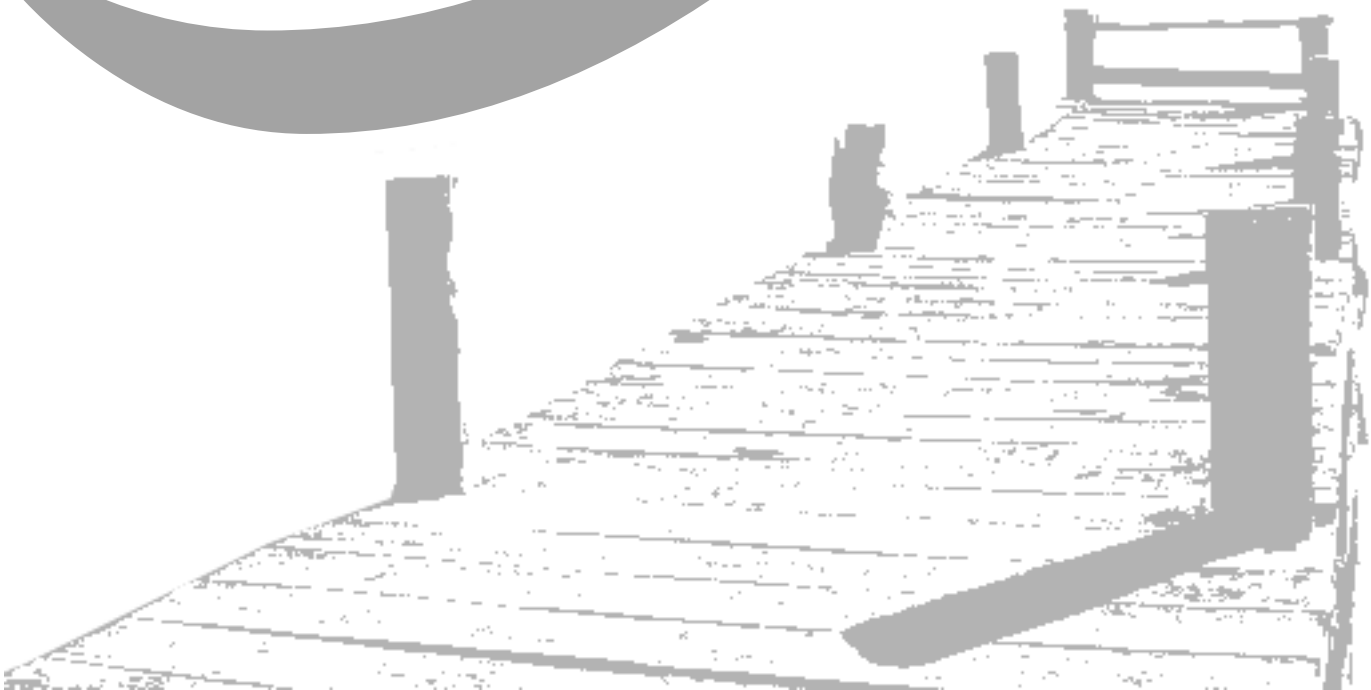
GCE
AS and A Level

Biology

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 5:
Specimen question paper

Version 0.2



Version 0.2 0807

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
Specimen Unit
Advanced Level Examination

BIOLOGY **BIOL5**
Control in cells and in organisms

Specimen Unit

In addition to this paper you will require
- a ruler with millimetre measurements

You may use a calculator.

Time allowed: 2 hours 15 minutes

Instructions
- Use black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in all answers.
- Answers for **Questions 1** to **10** are expected to be short and precise.
- Answer **Question 11** in continuous prose. Quality of Written Communication will be assessed in your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		11	
2			
3			
4			
5			
6			
7			
8			
9			
10			
Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

Answer **all** question in the spaces provided.

1 (a) The table shows the mRNA codons for some amino acids.

Codon	Amino Acid
CUA	Leucine
GUC	Valine
ACG	Threonine
UGC	Cysteine
GCU	Alanine
AGU	Serine

(i) Give the DNA sequence for cysteine.

.....

(1 mark)

(ii) Name the amino acid coded by the tRNA anticodon UCA.

.....

(1 mark)

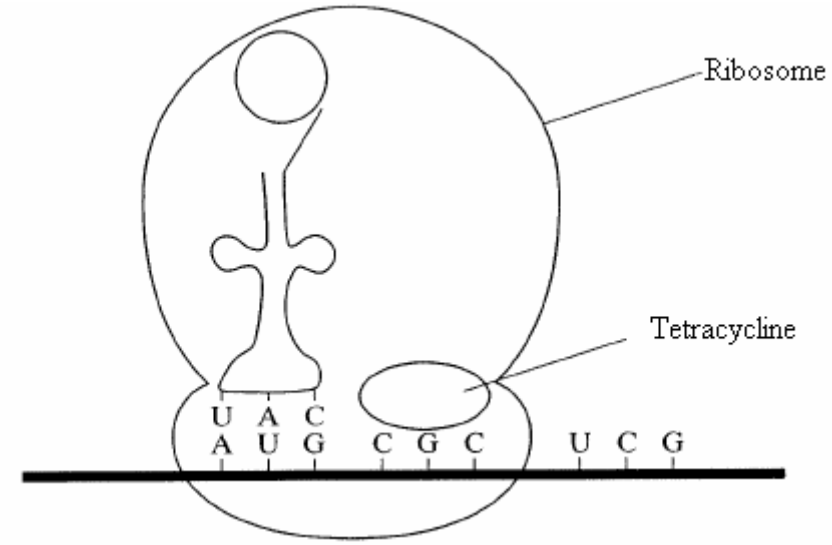
(b) A particular gene is 652 base pairs long. The mRNA produced from this gene is only 441 nucleotides long. Explain this difference.

.....

.....

(1 mark)

(c) Tetracycline is an antibiotic. The diagram shows how tetracycline binds to bacterial ribosomes.



Protein synthesis in bacteria is similar to that in eukaryotic cells. Explain how tetracycline stops protein synthesis in bacteria.

.....

.....

.....

.....

(3 marks)

6

2 (a) Effectors bring about responses in the body. They are stimulated when neurones secrete substances, called neurotransmitters, on to them.

(i) Name the type of neurone that stimulates muscles.

.....

(1 mark)

(ii) Other than muscle tissue, name **one** type of tissue that acts as an effector.

.....

(1 mark)

(b) Substances, called hormones, can also stimulate effectors.
Humans produce a large number of different hormones but only a small number of different neurotransmitters. Explain the significance of this difference.

.....

.....

.....

.....

.....

.....

(3 marks)

5

3 A student ate a meal containing carbohydrates at 07:00. He ate nothing else for the next five hours. The table shows the concentration of glucose in his blood at hourly intervals after the meal.

Time of day	Concentration of glucose in blood/mg per 100 cm^3 of blood
07:00	90
08:00	120
09:00	70
10:00	85
11:00	110
12:00	80

(a) Explain the rise in the concentration of glucose between 07:00 and 08:00.

.....

.....

(1 mark)

(b) The concentration of glucose in his blood fell between 08:00 and 09:00. Explain why.

.....

.....

.....

.....

(2 marks)

(c) Describe the role of hormones in the fluctuation of glucose concentration between 09:00 and 12:00.

.....

.....

.....

.....

.....

.....

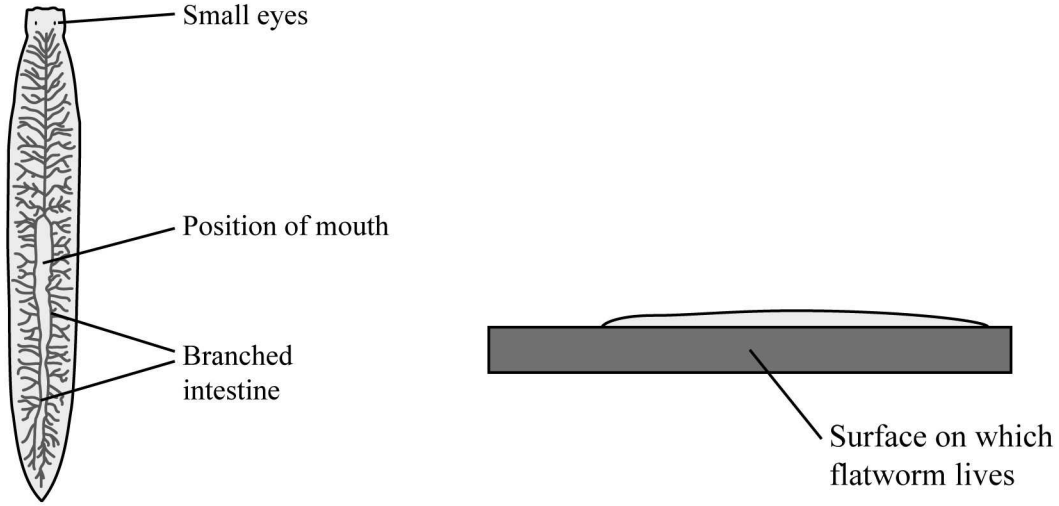
.....

(4 marks)

7

4 (a) **Figure 1** shows a small flatworm that lives in freshwater. This flatworm lacks specialised gas exchange surfaces and has no blood circulatory system. It secretes mucus, which enables it to move over the surfaces on which it lives

Figure 1



Flatworm viewed from above

Flatworm viewed from side

Use the information to suggest and explain **one** advantage to the flatworm of

(i) its body shape

.....

.....

(1 mark)

(ii) a branched intestine.

.....

.....

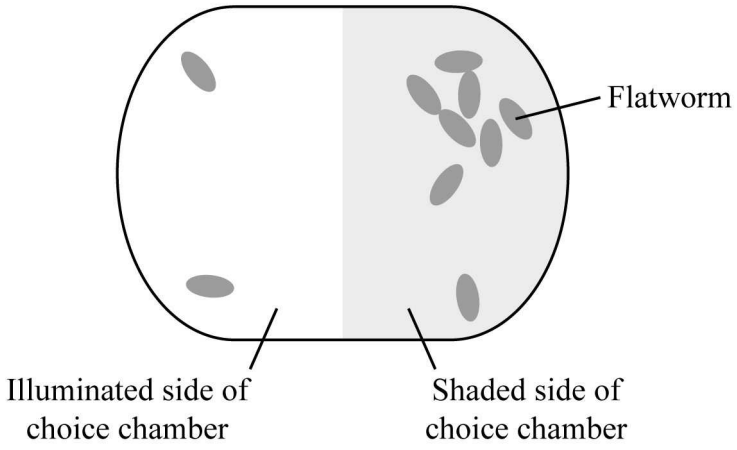
.....

.....

(2 marks)

(b) A student placed ten flatworms in freshwater in the centre of a choice chamber. After ten minutes, she recorded the position of each flatworm. **Figure 2** shows her results.

Figure 2



(i) Suggest **one** advantage to the flatworms of the behaviour shown.

.....

.....

(1 mark)

(ii) The student concluded that these flatworms had responded to light. Give **one** alternative explanation for her results. Explain your answer.

.....

.....

.....

.....

(2 marks)

(iii) Suggest **one** way in which this student could modify her observations to determine whether the behaviour of the flatworms is a kinesis. Explain your answer.

.....

.....

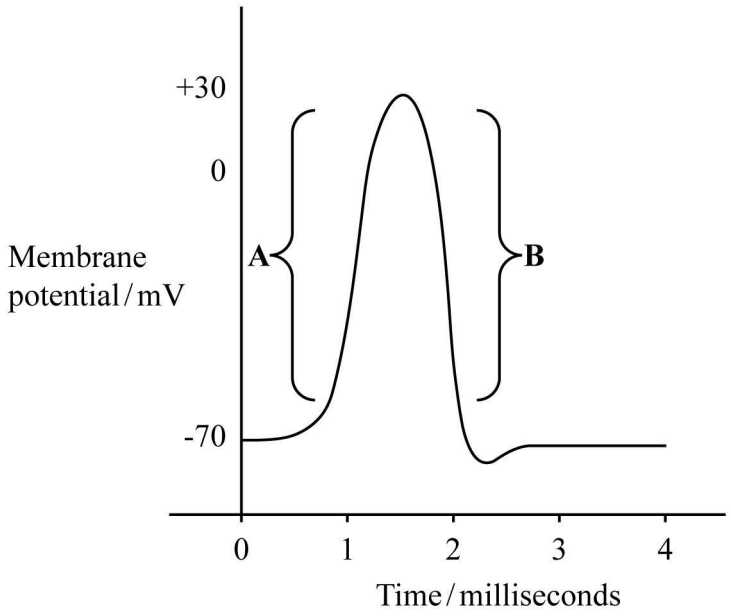
.....

.....

(2 marks)

8

5 The graph shows the electrical changes measured across the plasma membrane of an axon during the passage of a single action potential.



(a) Explain the shape of the curve

(i) over the range labelled **A**;

.....

.....

.....

.....

(2 marks)

(ii) over the range labelled **B**;

.....

.....

(1 mark)

(b) Fewer action potentials occur along a myelinated axon than along an unmyelinated axon of the same length. Explain why.

.....

.....

.....

.....

(2 marks)

5

6 (a) What is a gene probe?

.....

.....

.....

.....

.....

.....

(3 marks)

(b) Give **two** ways in which the information obtained from the use of gene probes might be helpful to a doctor who is counselling someone with a family history of cancer.

1 .....

.....

2 .....

.....

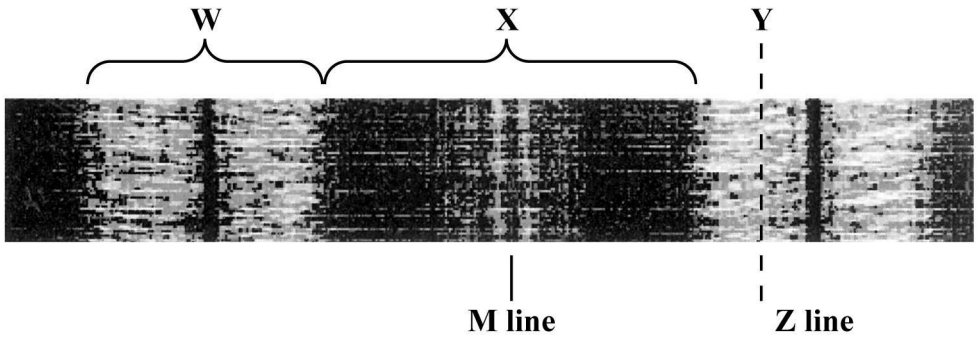
(2 marks)

5

Turn over for the next question

7 **Figure 3** shows part of a myofibril in a relaxed muscle.

Figure 3



(a) Name the main protein filaments present in

(i) region **W** .....

(1 mark)

(ii) region **X** .....

(1 mark)

(b) **Figure 4** shows the ends of the protein filaments when the myofibril was cut at position **Y.**
Figure 5 shows the ends of the protein filaments when the myofibril was cut the same distance from a Z line at a different stage of contraction.

Figure 4

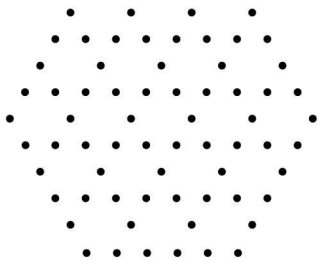
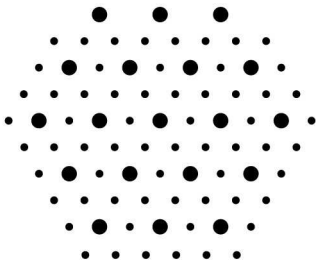


Figure 5



The pattern of protein filaments is different in **Figure 4** and **Figure 5**. Explain why.

.....

.....

.....

.....

(2 marks)

(c) Describe the roles of ATP and of calcium ions (Ca^{2+}) in bringing about the contraction of a myofibril.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

8

8 MDMA is a compound that is often used as a recreational drug. It is commonly known as ecstasy. Unfortunately, a number of people have died soon after taking ecstasy.

A research team investigated the effects of MDMA. They chose to work with groups of mice. The mice in one group were injected with MDMA whilst a second group acted as a control.

(a) Suggest **two** reasons why the research team chose to use mice in this investigation.

1 .....

.....

2 .....

.....

(2 marks)

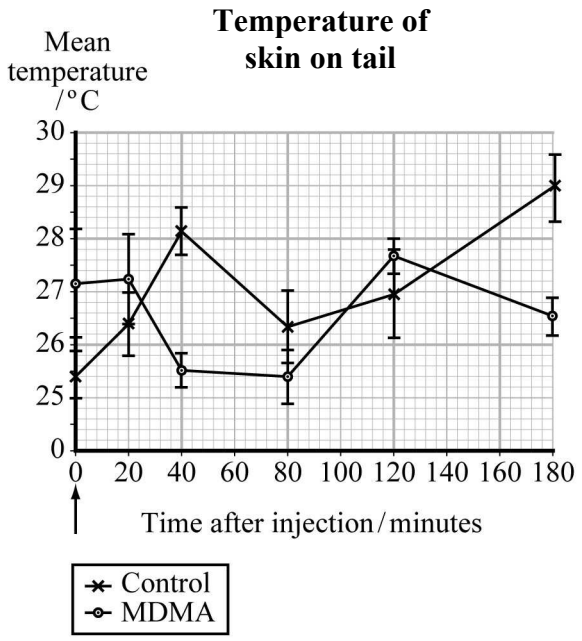
(b) How should the control group be treated?

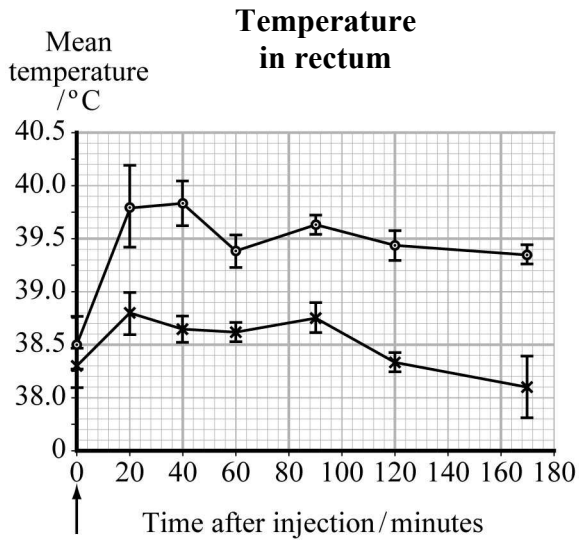
.....

.....

(1 mark)

(c) For each mouse, the scientists monitored the temperature of the skin on its tail and the temperature in its rectum (lower part of the gut).
The graphs show the mean temperatures, and standard deviations of these means, after the injections were administered.





(i) Explain why the tail temperatures were always lower than the temperature in the rectum.

.....

.....

.....

.....

(2 marks)

(ii) The scientists concluded that MDMA causes death by stimulating heat generation. Use the data to evaluate their conclusion.

.....

.....

.....

.....

.....

.....

(3 marks)

8

9 Restriction enzymes are used in DNA technology. They digest DNA at specific recognition sequences on the DNA molecule.

(a) **Figure 6** shows the recognition sequence of a restriction enzyme called *Eco*RI.

Figure 6

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

(i) Name the type of reaction that occurs when *Eco*RI digests DNA.

.....

(1 mark)

(ii) Explain why *Eco*RI digests DNA only at the specific recognition sequence shown in **Figure 6.**

.....

.....

(1 mark)

(iii) The recognition sequence shown is referred to as a 6 bp palindromic sequence. Use evidence from **Figure 6** to explain what this means.

.....

.....

.....

.....

(1 mark)

(b) The piece of DNA shown in **Figure 7** was labelled using a radioactive nucleotide. The piece of DNA is 10 kilobases long.

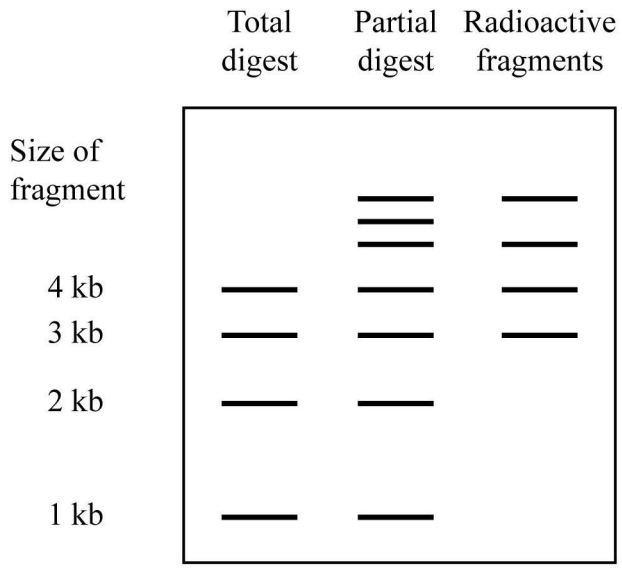
Figure 7

This piece of DNA was then digested using *Eco*RI and the resulting fragments of DNA were separated using electrophoresis.

Figure 8 shows the results of elecrophoresis. The three lanes of the electrophoresis gel show:

- the fragments of DNA formed after total digestion of the piece of DNA
- the fragments of DNA formed after partial digestion of the piece of DNA
- those fragments after partial digestion that contained radioactivity.

Figure 8



(i) The total digestion lane shows four fragments. How many times did the recognition sequence for *Eco*RI appear in the piece of DNA?

.....

(1 mark)

Question 9 continues on the next page

(ii) Explain the presence of the three additional fragments in the partial digestion lane.

.....

.....

.....

(2 marks)

(iii) The evidence from **Figure 8** was used to construct a restriction map of the piece of DNA. The map is shown in **Figure 9**

Figure 9

Explain why it is possible to map the positions of

the 3kb fragment .....

.....

the 1 kb fragment .....

.....

(2 marks)

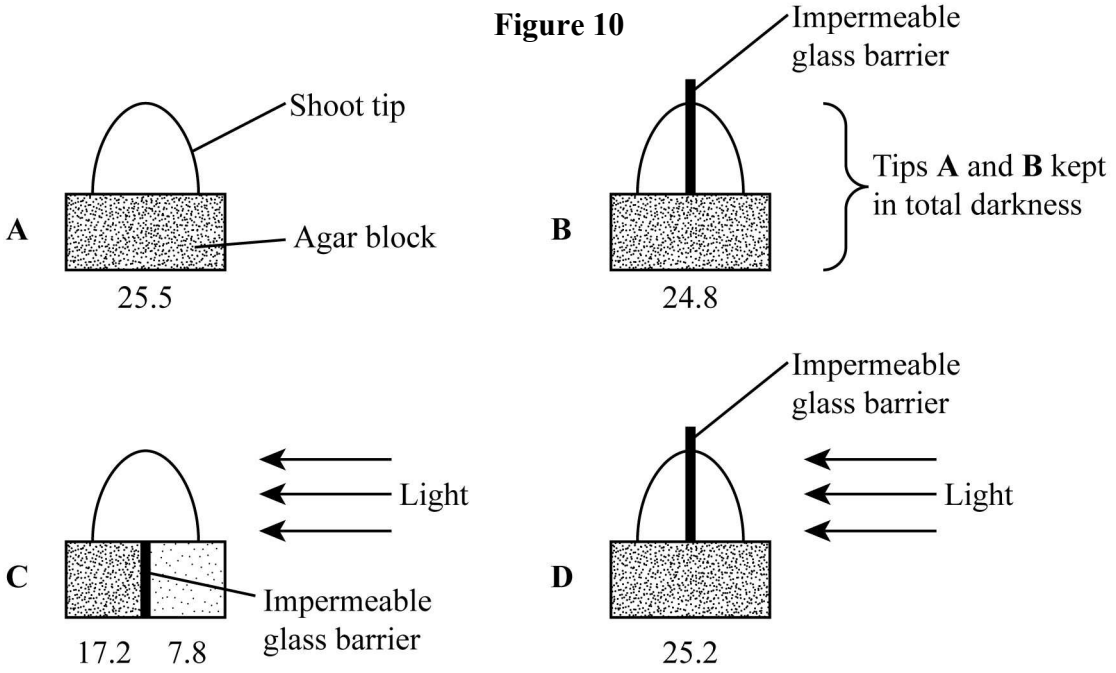
8

There are no questions printed on this page

10 IAA is a substance that affects the growth of plants. It is produced in the tips of shoots and moves downwards in the stem to the rest of the plant. A series of experiments was performed to investigate the effect of the IAA on the growth of cucumber seedlings.

(a) **Figure 10** shows the results of an investigation into the effect of unidirectional light on IAA.

Figure 10



(i) Give **one** reason for the use of the impermeable glass barriers.

.....

(1 mark)

(ii) What do the results of this experiment show about the effect of unilateral light on IAA? Use evidence from **Figure 10** to support your answer.

.....

.....

.....

.....

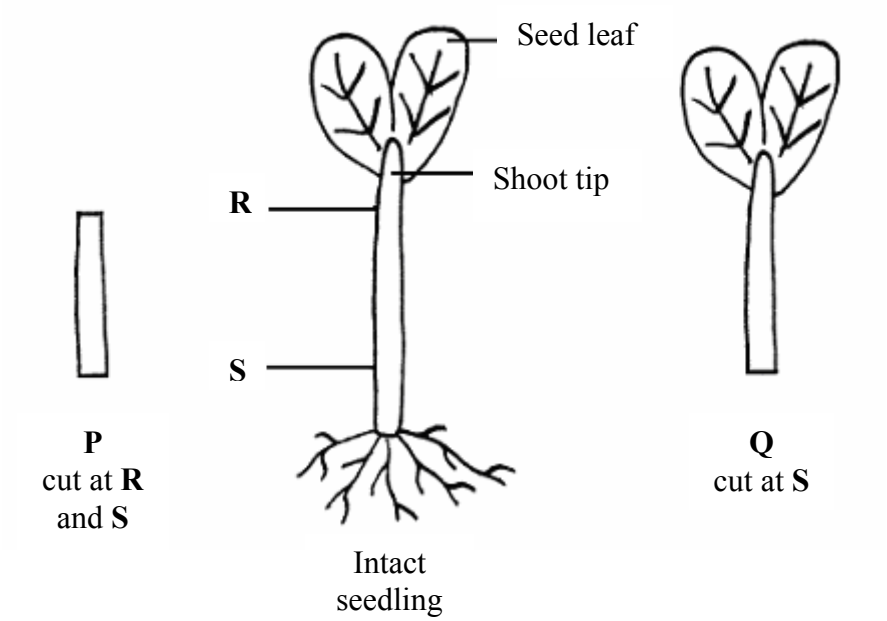
.....

.....

(3 marks)

(b) **Figure 11** shows the ways in which two groups of cucumber seedlings were cut before being used in a second investigation

Figure 11



The two types of cut seedlings, **P** and **Q**, were grown in different growth media over a four-hour period. The table shows the results.

Group of cut seedlings used	Growth medium	Mean increase in length/mm	
		Grown in the dark	Grown in blue light
P	1% sucrose solution	1.2	0.8
P	Solution of 1% sucrose and 6mg dm^{-3} IAA	3.9	5.2
Q	1% sucrose solution	4.1	3.3
Q	Solution of 1% sucrose and 6 mg dm^{-3} IAA	4.9	5.7

(i) The cut seedlings were grown in sucrose solution, rather than in distilled water. Give **one** reason why.

.....

(1 mark)

(ii) When they were both grown in the dark, the two groups of seedlings responded differently to the inclusion of IAA in their growth media. Suggest **one** explanation for this different response.

.....

.....

.....

.....

(2 marks)

(iii) Describe the effect of blue light on the growth of seedlings **P** and **Q**.

.....

.....

.....

.....

.....

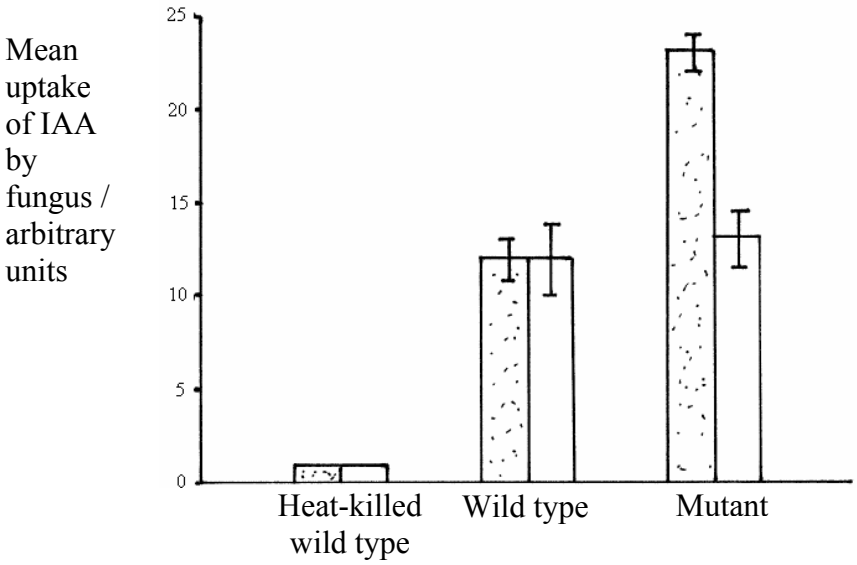
.....

(3 marks)

(c) Many fungi are parasites on plants. Uptake of IAA from the host plant affects the ability of these parasitic fungi to invade their plant host.

The uptake of IAA by a particular fungus was investigated. Two phenotypes of the fungus were used, the wild type and a particular mutant.

The bar chart shows the effect of DNP on the uptake of IAA by this fungus. DNP is a drug that affects the gradient of hydrogen ions across mitochondrial membranes.



Key: Untreated Treated with DNP Standard deviation of mean

Using evidence from the information given above and your own knowledge,

(i) explain how IAA is taken up by the cells of this fungus

.....

.....

.....

.....

(2 marks)

(ii) suggest how the mutation affected the cells of this fungus.

.....

.....

.....

.....

.....

(3 marks)

11 Write an essay on one of the following topics.

EITHER

(a) Mean temperatures are rising in many parts of the world. The rising temperatures may result in physiological and ecological effects on living organisms. Describe and explain these effects.

OR

(b) The causes of variation and its biological importance.

You should write your essay in continuous prose.
Your essay will be marked not only for its scientific accuracy, but also for your selection of relevant material from different parts of the specification.

The maximum number of marks that can be awarded is

Scientific content	*16*
Breadth of knowledge	*3*
Relevance	*3*
Quality of written communication	*3*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

END OF QUESTIONS

	Mark	Comment
S		
B		
R		
Q		

25