

FOR OFFICIAL USE

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Total for
Sections
B and C

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X007/301

NATIONAL
QUALIFICATIONS
2006

TUESDAY, 23 MAY
1.00 PM – 3.30 PM

BIOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

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Town

--

Forename(s)

--

Surname

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Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

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SECTION A—Questions 1–30 (30 marks)

Instructions for completion of Section A are given on page two.

For this section of the examination you must use an **HB pencil**.

SECTIONS B AND C (100 marks)

- (a) All questions should be attempted.
(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.
- The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, **and must be written clearly and legibly in ink**.
- Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this book.
- The numbers of questions must be clearly inserted with any answers written in the additional space.
- Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written. If further space is required a supplementary sheet for rough work may be obtained from the invigilator.
- Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.



Read carefully

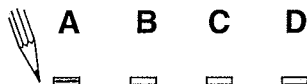
- 1 Check that the answer sheet provided is for **Biology Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) and **Centre Name** printed on it.
Do not change any of these details.
- 4 If any of this information is wrong, tell the Invigilator immediately.
- 5 If this information is correct, **print** your name and seat number in the boxes provided.
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the exam, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

The apparatus used to determine the energy stored in a foodstuff is a

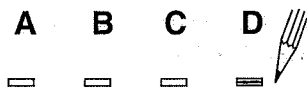
- A calorimeter
- B respirometer
- C klinostat
- D gas burette.

The correct answer is **A**—calorimeter. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).



Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil fill in the answer you want. The answer below has been changed to **D**.

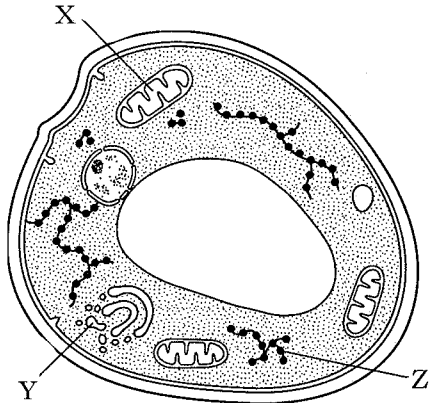


SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. The diagram below represents a highly magnified section of a yeast cell.



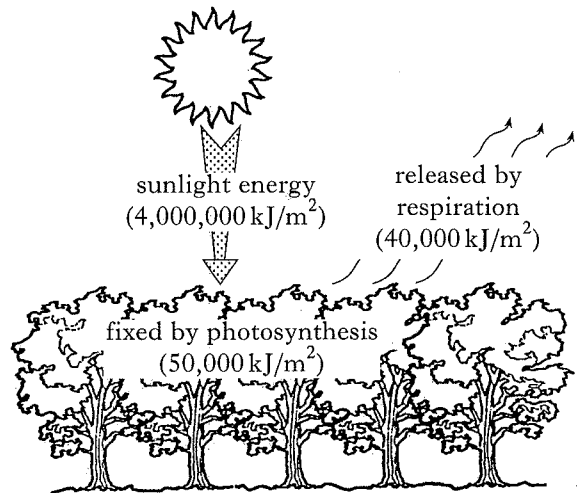
Which line of the table below correctly links each cell structure with its function?

	<i>Aerobic respiration</i>	<i>Protein synthesis</i>	<i>Packaging materials for secretion</i>
A	X	Y	Z
B	Y	Z	X
C	X	Z	Y
D	Z	X	Y

2. The action spectrum in photosynthesis is a measure of the ability of photosynthetic pigments to

- A absorb red and blue light
- B absorb light of different intensities
- C carry out photolysis
- D use light of different wavelengths for synthesis.

3. The diagram below shows the energy flow in an area of forest canopy during 1 year.

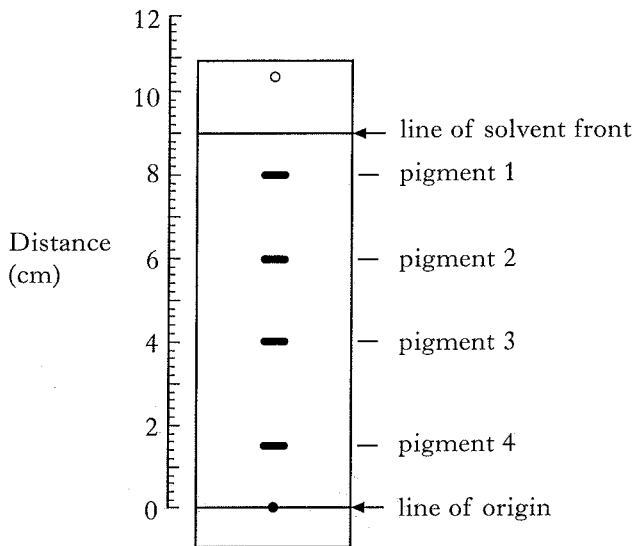


What percentage of available sunlight energy is fixed by the trees?

- A 0.25%
- B 1.00%
- C 1.25%
- D 2.25%

[Turn over

4. Photosynthetic pigments can be separated by means of chromatography as shown in the diagram below.



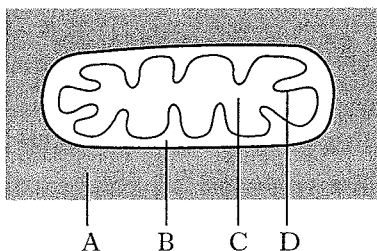
A pigment can be identified from its R_f value which can be calculated as follows:

$$R_f = \frac{\text{distance travelled by pigment from origin}}{\text{distance travelled by solvent from origin}}$$

Which line of the table correctly identifies the R_f values of pigments 2 and 3 on the above chromatogram?

	<i>Pigment 2</i>	<i>Pigment 3</i>
A	0.44	0.17
B	0.67	0.44
C	0.44	0.67
D	0.67	0.89

5. The diagram below shows a mitochondrion surrounded by cytoplasm.



Where does glycolysis take place?

6. Which of the following statements refer to glycolysis?
- 1 Carbon dioxide released.
 - 2 Occurs during aerobic respiration.
 - 3 The end product is pyruvic acid.
 - 4 The end product is lactic acid.
- A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4
7. During anaerobic respiration in muscle fibres what is the fate of pyruvic acid?
- A It is converted to lactic acid.
B It is broken down by the mitochondria.
C It is broken down to carbon dioxide and water.
D It is converted to citric acid.
8. Which of the following proteins has a fibrous structure?
- A Insulin
B Pepsin
C Amylase
D Collagen
9. If ten percent of the bases in a molecule of DNA are adenine, what is the ratio of adenine to guanine in the same molecule?
- A 1:1
B 1:2
C 1:3
D 1:4
10. In the life cycle of a bacterial virus which of the following sequences of events occurs?
- A Lysis of the cell membrane, synthesis of viral DNA, replication of viral protein
B Lysis of cell membrane, synthesis of viral protein, replication of viral DNA
C Replication of viral DNA, synthesis of viral protein, lysis of cell membrane
D Synthesis of viral protein, replication of viral DNA, lysis of cell membrane

11. The table below shows some genotypes and phenotypes associated with forms of sickle-cell anaemia.

Phenotype	Genotype
unaffected	Hb ^A Hb ^A
sickle-cell trait	Hb ^A Hb ^S
acute sickle-cell anaemia	Hb ^S Hb ^S

A woman with sickle-cell trait and a man who is unaffected plan to have a child.

What are the chances that their child will have acute sickle-cell anaemia?

- A None
 B 1 in 1
 C 1 in 2
 D 1 in 4
12. The following cross was carried out using two pure-breeding strains of the fruit fly, *Drosophila*.

P straight wing + curly wing
 + × +
 black body grey body

F₁ All straight wing + black body

The F₁ were allowed to interbreed

F₂ straight wing + curly wing
 + × +
 black body grey body

F₂ Phenotype Ratio 3 : 1

In a dihybrid cross the typical F₂ ratio is 9 : 3 : 3 : 1.

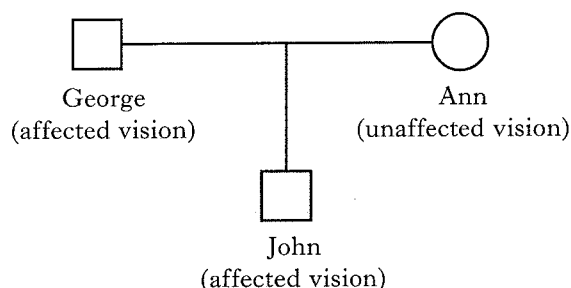
An explanation of the result obtained in the above cross is that

- A crossing over has occurred between the genes
 B before isolation F₁ females had mated with their own type males
 C non-disjunction of chromosomes in the sex cells has taken place
 D these genes are linked.

13. The recombination frequency obtained in a genetic cross may be used as a source of information concerning the

- A genotypes of the recombinant offspring
 B diploid number of the species
 C fertility of the species
 D position of gene loci.

14. Red-green colour deficient vision is a sex-linked condition. John, who is affected, has the family tree shown below.



If b is the mutant allele for the condition, which of the following could be the genotypes of George's parents and Ann's parents?

	George's parents		Ann's parents	
A	X ^B X ^b	X ^B Y	X ^B X ^B	X ^B Y
B	X ^B X ^B	X ^b Y	X ^B X ^B	X ^B Y
C	X ^B X ^b	X ^B Y	X ^B X ^b	X ^B Y
D	X ^B X ^B	X ^b Y	X ^B X ^B	X ^b Y

15. Klinefelter's syndrome is caused by the presence of an extra X chromosome in human males. Affected individuals are therefore XXY.

This syndrome is caused by

- A recombination
 B sex-linkage
 C crossing-over
 D non-disjunction.

[Turn over

16. The table refers to the mass of DNA in certain human body cells.

Cell type	Mass of DNA in cell ($\times 10^{-12}$ g)
liver	6.6
lung	6.6
R	3.3
S	0.0

Which of the following is the most likely identification of cell types R and S?

	R	S
A	ovum	mature red blood cell
B	mature red blood cell	sperm
C	nerve cell	mature red blood cell
D	kidney tubule cell	ovum

17. The following steps are involved in the process of genetic engineering.

- 1 Insertion of a plasmid into a bacterial host cell
- 2 Use of an enzyme to cut out a piece of chromosome containing a desired gene
- 3 Insertion of the desired gene into the bacterial plasmid
- 4 Use of an enzyme to open a bacterial plasmid

What is the correct sequence of these steps?

- A 4 1 2 3
 B 2 4 3 1
 C 4 3 1 2
 D 2 3 4 1

18. Osmoregulation in bony fish is achieved by a variety of strategies, depending on the nature of the environment.

Strategies

- 1 Large volume of dilute urine produced.
- 2 Small volume of concentrated urine produced.
- 3 Kidneys contain many large glomeruli.
- 4 Kidneys contain few small glomeruli.

Which of these strategies are employed by a freshwater bony fish?

- A 1 and 4
 B 2 and 4
 C 1 and 3
 D 2 and 3

19. The list below shows benefits which an animal species can obtain from certain types of social behaviour.

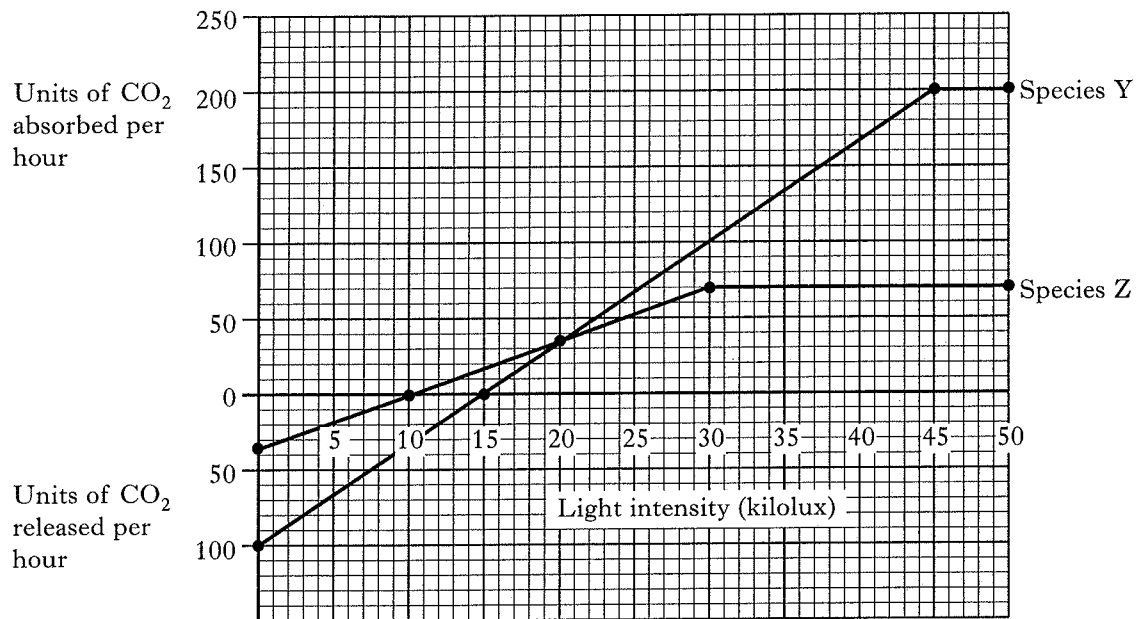
- 1 Aggression between individuals is controlled.
- 2 Subordinate animals are more likely to gain an adequate food supply.
- 3 Experienced leadership is guaranteed.
- 4 Energy used by individuals to obtain food is reduced.

Which statements refer to co-operative hunting?

- A 1 and 2 only
 B 1 and 3 only
 C 2 and 4 only
 D 3 and 4 only

20. The rates of carbon dioxide exchange by the leaves of two species of plants were measured at different light intensities.

The results are shown in the graph below.



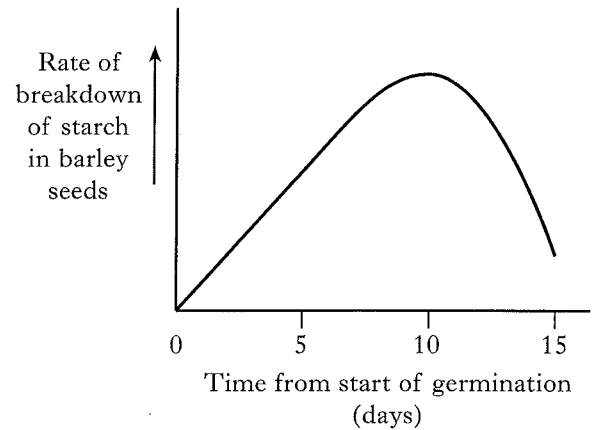
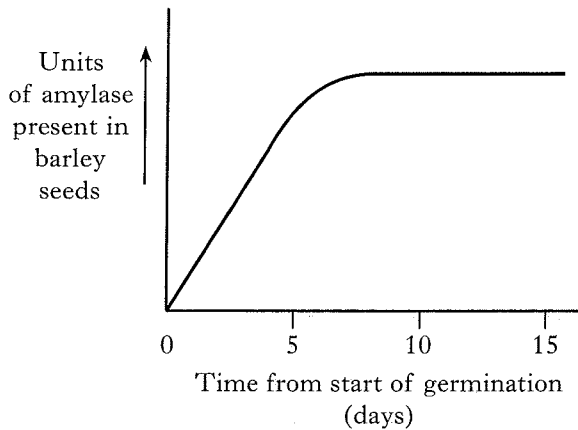
By how many kilolux is the compensation point for species Y greater than the compensation point for species Z?

- A 5
 B 10
 C 15
 D 130
-
21. A feature of phenylketonuria in humans is
- A the synthesis of excess phenylalanine
 B an inability to synthesise phenylalanine
 C the synthesis of excess tyrosine from phenylalanine
 D an inability to synthesise tyrosine from phenylalanine.
22. Plant ovary wall cells develop differently from plant phloem cells because of
- A random assortment in meiosis
 B genes being switched on and off during development
 C their having different numbers of chromosomes
 D their having different sets of genes.

[Turn over

23. An investigation was carried out into the germination of barley seeds.

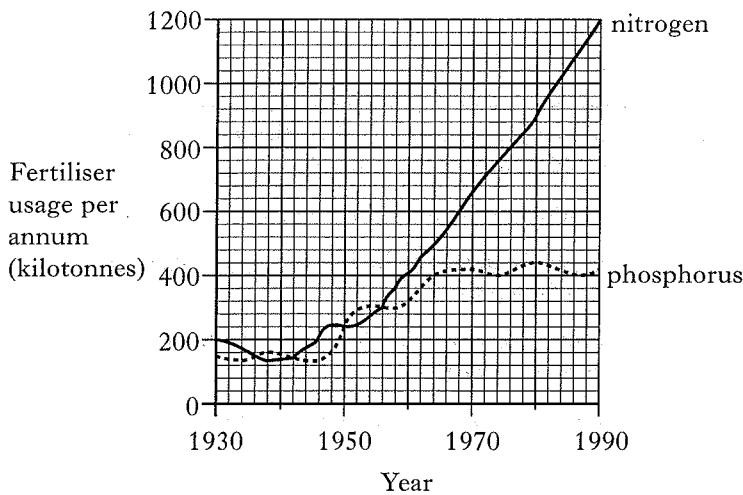
The concentration of amylase and the rate of breakdown of starch was measured over 15 days.



From the graphs it can be seen that after 10 days

- A the production of gibberellin has ceased
- B the rate of starch digestion decreases
- C the barley is synthesising its own starch
- D the amylase is becoming denatured.

24. The graph below contains information about fertiliser usage.



Which of the following statements about nitrogen usage between 1930 and 1990 is correct?

- A It increased steadily.
- B It increased by 500%.
- C It increased by 600%.
- D It always exceeded phosphorus usage.

25. Dietary deficiency of vitamin D causes rickets.

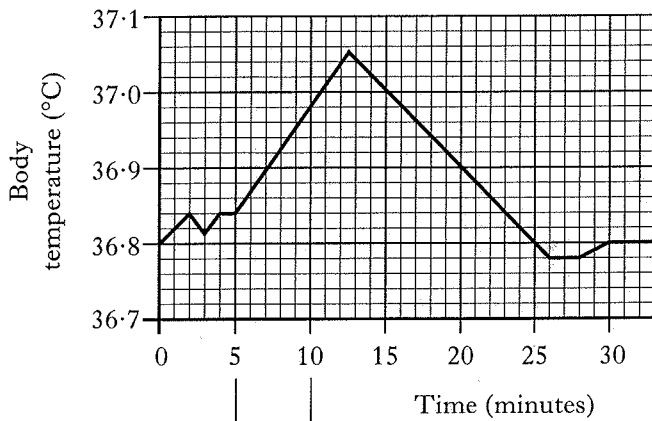
This effect is due to

- A poor uptake of phosphate into growing bones
- B low vitamin D content in the bones
- C poor calcium absorption from the intestine
- D loss of calcium from the bones.

26. Which of the following would result from an increased production of ADH?

- A The production of urine with a higher concentration of urea
- B Decrease in the permeability of the kidney collecting ducts
- C A decrease in the rate of glomerular filtration
- D An increase in the rate of production of urine

27. The graph below records the body temperature of a woman during an investigation in which her arm was immersed in water.

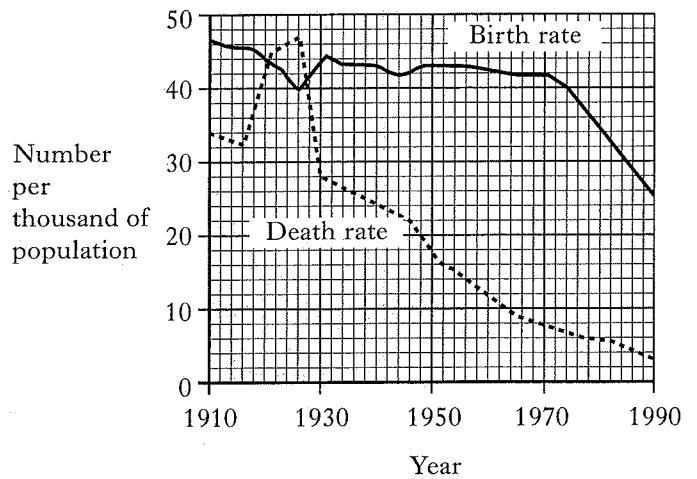


Arm immersed
in water during
this period

By how much did the temperature of her body vary during the 30 minutes of the investigation?

- A 2.7 °C
- B 0.27 °C
- C 2.5 °C
- D 0.25 °C

28. The graph below contains information about the birth rate and death rate in Mexico.

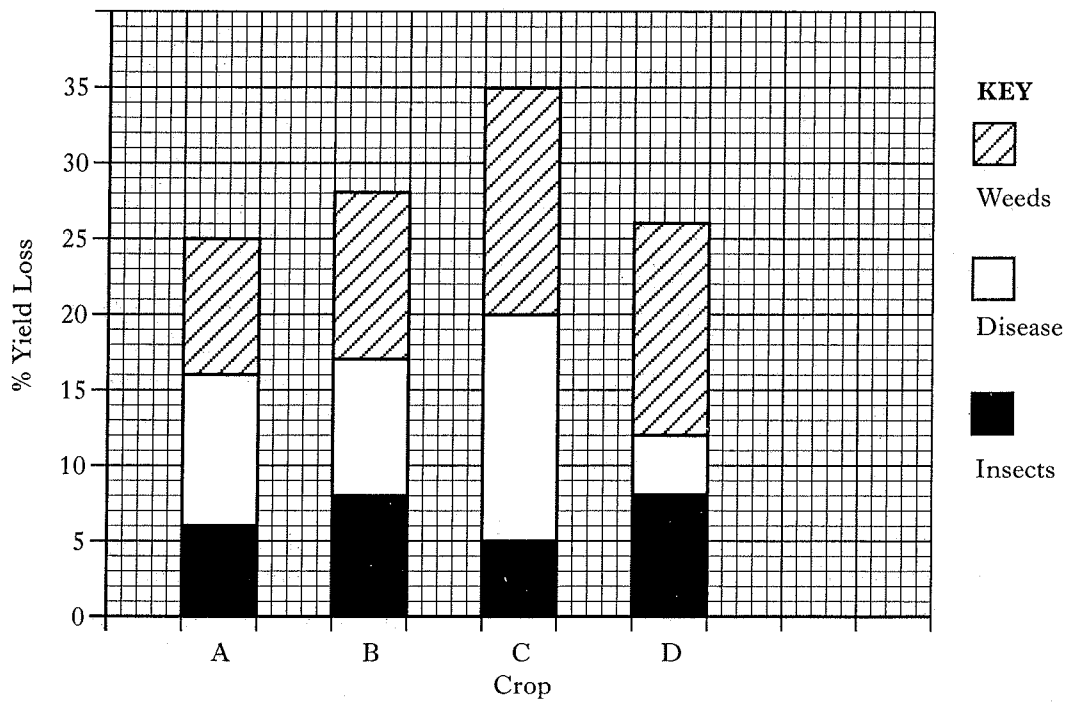


Which of the following conclusions can be drawn from the graph?

- A At no time during the century has the population of Mexico decreased.
- B The greatest increase in population occurred in 1970.
- C The population was growing faster in 1910 than in 1990.
- D Birth rate decreased between 1970 and 1990 due to the use of contraception.

[Turn over

29. The bar chart below shows the percentage loss in yield of four organically grown crops as a result of the effects of weeds, disease and insects.



Predict which crop is most likely to show the greatest increase in yield if herbicides and insecticides were applied.

30. During succession in plant communities a number of changes take place in the ecosystem. Which line of the table correctly describes some of these changes?

	<i>Species diversity</i>	<i>Biomass</i>	<i>Food web complexity</i>
A	rises	rises	rises
B	rises	falls	rises
C	falls	rises	rises
D	rises	rises	falls

Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of this answer book.

[Turn over for Section B on *Page twelve*

Marks

SECTION B

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. (a) The grid contains information about the plasma membrane and the cell wall.

A	contains phospholipid	B	fully permeable	C	made of fibres
D	contains cellulose	E	selectively permeable	F	made up of two layers

- (i) Two of the boxes contain information about the **structure** of the plasma membrane.

Identify these **two** boxes.

Letters _____ and _____

1

- (ii) One of the boxes contains information that relates to the role of the cell wall in the movement of water into a cell.

Identify this box.

Letter _____

1

- (b) The table shows the percentage change in mass of apple tissue after immersion in sucrose solutions of different concentrations.

<i>Concentration of sucrose solution (M)</i>	<i>Change in mass of apple tissue (%)</i>
0.00	+22.0
0.10	+13.0
0.15	+8.5
0.20	+4.0
0.25	-0.5
0.30	-5.0
0.40	-14.0
0.50	-23.0

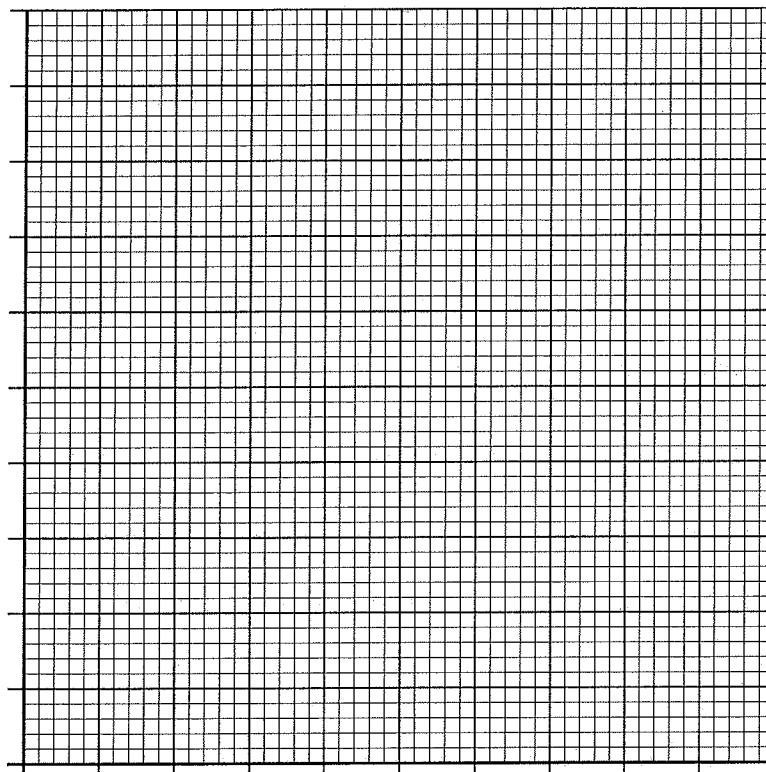
Marks

1. (b) (continued)

- (i) Using values from the table, plot a line graph to show the percentage change in mass of the apple tissue against the concentration of sucrose solution.

Use appropriate scales to fill most of the grid.

(An additional grid, if required, may be found on page 40.)



2

- (ii) Complete the following sentences by underlining **one** of the alternatives in each pair.

The 0.1 M sucrose solution is $\left\{ \begin{array}{l} \text{hypotonic} \\ \text{hypertonic} \end{array} \right\}$ to the apple tissue.

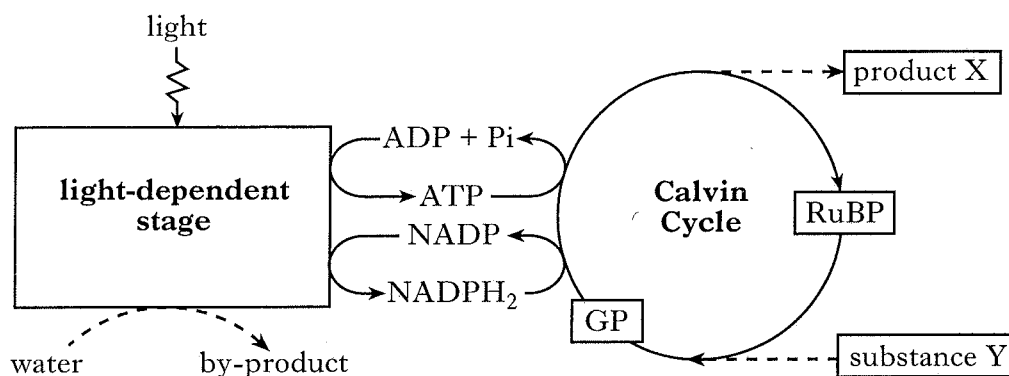
Apple cells immersed in this solution may become $\left\{ \begin{array}{l} \text{plasmolysed} \\ \text{turgid} \end{array} \right\}$.

1

[Turn over

2. The diagram shows an outline of the stages in photosynthesis.

Marks



(a) (i) Name the by-product produced by the light-dependent stage.

_____ 1

(ii) Name product X and substance Y.

Product X _____

Substance Y _____ 1

(iii) State the number of carbon atoms in RuBP and GP.

RuBP _____ GP _____ 1

(b) (i) Describe the role of ATP in photosynthesis.

_____ 1

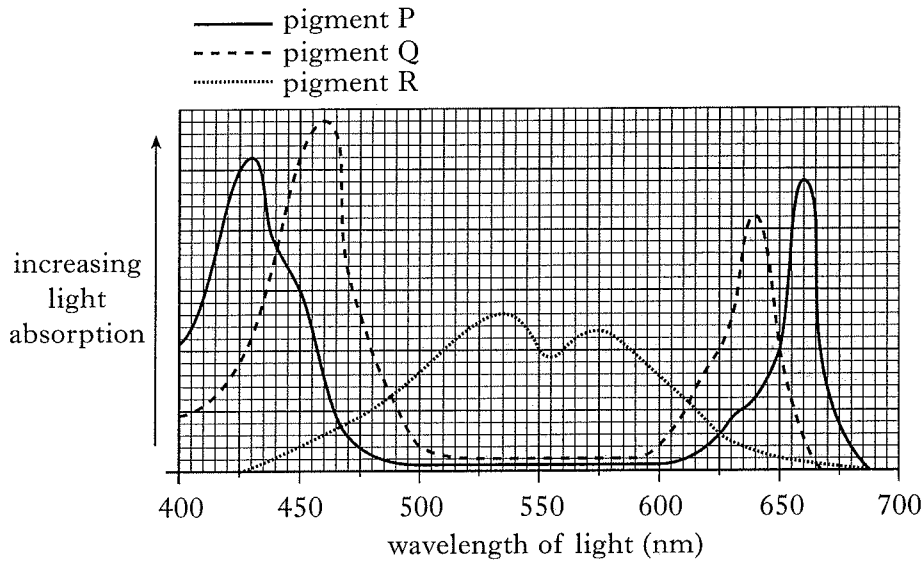
(ii) Explain why hydrogen from the light-dependent stage of photosynthesis is needed by the Calvin cycle.

_____ 1

2. (continued)

Marks

- (c) The graph shows the absorption spectra of three photosynthetic pigments. Pigments P and Q were extracted from a hydrophyte with leaves that float on the water surface. Pigment R was extracted from a species of photosynthetic algae that lives in the water below the hydrophyte.



- (i) Tick (✓) **one** box to identify the wavelengths of light at which pigment P shows greatest absorption.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
425–450 nm	450–475 nm	525–550 nm	625–650 nm	650–675 nm

1

- (ii) Explain why it is an advantage to the hydrophyte to have more than one pigment.

1

- (iii) Give **one** adaptation of hydrophyte leaves and state its effect.

Adaptation _____

Effect _____

1

- (iv) From the information given, explain how the algae from which pigment R was extracted are adapted to photosynthesise in their environment.

1

3. Experiments were carried out to investigate the hypothesis that the uptake of ions into mammalian cells takes place by active transport.

Marks

(a) The concentrations of potassium ions and chloride ions inside and outside a mammalian cell were measured.

The table shows the results obtained at an oxygen concentration of 4.0 units.

<i>Ion</i>	<i>Ion concentration inside cell (mM)</i>	<i>Ion concentration outside cell (mM)</i>
Potassium	140	5
Chloride	10	110

(i) Describe the information shown in the table that supports the original hypothesis.

1

(ii) From the table, calculate the simplest whole number ratio of potassium ions to chloride ions outside a mammalian cell.

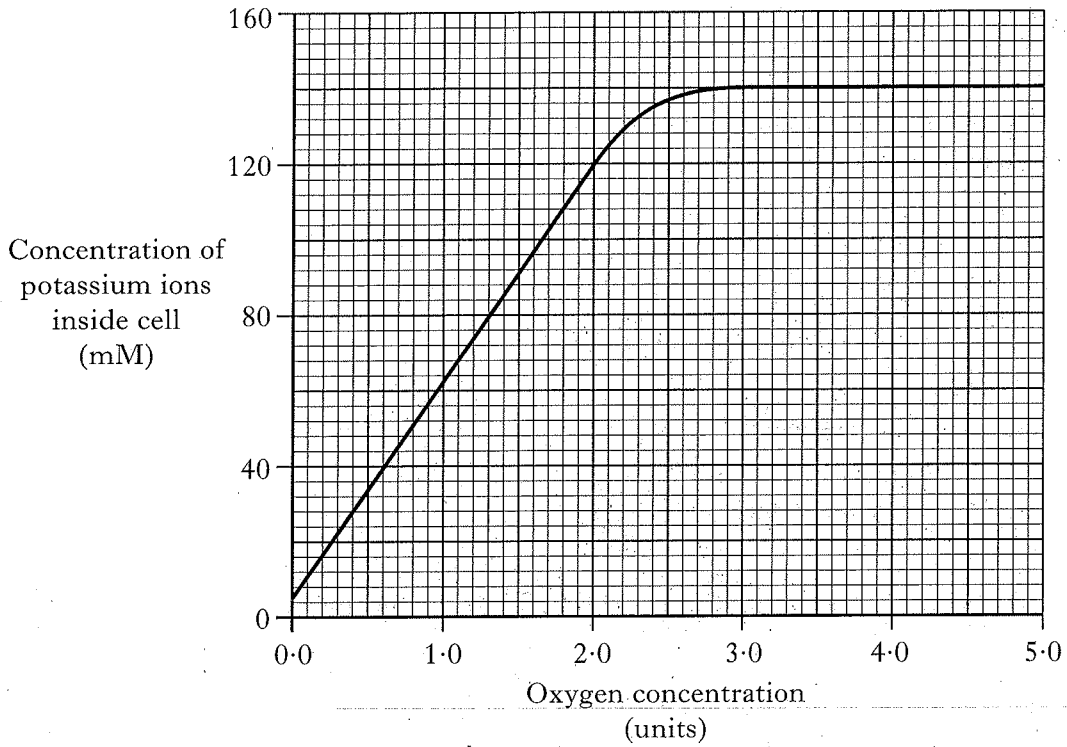
Space for calculation

_____ potassium ions : _____ chloride ions 1

Marks

3. (continued)

(b) The graph shows the effect of changing oxygen concentration on the concentration of potassium ions inside a mammalian cell.



(i) Explain the shape of the graph between oxygen concentrations of 1.0 and 2.0 units.

2

(ii) Suggest a reason why the graph levels off at oxygen concentrations above 3.0 units.

1

[Turn over

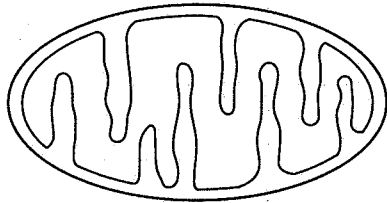
B. Yeast is a micro-organism capable of both aerobic and anaerobic respiration.

Marks

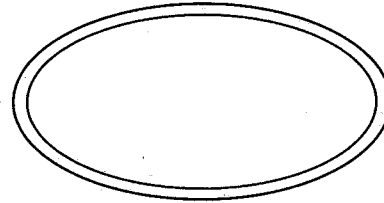
(a) Describe the role of oxygen in aerobic respiration.

1

(b) The diagrams represent a mitochondrion from a normal yeast cell and one from a mutant yeast cell.



mitochondrion from
normal yeast cell



mitochondrion from
mutant yeast cell

(i) Name the structures that are absent from the mitochondrion of the mutant yeast cell.

1

(ii) An experiment was carried out to investigate the effect of oxygen on the growth of normal and mutant yeast cells.

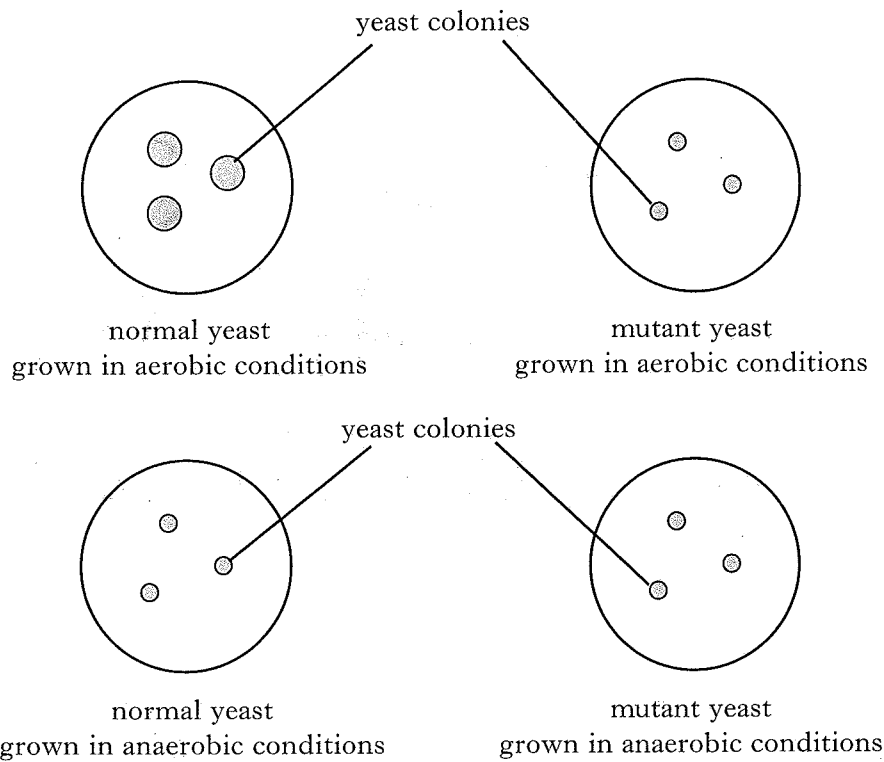
The method used in the experiment is outlined below.

- Three normal yeast cells were placed on agar growth medium containing glucose in a petri dish.
- Three mutant yeast cells were placed on the same agar growth medium containing glucose in a second dish.
- The dishes were then incubated at 30°C for four days in aerobic conditions to allow the cells to multiply and produce colonies of yeast cells.
- The above three steps were repeated and the dishes were incubated this time in anaerobic conditions.

The sizes of the colonies produced are shown in the following diagrams.

Marks

8 (b) (ii) (continued)



1. Suggest a possible improvement to the experimental method, other than repeating the experiment, that would increase the reliability of the results.

1

2. Give an explanation for the difference in colony size observed for the normal yeast grown in aerobic and anaerobic conditions.

2

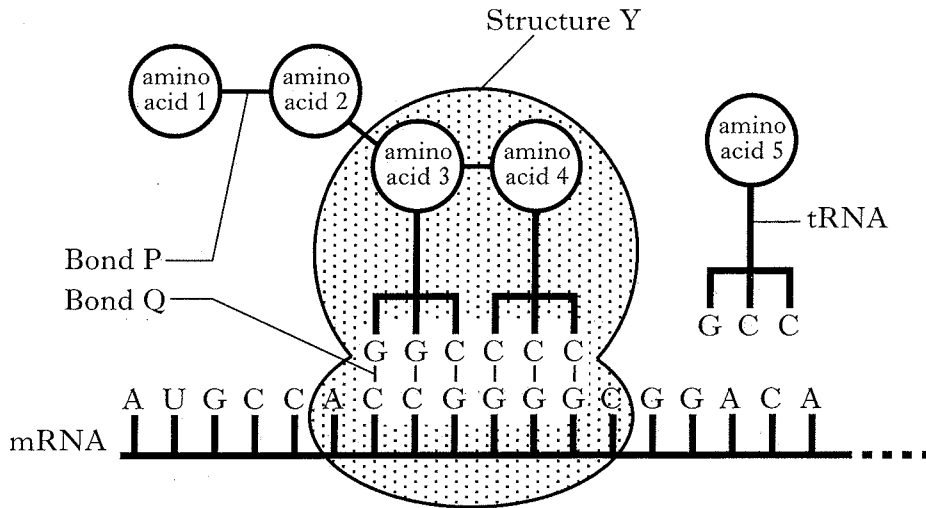
3. Suggest why there was no difference in colony size when the mutant cells were grown in aerobic and anaerobic conditions.

1

[Turn over

Marks

9. The diagram shows translation of part of a mRNA molecule during the synthesis of a protein.



- (a) Name structure Y.

_____ 1

- (b) Name the types of bond shown at P and Q.

Bond P _____

Bond Q _____ 1

- (c) Give the anticodon for the tRNA for amino acid 1.

_____ 1

- (d) Describe **two** functions of tRNA in protein synthesis.

1 _____ 1

_____ 1

2 _____ 1

_____ 1

- (e) Genetic information for protein synthesis is in the form of a triplet code. Explain what is meant by this statement.

_____ 1

Marks

6. Patients who have had tissue transplants may be treated with a drug that suppresses the immune system.

The table shows the number of lymphocytes in the blood of a patient before and after treatment.

<i>Number of lymphocytes before treatment (cells per mm³)</i>	<i>Number of lymphocytes after treatment (cells per mm³)</i>
7500	3000

- (a) Calculate the percentage decrease in the number of lymphocytes following treatment with the suppressor drug.

Space for calculation

_____ % 1

- (b) Explain why there is a risk of rejection when tissues are transplanted.

2

- (c) Some suppressor drugs act by binding to DNA molecules in such a way that the separation of the two DNA strands is prevented.

Predict **one** possible consequence of the use of this type of suppressor drug on the normal functions of DNA.

1

[Turn over

Marks

7. (a) The letters A – E represent five statements about meiosis.

Letter	Statement
A	haploid gametes are produced
B	chiasmata are formed
C	chromatids separate
D	gamete mother cell is present
E	homologous chromosomes form pairs

(i) Use **all** the letters from the list to complete the table to show the statements that are connected with the first and the second meiotic divisions.

<i>First meiotic division</i>	<i>Second meiotic division</i>

2

(ii) Independent assortment of chromosomes during meiosis is a source of genetic variation.

Describe the behaviour of chromosomes during the first meiotic division stage that results in independent assortment.

1

7. (continued)

Marks

- (b) Duchenne muscular dystrophy (DMD) is a recessive, sex-linked condition in humans that affects muscle function.

The diagram shows an X-chromosome from an unaffected individual and one from an individual with DMD.



- (i) Using information from the diagram, name the type of chromosome mutation responsible for DMD.

1

- (ii) **On the diagram** of the chromosome from the **unaffected individual**, put a **cross (X)** on the likely location of the gene involved in DMD.

1

- (iii) Males are more likely to be affected by DMD than females.
Explain why.

1

- (iv) A person with DMD has an altered phenotype compared with an unaffected individual.

Explain how an inherited chromosome mutation such as DMD may result in an altered phenotype.

1

[Turn over

Marks

8. Three species of small bird, the Blue Tit, the Great Tit and the Marsh Tit, forage for caterpillars in oak woods in early summer.

Investigators observed each bird species for ten hours. They recorded the percentage of time each species spent foraging in different parts of the trees. The results are shown in the **Bar Chart**.

Table 1 shows the percentage of the birds' diet that came from different caterpillar size ranges.

Table 2 shows the beak size index calculated for each species using the following formula.

$$\text{beak size index} = \text{average beak length (mm)} \times \text{average beak depth (mm)}$$

Bar Chart

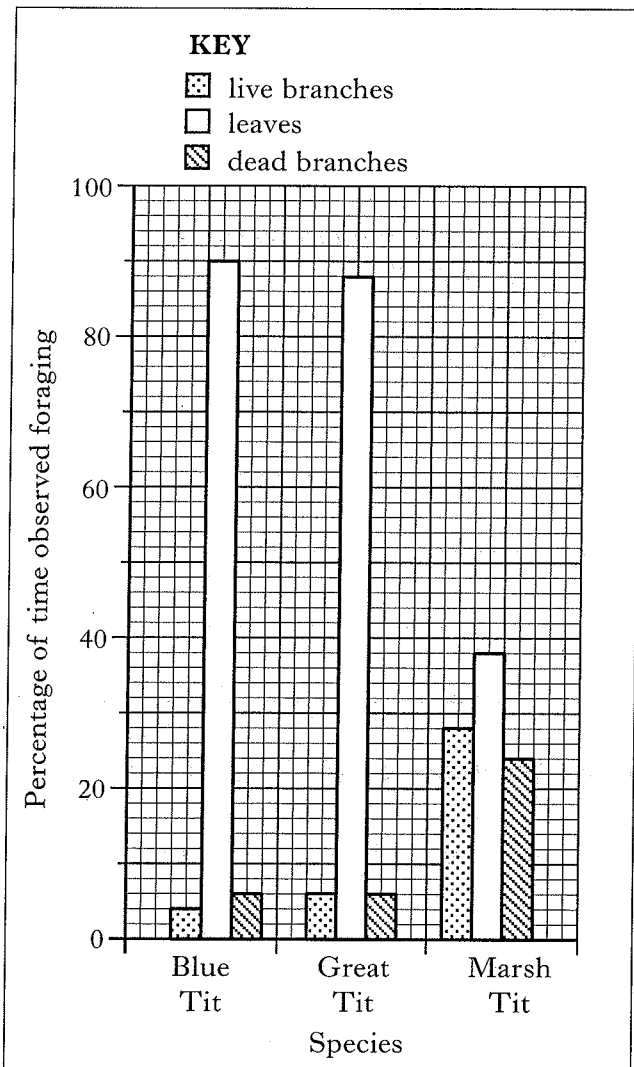


Table 1

caterpillar size range (mm)	% of diet from each size range		
	Blue Tit	Great Tit	Marsh Tit
1-2	63.6	18.2	18.1
3-4	24.3	20.4	60.6
5-6	10.0	27.2	12.1
7-8	2.1	34.2	9.2

Table 2

species	beak size index (mm ²)
Blue Tit	40.3
Great Tit	67.6
Marsh Tit	44.2

- (a) Calculate the number of minutes the Blue Tits were observed foraging on live branches.

Space for calculation

_____ mins **1**

8. (continued)

Marks

(b) What evidence from the **Bar Chart** suggests that Marsh Tits forage on tree parts other than those shown?

1

(c) Calculate the average percentage of the birds' diets in the 1–2 mm caterpillar size range.

Space for calculation

_____ %

1

(d) Describe the relationship between beak size index and caterpillar size range eaten.

1

(e) The average beak length of Great Tits is 13 mm.
Calculate their average beak depth.

Space for calculation

_____ mm

1

(f) From the information given, describe all of the ways by which interspecific competition for caterpillars is reduced between the following pairs of bird species.

(i) Blue Tits and Great Tits _____

1

(ii) Blue Tits and Marsh Tits _____

1

(g) Each bird species must forage economically.

Explain what is meant by this statement in terms of energy gain and loss.

1

Marks

9. The ancestor species of the modern tomato produces small fruits but can grow in soils with low nitrogen levels.

The modern species of tomato has been selectively bred to produce large fruit but requires soil rich in nitrogen to grow well.

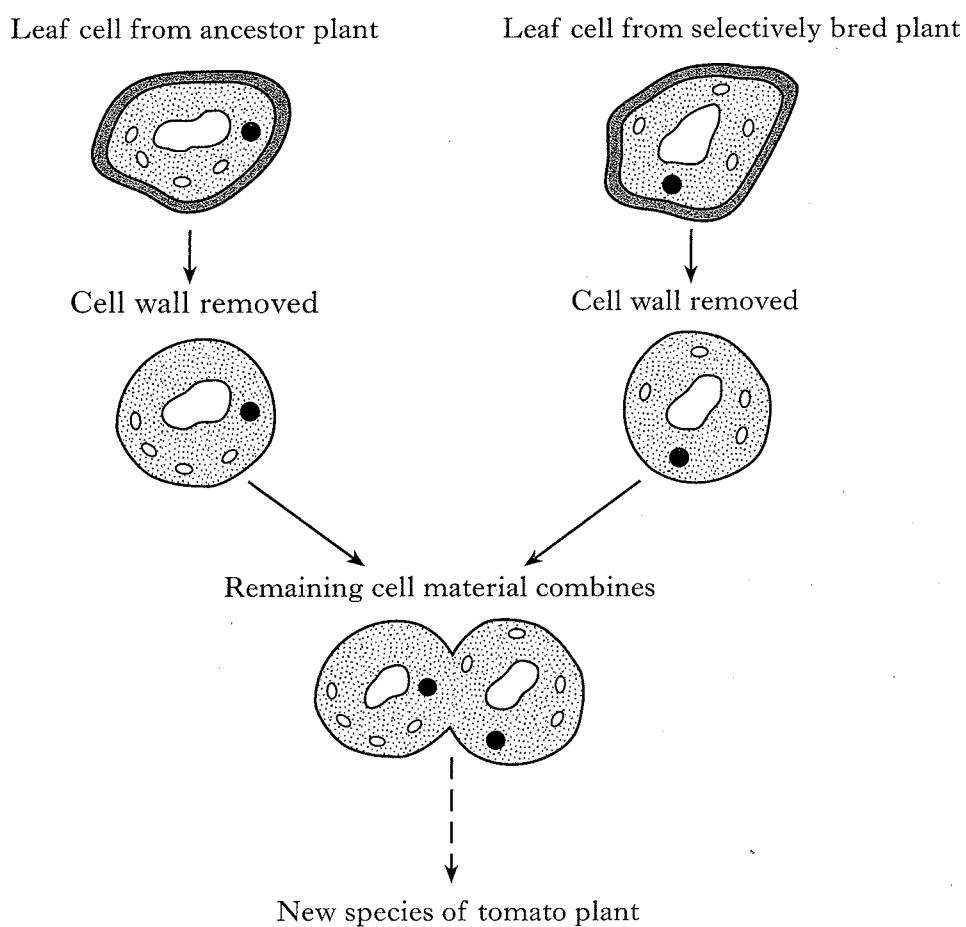
- (a) (i) Give **one** reason why nitrogen is important for plant growth.

1

- (ii) Give **one** symptom of nitrogen deficiency in plants.

1

- (b) The diagram represents steps in a technique used by tomato breeders to combine characteristics of these two species.



Marks

9. (b) (continued)

- (i) Give the name of the technique shown in the diagram.

1

- (ii) Name the enzyme that is used to remove the cell walls from the leaf cells.

1

- (iii) Explain why cultivation of the new species of tomato could lead to a reduction in the use of nitrogen fertiliser.

1

[Turn over

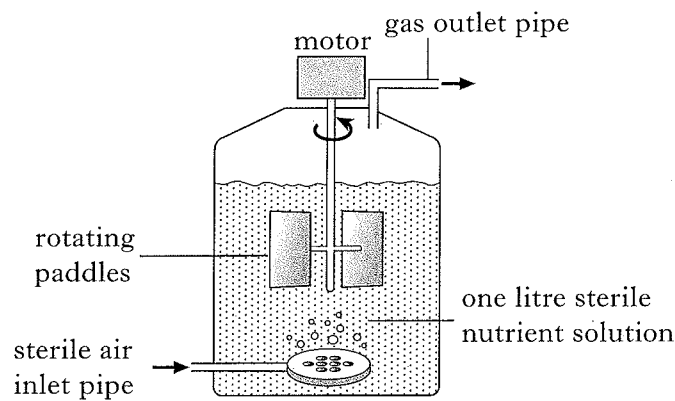
Marks

10. An investigation was carried out to compare the growth of *Escherichia coli* (*E. coli*) bacteria in different nutrient solutions.

E. coli were grown in a glucose solution for 24 hours. Two 50 cm³ samples were transferred to two identical containers each with different sterile nutrient solutions as shown in the table.

Container	Nutrient solution
X	0.5 mM glucose
Y	0.5 mM lactose

One container is shown in the diagram.



The pH and temperature were kept constant.

Every 30 minutes, a 2 cm³ sample was taken from each container.

An instrument was used to measure the number of bacteria present. The higher the instrument reading, the more bacteria.

- (a) (i) Suggest a reason for having rotating paddles.

1

- (ii) Explain why a gas outlet pipe is needed in the apparatus.

1

- (b) Identify **two** variables not already mentioned that would have to be controlled in both containers to make the procedure valid.

1

2

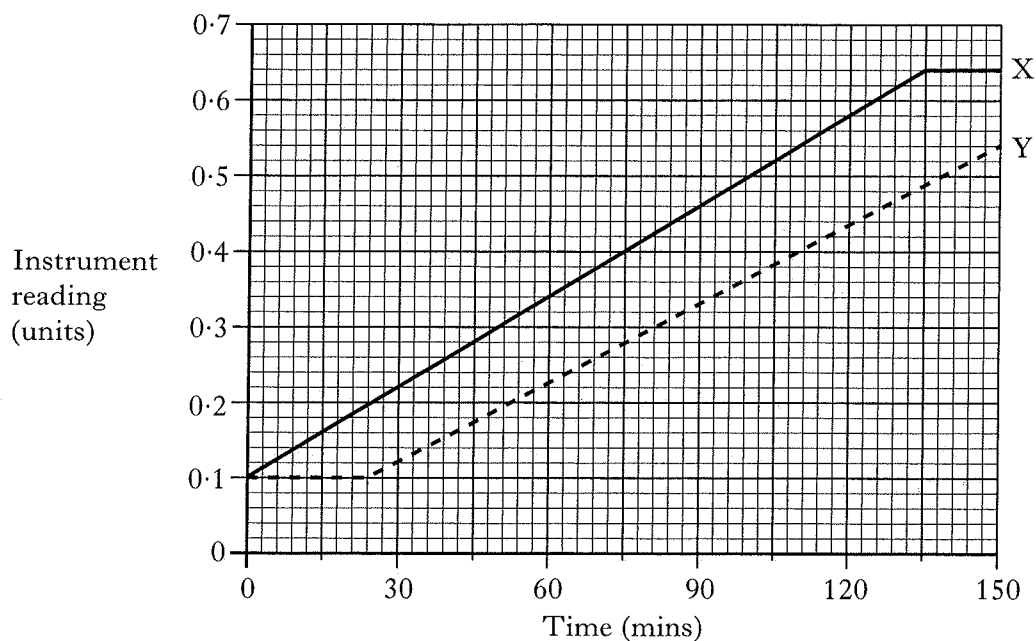
1

1

Marks

10. (continued)

(c) The results of the investigation are shown in the graph.



E. coli only produces the enzyme to metabolise lactose when there is no glucose available to the cells.

- (i) Use information from the graph to state the time taken for the bacterial cells to produce the enzyme needed to metabolise lactose.

Justify your answer.

Time _____ minutes

Justification _____

1

- (ii) Explain how lactose acts as an inducer of this enzyme.

2

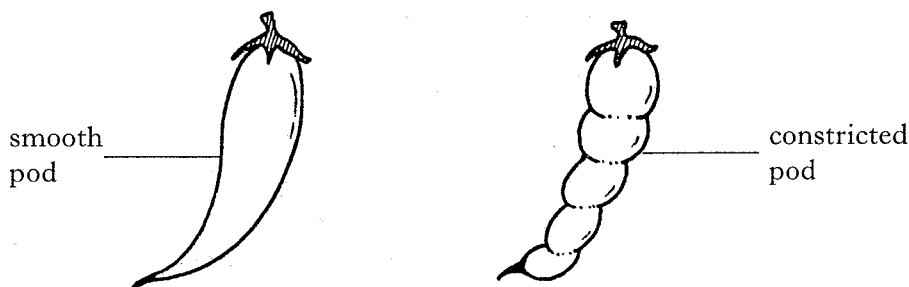
- (iii) Predict the instrument reading at 150 minutes if a third container had been used with nutrient solution containing 0.25 mM glucose.

_____ units 1

Marks

11. In seed pods of garden pea plants, smooth shape (T) is dominant to constricted shape (t) and green (G) is dominant to yellow (g).

The genes are not linked.



- (a) In an investigation, a pea plant heterozygous for both smooth and green pods was crossed with a pea plant with constricted, yellow pods.

Complete the table to give the genotypes of the parent plants and **all** of their possible gametes.

<i>Phenotype of parent</i>	<i>Genotype of parent</i>	<i>Genotype(s) of gamete(s)</i>
Smooth green pod		
Constricted yellow pod		

1

1

- (b) In a second investigation, two pea plants heterozygous for both seed shape and seed colour were crossed. This produced 112 offspring.

- (i) Calculate the **expected** number of offspring that would have yellow pods.

Space for calculation

1

The actual phenotypes obtained did not occur in the expected numbers.

- (ii) Suggest **two** reasons why the **actual** numbers observed may differ from the **expected** numbers in a dihybrid cross.

1 _____

1

2 _____

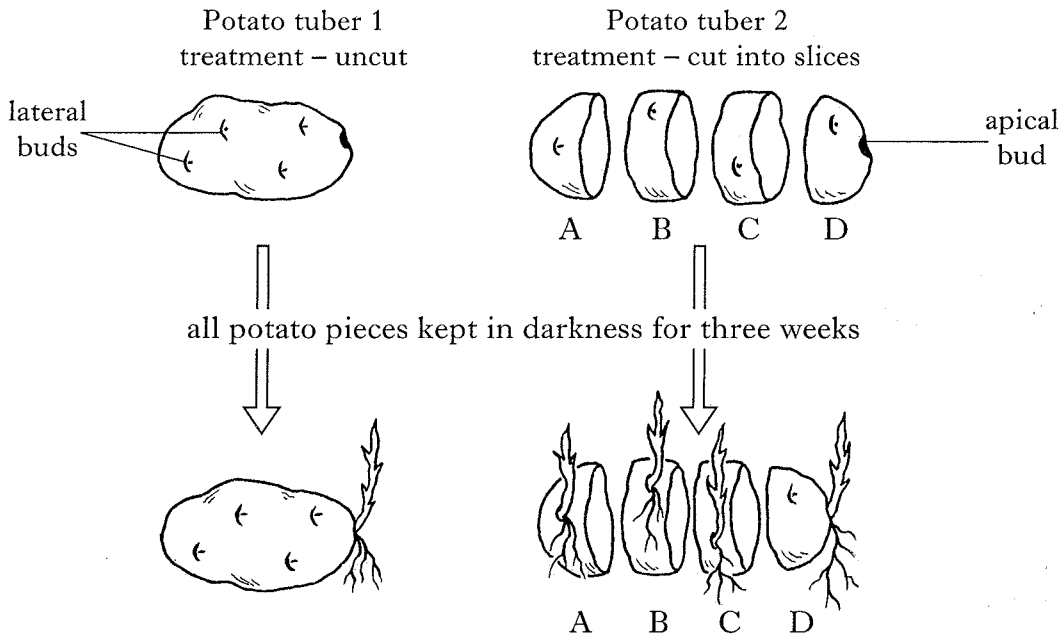
1

Marks

12. A potato tuber is a swollen underground stem.

Two similar tubers, each with one apical bud and four lateral buds were treated as shown in the diagram. Their appearance after being kept in the dark for three weeks is also shown.

Apical buds produce the plant growth substance IAA.



(a) Name the effect of IAA that is shown by potato tuber 1 after three weeks.

1

(b) Explain why the lateral buds on slices A, B and C produced shoots.

1

(c) Potato tuber 1 was then exposed to light from one direction for a further three days. The shoot showed phototropism.

Explain the role of IAA in phototropism.

2

(d) Potatoes are long day plants. In terms of changing photoperiod, describe what is meant by "long day plant".

1

Marks

13. The table shows the mass of salmon caught in coastal waters around Scotland.

<i>Year</i>	<i>Scottish catch (tonnes)</i>
1973	1300
1980	1200
1988	900
1998	200

(a) By how many times was the 1973 catch greater than the 1998 catch?

Space for calculation

_____ times **1**

(b) Scientists monitoring the salmon have suggested the following four possible factors for the decline in numbers.

- Predation by seals
- Food shortage
- Rising sea temperature
- Infection by sea louse parasites

Underline the factor(s) that would have had a density-independent effect on the salmon population.

1

(c) Populations of North Atlantic salmon are monitored because they are a food species.

Give **one** other reason for monitoring animal populations.

1

Marks

14. The table shows how two structures in mammalian skin respond to a drop in the surrounding air temperature from 20 °C to 5 °C.

<i>Structure</i>	<i>Air temperature</i>	
	20 °C	5 °C
hair erector muscles	relaxed	contracted
blood vessels	dilated	constricted

(a) (i) Name the temperature monitoring centre in the body of a mammal.

_____ 1

(ii) State how messages are sent from the temperature monitoring centre to the skin.

_____ 1

(b) Explain the advantage to the organism of constriction of skin blood vessels when the air temperature drops from 20 °C to 5 °C.

_____ 1

(c) Give the term that describes an animal that obtains most of its body heat from its own metabolism.

_____ 1

[Turn over for Section C on Page thirty-four

SECTION C

Marks

Both questions in this section should be attempted.

Note that each question contains a choice.

Questions 1 and 2 should be attempted on the blank pages which follow.

Supplementary sheets, if required, may be obtained from the invigilator.

All answers must be written clearly and legibly in ink.

Labelled diagrams may be used where appropriate.

1. Answer **either** A or B.

A. Give an account of transpiration under the following headings:

- (i) the effect of environmental factors on transpiration rate; 5
- (ii) adaptations of xerophyte plants that reduce the transpiration rate. 5

(10)

OR

B. Give an account of how animals and plants cope with dangers under the following headings:

- (i) behavioural defence mechanisms in animals; 5
- (ii) cellular and structural defence mechanisms in plants. 5

(10)

In question 2, ONE mark is available for coherence and ONE mark is available for relevance.

2. Answer **either** A or B.

A. Give an account of the principle of negative feedback with reference to the maintenance of blood sugar levels. (10)

OR

B. Give an account of the role of the pituitary gland in controlling normal growth and development and describe the effects of named drugs on fetal development. (10)

[END OF QUESTION PAPER]

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 1(b)(i)

