

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# Biology

**International Advanced Level**

**Unit 5: Respiration, Internal Environment,  
Coordination and Gene Technology**

Sample Assessment Materials for first teaching September 2018

**Time: 1 hour 45 minutes**

Paper Reference

**WBI15/01**

**You must have:**

Scientific article (enclosed), scientific calculator, ruler, HB pencil

Total Marks

## Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- **Show all your working in calculations and include units where appropriate.**

## Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (\*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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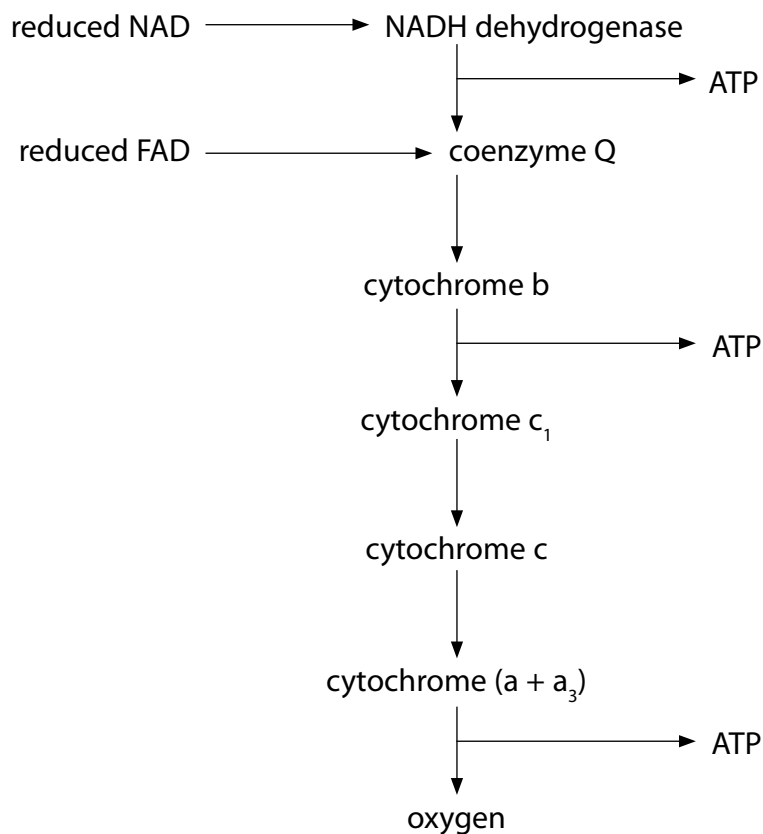
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**Answer ALL questions.**

**Write your answers in the spaces provided.**

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

- 1** The diagram shows the sequence of electron carriers in the electron transport chain. The diagram also shows the stages where ATP is generated.



(a) Where is the site of the electron transport chain?

(1)

- ☐ **A** cytoplasm
- ☐ **B** inner mitochondrial membrane
- ☐ **C** matrix
- ☐ **D** outer mitochondrial membrane

(b) The table gives some information about inhibitors of the electron transport chain.

| Inhibitor | Site of inhibition                                  |
|-----------|-----------------------------------------------------|
| Cyanide   | between cytochrome (a + a <sub>3</sub> ) and oxygen |
| Rotenone  | between NADH dehydrogenase and coenzyme Q           |

- (i) Explain the effect that cyanide will have on ATP production by the electron transport chain.

(2)

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- (ii) Metabolism of succinate results in the production of reduced FAD.

Explain the effect that rotenone will have on ATP production by the electron transport chain.

(2)

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(iii) Explain why these inhibitors will not affect the production of ATP from anaerobic respiration. Use the information in the table to support your answer.

(2)

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**(Total for Question 1 = 7 marks)**

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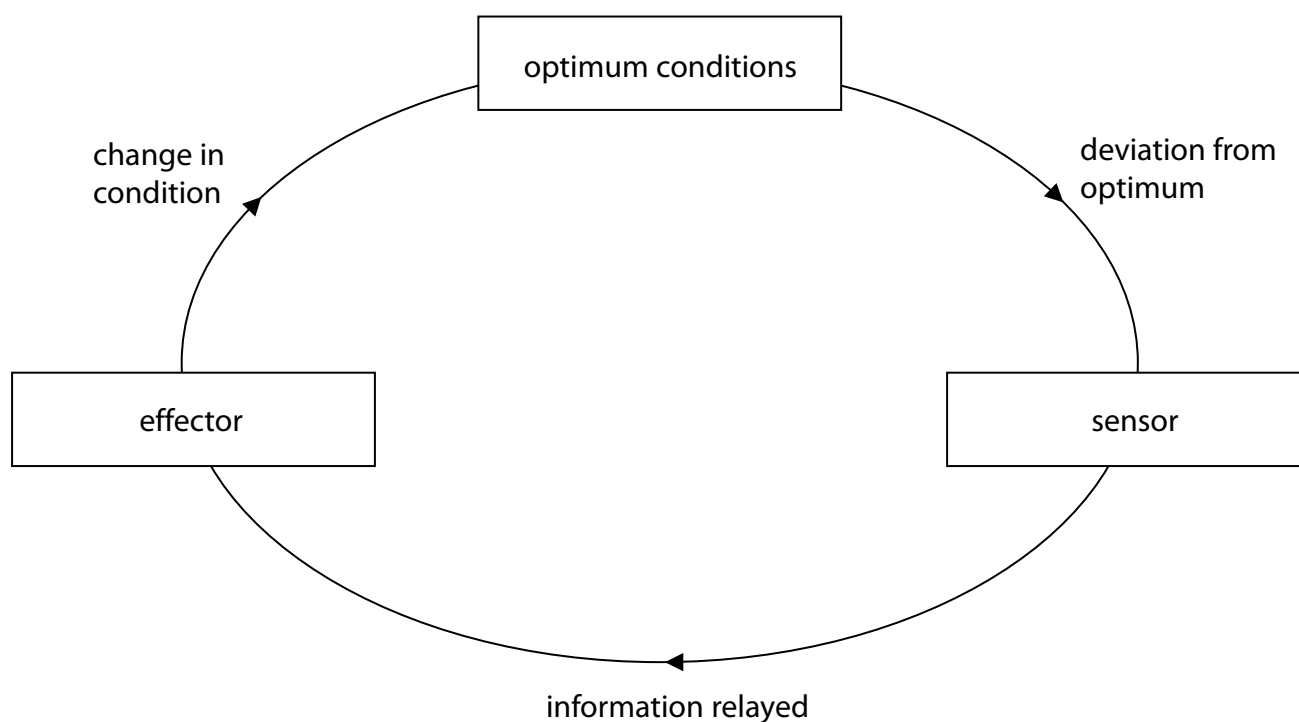
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- 2 (a) Negative feedback is important in maintaining homeostasis.

Control of the ventilation rate is an example of negative feedback.

The diagram summarises negative feedback.



- (i) Which row of the table shows the sensor and the location of the sensor involved in the control of ventilation?

(1)

|                            | sensor        | location of sensor |
|----------------------------|---------------|--------------------|
| <input type="checkbox"/> A | baroreceptor  | hypothalamus       |
| <input type="checkbox"/> B | baroreceptor  | medulla oblongata  |
| <input type="checkbox"/> C | chemoreceptor | hypothalamus       |
| <input type="checkbox"/> D | chemoreceptor | medulla oblongata  |

- (ii) Explain why the control of ventilation rate is an example of negative feedback.  
Use the information in the diagram to support your answer.

(4)

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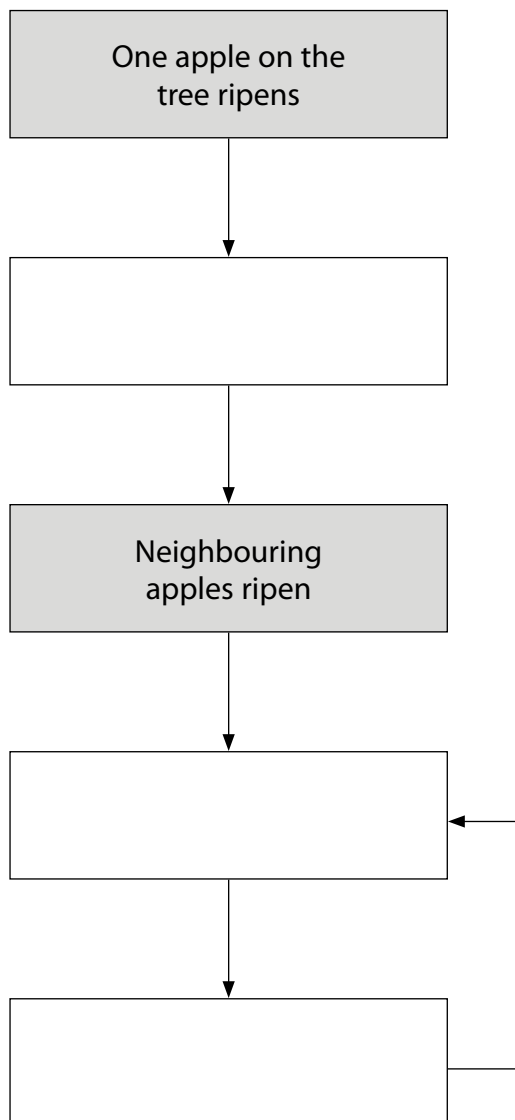
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(b) The ripening of apples is an example of positive feedback.

Ethene is a gas that causes apples to ripen. Ripe apples release ethene.

Complete the diagram to show positive feedback in the ripening of apples.

(3)



(Total for Question 2 = 8 marks)

**3** A number of insects can transmit disease when they bite their hosts.

The photograph shows *Rhodnius prolixus*, a blood-sucking insect that transmits Chagas disease between humans.

This insect feeds on blood by extending its proboscis and pushing it through the skin of a person. It is thought to do this when it detects body warmth.



© Oxford Scientific/Getty Images

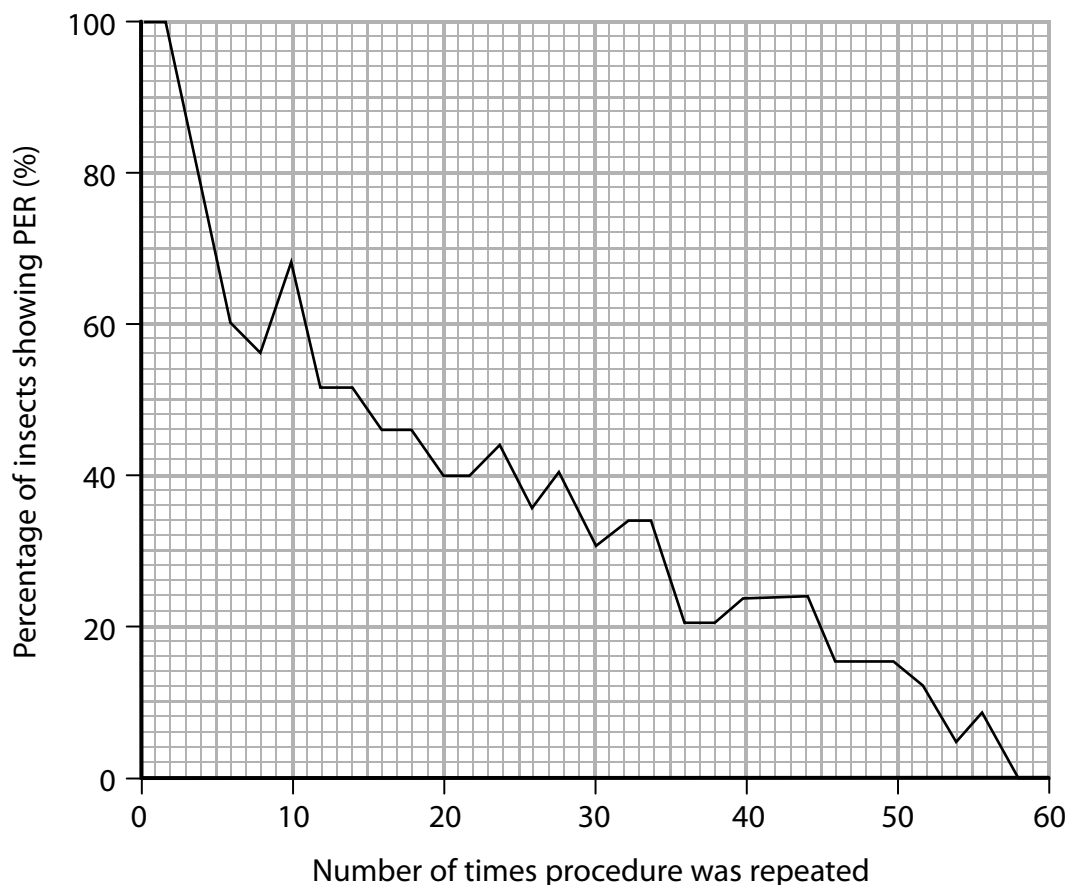
An investigation was carried out to study the effect of a heat stimulus on the proboscis extension response (PER).

Insects were kept in a temperature-controlled container with a heat pad placed in front of them. The heat pad could be touched by the proboscis when fully extended.

The heat pad was initially set at 25 °C. It was then heated up to 35 °C and the number of insects with a fully-extended proboscis were counted. It was then returned to a temperature of 25 °C.

This procedure was repeated a number of times.

The graph shows the results of this investigation.



(a) In this investigation, 350 insects were used.

Calculate the mean decrease in the number of insects showing PER each time the procedure was repeated.

(3)

Answer .....

(b) Explain the results of this investigation.

(3)

(c) Suggest why a drop in PER to a heat stimulus could be an advantage to these insects.

(2)

**(Total for Question 3 = 8 marks)**

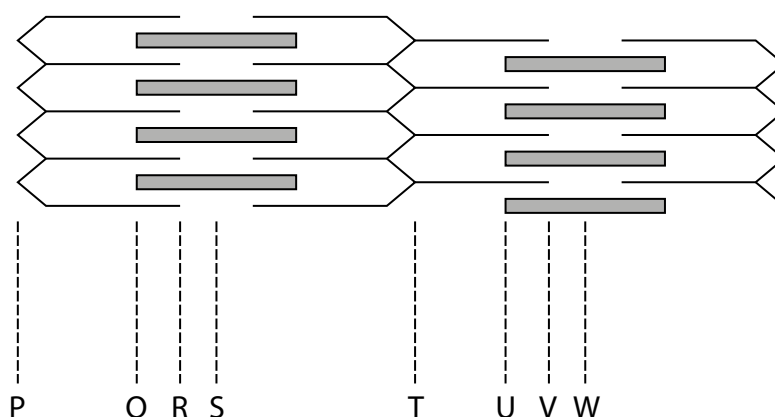
- 4 Movement in mammals results from the interaction between muscles, tendons, ligaments and the skeleton.

(a) Which row of the table describes tendons and ligaments?

(1)

|                            | <b>Tendons</b>                                         | <b>Ligaments</b>                                       |
|----------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> A | flexible, non-elastic tissue connecting bone to bone   | flexible tissue connecting muscle to bone              |
| <input type="checkbox"/> B | flexible, non-elastic tissue connecting muscle to bone | flexible tissue connecting bone to bone                |
| <input type="checkbox"/> C | flexible tissue connecting bone to bone                | flexible, non-elastic tissue connecting muscle to bone |
| <input type="checkbox"/> D | flexible tissue connecting muscle to bone              | flexible, non-elastic tissue connecting bone to bone   |

(b) (i) The diagram shows part of a skeletal muscle fibre.



Which pair of letters represents one sarcomere?

(1)

- ☐ A P to T
- ☐ B Q to U
- ☐ C R to V
- ☐ D S to W

(ii) Compare and contrast the structure of fast-twitch and slow-twitch muscle fibres.

(4)

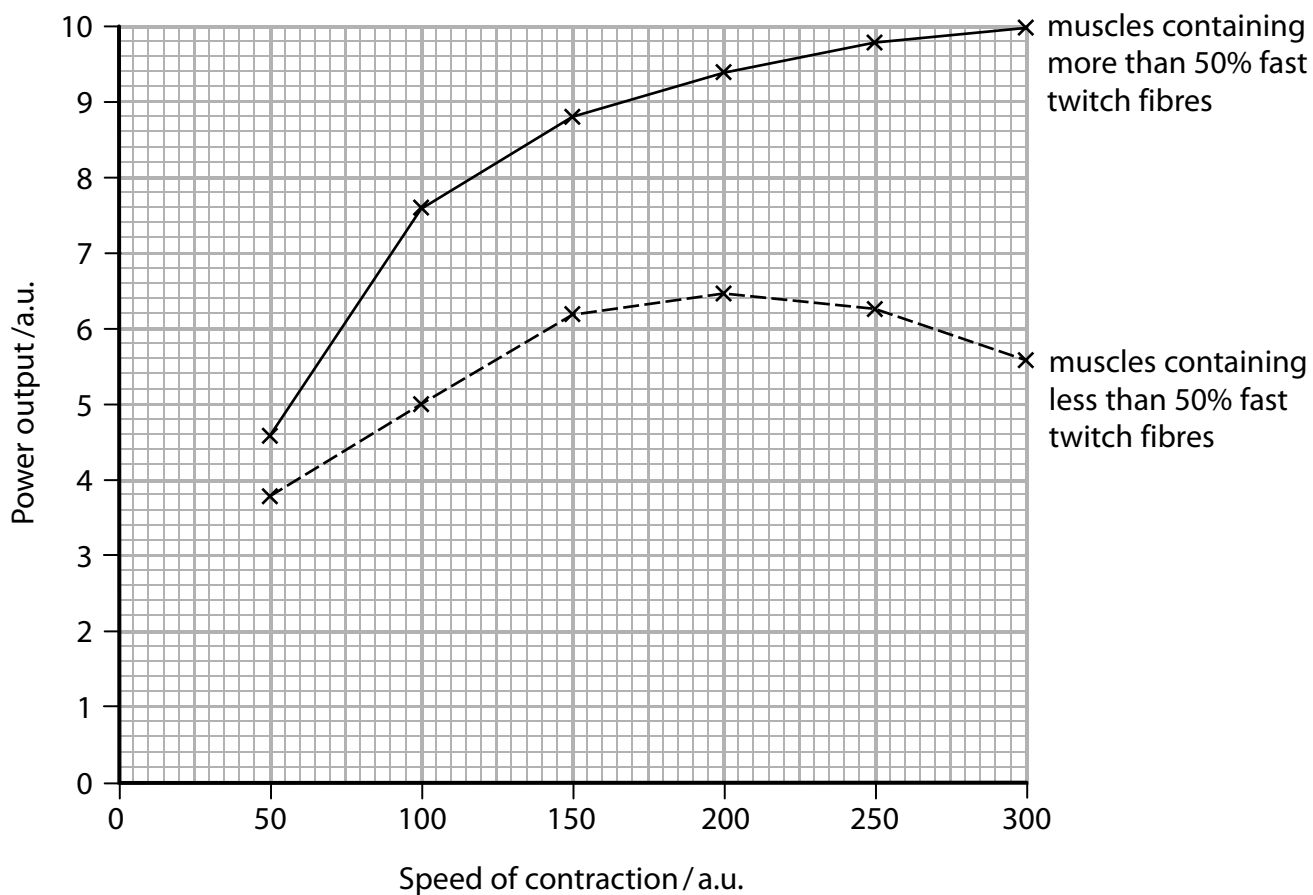
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- \*(c) The power output of a muscle depends on the speed of contraction and the proportion of fast-twitch and slow-twitch fibres in the muscle.

The graph shows the relationship between the power output and the speed of contraction of two different types of muscle.



Explain the relationship between power output and the speed of contraction of these two types of muscle. Use the information in the graph and your own knowledge to support your answer.

(6)

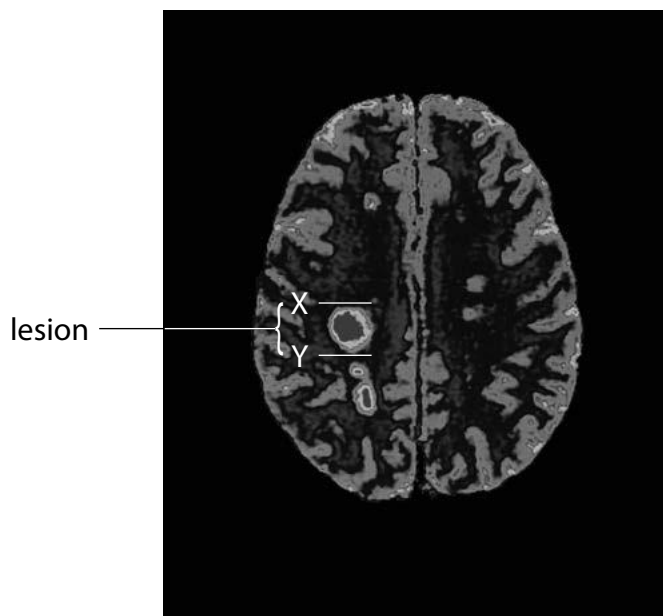
**(Total for Question 4 = 12 marks)**

- 5 Multiple sclerosis (MS) is a disease that causes the destruction of the myelin sheaths around neurones.

This destruction is caused by the person's own immune system.

Lesions form in the brain where myelin is destroyed.

- (a) The photograph shows lesions in the brain of a person with MS, as seen using magnetic resonance imaging (MRI).



© M210/0087 SGI/Science Photo Library

The actual length of this brain is 15 cm.

Calculate the actual diameter, in mm, of the lesion between X and Y.

(2)

Answer ..... mm

- (b) The table shows the speed of conduction of an impulse along non-myelinated and myelinated neurones with axons of different diameters.

| Type of neurone | Diameter of axon / $\mu\text{m}$ | Speed of conduction of impulse / $\text{m s}^{-1}$ |
|-----------------|----------------------------------|----------------------------------------------------|
| non-myelinated  | 1                                | 2.3                                                |
| non-myelinated  | 2                                | 3.1                                                |
| non-myelinated  | 4                                | 4.2                                                |
| myelinated      | 1                                | 2.6                                                |
| myelinated      | 2                                | 8.5                                                |

- (i) Show that the effect of diameter on the speed of conduction of an impulse is six times greater in a myelinated neurone than in a non-myelinated neurone.

(2)

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(ii) Explain the effect of the myelin sheath and the diameter of the axon on the speed of conduction of an impulse.

(4)

(iii) Symptoms of MS can include blindness in one eye and lack of coordination.  
Suggest why a person with MS could have these symptoms.

(3)

**(Total for Question 5 = 11 marks)**

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6 The kidney is involved in osmoregulation and the production of urine.

(a) (i) Which substances are filtered from the blood in the renal capsule?

(1)

- ☐ A glucose and fibrinogen
- ☐ B glucose, fibrinogen and urea
- ☐ C glucose and urea
- ☐ D urea and prothrombin

(ii) Which structure is acting as the filter in the renal capsule?

(1)

- ☐ A basement membrane
- ☐ B cells lining the renal capsule
- ☐ C endothelial cells in the walls of the capillaries
- ☐ D podocytes

(iii) Which transport mechanism is responsible for the uptake of glucose into the cells of the wall of the proximal tubule?

(1)

- ☐ A diffusion
- ☐ B endocytosis
- ☐ C sodium co-transport
- ☐ D osmosis

(iv) Explain why some urea is reabsorbed in the proximal tubule.

(2)

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- (b) In an investigation, salt solution was injected into the carotid artery of a mammal. The carotid artery carries blood to the head.

The rate of urine production was measured after the injection.

The table shows the results.

| Time after injection of salt solution / min | Rate of urine production / $\text{cm}^3 \text{ min}^{-1}$ |
|---------------------------------------------|-----------------------------------------------------------|
| 0                                           | 7.0                                                       |
| 5                                           | 1.1                                                       |
| 10                                          | 0.6                                                       |
| 15                                          | 1.0                                                       |
| 20                                          | 1.5                                                       |
| 25                                          | 2.2                                                       |
| 30                                          | 2.4                                                       |

- (i) Calculate the percentage decrease in the rate of urine production 10 minutes after the injection.

Give your answer to 2 decimal places.

(2)

Answer .....%

- (ii) At what times should more measurements be taken to find the lowest rate of urine production?

(1)

- ☐ **A** at 1-minute intervals between 5 minutes and 10 minutes
- ☐ **B** at 1-minute intervals between 5 minutes and 15 minutes
- ☐ **C** at 1-minute intervals between 10 minutes and 15 minutes
- ☐ **D** at 5 minutes, 10 minutes and 15 minutes, two more times

(iii) Explain the results of this investigation. Use the information in the table to support your answer.

(4)

**(Total for Question 6 = 12 marks)**

**7** Some groups of living organisms produce neurotoxins.

Neurotoxins act at synapses, preventing the generation of nerve impulses.

Some scientists have been studying neurotoxins using a combination of computer science, statistics and mathematics.

(a) What is the name of a study that combines computer science, statistics and mathematics?

(1)

- ☐ **A** bioinformatics
- ☐ **B** computed tomography
- ☐ **C** epigenetics
- ☐ **D** forensic entomology

(b) Some neurotoxins act in these ways:

- inhibiting the release of acetylcholine
- blocking of ion channels
- blocking of acetylcholine receptors.

Explain how these neurotoxins prevent the generation of nerve impulses.

(3)

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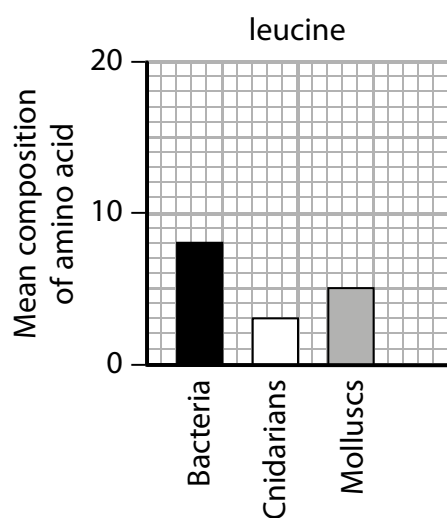
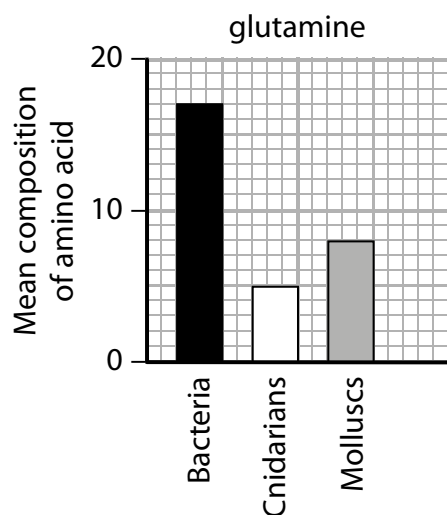
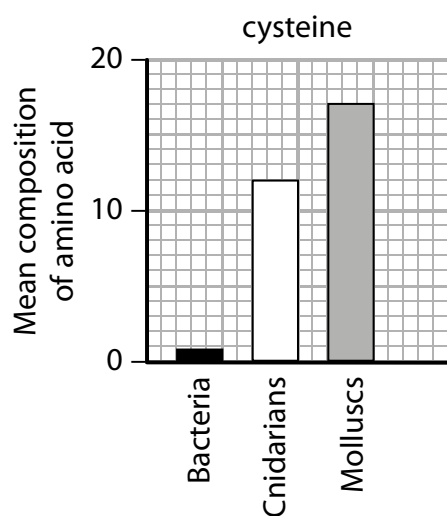
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- (c) The table shows the mean composition of three amino acids, in neurotoxins and non-toxins.

| Type of amino acid | Mean composition of amino acid in neurotoxins | Mean composition of amino acid in non-toxins |
|--------------------|-----------------------------------------------|----------------------------------------------|
| Cysteine           | 13.69                                         | 1.95                                         |
| Glutamine          | 2.35                                          | 4.16                                         |
| Leucine            | 5.53                                          | 10.17                                        |

The graphs show the mean composition of these amino acids in neurotoxins produced by three groups of organisms: bacteria, cnidarians and molluscs.



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\*(i) Comment on the amino acid composition of these neurotoxins. Use the information in the table and in the graphs to support your answer.

(6)

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- (ii) Explain why the replacement of one amino acid in a neurotoxin could decrease its toxicity.

(2)

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**(Total for Question 7 = 12 marks)**

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- 8 The scientific document you have studied is adapted from an article in nature.com:  
*Microgravity elicits reproducible alterations in cytoskeletal and metabolic gene and protein expression in space-flown Caenorhabditis elegans.*

Use the information from the scientific document and your own knowledge to answer the following questions.

- (a) Suggest why the authors of this article have named the species of nematode used in this study (paragraph 2).

(1)

- (b) State **one** ethical issue of using nematodes in this study.

(1)

- (c) Describe how microgravity can cause changes in gene expression in these nematodes (paragraph 4).

(3)

- (d) Suggest why there was a lower fat accumulation and shorter body length in nematodes grown in microgravity (paragraph 4).

(3)

- (e) Explain why there were reduced levels of a number of metabolic proteins in nematodes grown in microgravity (paragraph 6).

(4)

- (f) Explain why microarrays could be used to show that mitochondrial electron transport genes are downregulated, whereas the sirtuin gene was upregulated (paragraph 7).

(3)

- (g) Explain why Sudan Black was used in this study (paragraph 8).

(2)

(h) Comment on the reliability of the data presented in Table 1 (paragraph 9).

(3)

(Total for Question 8 = 20 marks)

**TOTAL FOR PAPER = 90 MARKS**