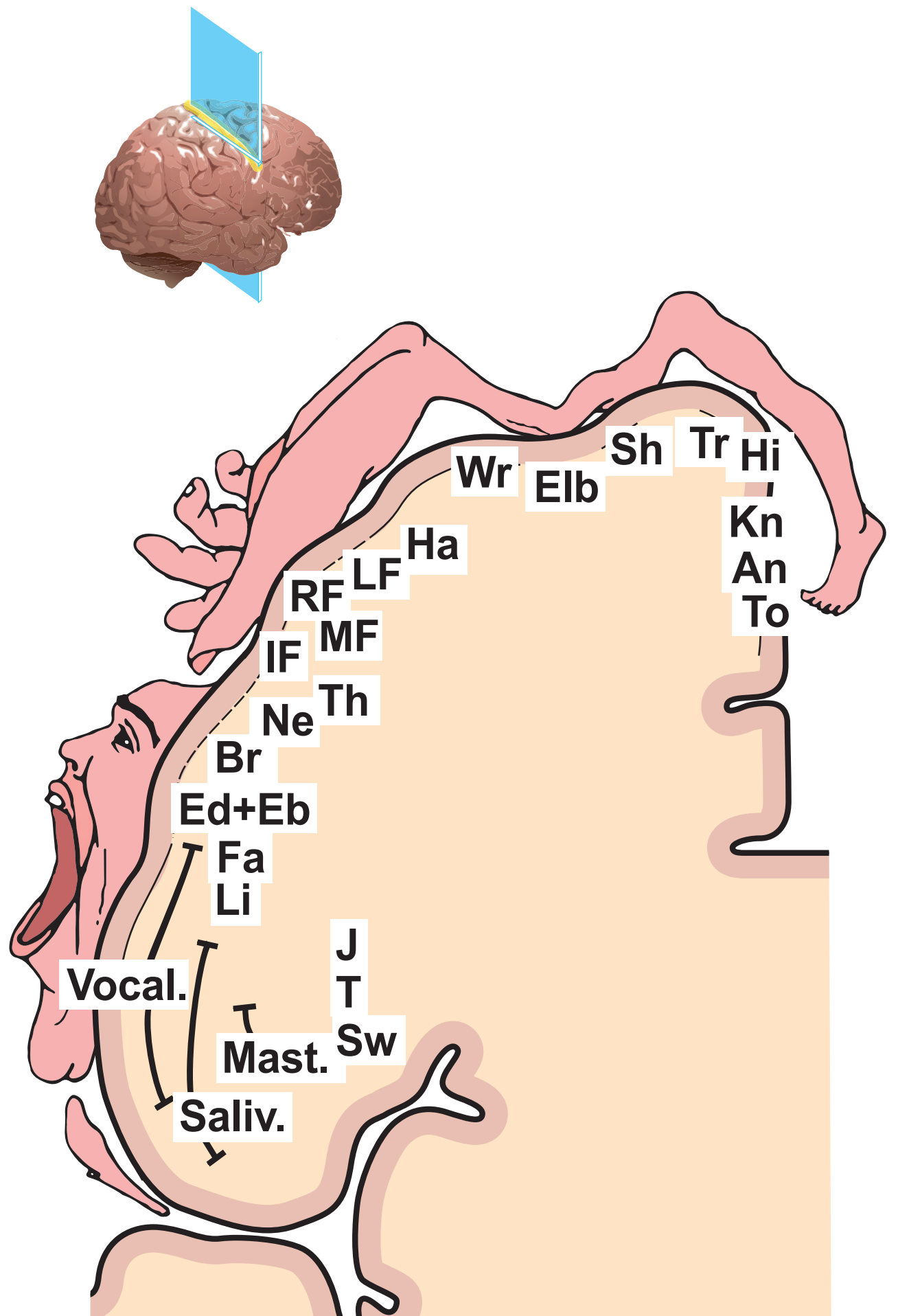


IMAGE 9.3

CAT/CT Scan

PET Scan

fMRI Scan

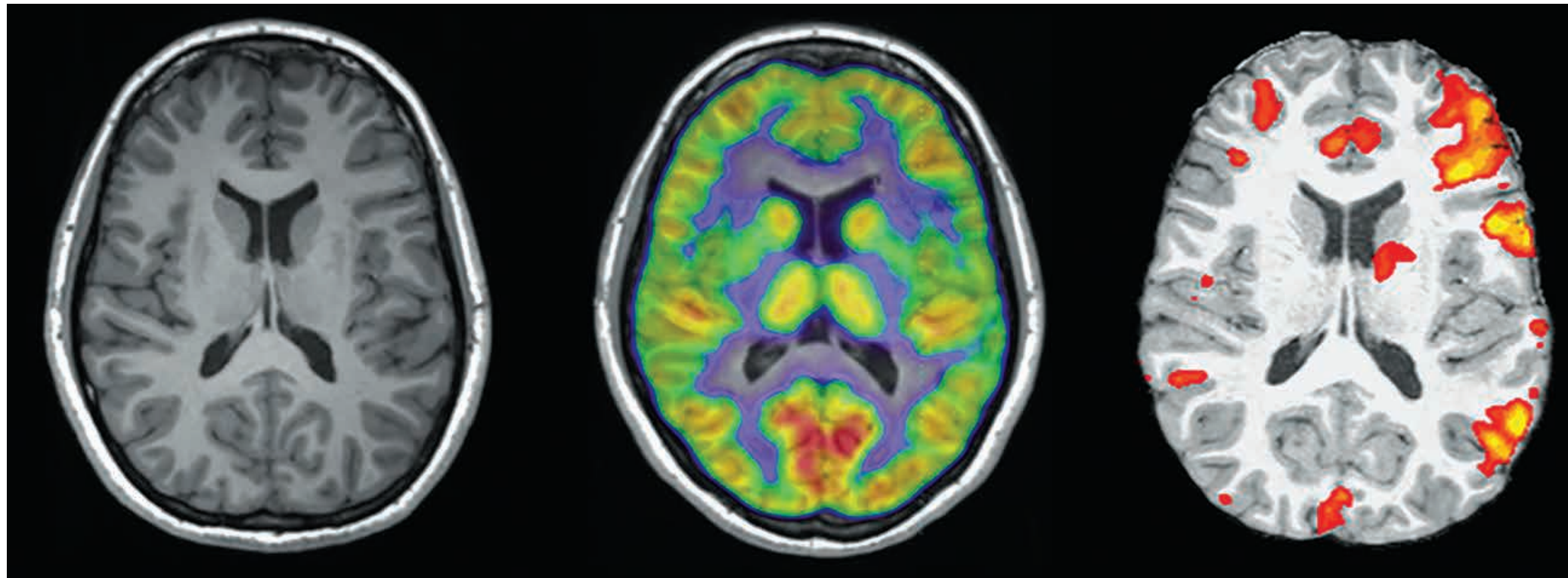
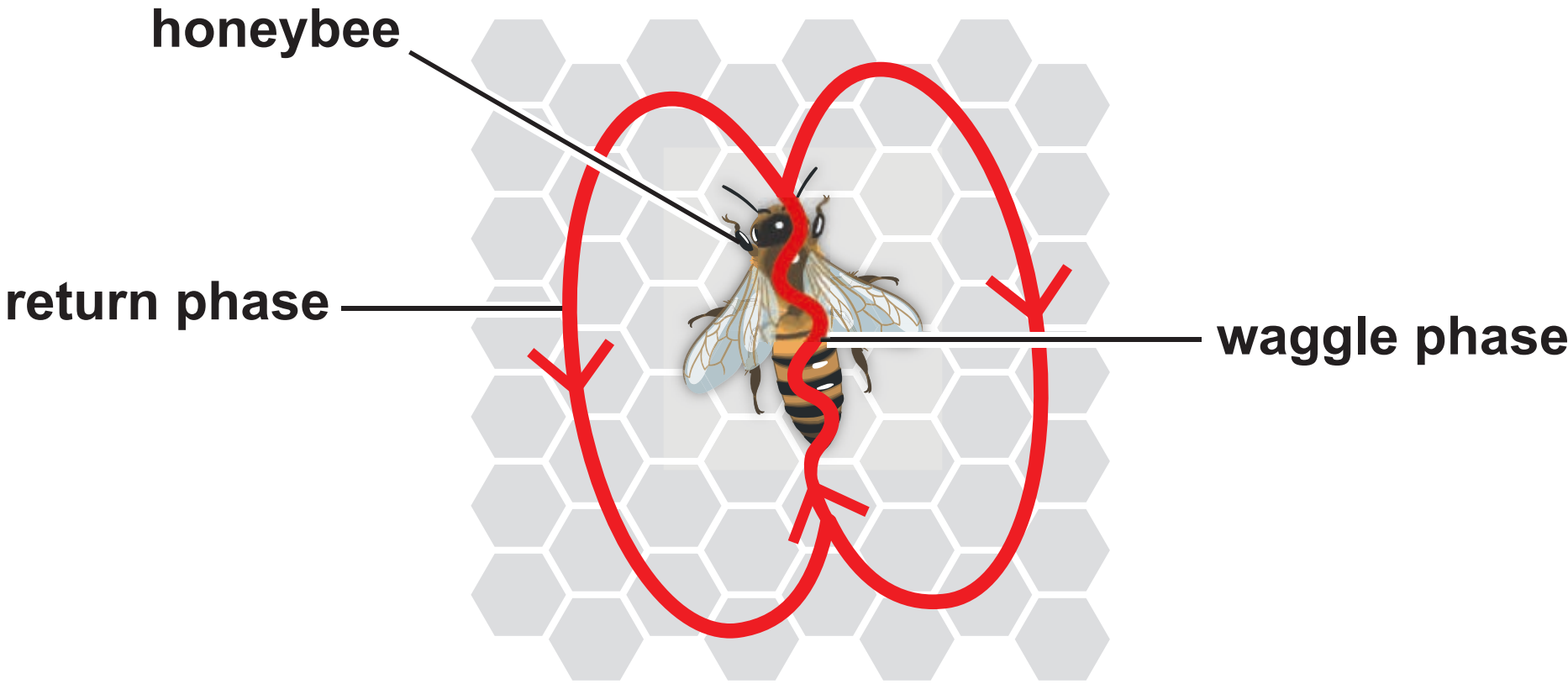


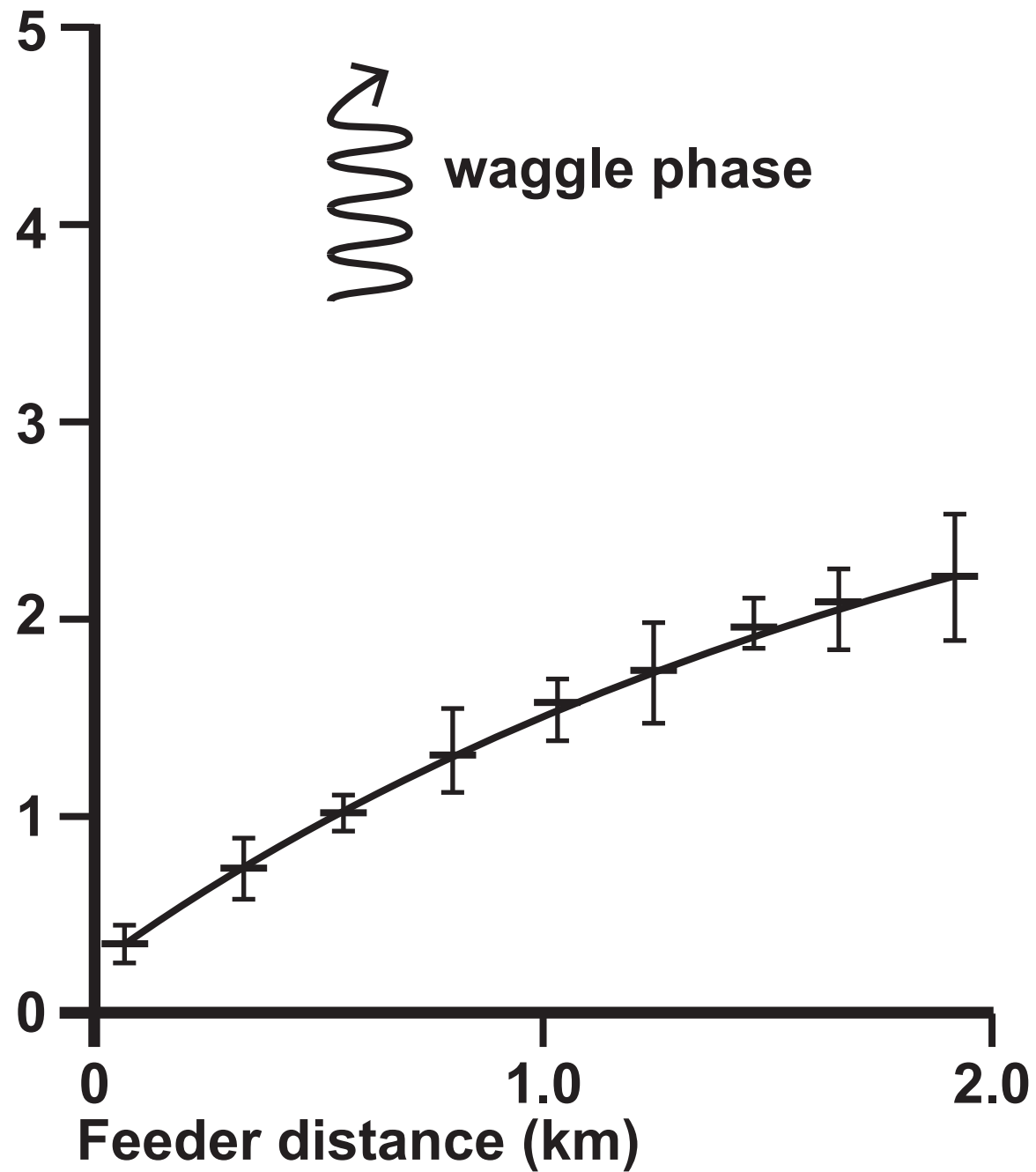
IMAGE 9.4



GRAPH 9.5A and GRAPH 9.5B

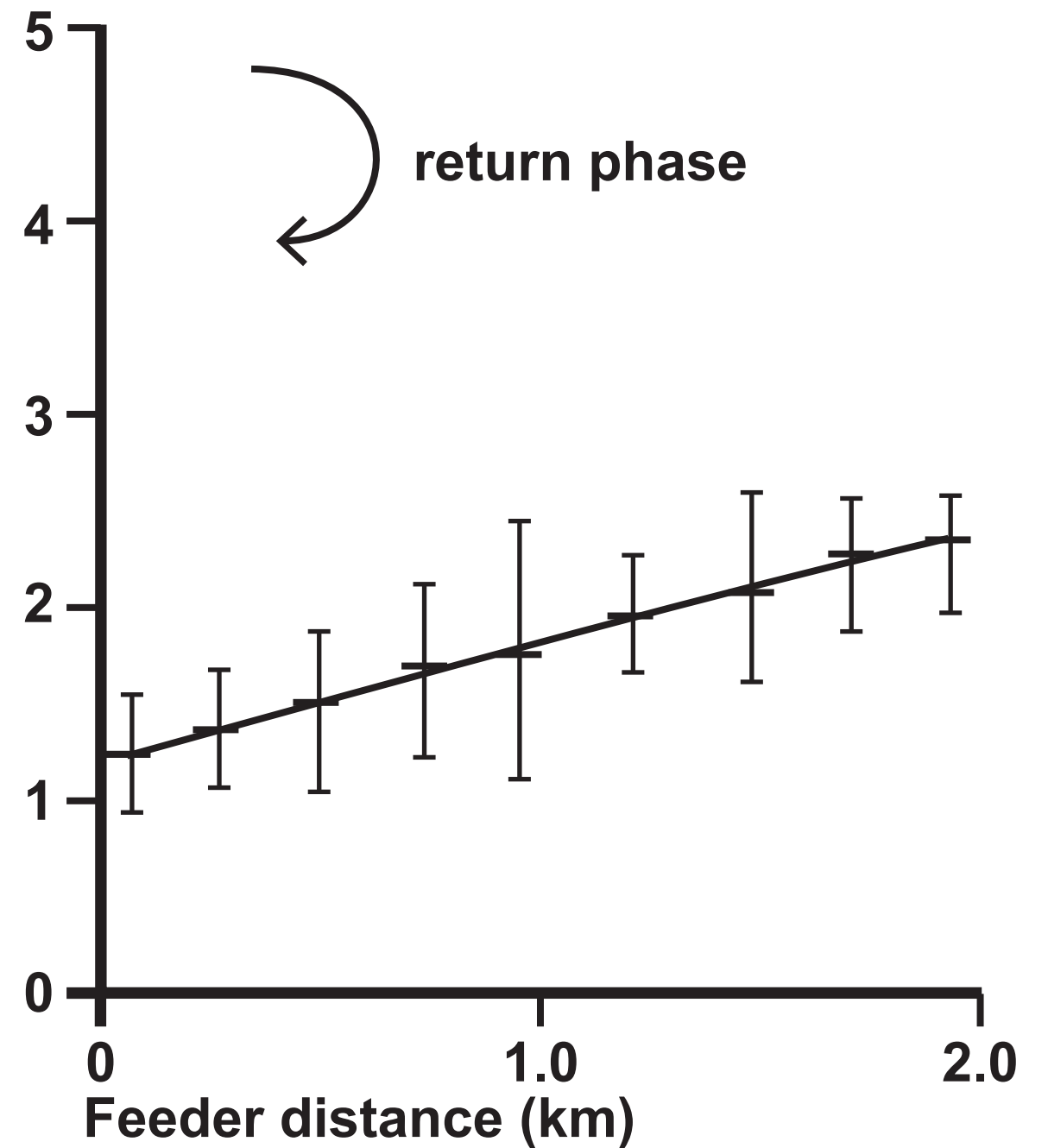
GRAPH 9.5A

Duration of waggle phase (s)



GRAPH 9.5B

Duration of waggle phase (s)



GRAPH 9.6

