

GCSE

WJEC Eduqas GCSE in
BIOLOGY

ACCREDITED BY OFQUAL

**SAMPLE ASSESSMENT
MATERIALS**

Teaching from 2016





For teaching from 2016
For awards from 2018

GCSE (9-1) BIOLOGY

SAMPLE ASSESSMENT
MATERIALS

Contents

		Page
Component 1:	Concepts in Biology	
Foundation Tier:	Sample Paper	5
	Marking Scheme	33
	Summary of marks allocated to assessment objectives	49
Higher Tier:	Sample Paper	51
	Marking Scheme	79
	Summary of marks allocated to assessment objectives	97
Component 2:	Applications in Biology	
Foundation Tier:	Sample Paper	99
	Resource Booklet	113
	Marking Scheme	116
	Summary of marks allocated to assessment objectives	124
Higher Tier:	Sample Paper	125
	Resource Booklet	139
	Marking Scheme	142
	Summary of marks allocated to assessment objectives	151

Candidate Name	Centre Number				Candidate Number				



GCSE BIOLOGY
COMPONENT 1
Concepts in Biology
FOUNDATION TIER
SAMPLE PAPER
(2 hours 15 minutes)



For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	10	
3.	5	
4.	6	
5.	10	
6.	12	
7.	14	
8.	13	
9.	14	
10.	8	
11.	8	
12.	14	
Total	120	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

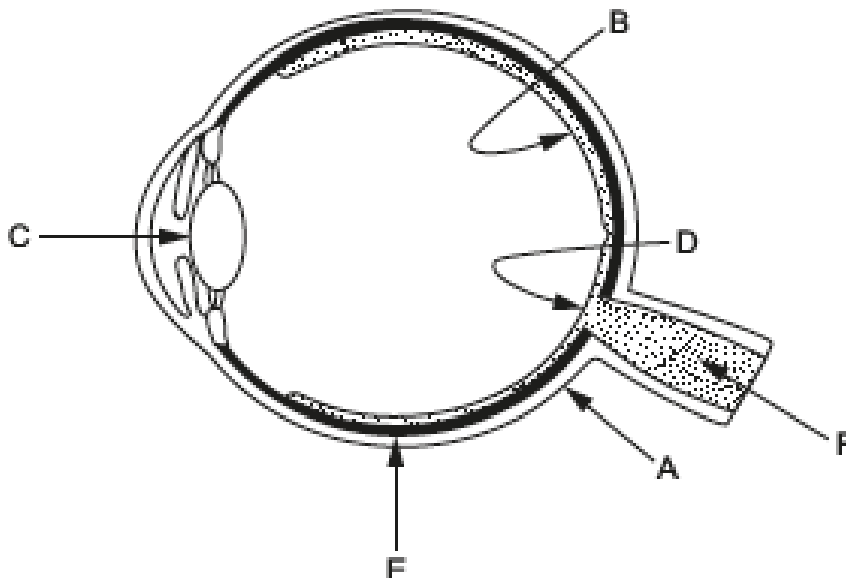
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
 Write your name, centre number and candidate number in the spaces at the top of this page.
 Answer **all** questions.
 Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

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 **9(b)**.

Answer **all** questions

1. The diagram shows a section through a human eye.



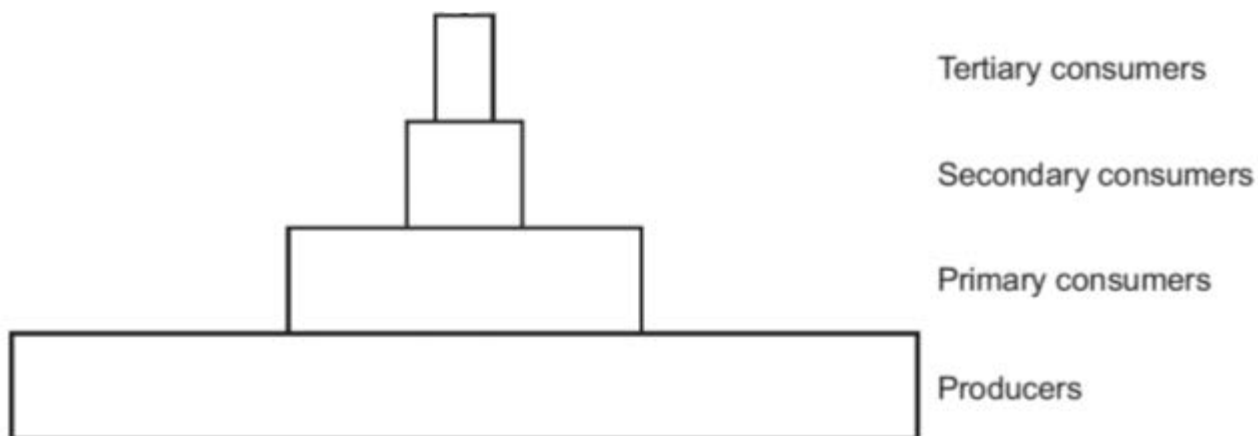
(a) Complete the table to match features on the diagram with the descriptions given. [4]

Label	Name of part of the eye	Description
B
.....	Optic nerve	Structure which transfers information from sensory cells to the brain
C	Structure which assists in focussing rays of light to form an image

(b) Matt goes into a darkened room and cannot see any of the items there. Describe how the pupil of his eye changes over the next few minutes and state how this affects his vision. [2]

.....

2. (a) The diagram below shows a pyramid of biomass for the trophic levels of organisms in a habitat.



- (i) Which trophic level consists of photosynthetic organisms? [1]

.....

- (ii) From the list below, add the biomass values ($\text{kg/m}^2/\text{yr}$) to each of the trophic levels. [2]

10 000 60 6 700 650

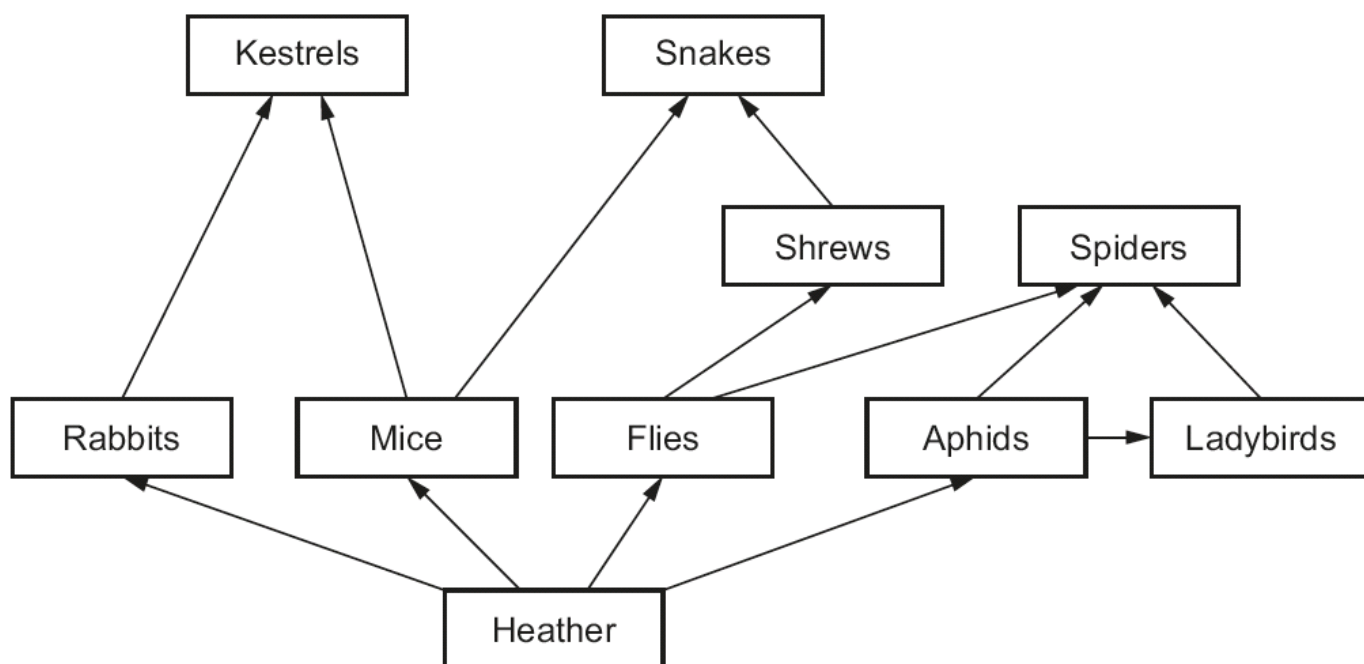
- (iii) From your pyramid, calculate the percentage of biomass which passes from the primary consumers to the secondary consumers. [2]

percentage of biomass = %

- (iv) Give **two** reasons why it is not possible for all the biomass from the primary consumers to pass to the secondary consumers. [2]

.....

(b) The food web below shows the organisms in a heathland habitat.



(i) State **two** secondary consumers which compete for the same species of herbivore as food. [1]

.....

(ii) Give **one** animal which feeds on both herbivores and carnivores. [1]

.....

(iii) Explain how the numbers of the animals in the food web would change if large quantities of heather plants were destroyed. [1]

.....

.....

3. *Aspidistra elatior* is a plant which grows in forests in Asia.



Aspidistra plants growing in Asia

- The *Aspidistra* plants survive best at low levels of light, temperatures between 18 – 20 °C and in acidic soil with a moisture content below 20%.
- It reproduces asexually in these conditions.
- It reproduces sexually when conditions become unfavourable by producing flowers which need soil invertebrates for pollination.

- (a) (i) Give a reason why *Aspidistra* flowers are produced at soil level. [1]

.....

- (ii) In the following table, **place a tick** (✓) by the environments (A to E) which would allow *Aspidistra* plants to reproduce asexually. A pH scale is provided to help you. [2]

1 2 3 4 5 6 7 8 9 10 11 12 13 14
acid ←————— neutral —————→ alkali

Environment	Light intensity (a.u)	Soil moisture content (%)	soil pH value	Temperature (°C)	Asexual reproduction ✓
A	18	13	9	15	
B	66	83	3	21	
C	13	15	4	20	
D	75	42	11	23	
E	9	17	4	19	

(b) Explain why it is an advantage for Aspidistra plants to reproduce asexually. [2]

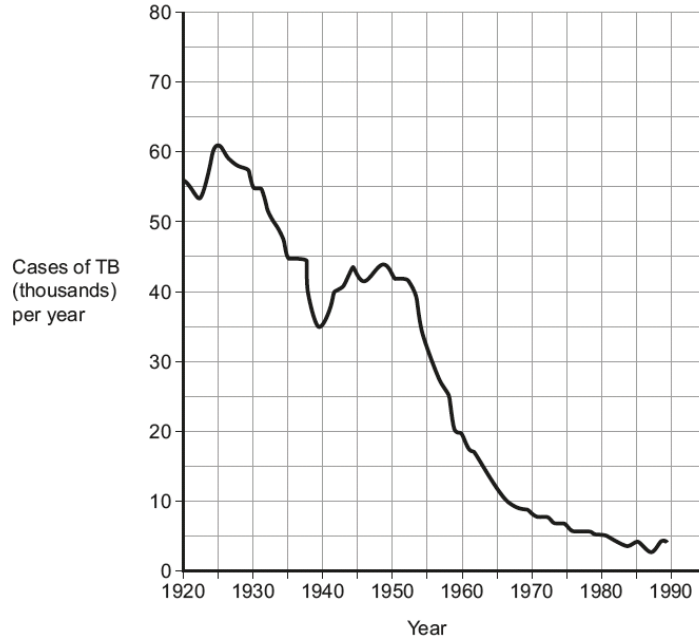
.....

.....

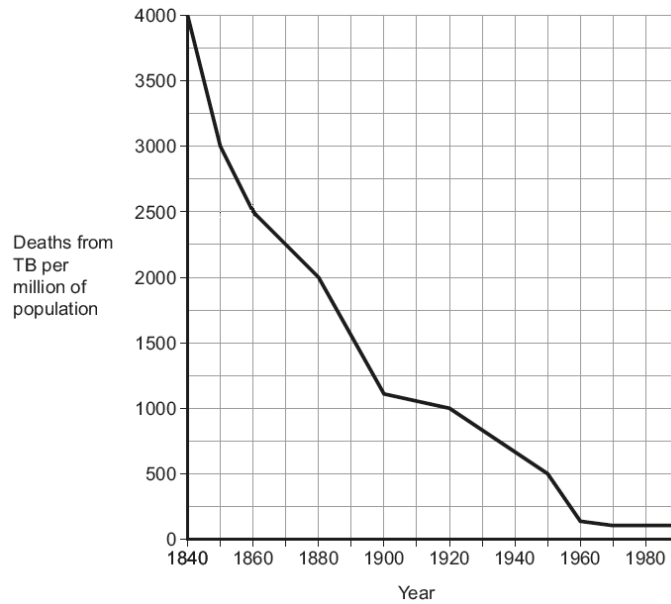
5

4. Tuberculosis (TB) is a disease caused by the bacterium *Mycobacterium tuberculosis*. The graphs below show information about TB in the UK. Antibiotics were first used to treat TB in the 1940s. Vaccination became available in the 1960s.

Graph 1



Graph 2



From this information

- (a) (i) I Calculate the reduction in the death rate from tuberculosis between 1860 and 1900. [2]

deaths per million population =

- II Suggest why the death rate fell during this time. [1]

.....

- (ii) From the graphs, what evidence is there that antibiotics were effective in reducing the death rate from TB between 1940 and 1950? [1]

.....

.....

- (iii) From graph 1, what evidence is there to support the idea that the vaccination against TB has been effective? [1]

.....

- (b) In 2012 an investigation by the World Health Organisation (WHO) revealed a problem. 20% of cases of TB occurring in the world were caused by a strain *Mycobacterium tuberculosis* called DRTB which had become resistant to antibiotics. Suggest how doctors and hospitals may have contributed to the problem. [1]

.....

.....

5. The photograph shows the 38 chromosomes in a body cell of a domestic cat, (*Felis catus*).

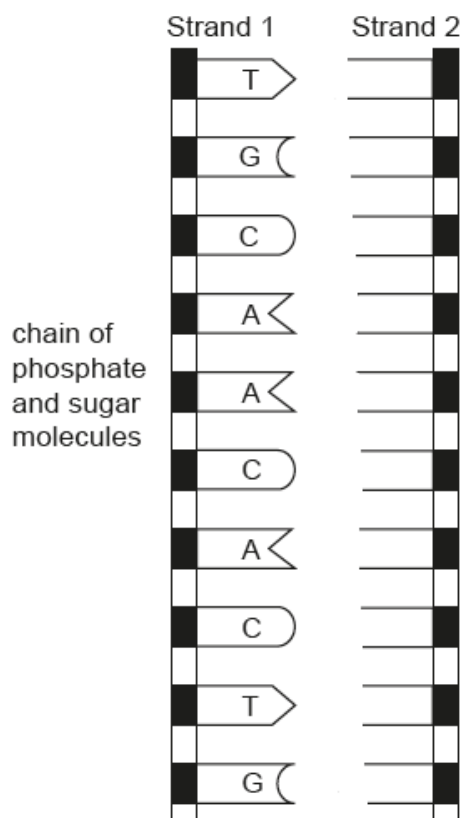


- (a) State the number of these chromosomes which would be found in a: [2]

(i) sperm cell;

(ii) fertilised egg cell.

- (b) Chromosomes are composed of DNA.
The diagram below shows a very short section of DNA from a gene on a chromosome of *Felis catus*.



- (i) Complete the diagram by adding the letters for the missing bases on strand 2 and completing the shapes. [3]
- (ii) Draw a circle around **one** nucleotide. [1]
- (iii) The bases from strand 1 of the same gene from three other species of cat are shown below.

Species 1	T G G T C C A C T G
Species 2	T G C A C C A C T G
Species 3	T G C G A G T G A G

- I Giving a reason, identify the species (1, 2 or 3) which **is most closely** related to *Catus felis* [2]

Species

Reason

.....

- II Explain how genetic profiling could be used to show the similarities between these species. [2]

.....

.....

6. (a) (i) Complete the word equation which summarises photosynthesis. [2]

carbon dioxide + water \longrightarrow +

(ii) I Name the structure in plant cells which contains chlorophyll. [1]

.....

II Explain why it is necessary in photosynthesis. [2]

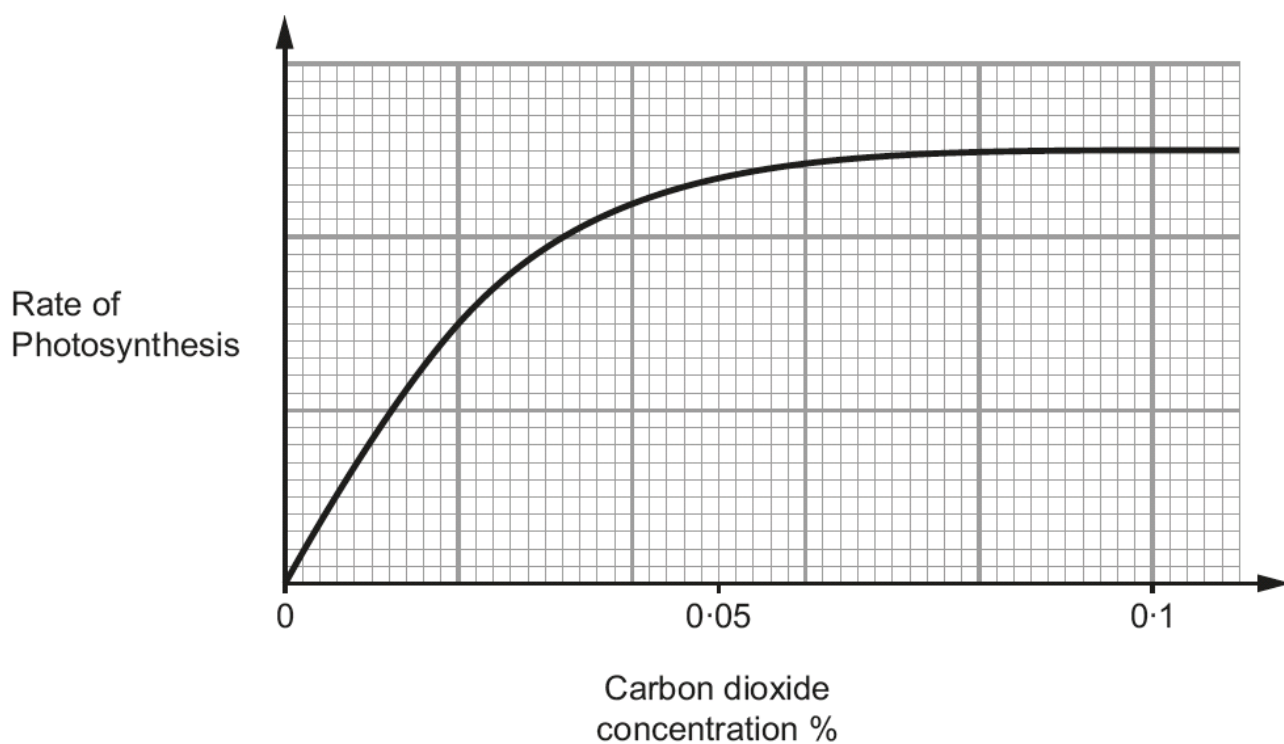
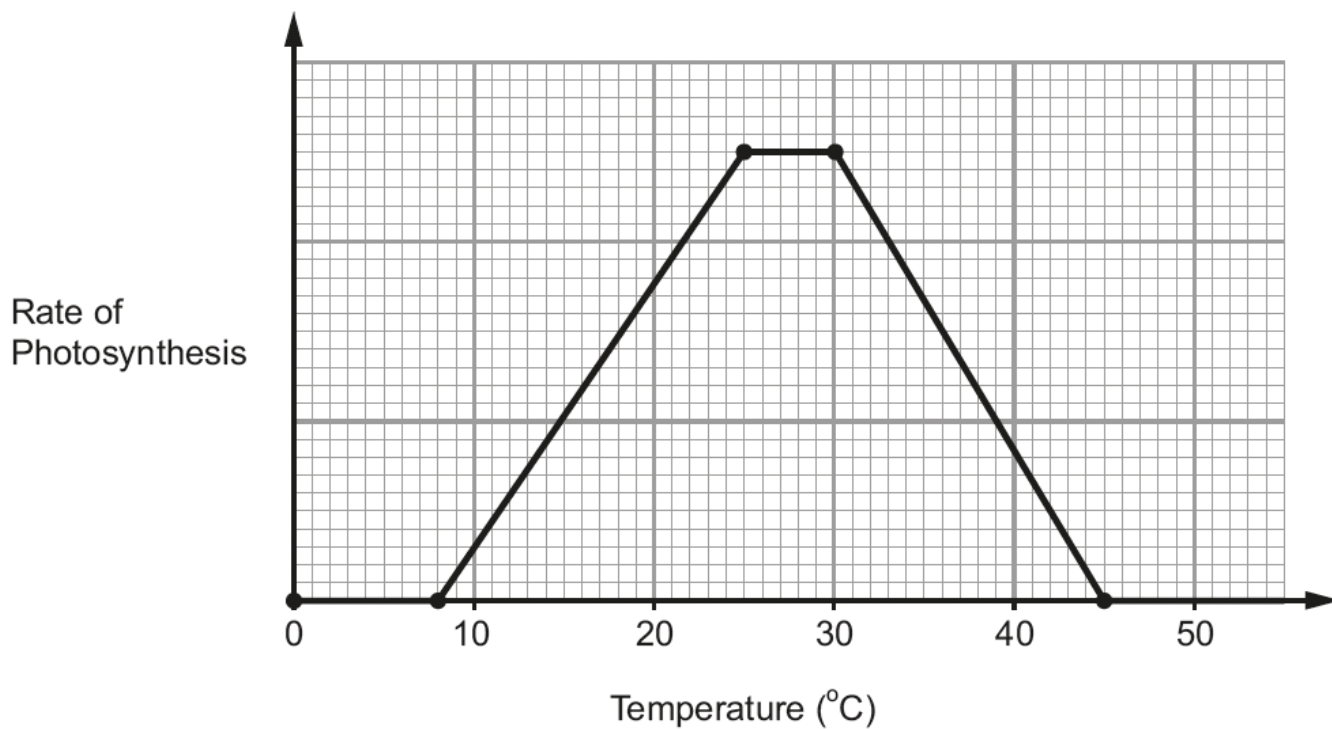
.....

.....

(b) Scientists investigated photosynthesis in tomato plants in greenhouses during the winter. They varied carbon dioxide levels and temperatures in order to identify the conditions which would give maximum photosynthesis and therefore maximum growth. There was no shortage of light at any time.



The graphs show the results of the investigation.



From these graphs:

- (i) Describe how the rate of photosynthesis in tomatoes is affected by changes of:

I temperature [2]

.....
.....

II carbon dioxide concentration [2]

.....
.....

- (ii) State the conditions which would be the best choice for commercial tomato growers wanting the highest yields and maximum profit. Explain your answer. [3]

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

7. Many species of butterflies and other insects have declined considerably in the UK since 1950. The main reason for this decline has been the destruction of habitat caused by human activities such as use of land for food production, with hedges and trees being removed.

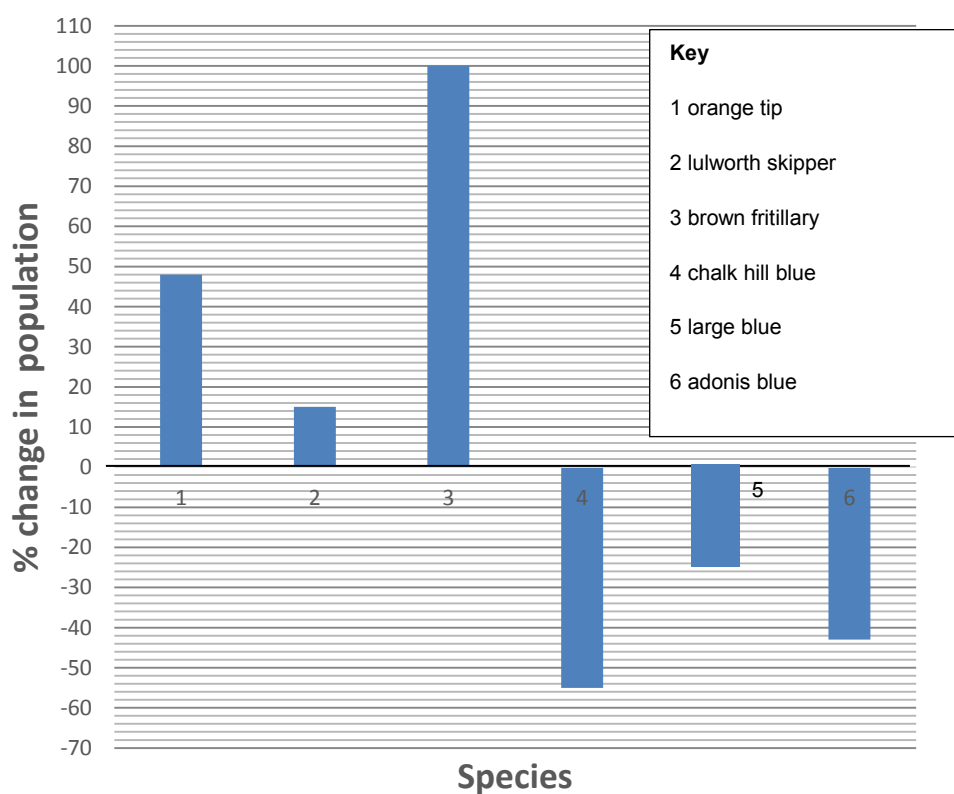


Orange tip



Chalk hill blue

The bar chart below shows data for six of these butterfly species from an investigation carried out between 2012 and 2014.



(a) From the bar chart:

(i) Which species shows the greatest percentage decrease between 2012 and 2014? [1]

species by%

(ii) Calculate

I The number of brown fritillary in 2014, based on a count of 256 in 2012. [1]

Number of butterflies =

II The number of the large blue in 2012, based on a count of 150 in 2014. [2]

Number of butterflies =

(iii) The chalk hill blue and large blue are officially listed as “Critically Endangered” in the UK. What will happen to these species if numbers do not recover in future years? Explain how this will affect biodiversity. [3]

.....

.....

.....

.....

(b) For some butterfly species, numbers are increasing because habitat is being restored or conserved.

(i) Suggest **one** way in which farmers could help to restore butterfly habitat. [1]

.....

(ii) How do groups such as the UK Environment agency help in conserving natural habitat? [1]

.....

(c) The charity 'Butterfly Conservation' collects data on 50 of the 260 species of UK butterflies. Observers make repeated counts every year in every part of the country.

(i) State **two** features of this monitoring process which would allow scientists to have confidence in the data obtained. [2]

.....
.....

(ii) Describe **one** way in which the monitoring process could be improved to give increased confidence in the results. [1]

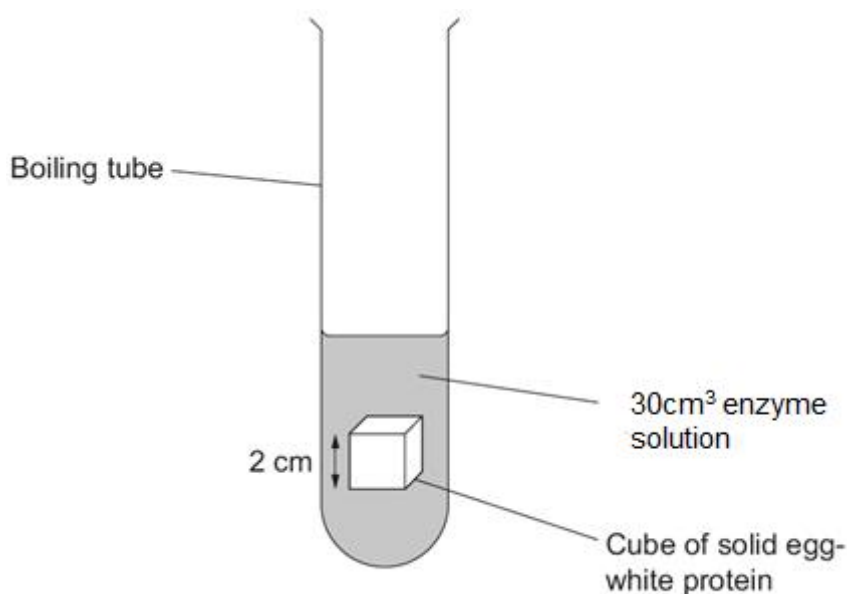
.....
.....
.....

(d) Farmers often use chemical sprays to kill insect pests and weeds which can reduce the growth of their crops. Give **two** reasons why many conservationists do not want chemical sprays to be used in the UK. [2]

.....
.....

8. Some students investigated the action of a protease enzyme which digests the protein in egg white. They set up six boiling tubes, as shown in the diagram below, each with a different pH value. The mass of the cube of egg white decreased as the protein was digested.

They carried out the investigation at 25 °C and also at 37 °C and recorded the percentage decrease in the mass of egg white protein after 24 hours.



- (a) Calculate the volume of the cube of egg white at the start of the investigation. [2]

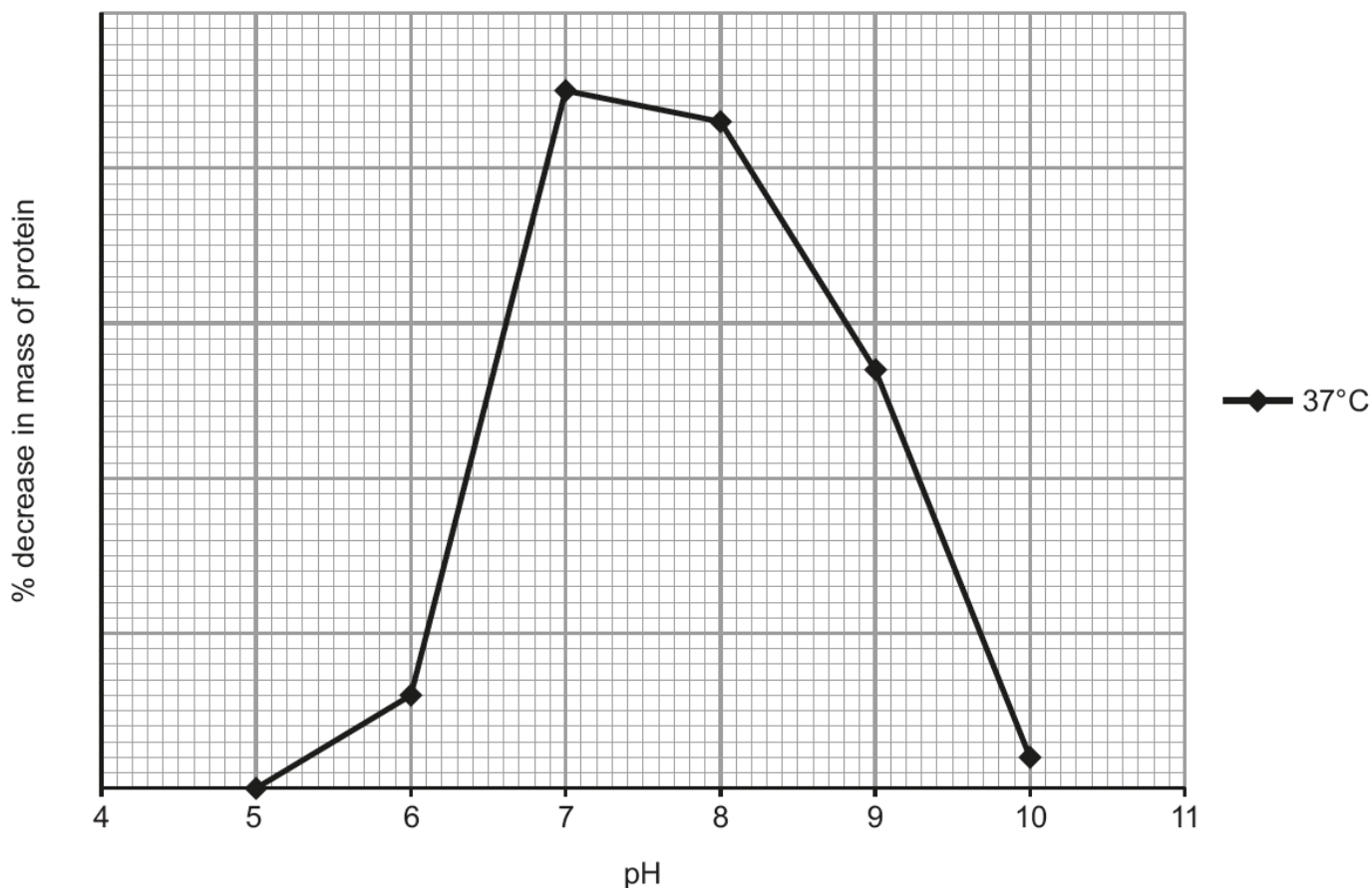
volume =cm³

The results of the investigation are shown below

	pH Value					
	5	6	7	8	9	10
% decrease in mass of protein at 25 °C	0	1	24	28	7	2
% decrease in mass of protein at 37 °C	0	6	45	43	27	2

Graph of results

The data for 37 °C have been plotted for you.



(b) Plot the results for 25 °C onto the graph above: [4]

- add a scale for the % decrease in mass of protein
- plot the points
- join your points with a ruler and label your line.

(c) From these results:

(i) Describe the effect of pH on the activity of the enzyme. [1]

.....

.....

(ii) Suggest an optimum pH value for the enzyme, giving a reason for your choice. [1]

pH

Reason

.....

- (iii) State why it is not possible to identify the optimum pH value accurately from these results. [1]

.....

- (iv) From the graphs, calculate the difference in the percentage decrease in mass at pH6.5 between 25 °C and 37 °C. [1]

percentage decrease =%

- (v) Explain the reason for the difference in the activity of the protease enzyme at 25 °C and 37 °C at pH6. [2]

.....

.....

- (d) The students set up a control tube with boiled enzyme to compare with the tubes they used in their investigation. What was the purpose of this control tube? [1]

.....

9. (a) The images below show three ways in which bacterial diseases can be transmitted. Explain how bacteria could be transmitted in each image and suggest how each means of transmission could be avoided. [6]

A



B



C



A

.....

.....

B

.....

.....

C

.....

.....

(c) Explain how the scientists could have confirmed the results of their investigation.

[2]

.....

.....

.....

14

10. (a) A breeder of prize-winning roses has two different rose bushes. One bush produces large red roses but has many thorns on its stems. The other bush produces small red roses and has stems with very few thorns. Explain how, by selective breeding, the rose breeder could produce a rose bush with large red flowers and very few thorns on its stems. [3]

.....

.....

.....

.....

.....

.....

- (b) If the rose breeder was successful, he could produce many more rose bushes by taking cuttings from the new parent bush.

(i) Why would the cuttings produce bushes identical to the parent bush? [1]

.....

(ii) Suggest **two** reasons why it would be unwise to produce all rose bushes in the country only from cuttings. [2]

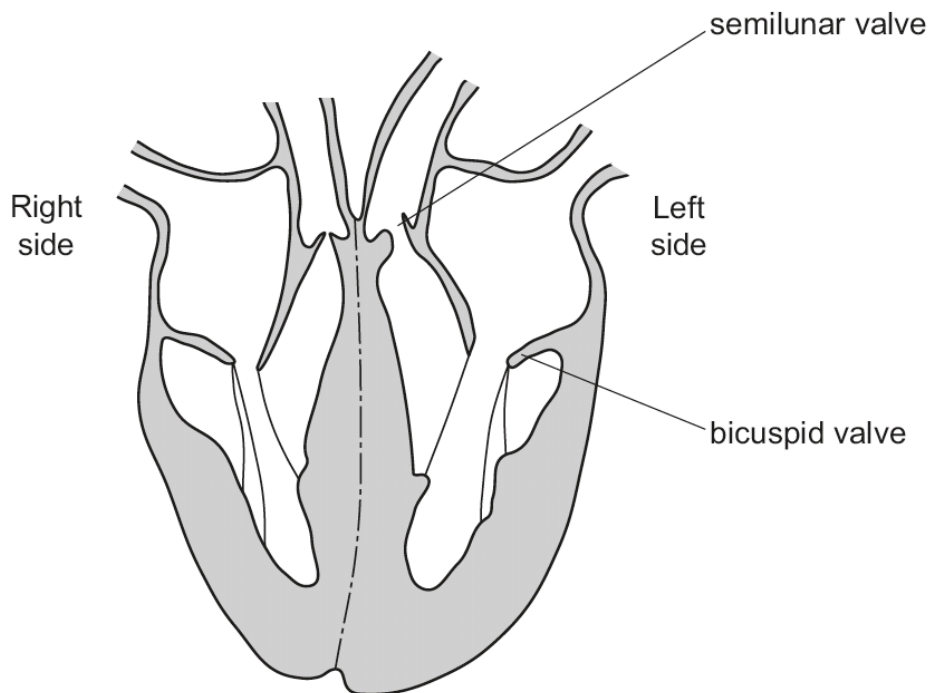
.....

.....

- (c) In roses, the allele for white flowers (r) is recessive to the allele for red flowers (R).

A rose bush with red flowers was self-fertilised. The seeds were collected and grown. 25% of these rose bushes produced white flowers. Using the symbols for the alleles given above, explain these results using a Punnett square in the space below. Give a key to the symbols used. [2]

11. The diagram shows a section through a heart.



(a) Complete the table below to show what is happening to the following parts of the **left** side of the heart during the passage of blood through the heart. [6]

Left atrium	Left ventricle	Bicuspid valve	Semi-lunar valve
contracts to force blood into left ventricle			
relaxes and fills with blood			

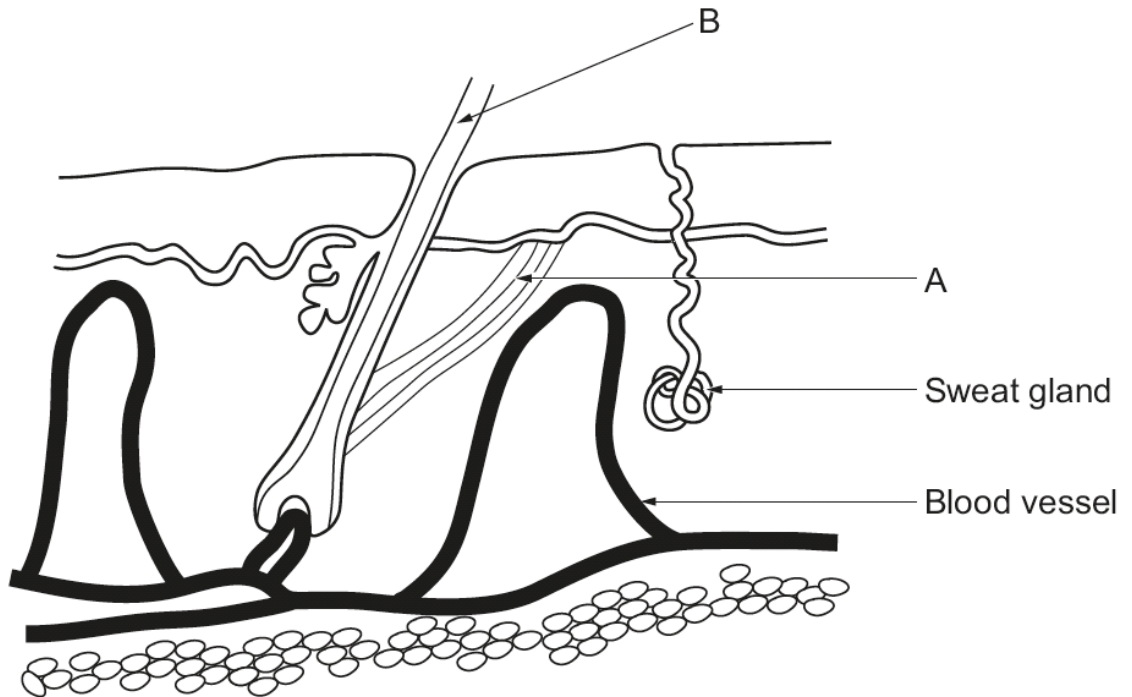
(b) Explain why the walls of the ventricles are thicker than those of the atria. [2]

.....

.....

.....

12. (a) The diagram shows the structure of human skin.



(i) Explain how the structures labelled **A** and **B** function to help reduce heat loss in cold conditions. [3]

.....

.....

.....

.....

(ii) Blood vessels and sweat glands are important in lowering the body temperature if it becomes too high. If the body temperature reaches 40 °C 'Heat Stroke' can occur, which can be fatal.

I State how the blood vessels help in cooling the body in hot conditions, such as on a sunny beach. [2]

.....

.....

II In hot, humid conditions the air may contain a very high level of water vapour. Explain why it is possible for heat stroke to occur in these conditions, even if sweat glands are functioning normally. [2]

.....

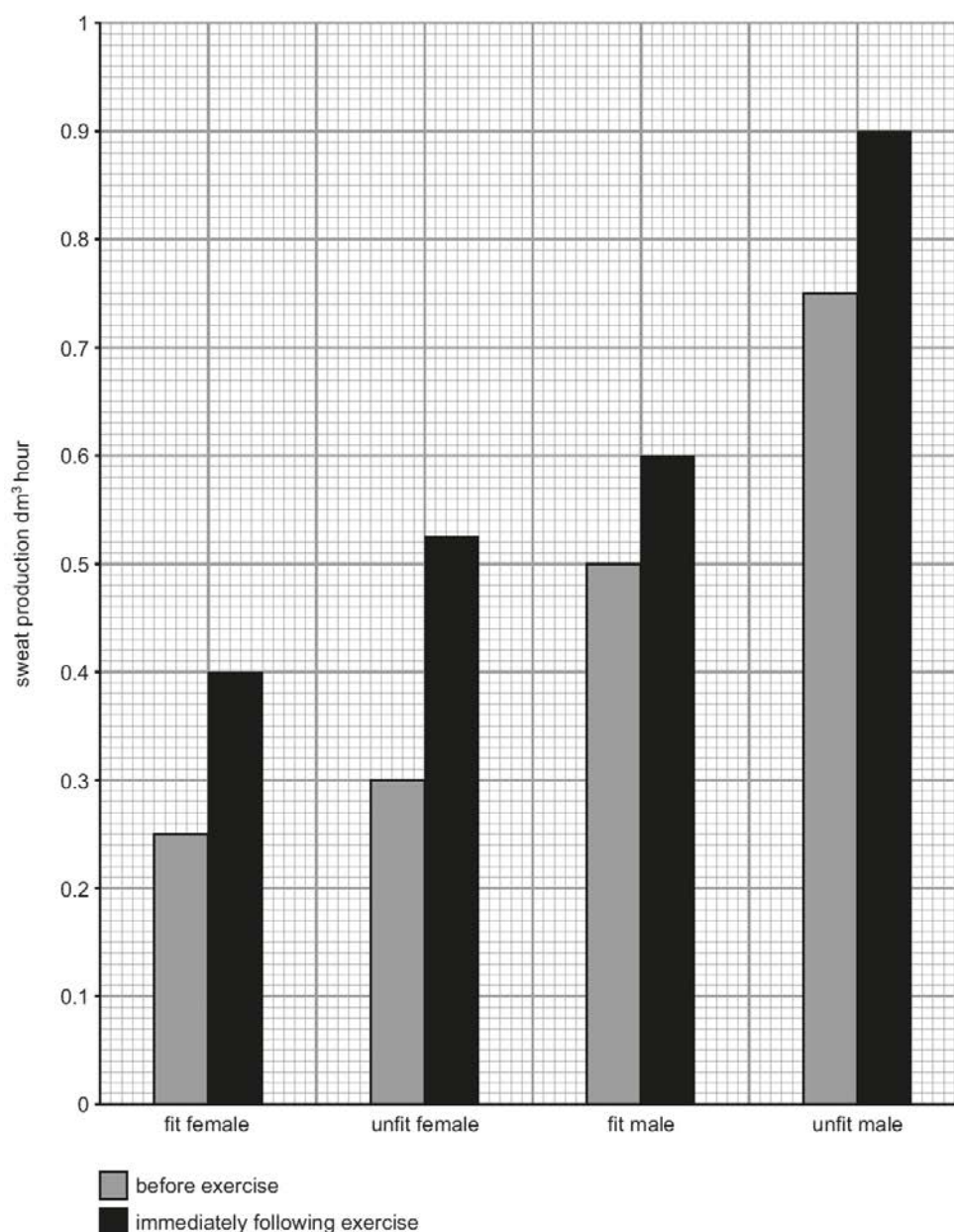
.....

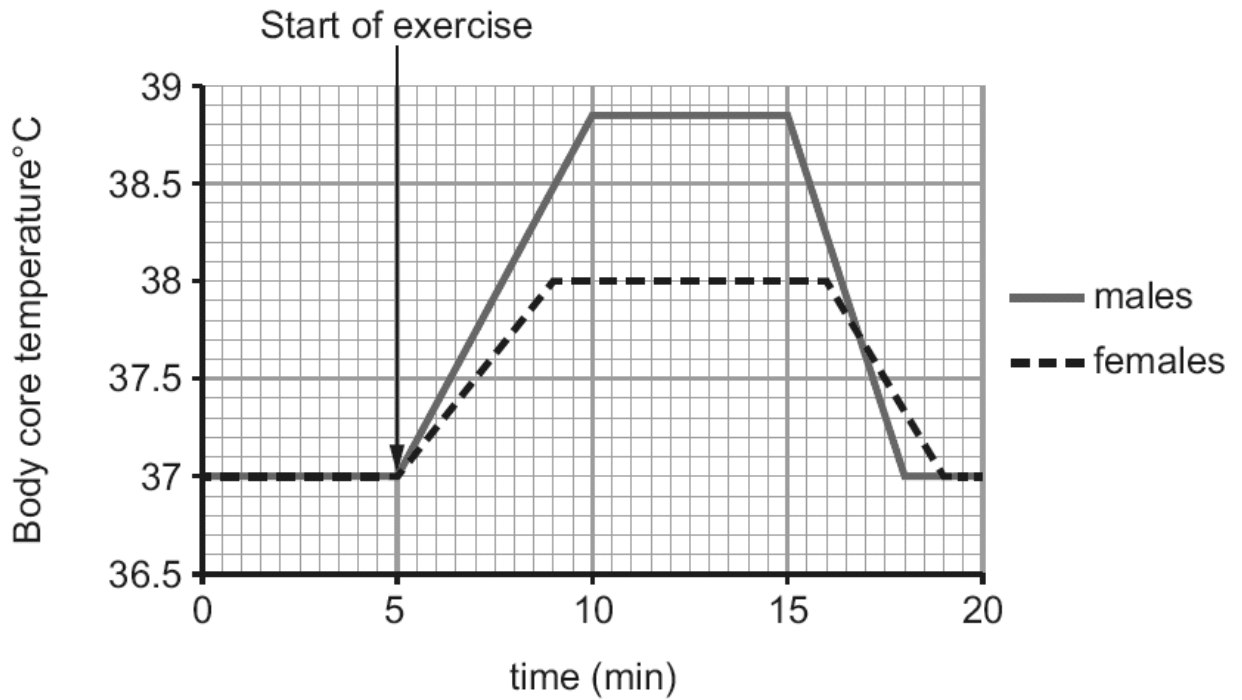
- (b) A student investigated how sweating changed during exercise in four people, two males and two females aged between 22 and 49.

He measured their rates of sweat production at rest and while they used an exercise cycle at a constant level of effort for 10 minutes, in a controlled environment.

Two of the people were fit athletes and two were not athletically fit. Sweat rates were measured on the arms or the forehead. Body temperature was also recorded.

The results are shown in the following graphs.





Use the graphs to answer the questions below.

- (i) Compare the effect of exercise on the rates of sweating in fit and unfit people. [2]

.....

- (ii) Calculate the percentage increase in the fit male's sweating rate after exercise. Show your working. [2]

Sweating rate =%

- (iii) Describe **one** difference in the way the body temperature of males and females changes during exercise. [1]

.....

- (iv) What is the evidence that sweating is more efficient at lowering body temperature in males? [1]

.....

- (v) State **one** way in which the student could improve his investigation in order to make it a fairer test. [1]

.....

.....

14

COMPONENT 1: Concepts in Biology

FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Retina (1) A layer containing sensory cells sensitive to light (1) F (1) Lens (1)	4			4		
	(b)			Pupil <u>increases in diameter/ becomes larger/ widens</u> to allow more light in (1) Able to see objects (in the dark room)(1)	2			2		
				Question 1 total	6	0	0	6	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		producers	1			1		
		(ii)		<p>All 4 correct = 2 marks 3 correct = 1 mark</p>		2		2		
		(iii)		$650/6700 \times 100(1)$ 9.7%(1) ecf from (i)		2		2	2	
		(iv)		some lost in: respiration (1) waste (1)	2			2		
	(b)	(i)		Kestrels and snakes / shrews and spiders		1		1		
		(ii)		snakes		1		1		
		(iii)		Number of all species reduced and As all trophic levels depend on producers			1	1		
				Question 2 total	3	6	1	10	2	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)	Soil animals are needed (for pollination / sexual reproduction)	1			1		
		(ii)	C (1) E(1)			2	2		
	(b)		Rapid spread /multiplication in the forest (1) Using less energy than flowering/ for sexual reproduction (1)		2		2		
			Question 3 total	1	2	2	5	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	I	2500 – 1125 (1) = 1375(1)		2		2	2	
			II	Improved hygiene/improved living conditions/improved water quality		1		1		
		(ii)		Number of cases increases and While death rate falls			1	1		
		(iii)		Incidence fell and remained low 1960 onwards			1	1		
	(b)			Overuse / over-prescription /poor hygiene /cross-contamination among patients		1		1		
				Question 4 total	0	4	2	6	2	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		19	1			1		
		(ii)		38	1			1		
	(b)	(i)		All A matched with T (1) All C matched with G (1) All shapes complementary (1)	3			3		
			(ii)		Nucleotide (anywhere) correctly indicated	1			1	
		(iii)	I	Species 2 (1) Fewest bases are different (1)			2	2		
				II	Compare the genetic profiles of species 1, 2 and 3 (1) The more closely related, the more similarities in banding (1)	2			2	
				Question 5 total	8	0	2	10	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		Oxygen (1) Glucose (1)	2			2		
		(ii)	I	Chloroplast	1			1		
			II	Chlorophyll absorbs light (1) Light needed for photosynthesis (1)	2			2		
	(b)	(i)	I	Rate increases, then plateaus and then decreases (1) Ref to highest rate at 25 °C-30 °C (1)		2		2		
			II	increase then plateau (1) Ref to plateau from 0.08% (1)		2		2		
		(ii)		Temp 24 °C , CO ₂ 0.04% (1) Highest rate of photosynthesis (1) Above this extra cost (electricity /resources) no extra yield (1)			3	3		
				Question 6 total	5	4	3	12	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		Chalk hill blue and 55% (1)		1		1	1	
		(ii)	I	256 x 2 = 512		1		1	1	
			II	$\frac{150}{0.75}$ (1) 200 (1)		2		2	2	
		(iii)		Become extinct [in the wild] (1) Biodiversity decreased (1) Numbers of different species / variety of species reduced (1)		2	1	3		
	(b)	(i)		Plant hedges/trees/set aside /encourage growth of wild flowers / environmental stewardship		1		1		
		(ii)		Reference to legislation to protect environment		1		1		
	(c)	(i)		Regular monitoring (1) Repeated counts (1)			2	2		2
		(ii)		Larger number of species			1	1		1
	(d)			Weed/flowers plants provide food (1) Insecticides kill [endangered] butterflies(1)		2		2		
				Question 7 total	0	10	4	14	4	3

Question		Marking details		Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)		2 x 2 x 2 (1) 8(cm ³)(1)		2		2	2	
	(b)		Correct scale 0-50 in 10 divisions (1) Correct plots (tolerance ½ small square) All 6 correct = 2 marks 5 correct = 1 mark Line and label (1)		4		4	4	4
	(c)	(i)	As pH rises the activity increases then decreases		1		1		1
		(ii)	7.0 – 8.0 and pH corresponding to greatest activity		1		1		1
		(iii)	No intermediate values		1		1		1
		(iv)	24 - 13 = 11 (1)		1		1	1	
		(v)	Increased temperature gives increased movement of molecules (1) Increased chance of collisions (1) Alternative answer The protease works faster at higher temperatures(1) Up to its optimum(1)		2		2		
	(d)		Confirms results are due to enzyme activity and not other factors	1			1		1
			Question 8 total	1	12	0	13	7	8

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Prac	
9	(a)		<p>A = aerosol transmission / bacteria carried in droplets of mucus/ saliva and breathed in (1) use of tissues / washing hands after sneezing etc (1)</p> <p>B = insect bite transmitting bacteria while feeding (1) use of insect repellents / nets while sleeping / long sleeves (1)</p> <p>C = undercooked meat – temperature not high enough to kill bacteria OR food kept warm at temperatures that don't kill bacteria (1) cook meat thoroughly / check temperature using meat thermometer before eating / don't keep food warming at too low a temperature (1)</p>	6				6		
	(b)		<p>Indicative content: <i>Bacterium X</i> antibiotic A is the most effective (AO3) as it has the widest zone of killed bacteria (AO2) <i>Bacterium Z</i> both antibiotics A and C could be used (AO3) antibiotic C slightly better as larger zone of killed bacteria (AO2) <i>Bacterium Y</i> cannot be treated using the antibiotics tested (AO3) as no bacteria killed by any of the antibiotics (AO2) bacteria could be resistant (AO3)</p>		3	3		6		6

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
9	(b)	<p>5-6 Marks Correct identification of the most effective antibiotic against bacteria X and Z with correct reasons given. Identifies that Y cannot be treated using antibiotics A, B, C or D and supports answer with correct reason. Suggests that Y may be resistant to antibiotics. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The information included in the response is relevant to the argument.</i></p> <p>3-4 Marks Correctly identifies A as being most effective against both X and Z correctly and supports identification with correct reasons. Recognises that C is slightly more effective than A at killing Z and identifies that Y is not affected by any of the antibiotics. Does not recognise that Y may be resistant to antibiotics. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i></p> <p>1-2 Marks Identifies that X and Z are most affected by A and C respectively and that Y is not affected by any of the antibiotics but does not support answers with correct reasons. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i></p> <p>0 Marks <i>No attempt made or no response worthy of credit</i></p>						

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
9	(c)		repeated experiment using more plates of each bacterium (1)			2	2		2
			investigated using different concentrations of antibiotics (1)						
			Question 9 total	6	3	5	14	0	8

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
10	(a)		Cross the rose with large red flowers and thorns with the rose with small red flowers and few thorns (1) Grow seeds and select those with largest red flowers and fewest thorns and self-fertilise them (1) Grow seeds and select again those with largest red flowers and fewest thorns. Continue this process until all plants have large red flowers and few thorns.(1)		3		3		
	(b)	(i)	They have the same genotype/same genes/clones	1			1		
		(ii)	No potentially advantageous variation/resistance to disease (1) Could spread a harmful mutation (1)	2			2		
	(c)		Correct gametes Rr x Rr (1) Correct outcome: RR Rr Rr rr (1)		2		2		
			Question 10 total	3	5	0	8	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			First row: Relaxes and fills with blood (1) Open (1) Closed (1) Second Row: Contracts to force blood through aorta (1) Closed (1) Open (1)	6			6		
	(b)			Ventricles have more muscle in walls (1) to force/pump blood a greater distance (1)	2			2		
				Question 11 total	8	0	0	8	0	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
12	(a)	(i)	A: Muscle contracts (1) B: Hair becomes erect (1) Air movement over skin reduced to reduce heat loss (1)	3			3		
		(ii) I	Vessels widen/increase diameter so more blood flow near skin surface (1) More heat radiated/loss (from surface) (1)	2			2		
		II	Less/ no evaporation of sweat possible (1) So less heat loss from skin (1)	2			2		
	(b)	(i)	Exercise linked to increased sweating in both (1) Increase is less in athletic/ trained people (1)			2	2		
		(ii)	$(0.6-0.5)/0.5 \times 100$ (1) 20% (1)		2		2	2	
		(iii)	Males reach higher body temperature / Return to normal temperature more quickly (than females)			1	1		1
		(iv)	Faster cooling in males is accompanied by higher rates of sweating during exercise			1	1		1
		(v)	Ensure all of same age/ take reading at same body part			1	1		1
			Question 12 total	7	2	5	14	2	3

COMPONENT 1 - Concepts in Biology**FOUNDATION TIER****SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	0	0	6	0	0
2	3	6	1	10	2	0
3	1	2	2	5	0	0
4	0	4	2	6	2	0
5	8	0	2	10	0	0
6	5	4	3	12	0	0
7	0	10	4	14	4	3
8	1	12	0	13	7	8
9	6	3	5	14	0	8
10	3	5	0	8	0	0
11	8	0	0	8	0	0
12	7	2	5	14	2	3
TOTAL	48	48	24	120	17	22

Candidate Name	Centre Number				Candidate Number				



GCSE BIOLOGY
COMPONENT 1
Concepts in Biology
HIGHER TIER
SAMPLE PAPER
(2 hours 15 minutes)



For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	8	
3.	14	
4.	4	
5.	9	
6.	11	
7.	9	
8.	6	
9.	11	
10.	5	
11.	6	
12.	6	
13.	17	
14.	6	
Total	120	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
 Write your name, centre number and candidate number in the spaces at the top of this page.
 Answer **all** questions.
 Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

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 **14**.

Answer **all** questions

1. (a) A breeder of prize-winning roses has two different rose bushes. One bush produces large red roses but has many thorns on its stems. The other bush produces small red roses and has stems with very few thorns. Explain how, by selective breeding, the rose breeder could produce a rose bush with large red flowers and very few thorns on its stems. [3]

.....

.....

.....

.....

.....

.....

- (b) If the rose breeder was successful, he could produce many more rose bushes by taking cuttings from the new parent bush.

- (i) Why would the cuttings produce bushes identical to the parent bush? [1]

.....

- (ii) Suggest **two** reasons why it would be unwise to produce all rose bushes in the country only from cuttings. [2]

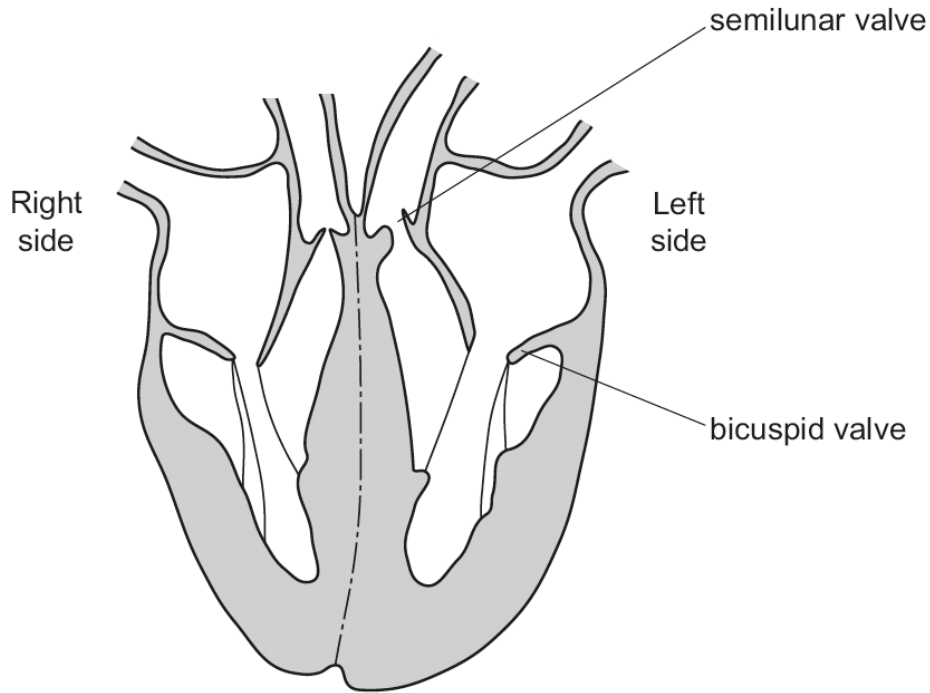
.....

.....

- (c) In roses, the allele for white flowers (r) is recessive to the allele for red flowers (R).

A rose bush with red flowers was self-fertilised. The seeds were collected and grown. 25% of these rose bushes produced white flowers. Using the symbols for the alleles given above, explain these results using a Punnett square in the space below. Give a key to the symbols used. [2]

2. The diagram shows a section through a heart.



(a) Complete the table below to show what is happening to the following parts of the **left** side of the heart during the passage of blood through the heart. [6]

Left atrium	Left ventricle	Bicuspid valve	Semi-lunar valve
contracts to force blood into left ventricle			
relaxes and fills with blood			

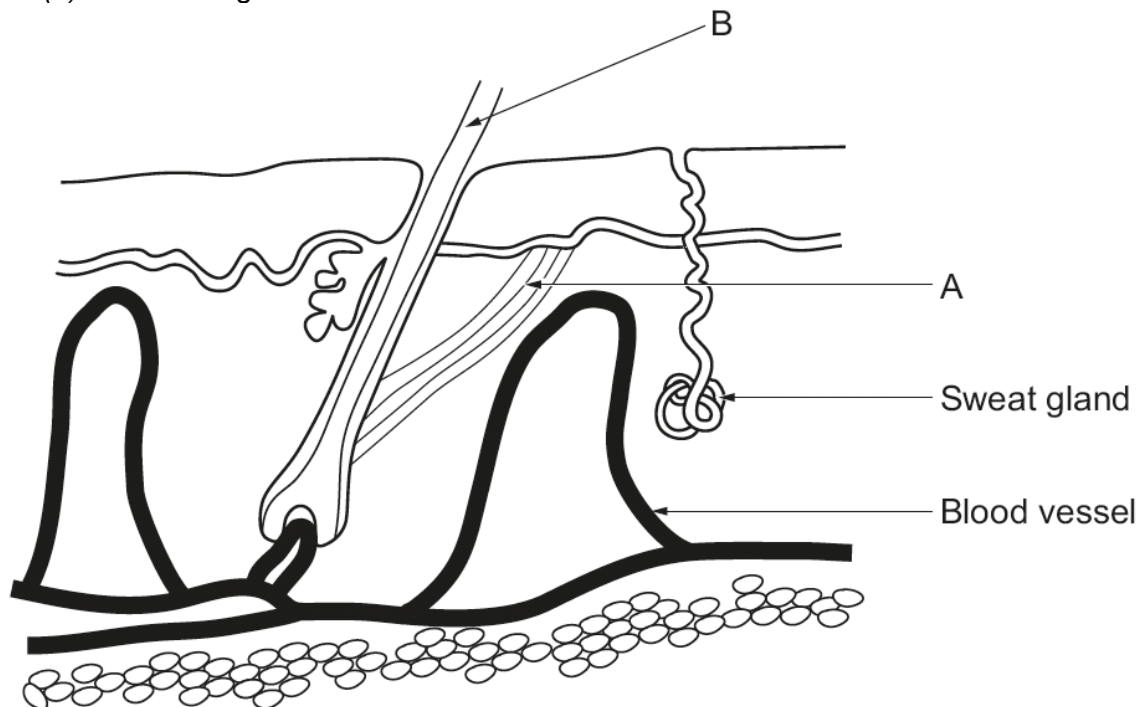
(b) Explain why the walls of the ventricles are thicker than those of the atria. [2]

.....

.....

.....

3. (a) The diagram shows the structure of human skin.



(i) Explain how the structures labelled **A** and **B** function to help reduce heat loss in cold conditions. [3]

.....

.....

.....

.....

(ii) Blood vessels and sweat glands are important in lowering the body temperature if it becomes too high. If the body temperature reaches 40 °C “Heat Stroke” can occur, which can be fatal.

I State how the blood vessels help in cooling the body in hot conditions, such as on a sunny beach. [2]

.....

.....

II In hot, humid conditions the air may contain a very high level of water vapour. Explain why it is possible for heat stroke to occur in these conditions, even if sweat glands are functioning normally. [2]

.....

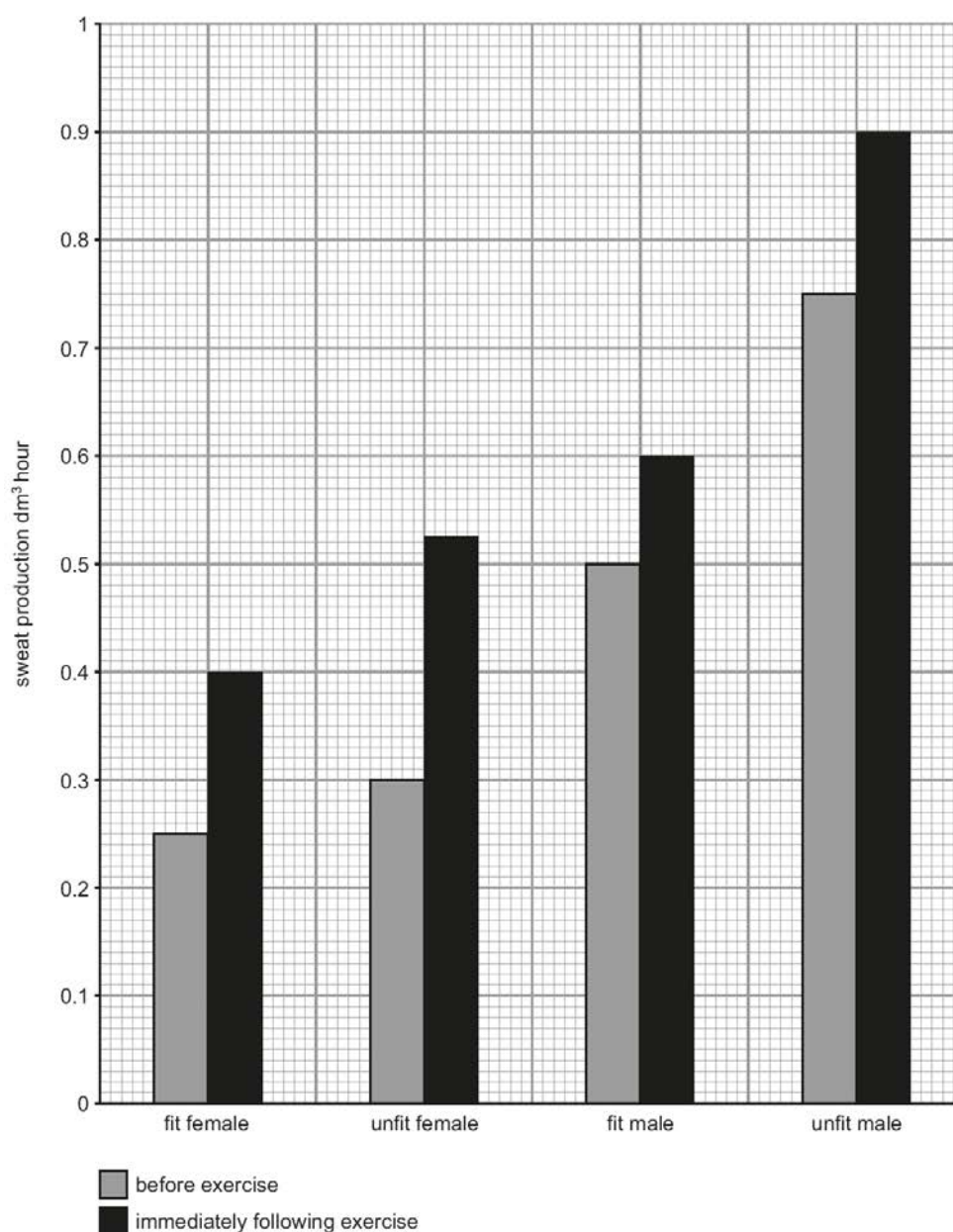
.....

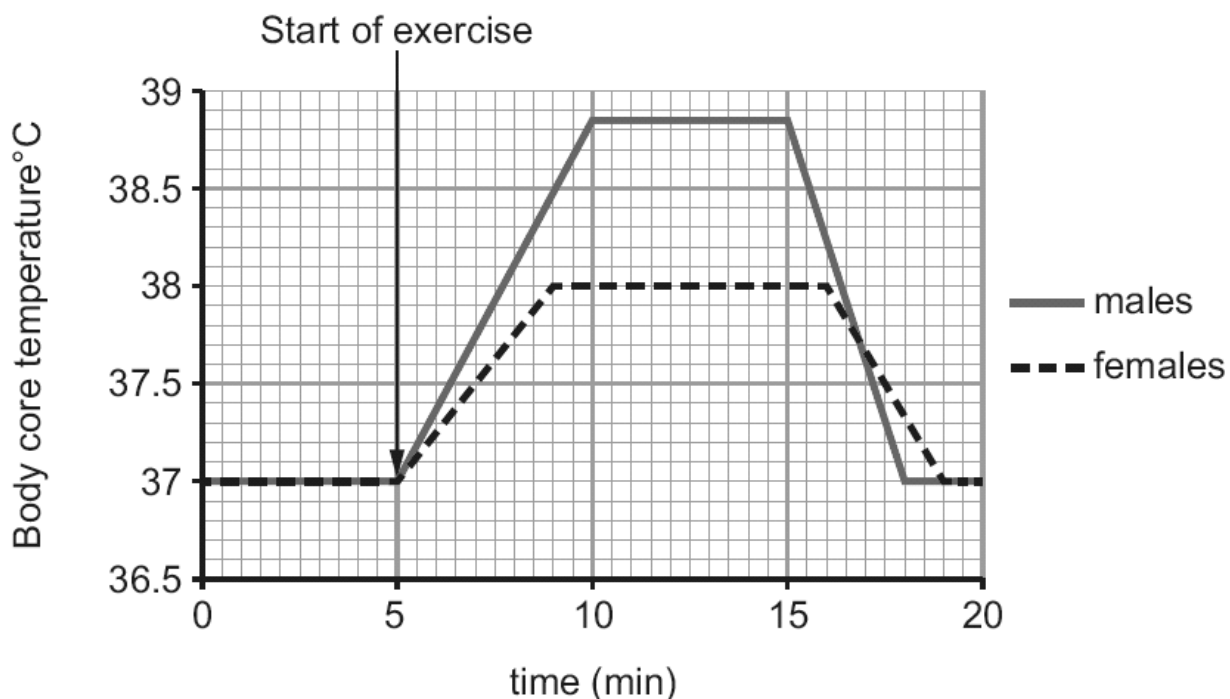
- (b) A student investigated how sweating changed during exercise in four people, two males and two females aged between 22 and 49.

He measured their rates of sweat production at rest and while they used an exercise cycle at a constant level of effort for 10 minutes, in a controlled environment.

Two of the people were fit athletes and two were not athletically fit. Sweat rates were measured on the arms or the forehead. Body temperature was also recorded.

The results are shown in the following graphs.





Use the graphs to answer the questions below.

- (i) Compare the effect of exercise on the rates of sweating in fit and unfit people. [2]

.....

- (ii) Calculate the percentage increase in the fit male's sweating rate after exercise. Show your working. [2]

Sweating rate = %

- (iii) Describe **one** difference in the way the body temperature of males and females changes during exercise. [1]

.....

- (iv) What is the evidence that sweating is more efficient at lowering body temperature in males? [1]

.....

- (v) State **one** way in which the student could improve his investigation in order to make it a fairer test. [1]

.....

.....

14

4. (a) What are stem cells? [2]

.....
.....

(b) Stem cell transplants are classified differently depending on the individual providing the stem cells.

- Stem cells which come from the patient are called autologous stem cells.
- Stem cells which come from a donor are called allogenic stem cells.

(i) Explain the advantage to the patient of treating them with autologous stem cells rather than allogenic stem cells. [1]

.....
.....

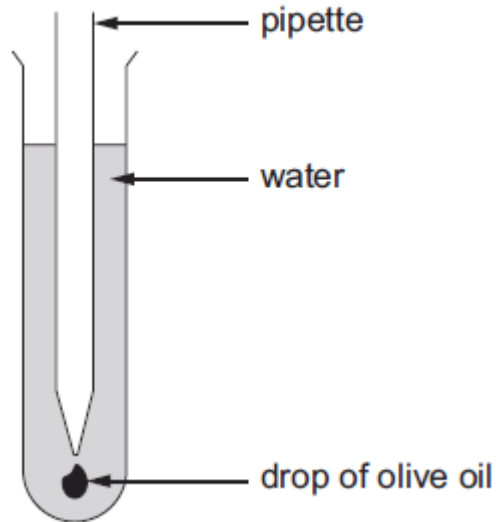
(ii) Name the source of allogenic (donor) stem cells whose use, for some people, raises a serious ethical issue. [1]

.....

4

5. A student investigated the process of digestion of fat as follows:

She filled a test tube with water of pH7. Any change in pH could be detected by a pH sensor connected to a computer. A drop of fat (olive oil) was released into the test tube from a pipette as shown in the diagram.



When the drop of oil was released from the pipette it floated to the surface. Two different types of milk, **A** and **B**, were used in a similar way to the olive oil in two different test tubes of water. The drop of milk **A** floated to the surface but the drop of milk **B** sank.

- (a) What does this observation tell you about the fat content of milk **A** compared to that of milk **B**? [1]

.....

- (b) 5 cm³ of milk **A** was placed in a test tube with 2 cm³ of lipase at pH7. The mixture was left at 35 °C for 10 minutes. After this time, the pH of the mixture had changed from pH7 to pH5. Explain what happened to cause the change in pH. [2]

.....

.....

(c) The same procedure was repeated with milk **B**.

(i) What would you expect the pH to be after 10 minutes? [1]

.....

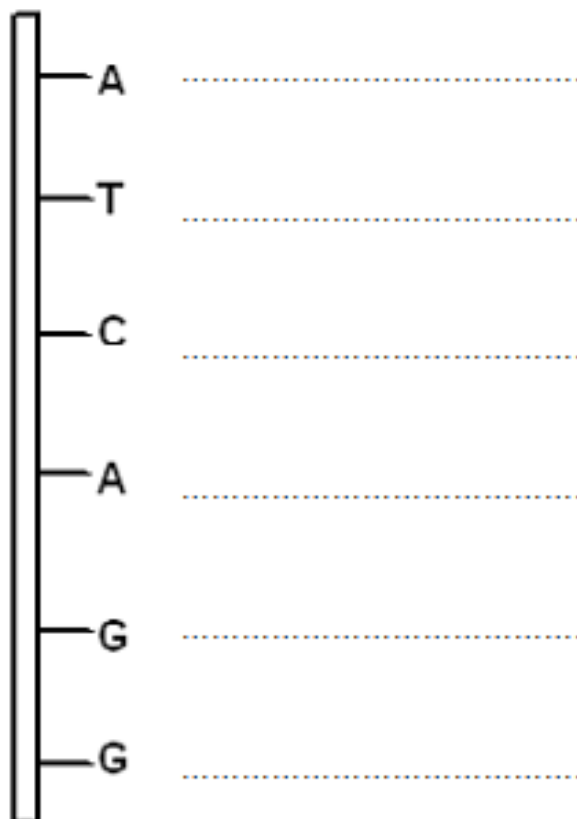
(ii) Give a reason for your answer to (c)(i). [1]

.....
.....

(d) When the procedure was repeated with milk **A** and lipase, which had been boiled and cooled, the mixture remained at pH7. Explain this observation. [4]

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

6. The diagram shows part of a sequence of bases that code for adrenaline in a molecule of DNA.



- (a) (i) **Write the order of bases** in the **complementary strand of DNA** from the top to the bottom by giving their **chemical names**. [2]
- (ii) How many different amino acids are coded for in the sequence shown? [1]
-
- (iii) A DNA molecule contains 2 000 base pairs. 30% of the bases are **G**. Calculate how many **A** bases are contained in this DNA molecule. [2]

number of **A** bases =

(b) Describe the structure of a nucleotide. [3]

.....

.....

.....

.....

.....

.....

(c) Explain how a mutation in the sequence of bases which codes for adrenaline may prevent it from functioning. [3]

.....

.....

.....

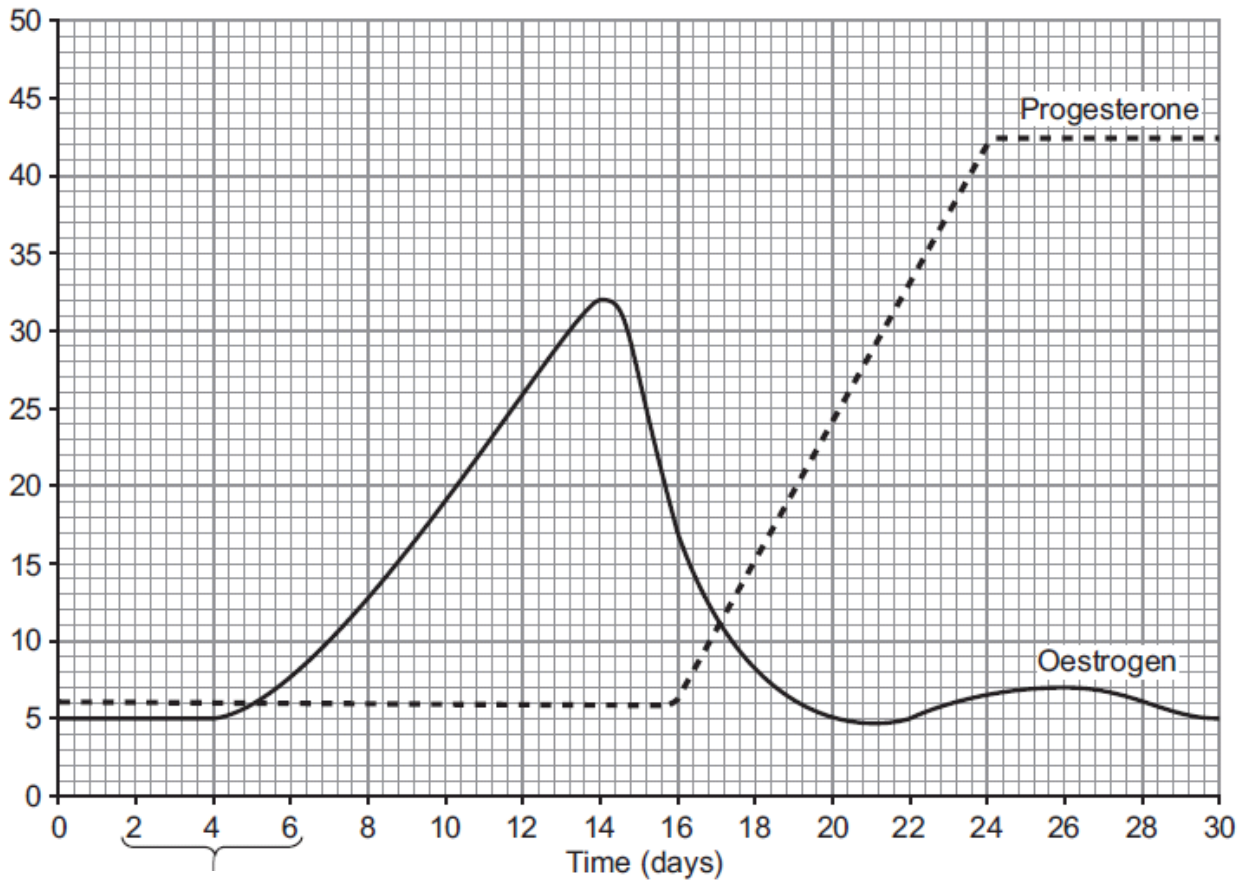
.....

.....

.....

7. In some women infertility may be treated with the drug, clomiphene. The graph shows the blood-oestrogen and blood-progesterone levels in a woman during and after treatment with clomiphene. It also shows that she has become pregnant.

Concentration of hormone in blood (a.u.)



Days when clomiphene is taken

Use the information in the graph and your knowledge to answer the following questions.

- (a) (i) On which days were the levels of oestrogen and progesterone equal? [1]

day and day

- (ii) Which process occurred between day 0 and day 5? [1]

.....

- (iii) State **one** function of:

I oestrogen; [1]

.....

II progesterone. [1]

.....

(b) Clomiphene stimulates the production of a hormone by the pituitary gland in the brain.

(i) From the timing of the treatment with clomiphene shown in the graph, name the hormone whose secretion is stimulated by clomiphene. [1]

.....

(ii) Explain how this hormone brings about the change in oestrogen secretion shown in the graph. [2]

.....

.....

(iii) **Mark on the graph** with an **X** the day when the ovulation would be most likely. [1]

(iv) State how the graph shows that the woman is pregnant. [1]

.....

8. A student wanted to estimate the population size of the two-spot ladybird, *Adalia bipunctata* which had invaded a garden in large numbers. He used a capture/recapture method as follows.

- He captured as many as possible in two hours and recorded the number.
- He marked each one with a harmless coloured dye and then released them.
- Two days later, he captured as many as possible in two hours in the garden.
- He recorded the number captured and also any that were marked with the dye previously.

If **Q** equals the number captured on the first day; **R** the total number captured two days later, and **S** the number of marked ones captured, the following formula gives an estimate of the population.

$$P = \frac{Q \times R}{S}$$

(a) State **three** factors which this formula does not account for and so could lead to an inaccurate answer. [3]

.....

.....

.....

(b) *Adalia bipunctata* is normally red with two black spots. However, variants occur which are black with two red spots. The variant is caused by an allele which only expresses itself as a homozygote.

(i) What name is given to such an allele? [1]

.....

(ii) Using the example of *Adalia bipunctata*, distinguish between the terms phenotype and genotype. [2]

The phenotype is:

.....

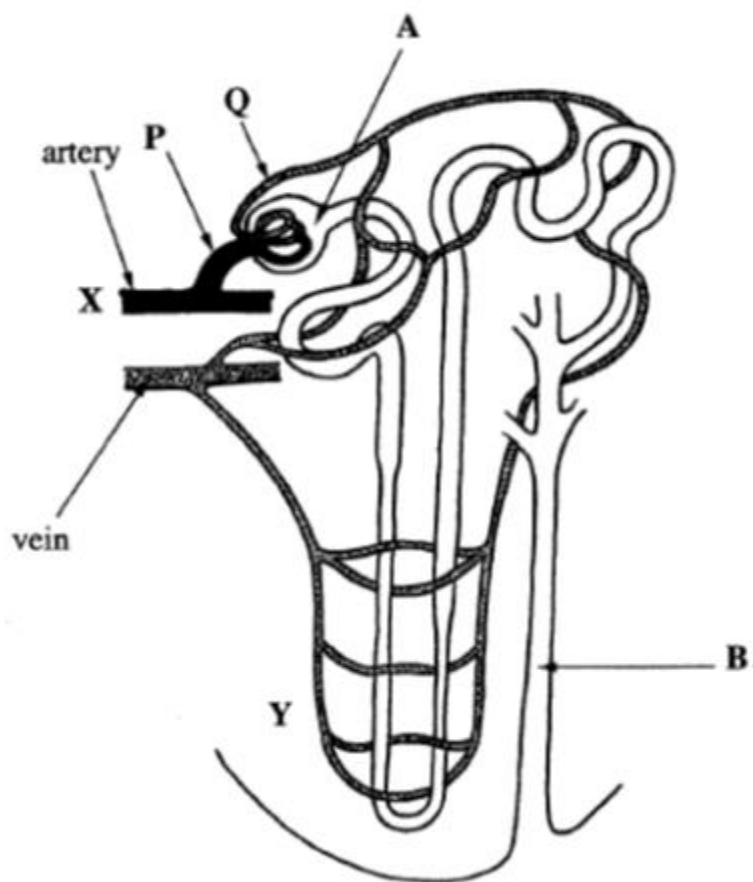
.....

The genotype is:

.....

.....

9. The diagram shows a nephron and its associated blood vessels.



- (a) (i) **Draw** arrows at points **X** and **Y** on the diagram to show the direction of flow of blood. [1]
- (ii) Explain how the difference in the diameter of **P** and **Q** helps a process taking place in the kidney. [2]

.....

.....

.....

.....

(b) The table below shows the presence or absence of some substances in parts **A** and **B** in the diagram. The numbers represent units recorded per day.

Substance	Part A	Part B
water	18 000	3 000
salts	2 600	150
glucose	800	0
urea	56	56
protein	0	0

Explain the data for the following substances:

(i) Protein [1]

.....

(ii) Glucose [1]

.....

(iii) Water [1]

.....

(c) Calculate the percentage difference between the data for salts in part A and Part B. Show your working. [2]

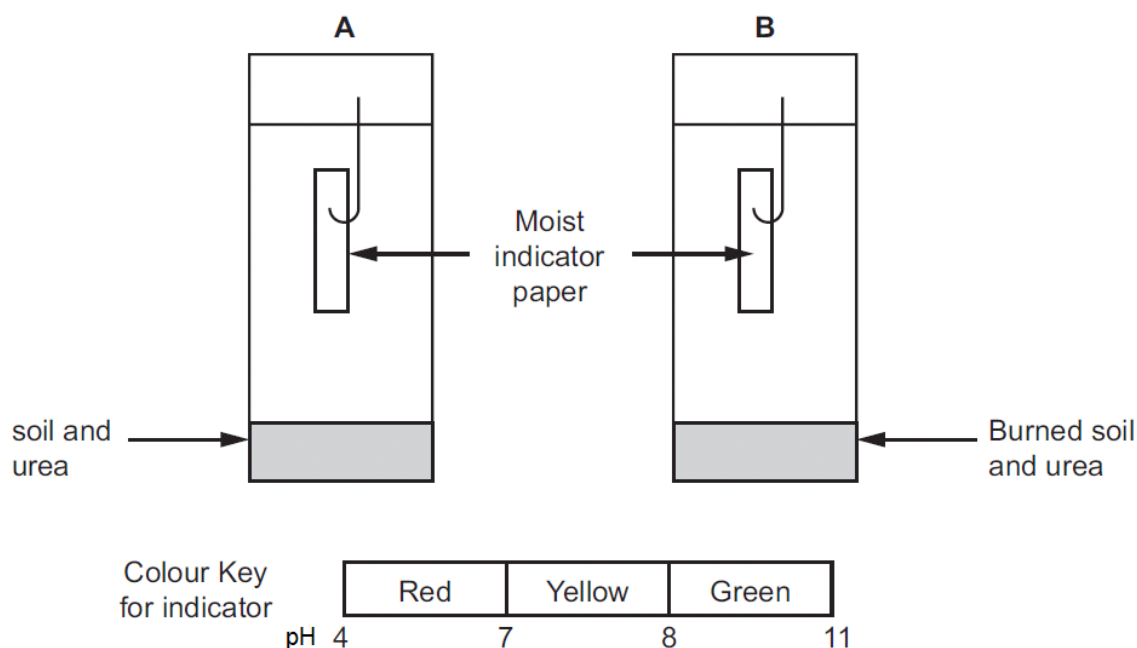
percentage difference = %

(d) If the concentration of ADH was increased in the blood, state **three** changes that you would expect in the composition of urine. [3]

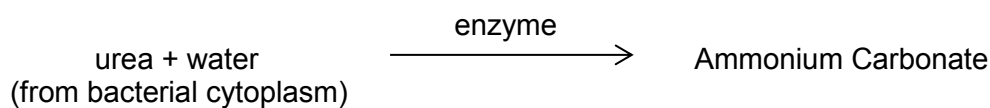
.....

10. In order to investigate how nitrogen is recycled by bacteria in soil, the apparatus shown in the diagram was kept at 25 °C for two days.

At the start, the indicator paper in both tubes was yellow. After two days, the indicator paper in tube A was green but the indicator paper in tube B was still yellow.



A word equation representing the reaction in tube **A** is:



What do you conclude about the results obtained in:

- (a) tube **A**; [2]

.....

.....

.....

- (b) tube **B**? [3]

.....

.....

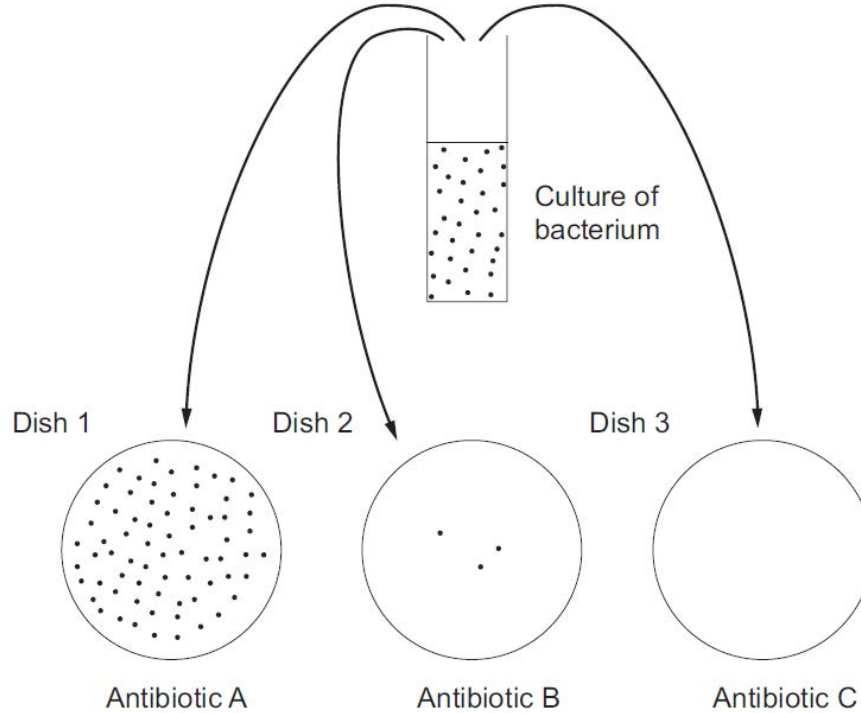
.....

.....

.....

11. Equal sized samples from a culture of a bacterium were inoculated on to three Petri dishes containing nutrient agar. In each of the Petri dishes the agar contained a different antibiotic **A**, **B** and **C**.

The Petri dishes were incubated at the same temperature for the same time. The results after incubation are shown below. The dots represent colonies of bacteria.



- (a) What conclusions can you draw about the effects of the three antibiotics on this type of bacterium?

(i) Antibiotic **A** [1]

.....

(ii) Antibiotic **B** [1]

.....

(iii) Antibiotic **C** [1]

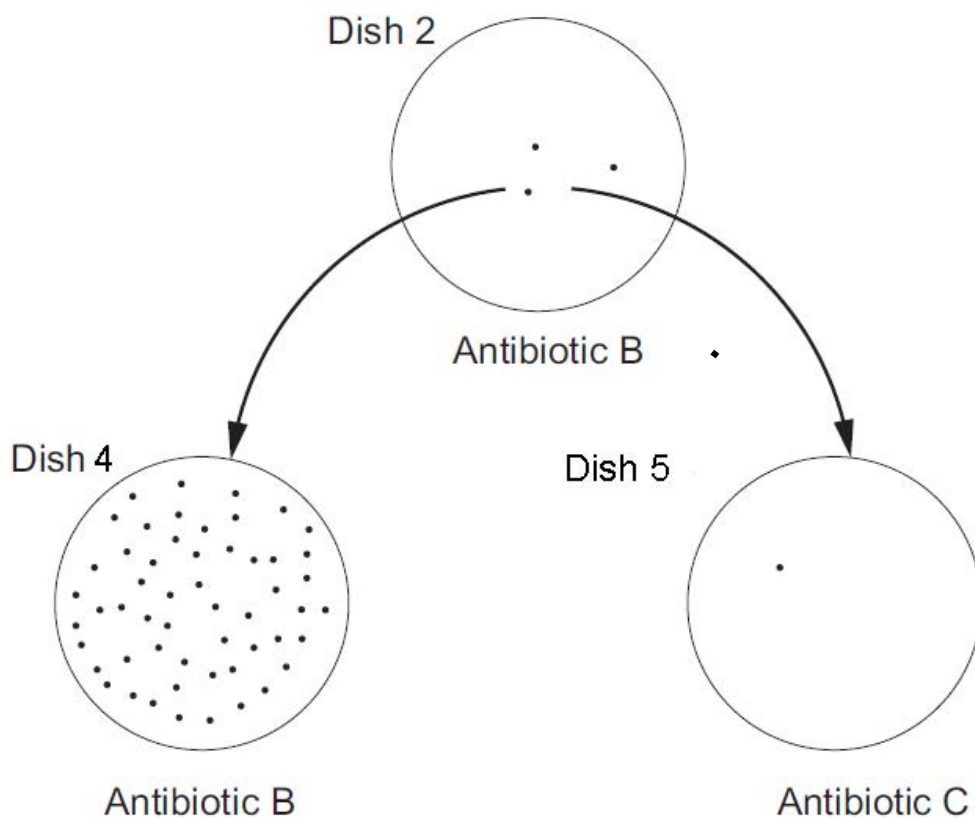
.....

(b) What would you use as a control? [2]

.....

.....

(c) Bacteria from one of the colonies growing on dish 2 were later inoculated on to two other Petri dishes, 4 and 5, one containing antibiotic **B**, and one containing antibiotic **C**. The results are shown below after incubation at the same temperature for the same time.

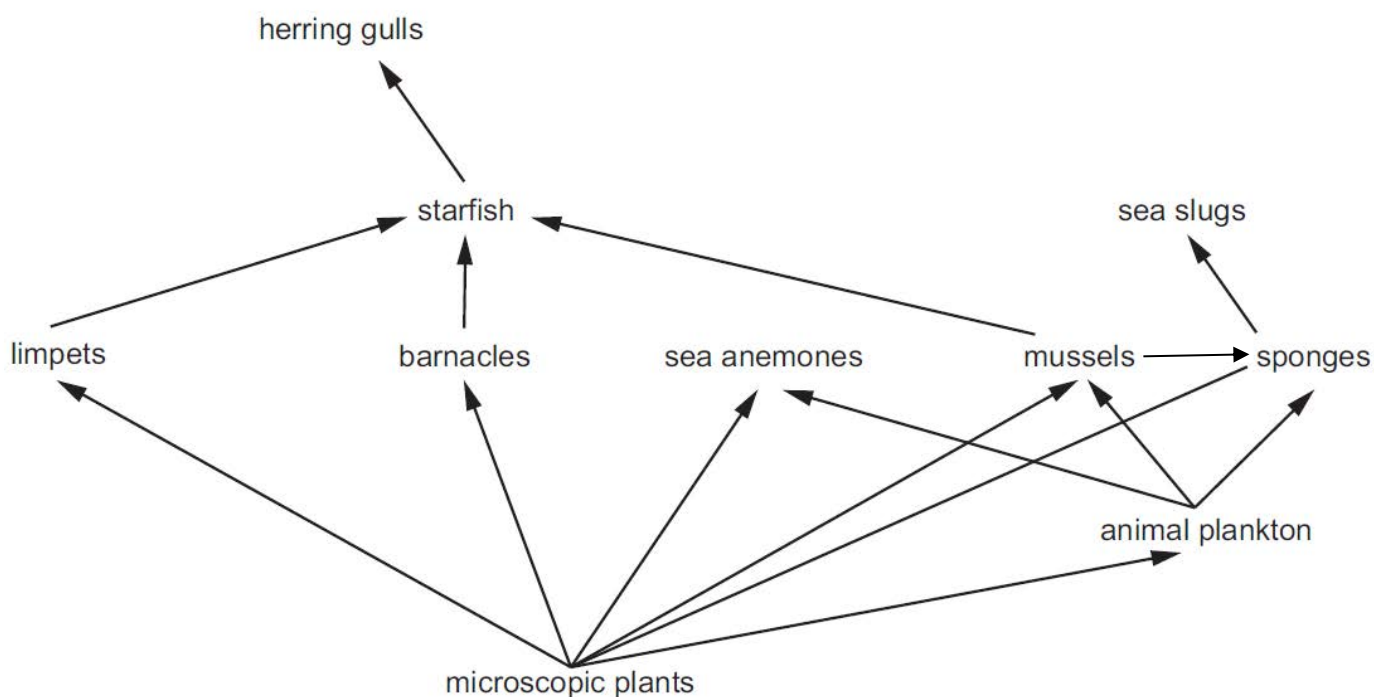


Account for the differences in the results seen in Petri dish 2 compared with Petri dishes 4 and 5. [1]

.....

.....

12. The common starfish *Asterias rubens* lives on a mussel bed on a rocky shore in South Wales. The following diagram shows part of the food web for the mussel bed.



An investigation was carried out in which all the starfish were removed from an 8 m x 2 m area of the mussel bed. In an equal area, on the mussel bed, the starfish were **not** removed.

The abundance of other organisms in the food web was monitored each month for a year.

The observations were:

- In the area in which starfish were removed the abundance of limpets, sea anemones, sponges and sea slugs **decreased** and the barnacles and mussels **increased**.
- In the area in which starfish were **not** removed, the abundance of all organisms remained the same as at the beginning of the investigation.

(a) (i) State the purpose of not removing starfish from one area. [1]

.....

(ii) Suggest how the investigation was made valid. [1]

.....

(b) Explain the decrease in number of limpets in the area from which starfish were removed. [1]

.....

.....

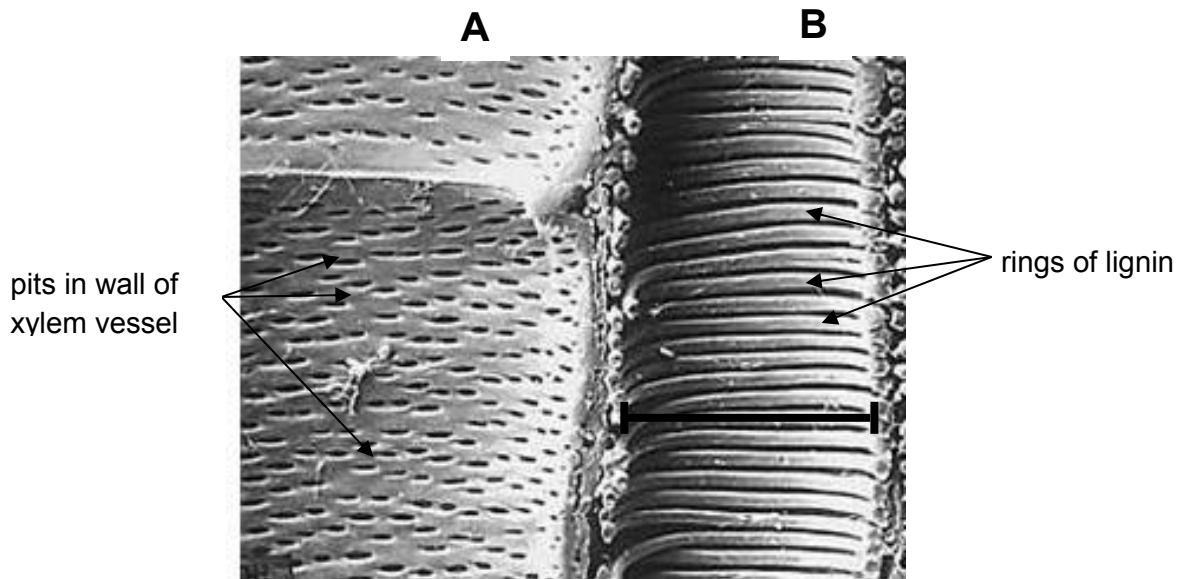
(c) Explain the decrease in numbers of sea slugs in the area from which starfish were removed. [3]


.....

.....

.....

13. Xylem vessels are responsible for the transport of water and ions in a plant and also provide support for stems. The walls are made of lignin which is laid down in different ways depending on the main function of the xylem vessel. The electron micrograph below shows a longitudinal section through two xylem vessels, **A** and **B**. The image is x800 greater than actual size.



- (a) (i) Calculate the diameter of xylem vessel **B** at the point shown by the line . [2]

diameter = mm

- (ii) Assuming that the xylem vessel is a cylinder, calculate the cross sectional area of xylem vessel **B** using the formula πr^2 . Give your answer to two significant figures. Use $\pi = 3.142$ [2]

cross-sectional area =mm²

- (b) Identify the functions of xylem vessels A and B and explain how each is adapted to its function. [4]

A

.....

.....

B

.....

.....

(c) *Ophiostoma ulmi* is a fungus that infects elm trees. It enters damaged xylem vessels and then spreads through the plant. Infected trees respond to the fungal infection by plugging the infected xylem vessels. However, if too many xylem vessels are plugged the leaves die first followed by the roots.

(i) Explain why plugging the xylem vessels reduces a tree's ability to absorb water through its roots. [3]

.....

.....

.....

.....

.....

(ii) Explain why the roots of the tree die after the death of the leaves. [2]

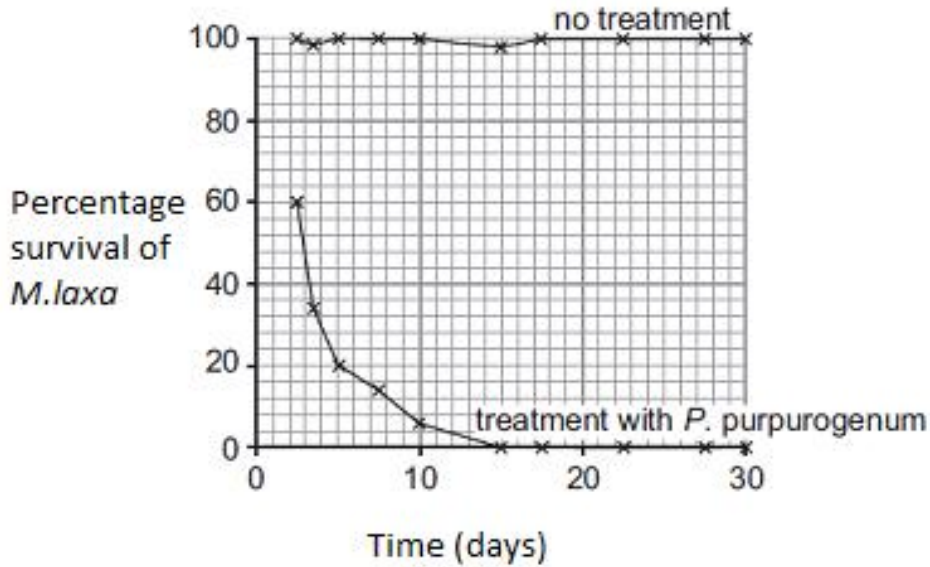
.....

.....

.....

.....

- (d) *Monilinia laxa* is a fungus that infects apricot and peach trees in Spain. Another fungus, *Penicillium purpurogenum*, secretes an enzyme that can break down the cell wall of *Monilinia laxa*. The graph shows the effect of *Penicillium purpurogenum* on *Monilinia laxa*.



It has been proposed that *Penicillium purpurogenum* could be used as a biological control agent to cure trees infected with *Monilinia laxa*.

- (i) Explain how the results shown in the graph indicate that *Penicillium purpurogenum* could be used as a biological control agent. [2]

.....

.....

.....

.....

- (ii) It has also been proposed that *Penicillium purpurogenum* could be used to control the spread of Ash Dieback disease which is also caused by a fungus. Explain why both laboratory and field trials would need to be carried out before *Penicillium purpurogenum* could be used in the UK. [2]

.....

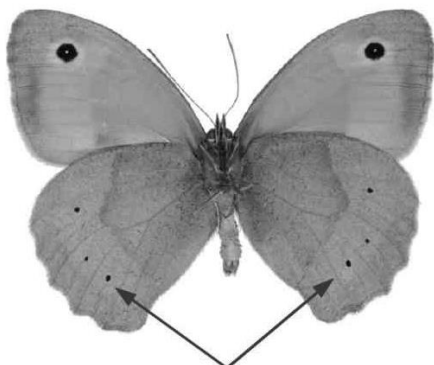
.....

.....

.....

.....

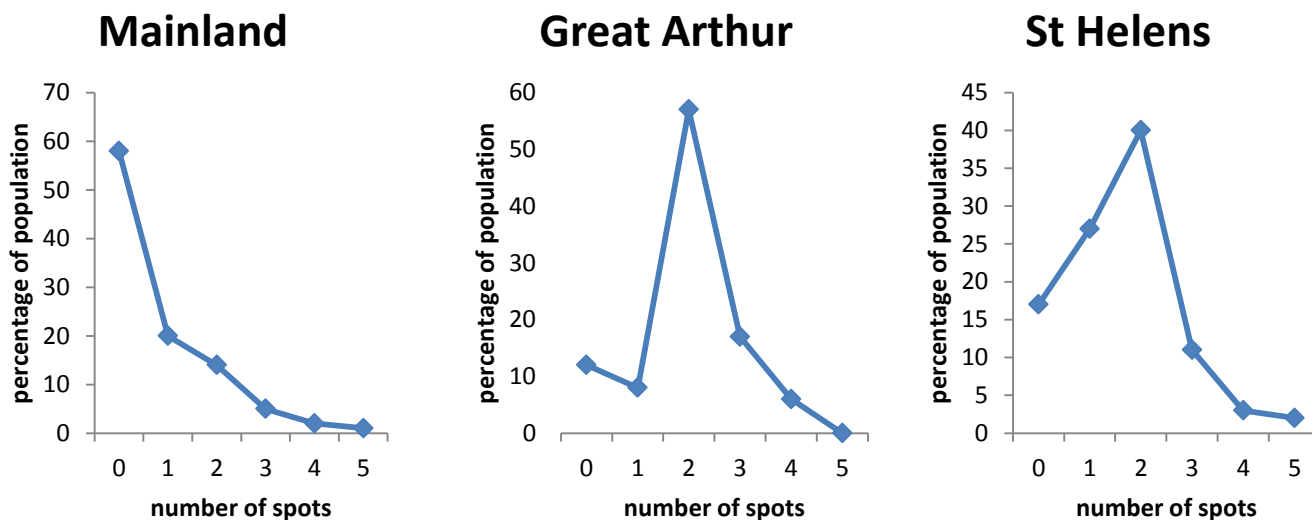
14. In the 1950s, the scientist E. B. Ford studied variation in populations of the Meadow Brown butterfly (*Maniola jurtina*). He counted the number of spots on the hind wings of butterflies found on the Isles of Scilly and on the UK mainland. The butterfly can have from zero to five spots on each hind wing. The image below shows a three-spotted butterfly.



three spots on each hind wing

The caterpillar larvae of these butterflies feed on grasses while the adults feed on the nectar of a range of plants. They will not fly over open water of more than 10 m width and are believed to have been blown, by strong winds, to the Isles of Scilly which lie about 45 km off the coast of Cornwall. Small populations of the butterfly are found on most of the Isles of Scilly; on the mainland the butterfly is found across the whole of the UK.

The distribution of butterflies with different numbers of spots is shown below for the mainland and for two of the islands.



COMPONENT 1 - Concepts in Biology

HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)		Cross the rose with large red flowers and thorns with the rose with small red flowers and few thorns (1) Grow seeds and select those with largest red flowers and fewest thorns and self-fertilise them (1) Grow seeds and select again those with largest red flowers and fewest thorns. Continue this process until all plants have large red flowers and few thorns.(1)		3		3		
	(b)	(i)	They have the same genotype/same genes/clones	1			1		
		(ii)	No potentially advantageous variation/resistance to disease (1) Could spread a harmful mutation (1)	2			2		
	(c)		Correct gametes Rr x Rr (1) Correct outcome: RR Rr Rr rr (1)		2		2		
			Question 1 total	3	5	0	8	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			First row: Relaxes and fills with blood (1) Open (1)Closed (1) Second Row: Contracts to force blood through aorta (1)Closed (1)Open (1)	6			6		
	(b)			Ventricles have more muscle in walls (1) to force/pump blood a greater distance (1)	2			2		
				Question 2 total	8	0	0	8	0	0

Question			Marking details		Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		A: Muscle contracts (1) B: Hair becomes erect (1) Air movement over skin reduced to reduce heat loss (1)	3			3		
		(ii)	I	Vessels widen/increase diameter so more blood flow near skin surface (1) More heat radiated/loss (from surface) (1)	2			2		
			II	Less/ no evaporation of sweat possible (1) So less heat loss from skin (1)	2			2		
	(b)	(i)		Exercise linked to increased sweating in both (1) Increase is less in athletic/ trained people (1)			2	2		
		(ii)		$(0.6-0.5)/0.5 \times 100$ (1) 20% (1)		2		2	2	
		(iii)		Males reach higher body temperature / Return to normal temperature more quickly(than females)			1	1		1
		(iv)		Faster cooling in males is accompanied by higher rates of sweating during exercise			1	1		1
		(v)		Ensure all of same age/ take reading at same body part			1	1		1
				Question 3 total	7	2	5	14	2	3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Undifferentiated/unspecialized cells (1) which can become any type of cell/any specialized cell (1)	2			2		
	(b)	(i)		Unlikely to be rejected/more likely to be accepted as they are genetically identical	1			1		
		(ii)		Embryos	1			1		
				Question 4 total	4	0	0	4	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			There is more fat in milk A than in milk B			1	1		1
	(b)			Lipase had digested/broken down/hydrolysed (1) fat to fatty acid [and glycerol] (1)		2		2		2
	(c)	(i)		It would stay at pH7			1	1		1
		(ii)		There is no substrate/fat in B		1		1		
	(d)			Boiling denatures enzyme (1) by altering the active site (1) Enzyme-substrate complex cannot form (1) so no product/fatty acid can be produced (1)		4		4		4
				Question 5 total	0	7	2	9	0	8

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Thymine.adenine.guanine.thymine.cytosine.cytosine All 6 correct = 2 marks 5 correct = 1 mark	2			2		
		(ii)	2		1		1		
	(iii)	60% of 4000 = G + C = 2400 bp (1) Therefore A + T = 1600 bp Therefore A = 800 bp (1)		2		2	2		
	(b)		Phosphate (1) Linked to sugar (1) Linked to base (1)	3			3		
	(c)		The code for one or more amino acid is/are changed. (1) Sequence of amino acids is changed (1) Adrenaline is not produced (1)	1		1 1	3		
			Question 6 total	6	5	0	11	2	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	<i>(a)</i>	(i)		Day 5 and day 17		1		1	1	
		(ii)		Menstruation		1		1		
		(iii)	I	Ovulation/triggers production of Luteinising Hormone	1			1		
			II	Preparation of uterus for pregnancy	1			1		
	<i>(b)</i>	(i)		FSH		1		1		
		(ii)		Causes follicles to grow (1) which produce oestrogen (1)	2			2		
		(iii)		Day 14	1			1	1	
		(iv)		Progesterone remains high		1		1		
				Question 7 total	5	4	0	9	2	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			immigration(1) emigration(1) predation (1)	3			3		3
	(b)	(i)		Recessive	1			1		
		(ii)		In Adalia the background colour or colour of spots (1) The genotype is the genetic composition/constitution of an organism/its genes/genome/DNA (1)	1	1		2		
				Question 8 total	5	1	0	6	0	3

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)	Arrow on X pointing into capsule + Arrow at Y pointing away		1		1		
		(ii)	Q is narrower than P to increase pressure (1) for ultrafiltration (1)		2		2		
(b)	(i)	(i)	Molecules of protein are too big to pass through filter		1		1		
		(ii)	All the glucose is reabsorbed in the tubule		1		1		
		(iii)	Some water is reabsorbed in the tubule		1		1		
(c)		2600 – 150 = 2450. (2450 / 2600) × 100 (1) 94.23 (1)		2		2	2		
(d)		The volume of water in B would decrease(1) The concentration of salts would increase (1) Concentration of urea would increase (1)	3			3			
Question 9 total				3	8	0	11	2	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Bacteria produced an enzyme (1) Enzyme broke down urea into ammonium carbonate which is alkali/pH8 -11 (1)		1	1	2		2
	(b)			Burning the soil killed the bacteria (1) Enzyme denatured/active site destroyed (1) so contents remained neutral/pH7 (1)		1	1	3		3
				Question 10 total	0	2	3	5	0	5

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)		Most bacteria not killed/resistant to antibiotic			1	1		1
		(ii)		Some bacteria resistant to antibiotic/ most are killed			1	1		1
		(iii)		None are resistant to antibiotic/ all are killed			1	1		1
	(b)			Same Petri dish and agar and Same size bacteria culture (1) No antibiotic (1)			2	2		2
	(c)			They are now resistant to antibiotic B and One has mutated to become resistant to antibiotic C			1	1		
				Question 11 total	0	0	6	6	0	5

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)	(i)		As a control/for comparison/to see the effect of removal of starfish	1			1		1
		(ii)		Equal size of area studied/same method of sampling/ same area studied		1		1		1
	(b)			More competition for food for limpets/ Barnacles and mussels increased because of less predation (1)			1	1		
	(c)			Barnacles, sea anemones, mussels compete for food with sponges (1) Sponges decrease (1) Less food for sea slugs (1)		1 1	1	3		
				Question 12 total	1	3	2	6	0	2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)	(i)		$\frac{34}{800}$ (1) 0.0425 mm (1)		2		2	2	
		(ii)		radius = $\frac{0.0425}{2} = 0.02125$ area = $\pi \times 0.02125^2$ (1) = 0.00141881 = 0.0014 mm ² (1)		2		2	2	
	(b)			A = transport (1) pits enable water (and ions) to leave xylem and pass into surrounding tissues (1) B = support (1) rings of lignin strengthen xylem vessel walls (1)	4			4		
	(c)	(i)		water moves into root cells by osmosis down a water concentration gradient (1) if plugged water cannot move up xylem and water concentration increases in root tissues (1) water concentration gradient between soil and root tissues reduced so less uptake of water (1)		3		3		
		(ii)		leaves no longer produce sugars (1) roots no longer receive sugars for respiration and die (1)			2	2		
	(d)	(i)		biological control involves using one organism to control the population of another (1) <i>P. pupurogenum</i> causes 100% death of <i>M.laxa</i> (1)	1			2		
							1			

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		<p>laboratory enzymes are specific so experiments needed to confirm that enzymes produced by <i>P.purpurogenum</i> will break down / digest the cell wall of the fungus that causes Ash Dieback Disease (1)</p> <p>field trials need to make sure that <i>P.purpurogenum</i> will only act against target species / does not affect useful species of fungus can itself be controlled in the wild (1)</p>	1	1		2		2
Question 13 total				6	8	3	17	4	2	

Question		Marking details		Marks available						
				AO1	AO2	AO3	Total	Maths	Prac	
14	(a)									
			<p>On the mainland there is a large population of butterflies that can breed over a large area due to not having to cross large expanses of water. (AO2)</p> <p>Only small numbers colonised each island. (AO3)</p> <p>Probably separate colonisation events as butterflies [won't cross open water]. (AO3)</p> <p>Butterflies colonising islands may have had non-standard distribution of spots (AO2)</p> <p>so some spot numbers became more common as they were more likely to reproduce. (AO3)</p> <p>Each island may have had different plant species so different selection pressures in place on each island.(AO2)</p> <p>Different numbers of spots may give better camouflage to adults under different conditions.(AO2)</p> <p>5-6 Marks</p> <p>Clear understanding that mainland butterflies have no / few barriers to breeding but island populations can only breed amongst themselves due to the sea forming a barrier between the islands. Explains that original populations blown to the islands may have had a different distribution of spots to normal and so more genes present for more / less spots. Also suggests that plants present could act as selection pressures on caterpillars or adults leading to greater survival of some butterflies than others, hence, the change in the spot numbers.</p> <p><i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The information included in the response is relevant to the argument.</i></p>							
					3	3	6			

			<p>3-4 Marks: Understands that different selection pressures could be acting on the caterpillars and adults on the islands compared to the mainland. That these pressures could result in the greater survival of some spot numbers than others and hence the change in spot number distribution. Some attempt is made to explain that the original populations may not have had the normal distribution of spot numbers seen on the mainland but does not clearly relate this to different gene distributions or to island populations not being able to interbreed. <i>Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i></p> <p>1-2 Marks Explains different distributions in terms of mutation, variation, advantage and survival. Does not relate distributions to different plants present and therefore different survival rates and has no understanding of colonising populations having different spot distributions to the normal seen on the mainland. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i></p> <p>0 marks: <i>No attempt made or no response worthy of credit.</i></p>						
			Question 14 total	0	3	3	6	0	0

COMPONENT 1 - Concepts in Biology**HIGHER TIER****SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	5	0	8	0	0
2	8	0	0	8	0	0
3	7	2	5	14	2	3
4	4	0	0	4	0	0
5	0	7	2	9	0	8
6	6	5	0	11	2	0
7	5	4	0	9	2	0
8	5	1	0	6	0	3
9	3	8	0	11	2	0
10	0	2	3	5	0	5
11	0	0	6	6	0	5
12	1	3	2	6	0	2
13	6	8	3	17	4	2
14	0	3	3	6	0	0
TOTAL	48	48	24	120	12	28

Candidate Name	Centre Number				Candidate Number				



GCSE BIOLOGY
COMPONENT 2
Applications in Biology
FOUNDATION TIER
SAMPLE PAPER
(1 hour 15 minutes)



	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
Section A	1.	8	
	2.	14	
	3.	9	
	4.	14	
Section B	5.	15	
	Total	60	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a resource booklet, calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
 Write your name, centre number and candidate number in the spaces at the top of this page.
 Answer **all** questions.
 Write your answers in the spaces provided in this booklet.

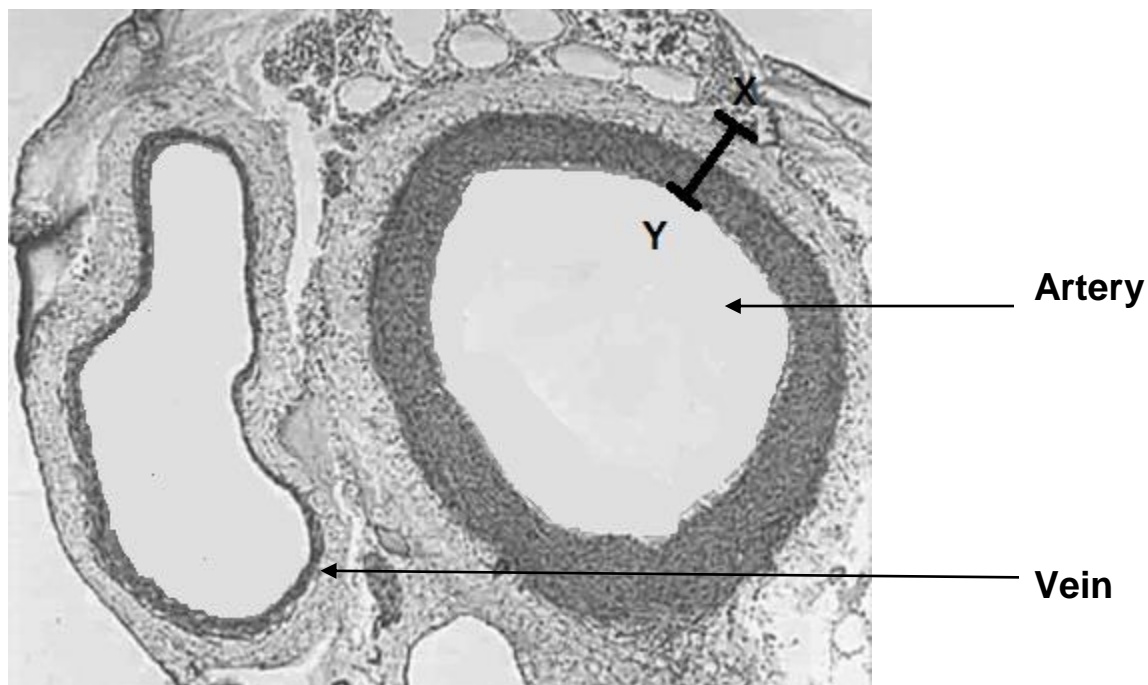
INFORMATION FOR CANDIDATES

This paper is in 2 sections, **A** and **B**.
Section A: 45 marks. Answer **all** questions. You are advised to spend about 50 minutes on this section.
Section B: 15 marks. Read the article in the resource booklet carefully then answer **all** questions. You are advised to spend about 20 minutes 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 **4(b)**.

SECTION A

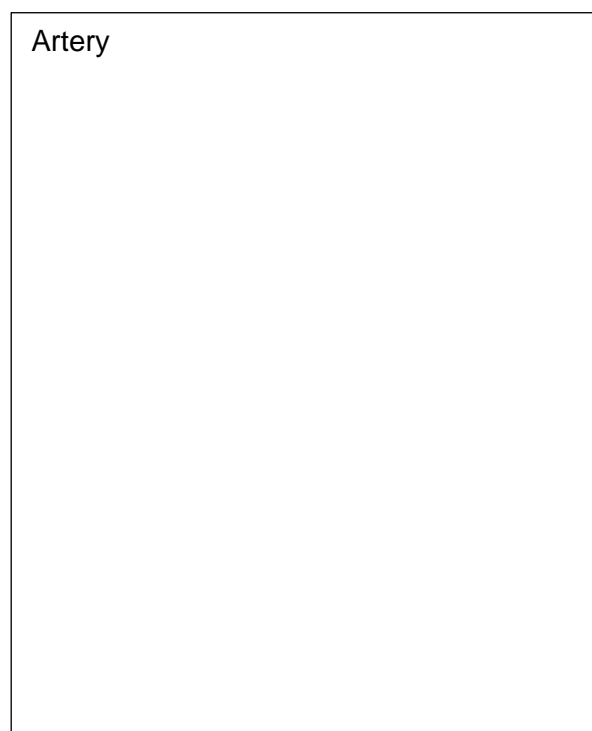
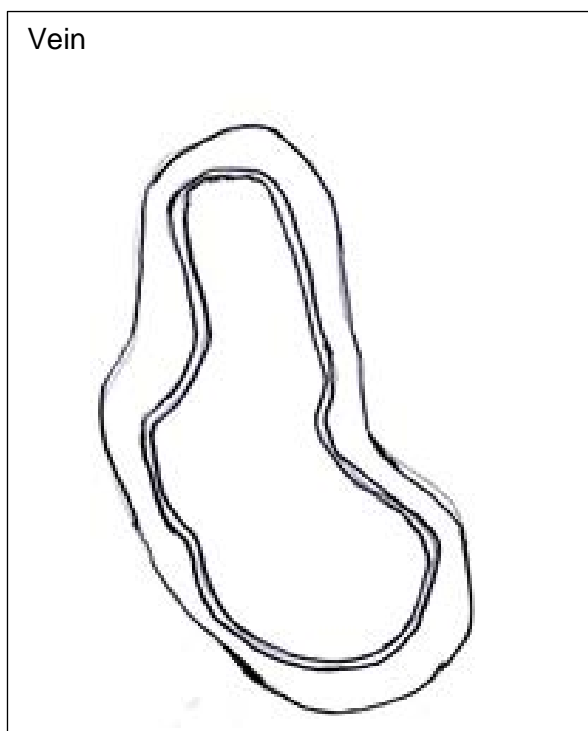
Answer **all** questions.

1. The photograph below shows a cross-section through an artery and a vein as seen under a light microscope.



Magnification X 50

- (a) (i) In the space below, make a drawing of the **artery**. The vein has been done for you. [2]



(ii) On your drawing, label: [2]

I the lumen;

II the muscle layer.

(iii) Calculate the actual thickness of the artery wall from **X** to **Y**, showing your working. [2]

artery wall = mm

(b) From the photograph, state **two** ways in which the structure of the artery is different from that of the vein. [2]

.....

.....

.....

.....

2. Robert investigated reaction times in humans. He wanted to compare the reaction times of people of different ages. Three people aged 20, 40 and 60 looked at a coloured shape on a computer screen. When it changed colour they tapped a key on the keyboard as quickly as possible. The computer logged the reaction time in milliseconds (ms) i.e. the time between the change of colour and the tap on the keyboard. Each person took the test six times (Trials 1 – 6) and they all used the same computer.



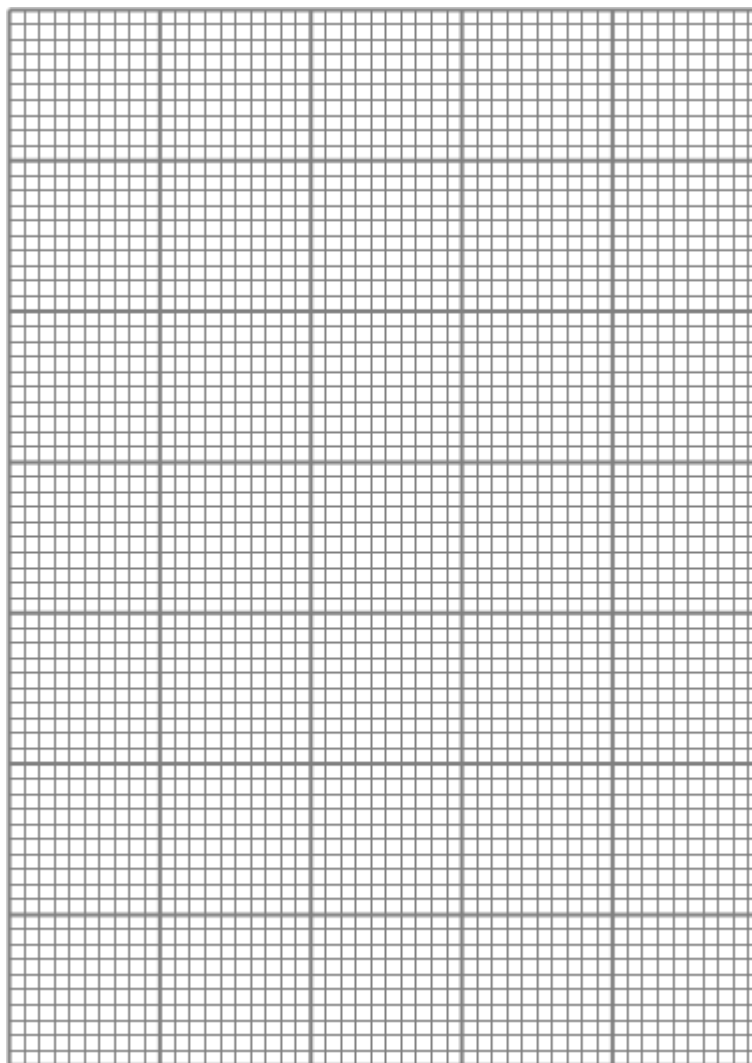
(a) The results of the investigation are shown in the table below.

Person	Age	Gender	Reaction times (ms)						Mean reaction time
			Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	
1	20	male	276	261	255	250	245	242	254.8
2	40	female	303	272	270	264	256	253
3	60	male	316	284	276	270	268	265	319.8

- (i) Calculate the mean reaction time for person 2. Show your working. [2]

reaction time = ms

- (ii) On the grid below, plot a bar chart to show the mean reaction time for each person by choosing a suitable scale for the mean reaction time, plotting the mean reaction times and labelling your bars clearly. [3]



- (b) (i) From **these results** which person reacted most quickly? What evidence in the bar chart supports your choice? [2]

.....

.....

.....

- (ii) What do these results indicate about the effect of age on reaction time? [1]

.....

- (iii) Based on these results, suggest what might have happened to the reaction times if more than six trials had been completed. [1]

.....

(c) Robert's teacher told him that although his investigation had been accurate and precise, he could not have much confidence in the results.

(i) In what ways was Robert's investigation accurate and precise? [2]

.....
.....

(ii) State how Robert could improve confidence in his results by:

I ensuring that his results were repeatable; [1]

.....

II ensuring that his results were reproducible. [1]

.....

(iii) Suggest **one other** way in which Robert's investigation could be improved. [1]

.....
.....

3. The following information relates to an investigation into osmosis.



Raw potato chips

Materials and apparatus

- Peeled potatoes
- 5 large test tubes
- 5 sugar solutions – % concentrations
1.0, 2.5, 5.0, 7.5 and 10.0.
- Ruler
- Sharp knife
- White tile
- Balance
- Measuring cylinder

Outline method

- Find the mass of potato chips
- Place potato chips in sugar solutions for a short time.
- Find the mass of potato chips again
- Calculate the percentage change in mass from the start of the investigation.

(a) Using the information above, describe how you could set up a series of test tubes to investigate how the mass of potato chips would change when they are placed in sugar solutions of different concentrations. The investigation must be as accurate and fair as possible.

(i) State how you would prepare the potato chips. [2]

.....

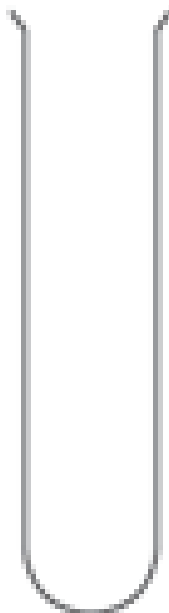
.....

.....

(ii) What essential step must be taken before weighing each chip? [1]

.....

- (iii) I **Complete the diagram**, to show how you would set up **one** of your test tubes. Label your diagram. [2]



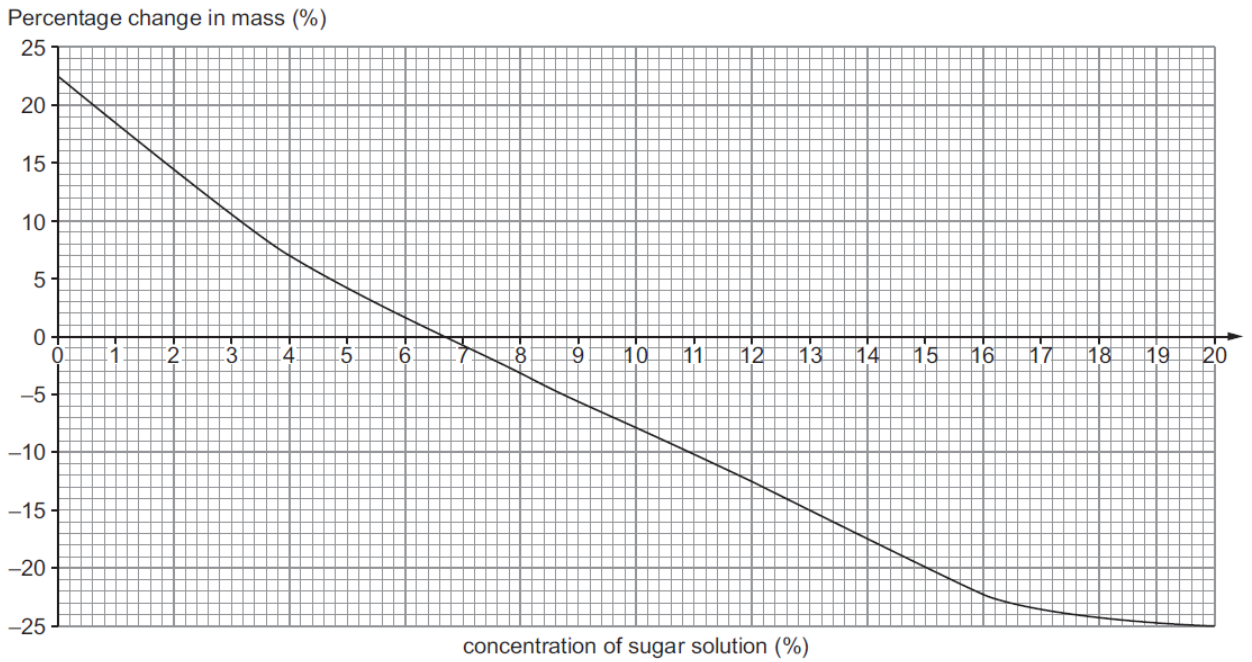
- II How would the contents of this tube differ from your other tubes? [1]

.....

- (iv) Identify **one** feature of the investigation which you judge to be a safety hazard. **Complete the risk assessment table** to show how you would deal with this problem. [1]

Hazard	Risk	Control measure

(b) The graph below shows the results of a similar investigation.



From this graph, give the concentration of sugar solution which would be the same as that of the potato cells and explain your answer with reference to osmosis. [2]

.....

.....

.....

.....

9

4. Scientists investigated the effects of certain factors on the decomposition of dead leaves. They collected dead leaves from one sycamore tree and carefully cut them into 20mm squares.
- They then placed the squares into mesh bags of two different mesh sizes. The bags were then buried in soil in large containers. One container was incubated at 15 °C and the other at 30 °C. The soil was obtained from the same field.
- After six weeks, the mesh bags were removed from the soil. Some of the leaf material had decomposed. The scientists then observed the area of each leaf square which remained. They did this by placing the squares on pieces of graph paper.

- (a) (i) State **three** features of the scientists' method which contributed to making the investigation fair and valid. [3]

.....

.....

.....

- (ii) How did the scientists ensure that their observations were accurate? Explain your answer. [2]

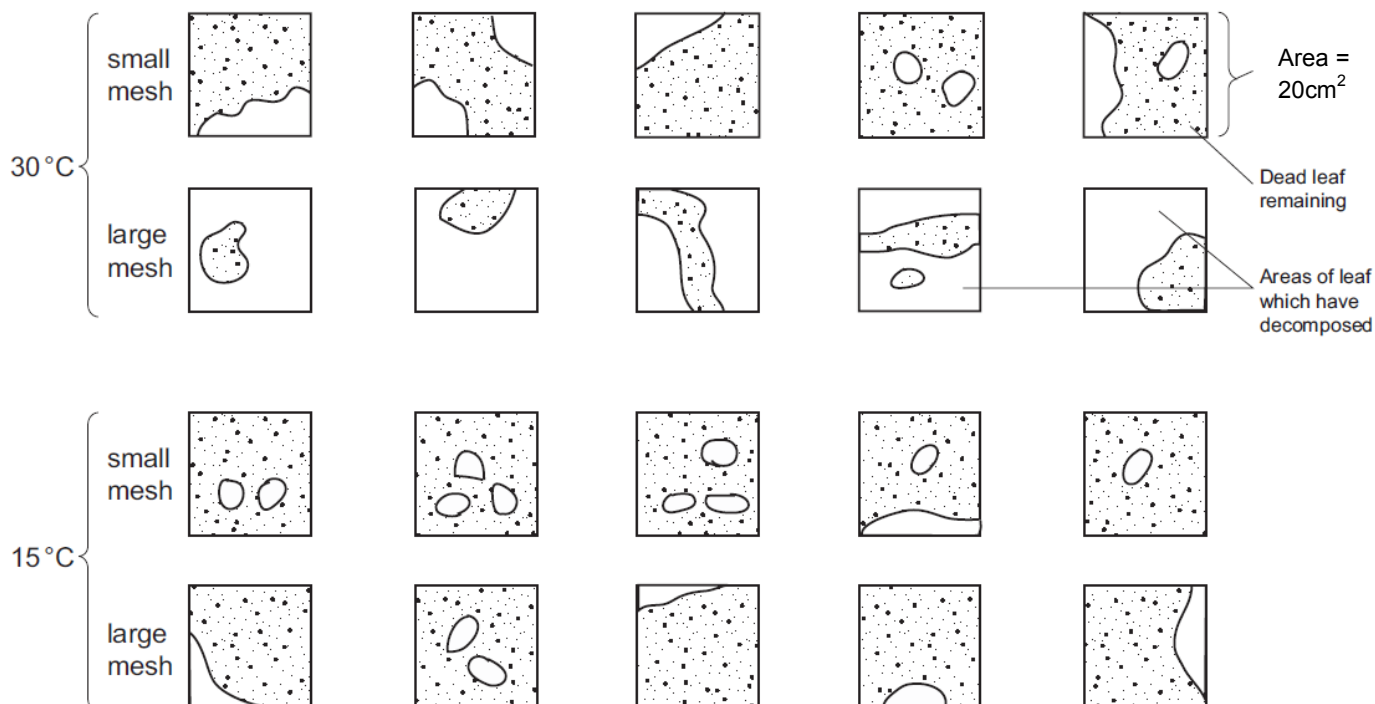
.....

.....

.....

.....

- (b) The diagrams below show samples of the leaf squares at the end of the investigation.



SECTION B

Answer **all** questions

Read the article in the resource booklet carefully and answer **all** the questions that follow.

5. (a) (i) Calculate the number of alien species that are in Britain today. Show your working. [2]

number of species =

- (ii) Suggest why the answer in (i) is only an estimated value. [1]

.....
.....

- (b) Using the information in **Figure 1** describe how the distribution of invasive marine species changed between 1960 and 2008. [4]

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

- (c) Research suggests that black swan numbers have increased at such a rate that they may now be added to the "British List" of birds found in the UK.

- (i) Suggest a method by which black swans were introduced into England. [1]

.....

- (ii) Describe the method of collecting data to estimate the number of black swans in a habitat. [2]

.....
.....

(d) State **two** adverse effects on the ecosystem in **Figure 2** caused by the black swan feeding on seagrass. [2]

1.

2.

(e) Adult and cygnet black swans are introduced into the food web shown in **Figure 3**. Explain how this will affect the pike population. [3]

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



GCSE BIOLOGY

COMPONENT 2
Applications in Biology

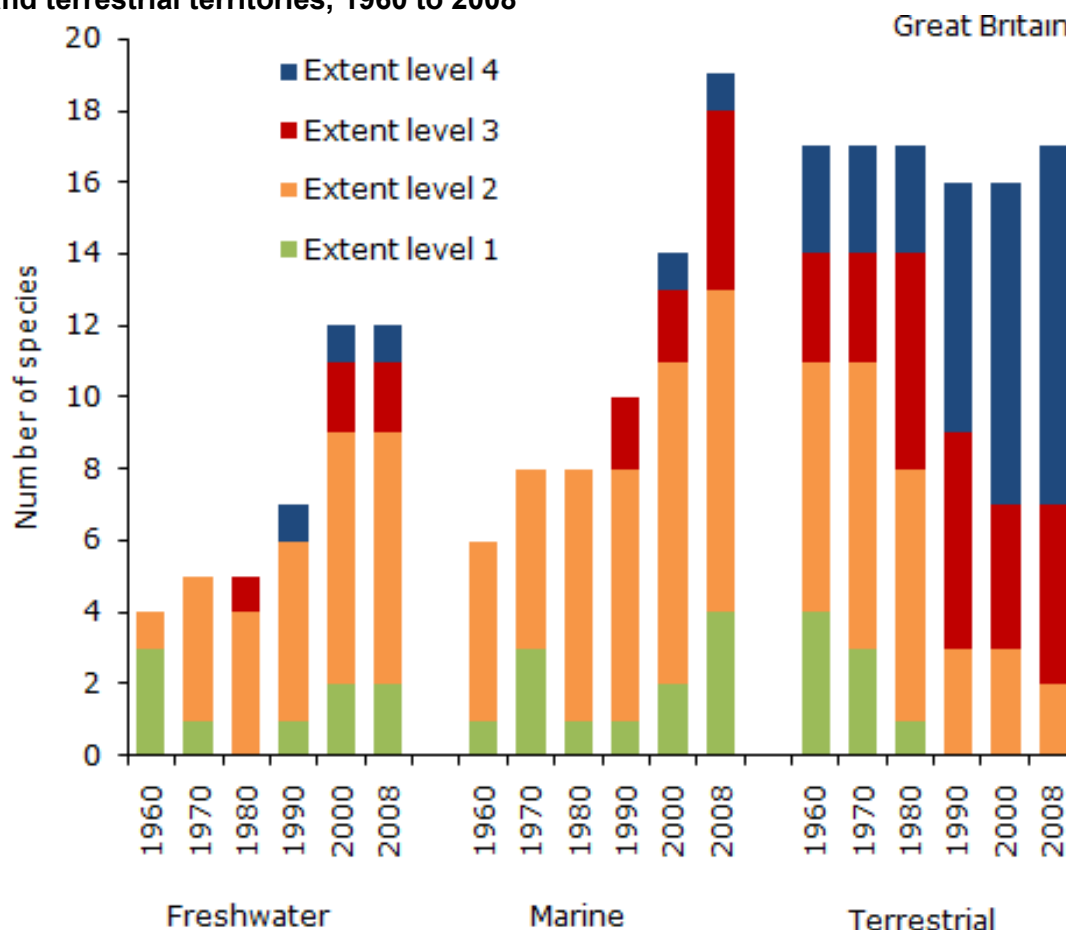
FOUNDATION TIER

RESOURCE BOOKLET
for use in Section B

ALIENS HAVE LANDED

Every year new 'alien invaders' are being found in Britain. These invasive species have been introduced either deliberately or by accident into habitats where they do not usually live. In the 1990s, conservationists estimated that 600 alien species were breeding in Britain. Since then, the number has increased by 80%.

Figure 1 Changes in the extent of invasive non-native species in marine, freshwater and terrestrial territories, 1960 to 2008



KEY: Extent levels are defined as follows:

Extent level 1	Present in territory and have not spread more than 10 km from their source
Extent level 2	Established populations represent less than 10% of territory
Extent level 3	Established populations represent 10 to 50% of the territory
Extent level 4	Established in more than 50% of the territory

Black swans are an example of an invasive species. They originate in Australia. They were first introduced to England in 1791. Now the species has a wide geographical spread throughout the British Isles. Black swans are regarded as pests by farmers, because of their grazing and fouling grass and eating crops. The species is also known to be aggressive and can out-compete native species of wildfowl. Adult black swans mainly feed on aquatic plants. Their cygnets (young swans) will also eat small insects.

Figure 2 A black swan in its natural habitat in Australia

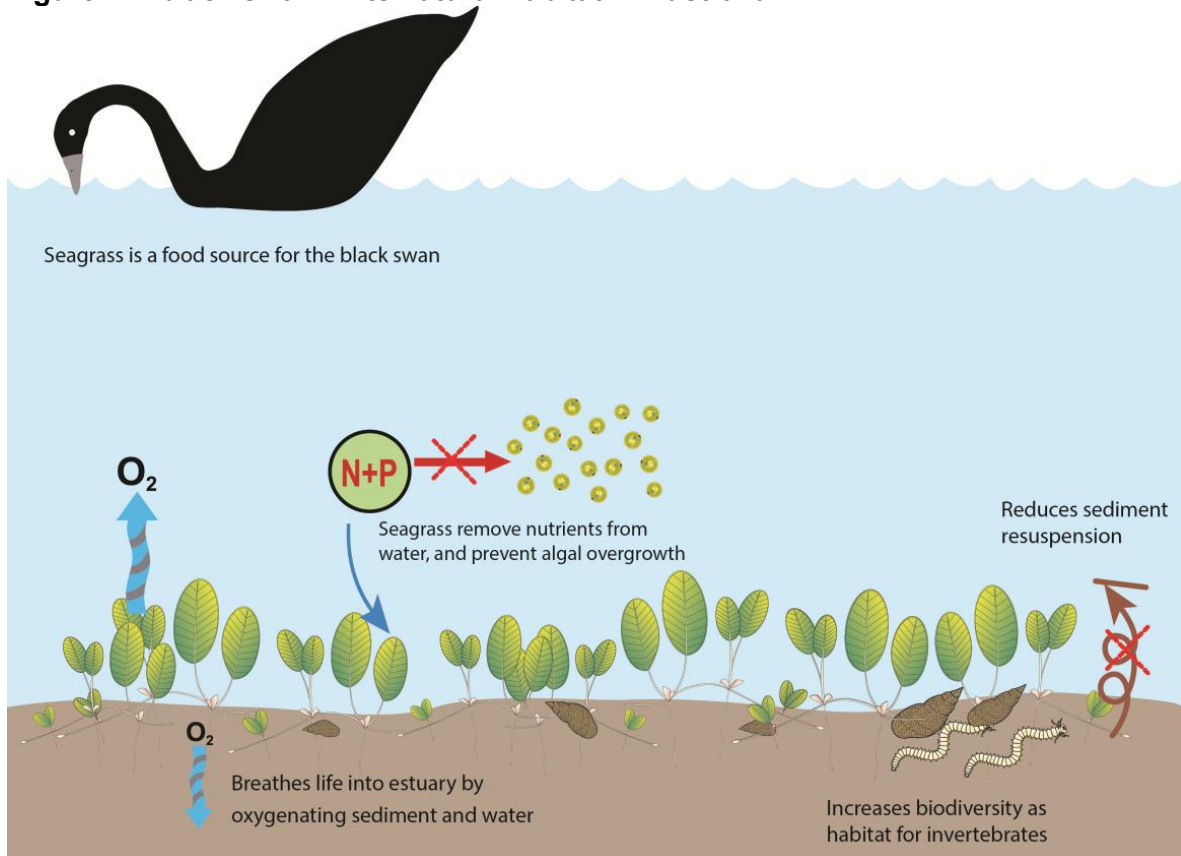
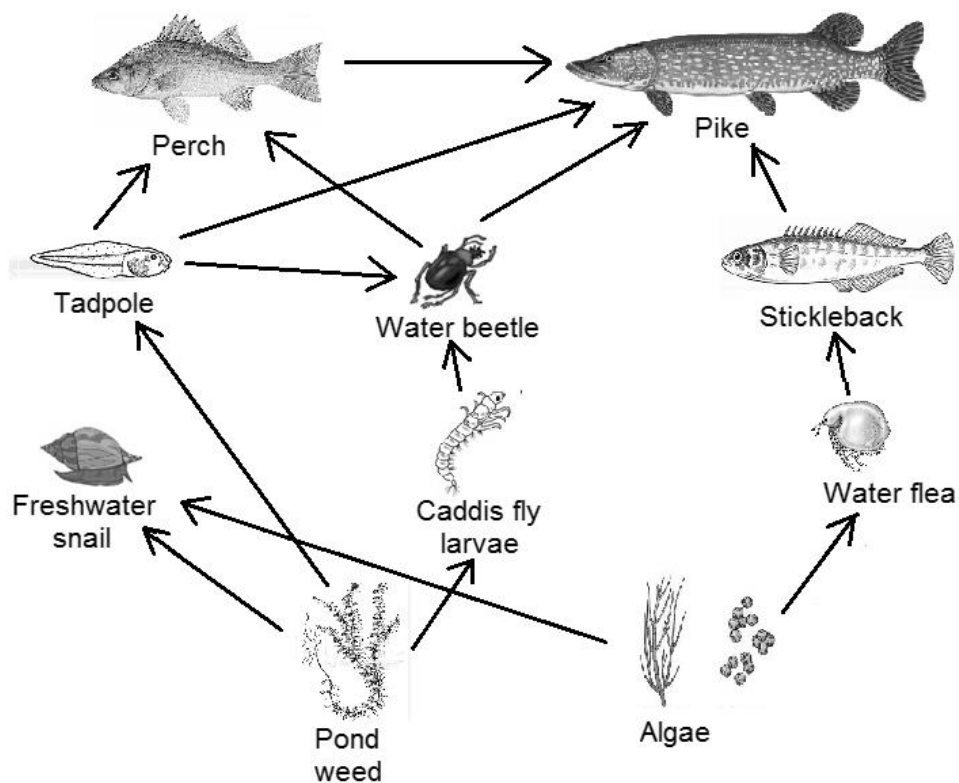


Figure 3 An aquatic food web in the UK



COMPONENT 2 - Applications in Biology

FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		Proportion of lumen (1) Line quality(1)	2			2		2
		(ii)		Correct lumen label (1) Correct muscle label (1)	2			2		2
		(iii)		$\frac{13}{50}$ (1) 0.26 mm (1)		2		2	2	2
	(b)			Thickness of muscular wall (1) Relative size / shape of lumen (1)	2			2		
				Question 1 total	6	2	0	8	2	6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		303+272+270+264+256+253(1) 1618/6 = 269.7 (1)		2		2	2	
		(ii)		0-350 Scale (1) Bar heights (1) Placement and labels (1)		3		3	3	
	(b)	(i)		Person 1 (1) Smaller value = quickest response(1)			2	2		2
		(ii)		Increase in age associated with increase in reaction time			1	1		
		(iii)		Decreased reaction time until minimum level reached			1	1		1
	(c)	(i)		Use of computer to log data /results –accuracy (1) Small unit of measurement (ms) precision (1)		2		2		2
		(ii)	I	same investigator and subjects - further repeats	1			1		1
			II	Different investigator(s) carry out same method	1			1		1
		(iii)		Much larger sample size/ equal number of males and females			1	1		1
				Question 2 total	2	7	5	14	5	8

Question			Marking details	Marks Available										
				AO1	AO2	AO3	Total	Maths	Prac					
3	(a)	(i)	Cut pieces with sharp knife measuring length/width /size with ruler (1) so all chips of uniform size (1)	1	1		2		2					
		(ii)	Dry chip	1			1		1					
	(iii)	I	One chip in test tube, below surface of solution (1) Labels – sugar solution of (any) concentration, chip (1)	2			2		2					
		II	Solutions of different sugar concentrations		1		1		1					
	(iv)	<p>All correct for 1 mark</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Hazard</th> <th style="width: 33%;">Risk</th> <th style="width: 33%;">Control measure</th> </tr> </thead> <tbody> <tr> <td>Sharp knife could cut you</td> <td>cutting skin when cutting potato</td> <td>cut away from body onto tile</td> </tr> </tbody> </table>		Hazard	Risk	Control measure	Sharp knife could cut you	cutting skin when cutting potato	cut away from body onto tile	1			1	
Hazard	Risk	Control measure												
Sharp knife could cut you	cutting skin when cutting potato	cut away from body onto tile												
(b)		6.7% (from graph) (1) No change in mass, no net movement of water by osmosis (1)		1		1	2	1						
Question 3 total				5	3	1	9	1	7					

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	leaves from same sycamore tree (1) soil taken from same field(1) left for same length of time / 6 weeks (1)	3			3		3
		(ii)	used graph paper to measure area of leaf remaining (1) results were numerical / quantitative (1)	2			2		2
	(b)		<p>Indicative Content: Higher temperature and larger mesh size results in a higher rate of decomposition as there is less leaf remaining after 6 weeks. At lower temperature mesh size does not seem to affect the rate of decomposition as about the same area of leaf remains after 6 weeks. Explains that decomposition is carried out by microorganisms, e.g. bacteria / fungi, and involves enzymes which are more active at a higher temperature. Large mesh size would allow larger decomposers / detritivores to enter the mesh bags which would speed up rate of decomposition. At lower temperatures these organisms would be less active.</p> <p>5-6 Marks Recognises that rate of decomposition is highest with high temperature and large mesh size but that at low temperature, mesh size has no affect – answers are related to area of leaf remaining after 6 weeks. Clear understanding of the role of microbes, giving examples of bacteria or fungi, in decay and that they use enzymes to digest leaf material. Links made to the effect of temperature on enzyme activity. Understands that larger organisms also place a part in decomposition and that larger mesh gives them access to leaf material but that low temperature will also reduce their level of activity. <i>There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.</i></p>		6		6		

			<p>3-4 Marks Understands the combined effects of mesh size and temperature and relates their conclusion to leaf area remaining after 6 weeks. Recognises the role of microbes in decay and attempts to link effect of temperature on enzymes to rate of decomposition. Identifies that larger organisms are also involved in decomposition and that larger mesh size allows access to the leaf material but is unclear regarding how low temperature affects them. <i>There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i></p> <p>1-2 Marks Can conclude the relationship between temperature and mesh size at the higher temperature investigated and recognises the role of microbes in decay but does not make a clear link to the effect of temperature on enzymes. A basic understanding of larger mesh size allowing greater access to the leaf material for larger organisms but is unable to explain results at lower temperatures. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i></p>						
	(c)		No leaf decay (1) at either temperature or mesh size (1) microbes / decomposers in soil killed / dead (1)			3	3		
			Question 4 total	5	6	3	14	0	5

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	$\frac{80}{100} \times 600 = 480$ (1) $480 + 600 = 1\ 080$ (1)		2		2	2	
		(ii)	Aliens are continually invading/ more arriving each year/ original was only an estimate	1			1		1
	(b)		Any 4 (x1) from: <ul style="list-style-type: none"> Over the time period the number of invasive marine species increased from 6 to 19. There is an upward trend in the number of species within 10 km of their source. There is an upward trend in the number of species within 10% of the territory. Until 1990 there were no species occupying more than 10% of the territory/between 1990 and 2008 the number of species occupying between 10-50% of territory has increased. In 2000 one species established itself in over 50% of territory. 		4		4	4	
	(c)	(i)	Deliberately transported by boat	1			1		
		(ii)	A number of black swans are captured marked and released back into the wild (1) Later another sample captured and population is estimated using two sets of data (1)	2			2		2
	(d)		Decreases biodiversity Overgrowth of algae	2			2		
	(e)		Pike population will decline due to more competition for/less food. (1) Cygnetts compete for insect species/beetles so less food for pike (1) Adult swans compete for plants and algae so less food for snail / caddis fly / fleas / tadpole (1)			3	3		
			Question 5 total	6	6	3	15	6	3

COMPONENT 2 - Applications in Biology

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

	Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	1	6	2	0	8	2	6
	2	2	7	5	14	5	8
	3	5	3	1	9	1	7
	4	5	6	3	14	0	5
Section B	5	6	6	3	15	6	3
	TOTAL	24	24	12	60	14	29

Candidate Name	Centre Number				Candidate Number			



GCSE BIOLOGY
COMPONENT 2
Applications in Biology
HIGHER TIER
SAMPLE PAPER

(1 hour 15 minutes)



	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
Section A	1	15	
Section B	2	10	
	3	11	
	4	8	
	5	10	
	6	6	
	Total	60	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a resource booklet, a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
 Write your name, centre number and candidate number in the spaces at the top of this page.
 Answer **all** questions.
 Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

This paper is in 2 sections, **A** and **B**.
 Section **A**: 15 marks. Read the article in the resource folder carefully then answer **all** questions. You are advised to spend about 20 minutes on this section.
 Section **B**: 45 marks. Answer **all** questions. You are advised to spend about 50 minutes 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**.

SECTION A

Answer **all** questions

Read the article in the resource booklet carefully and answer **all** the questions that follow.

1. (a) (i) Calculate the number of alien species that are in Britain today. Show your working. [2]

number of species =

- (ii) Suggest why the answer in (i) is only an estimated value. [1]

.....
.....

- (b) Using the information in **Figure 1** describe how the distribution of invasive marine species changed between 1960 and 2008. [4]

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

- (c) Research suggests that black swan numbers have increased at such a rate that they may now be added to the "British List" of birds found in the UK.

- (i) Suggest a method by which black swans were introduced into England. [1]

.....

- (ii) Describe the method of collecting data to estimate the number of black swans in a habitat. [2]

.....
.....

(d) State **two** adverse effects on the ecosystem in **Figure 2** caused by the black swan feeding on seagrass. [2]

1.

2.

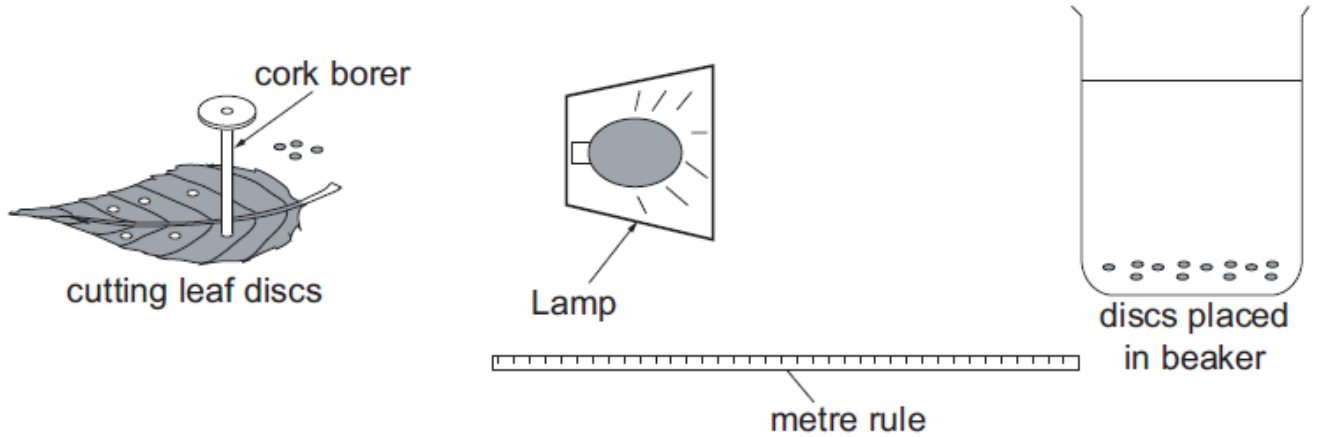
(e) Adult and cygnet black swans are introduced into the food web shown in **Figure 3**. Explain how this will affect the pike population. [3]

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

SECTION B

Answer **all** questions.

2. Students investigating the effect of a limiting factor on the rate of photosynthesis cut discs from a leaf using a cork borer as shown below.



- The air was removed from the leaf discs using a syringe.
- The discs were then placed in beakers of sodium hydrogen carbonate solution where they sank to the bottom of the beakers.
- The beakers were placed at different distances from a lamp.
- The time taken for the discs to rise to the surface of the solutions was recorded in the table below.

Results

Distance from lamp (cm)	5	25	50	75	100
Mean time taken for all discs to rise (minutes)	5	20	27	55	97

- (a) Name the limiting factor being investigated. [1]

.....

- (b) (i) What trend is shown by the results? [1]

.....

(ii) What conclusions could be reached from the trend shown? Explain your answer. [4]

.....

.....

.....

.....

.....

(c) State why sodium hydrogen carbonate was used in this investigation. [2]

.....

.....

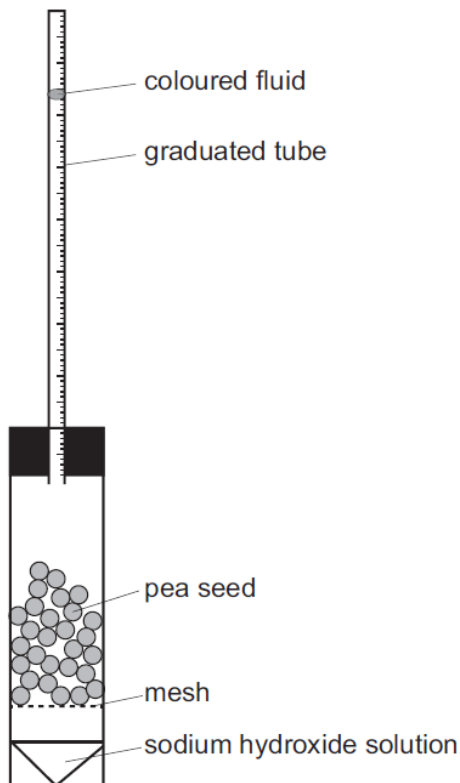
(d) Identify the variable which should have been controlled in the experiment, which could have affected the discs in the beaker nearest to the lamp. Suggest how this variable could be controlled. [2]

.....

.....

3. One way of calculating the rate of respiration of germinating pea seeds is to measure the volume of oxygen taken up over a period of time.

A student investigated the effect of temperature on the rate of respiration in germinating pea seeds by using the apparatus shown below.



If the apparatus is kept at a constant temperature, any changes in the volume of air in the graduated tube will be due to oxygen uptake.

- (a) What is the purpose of the sodium hydroxide? [2]

.....

- (b) The student set up 4 pieces of apparatus as illustrated, **A**, **B**, **C** and **D**. **A** and **B** were kept at 15 °C, **C** and **D** were kept at 25 °C. The contents of each apparatus are shown in the table:

Temperature (°C)	Apparatus	Contents
15	A	30 germinating pea seeds
	B	28 glass beads
25	C	30 germinating pea seeds
	D	28 glass beads

- (i) What was the purpose of apparatus **B** and **D**? [1]

.....

- (ii) State what the student would have had to measure to determine the number of glass beads to use in apparatus **B** and **D**. [1]

.....

.....

- (c) The apparatus **A**, **B**, **C** and **D** were kept at their appropriate temperatures for 20 minutes in water baths. During this time the level of coloured fluid changed in some of the graduated tubes. The level of the coloured fluid in each piece of apparatus was recorded at the start of the investigation and after 20 minutes.

The results are shown in the table:

Temperature (°C)	Apparatus	Reading at start (cm ³)	Reading after 20 min (cm ³)	Difference (cm ³)	Rate of oxygen uptake (cm ³ /min)
15	A	0.93	0.74	0.19	0.009
	B	0.91	0.91	0	0
25	C	0.94	0.63	0.31	
	D	0.95	0.95	0	0

- (i) Calculate the rate of oxygen uptake for the germinating pea seeds in Apparatus **C** at 25 °C. Give your answer to a suitable number of significant figures. [2]

rate of oxygen uptake cm³/min

- (ii) Explain why there is an increase in the rate of respiration in germinating pea seeds at 25 °C compared with those at 15 °C. [2]

.....

.....

.....

.....

(d) Describe how the carbohydrate stores in the pea seeds are made available for use in respiration. [3]

.....

.....

.....

.....

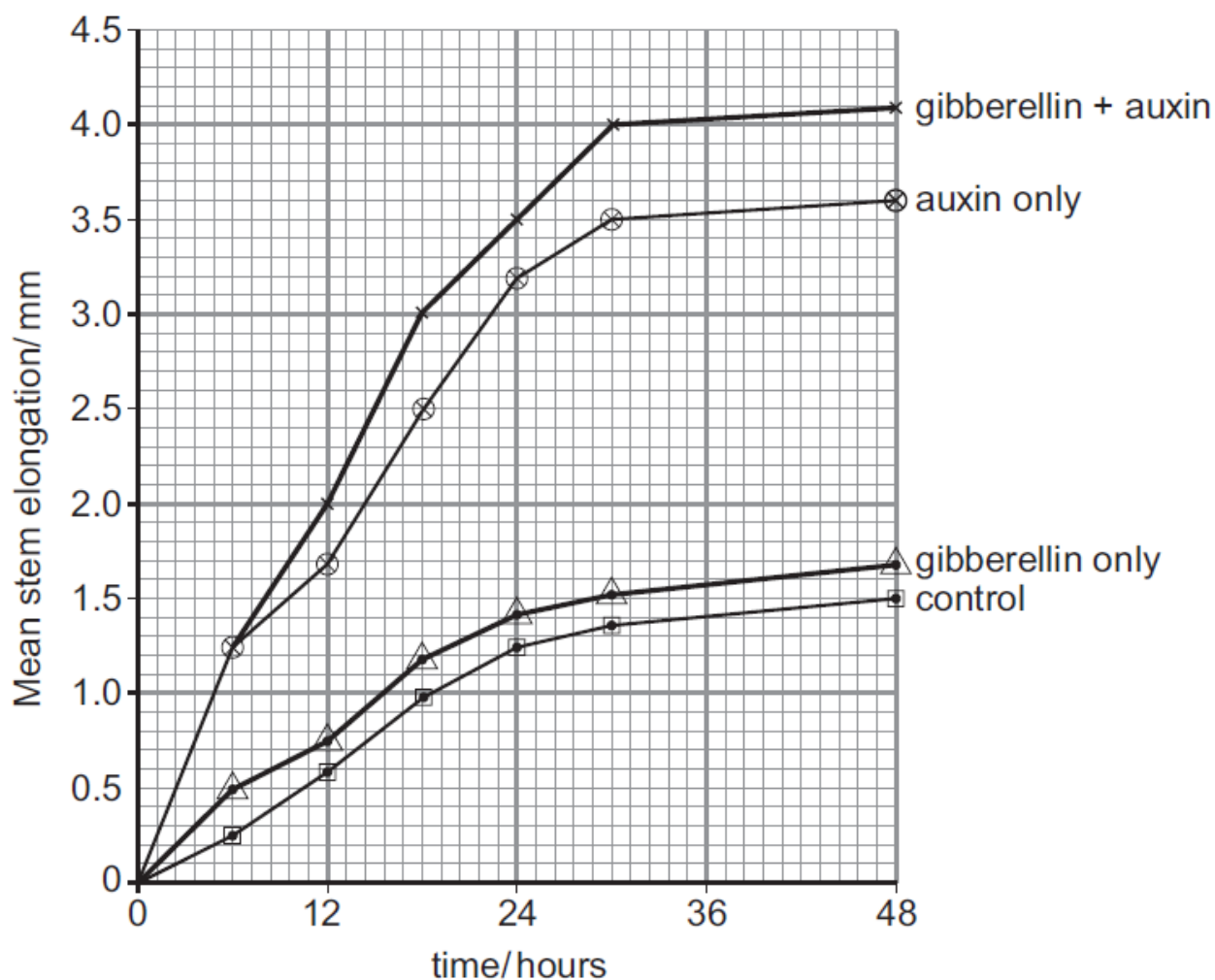
11

4. Four pea seedlings, **A**, **B**, **C** and **D**, were used in an investigation into the effects of the plant hormones, auxin and gibberellin on the growth of stems. All the seedlings were of the same age.

- A** had gibberellin + auxin
- B** had auxin only
- C** had gibberellin only
- D** was the control without hormones.

After the application of the hormones to the stem, the seedlings were left for 48 hours.

The results are shown in the graphs below.



(a) What observations can you make from the graphs? [4]

.....

.....

.....

.....

(b) Describe **four** different ways that people use plant hormones to control plant growth. [4]

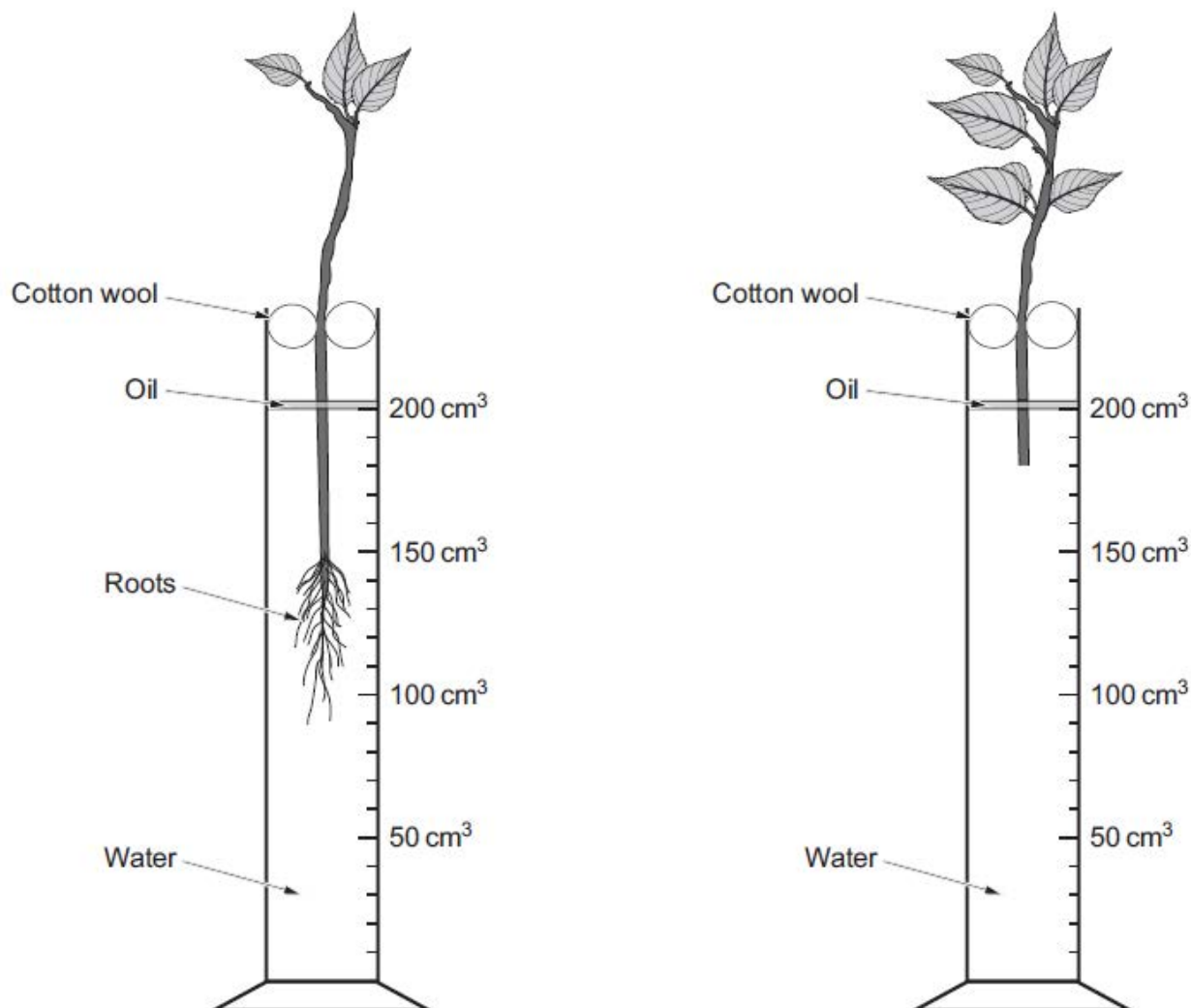
.....

.....

.....

.....

5. An experiment was carried out to compare the uptake of water in plants with and without roots. The experiment was set up as shown in the diagram below.



The volume of water in each measuring cylinder was recorded at the start of the experiment and, again, after 24 hours. The results are shown below.

Measurement	Plant with roots	Plant without roots
Total water uptake after 24 hours (cm ³)	6	6
Total surface area of leaves (cm ²)	60	100

- (a) Using the results of this experiment draw a conclusion about the effect of roots on the rate of water uptake per cm² of leaf. [4]

.....

.....

.....

.....

.....

.....

- (b) Explain how the use of oil, as shown in the diagram, helped to make the experiment a fair comparison. [2]

.....

.....

- (c) It was concluded that the experimental method used did not produce valid results. Identify problems with this method and explain how the method could be improved to increase confidence in your conclusion. [4]

.....

.....

.....

.....

.....

.....



GCSE BIOLOGY

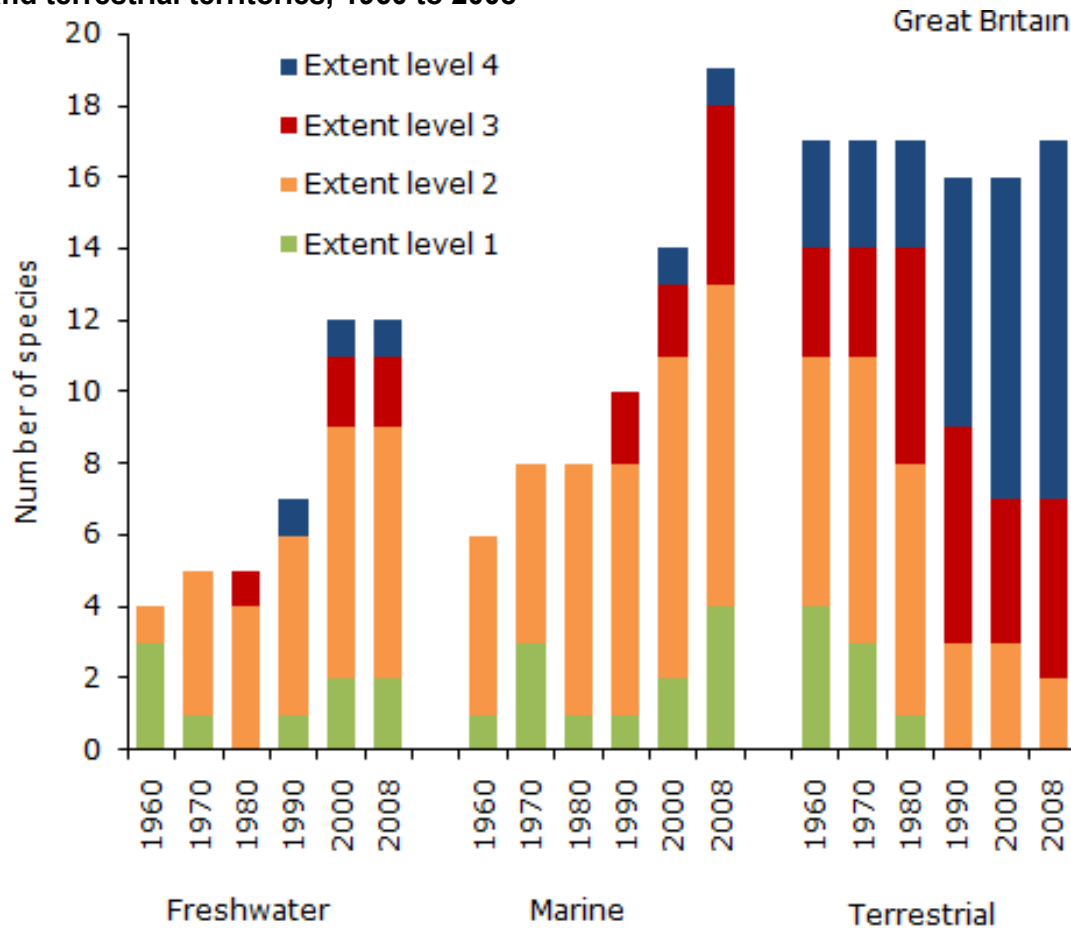
COMPONENT 2
Applications of Biology
HIGHER TIER

RESOURCE BOOKLET
for use in Section A

ALIENS HAVE LANDED

Every year new 'alien invaders' are being found in Britain. These invasive species have been introduced either deliberately or by accident into habitats where they do not usually live. In the 1990s, conservationists estimated that 600 alien species were breeding in Britain. Since then, the number has increased by 80%.

Figure 1 Changes in the extent of invasive non-native species in marine, freshwater and terrestrial territories, 1960 to 2008



KEY: Extent levels are defined as follows:

- | | |
|----------------|--|
| Extent level 1 | Present in territory and have not spread more than 10 km from their source |
| Extent level 2 | Established populations represent less than 10% of territory |
| Extent level 3 | Established populations represent 10 to 50% of the territory |
| Extent level 4 | Established in more than 50% of the territory |

Black swans are an example of an invasive species. They originate in Australia. They were first introduced to England in 1791. Now the species has a wide geographical spread throughout the British Isles. Black swans are regarded as pests by farmers, because of their grazing and fouling grass and eating crops. The species is also known to be aggressive and can out-compete native species of wildfowl. Adult black swans mainly feed on aquatic plants. Their cygnets (young swans) will also eat small insects.

Figure 2 A black swan in its natural habitat in Australia

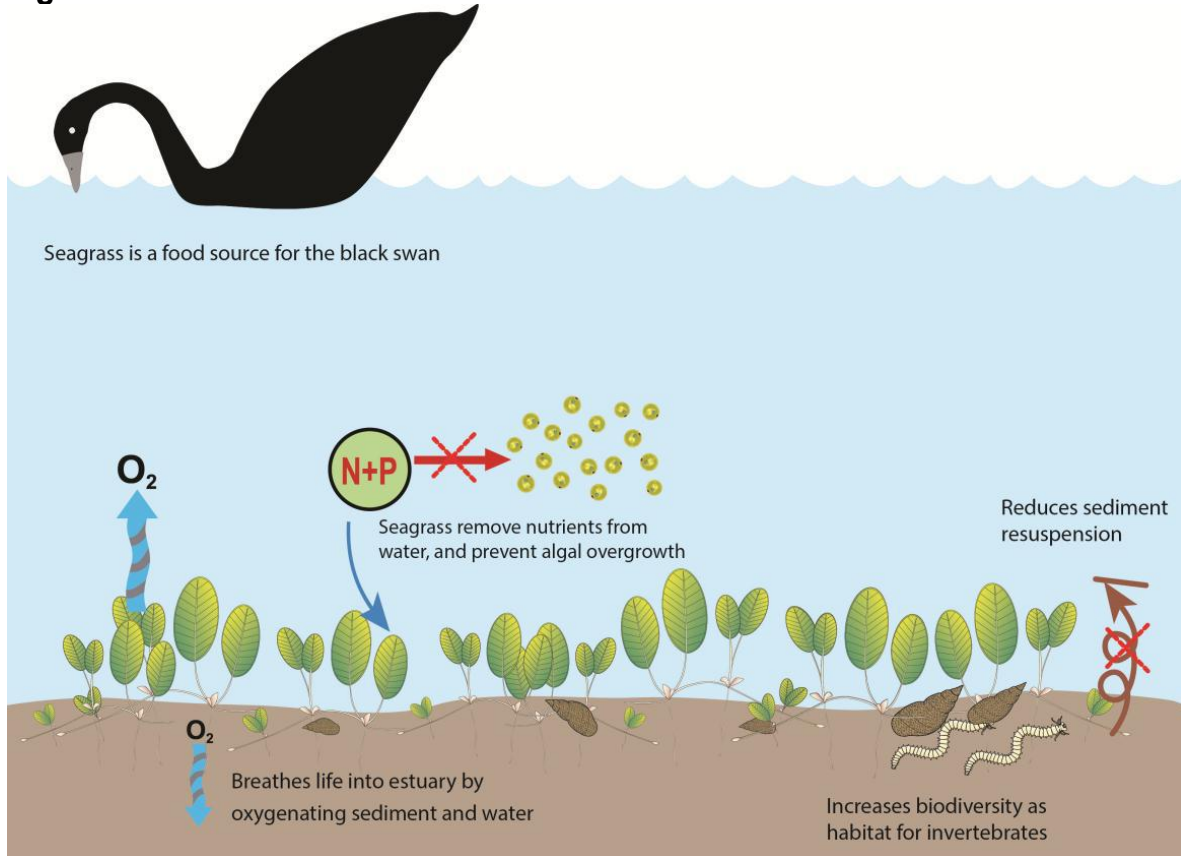
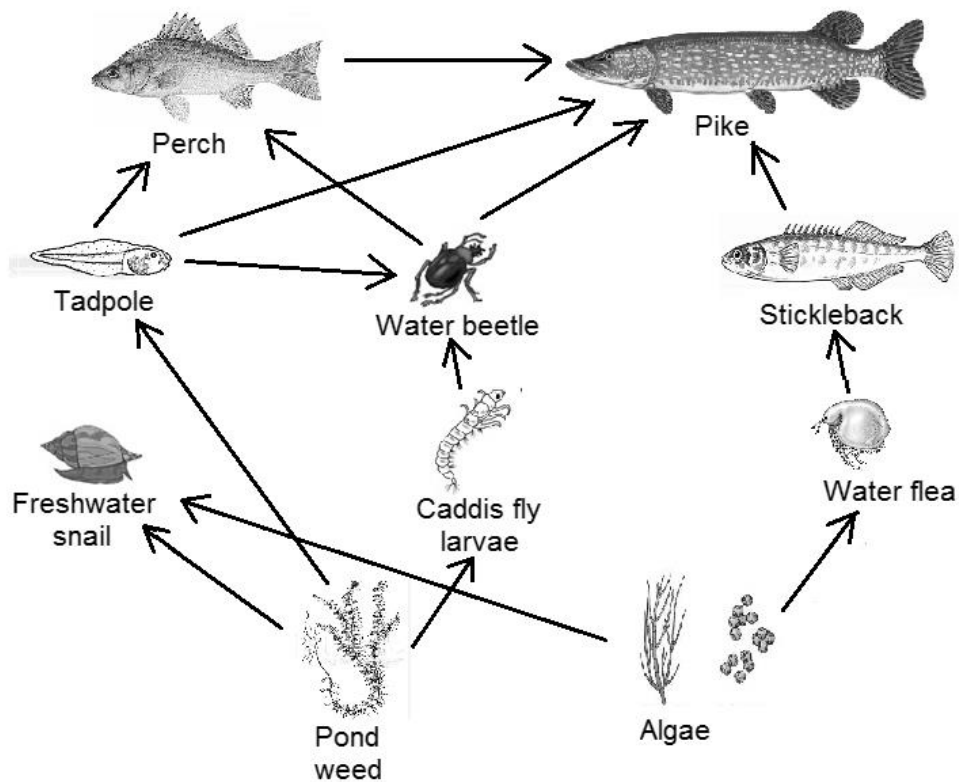


Figure 3 An aquatic food web in the UK



COMPONENT 2 - Applications of Biology

HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement. Award the middle mark in the level if most of the content statements are given and the communication statement is partially met. Award the lower mark if only the content statements are matched.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)	$\frac{80}{100} \times 600 = 480$ (1) $480 + 600 = 1\ 080$ (1)		2		2	2	
		(ii)	Aliens are continually invading/ more arriving each year/ original was only an estimate	1		1	1		1
	(b)		<p>Any 4 (x1) from:</p> <ul style="list-style-type: none"> Over the time period the number of invasive marine species increased from 6 to 19. There is an upward trend in the number of species within 10 km of their source. There is an upward trend in the number of species within 10% of the territory. Until 1990 there were no species occupying more than 10% of the territory/between 1990 and 2008 the number of species occupying between 10-50% of territory has increased. In 2000 one species established itself in over 50% of territory. 		4		4	4	
	(c)	(i)	Deliberately transported by boat	1			1		
		(ii)	A number of black swans are captured marked and released back into the wild (1) Later another sample captured and population is estimated using two sets of data (1)	2			2		2
	(d)		Decreases biodiversity (1) Overgrowth of algae (1)	2			2		
	(e)		Pike population will decline due to more competition for/less food. (1) Cygnetts compete for insect species/beetles so less food for pike (1) Adult swans compete for plants and algae so less food for snail / caddis fly / fleas / tadpole (1)			3	3		
			Question 1 total	6	6	3	15	6	3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Light	1			1		1
	(b)	(i)		As distance from lamp increases time taken for disc to float increases		1		1		1
		(ii)		Further away light intensity decreases (1) (Less light) for photosynthesis (1) so less oxygen produced (1) longer time taken for discs to float (1)		1 1 1	1	4		4
	(c)			To provide carbon dioxide (1) Which is required for photosynthesis to occur (1)	2			2		2
	(d)			Temperature (1) Heat filter/ beaker of water (1)	1		1	2		2
				Question 2 total	4	4	2	10	0	10

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		to absorb carbon dioxide (1) so that any changes in volume can only be due to decrease in oxygen(1)	2			2		2
	(b)	(i)	to act as a control/to see if the peas were responsible for oxygen uptake	1			1		1
		(ii)	total volume of peas		1		1		1
	(c)	(i)	$\frac{(0.94 - 0.63)}{20}$ (1) 0.016 (1)		2		2	2	
		(ii)	increase in temp increases diffusion of oxygen into seeds (1) increase activity of enzymes (1)		2		2		2
	(d)		starch (1) digested/broken down to glucose (1) by enzymes (1)	3			3		
			Question 3 total	6	5	0	11	2	6

Question				Marking details	Marks available						
					AO1	AO2	AO3	Total	Maths	Prac	
4	(a)			Both hormones cause greater {growth/elongation} than the control (1) Gibberellin causes the least increase in elongation (1) IAA causes double or a much greater increase than GA (1) Greatest growth is caused by the combined effect of GA and IAA. (1)		4		4			4
	(b)			Promote root growth in stem cuttings (1) Breaks dormancy in seeds or buds/bulbs (1) Controls fruit ripening/growth (1) Promotes cell division in tissue cultures (1)	4			4			
				Question 4 total	4	4	0	8	0		4

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		Rate of uptake plant with roots = $6/60 = 0.1 \text{ cm}^3 \text{ cm}^{-2}$ (1)		1		4	2	4
			Plant without roots = $6/100 = 0.06 \text{ cm}^3 \text{ cm}^{-2}$ (1)		1				
			Presence of roots increases rate of uptake (1)			1			
			Even though less leaf area in plant with roots (1)			1			
	(b)		oil prevents evaporation from water surface (1)	2			2		2
			so only route for water loss is through leaves (1)						
	(c)		not repeated + repeat to increase reliability in the results (1)			4	4		4
			Different leaf surface area + therefore different rates of transpiration and photosynthesis (1)						
			use same plants with roots and then remove roots / use plants with same / similar leaf area (1)						
			{Temperature / wind speed / air humidity / light intensity } not controlled + keep under same environmental conditions to prevent different transpiration / photosynthesis rates (1)						
			Question 5 total	2	2	6	10	2	10

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6			<p>Indicative content: Add biuret reagent to urine sample to check for protein – colour change from pale blue to purple without heating. Add Benedict's solution to urine sample and heat strongly to check for glucose – colour change from blue to brick red if high concentration of glucose, green if low concentration.</p> <p>Expect: Healthy urine to have no colour change with either test. Kidney disease to show positive result with biuret Diabetes to have a positive result with both tests</p> <p>Healthy person would not excrete proteins as they would be too large to pass through glomerular membrane and all glucose would be reabsorbed by proximal convoluted tubule so no glucose. Kidney disease would excrete protein as damage to glomerular membrane would allow large molecules to pass through; glucose should still be reabsorbed by pct. In uncontrolled diabetes both protein and glucose would be present in urine due to damage to glomerular membranes and lack of reabsorption by pct.</p>	2		1	6		3

			<p>5 – 6 marks: Correct details of both biuret and Benedict's tests are given including colour changes expected if protein / glucose present in urine samples. Explains why healthy person would have no colour change and relates this to intact and fully functioning glomeruli and pct's. Explains why large molecules / proteins will be found in urine of kidney disease patients and why both protein and glucose would be present in urine of a diabetic. <i>There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.</i></p> <p>3 – 4 marks: Correctly describes both biuret and Benedict's tests including colour changes. Correctly describes the expected results for each urine sample and provides some explanation of why protein / glucose could appear in urine. <i>There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i></p> <p>1 – 2 marks: Describes how to carry out biuret and Benedict's tests with some omissions, e.g. colour changes or need to heat / not to heat. Attempts to relate expected results to effects of complaints on kidney function. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i></p> <p>0 marks: No attempt made or no response worthy of credit.</p>						
			Question 6 total	2	3	1	6	0	3

COMPONENT 2 - Applications of Biology**HIGHER TIER****SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

	Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	1	6	6	3	15	6	3
Section B	2	4	4	2	10	0	10
	3	6	5	0	11	2	6
	4	4	4	0	8	0	4
	5	2	2	6	10	2	10
	6	2	3	1	6	0	3
	TOTAL	24	24	12	60	10	36