FOR OFFICIAL USE

Total for Sections B and C

X007/301

NATIONAL QUALIFICATIONS 2010

THURSDAY, 27 MAY
1.00 PM – 3.30 PM

BIOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

Scottish candidate number

Number of seat

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)

1 (a) All questions should be attempted.

(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.

2 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**.

3 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.

4 The numbers of questions must be clearly inserted with any answers written in the additional space.

5 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.

6 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 examination, 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

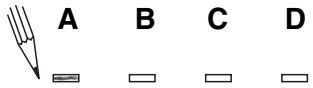
A calorimeter

B respirometer

C klinostat

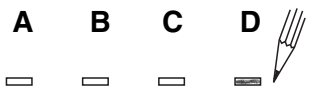
D gas burette.

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**.

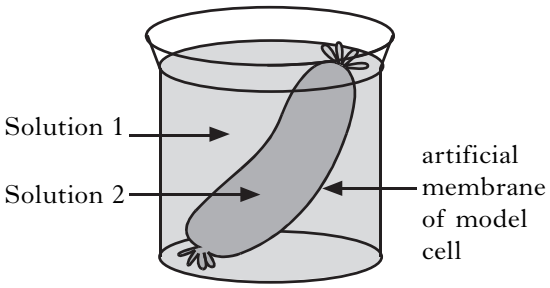


SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. The diagram below represents an osmosis experiment, using a model cell.



Which line of the table below shows a correct result for the solutions used in the experiment?

	Solution 1	*Solution 2*	*Change of volume in model cell*
A	water	5% sucrose	decrease
B	10% sucrose	water	increase
C	10% sucrose	5% sucrose	increase
D	10% sucrose	15% sucrose	increase

2. The cells of seaweed which actively absorb iodide ions from sea water would be expected to have large numbers of

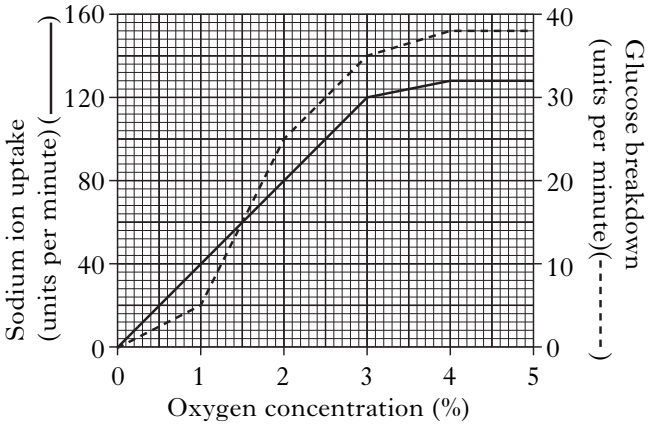
A chloroplasts

B mitochondria

C ribosomes

D vacuoles.

3. An investigation was carried out into the uptake of sodium ions by animal cells. The graph below shows the rates of sodium ion uptake and breakdown of glucose at different concentrations of oxygen.



How many units of sodium ions are taken up over a 5 minute period when the concentration of oxygen in solution is 2%?

A 80

B 100

C 400

D 500

4. Which line in the table below correctly shows the two chemical reactions which occur in the grana of a chloroplast following the absorption of light energy by chlorophyll?

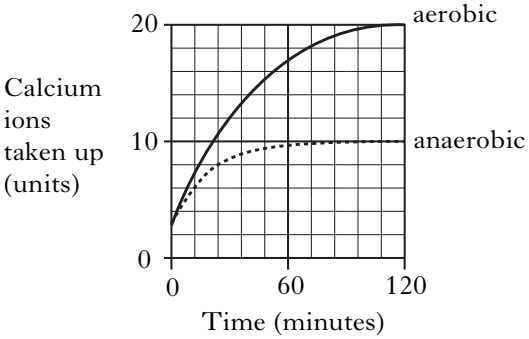
	Chemical reaction 1	*Chemical reaction 2*
A	ATP → ADP + Pi	water → hydrogen + oxygen
B	ADP + Pi → ATP	water → hydrogen + oxygen
C	ATP → ADP + Pi	hydrogen + oxygen → water
D	ADP + Pi → ATP	hydrogen + oxygen → water

5. Which line in the table below correctly shows the number of molecules of ATP used and produced when one molecule of glucose undergoes glycolysis?

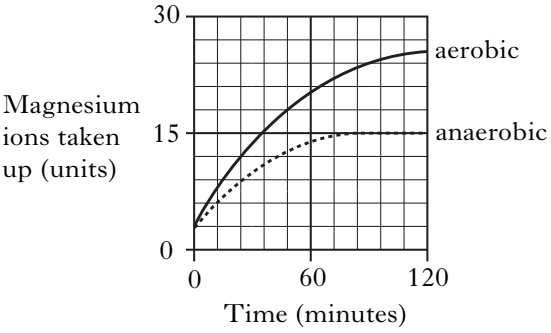
	Number of molecules of ATP	
	Used	*Produced*
A	0	2
B	2	0
C	2	4
D	4	2

6. The graphs below show the results of an experiment into the effect of aerobic and anaerobic conditions on the uptake of calcium and magnesium ions by pond algae.

Uptake of calcium ions by pond algae



Uptake of magnesium ions by pond algae



Which of the following is a valid conclusion that can be drawn from the results?

A At 120 minutes in aerobic conditions the uptake of calcium ions is greater than that of magnesium ions.

B At 60 minutes in anaerobic conditions there was a greater uptake of calcium ions compared with magnesium ions.

C Over the 120 minutes in aerobic conditions the average rate of uptake of calcium ions is greater than that of magnesium ions.

D At 60 minutes in anaerobic conditions there was a greater uptake of magnesium ions compared with calcium ions.

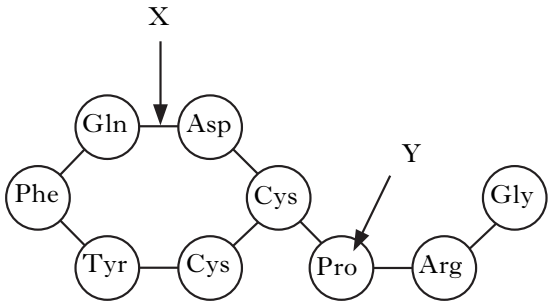
7. The table below refers to processes in cellular respiration.

Process	*Carbon dioxide produced*	*Water produced*
X	no	no
Y	yes	no
Z	no	yes

Which line in the table below correctly identifies processes X, Y and Z?

	X	*Y*	*Z*
A	glycolysis	Krebs cycle	cytochrome system
B	Krebs cycle	glycolysis	cytochrome system
C	cytochrome system	Krebs cycle	glycolysis
D	glycolysis	cytochrome system	Krebs cycle

8. The diagram below represents the chemical structure of the protein ADH.



Which line in the table below identifies X and Y correctly?

	X	*Y*
A	hydrogen bond	base
B	hydrogen bond	amino acid
C	peptide bond	base
D	peptide bond	amino acid

9. A fragment of DNA was found to have 120 guanine bases and 60 adenine bases. What is the total number of sugar molecules in this fragment?

A 60

B 90

C 180

D 360

10. Which of the following statements about viruses is true?

A Viral protein directs the synthesis of new viruses.

B New viruses are assembled outside the host cell.

C Viral protein is injected into the host cell.

D Viral DNA directs the synthesis of new viruses.

11. Which line in the table below correctly describes the cells produced by meiosis?

	Cells produced by meiosis	
	Chromosome complement	*Genetic composition*
A	haploid	all cells different
B	diploid	all cells identical
C	diploid	all cells different
D	haploid	all cells identical

[Turn over

12. In mice, coat length is determined by the dominant allele **L** for long coat and the recessive allele **l** for short coat.

Coat colour is determined by the dominant allele for brown colour **B** and recessive allele for white colour **b**.

The genes are not linked.

What proportion of the offspring produced from a cross between two mice heterozygous for coat length and colour would have short brown coats?

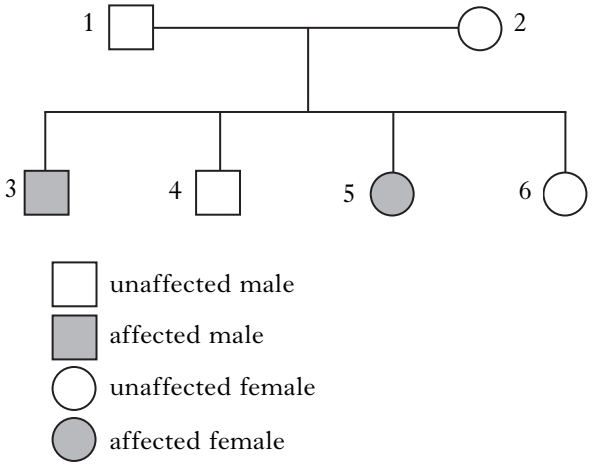
A 1 in 16

B 3 in 16

C 9 in 16

D 1 in 4

13. Cystic fibrosis is an inherited condition caused by a recessive allele. The diagram below shows a family tree with affected individuals.



Which individuals in this family tree **must** be heterozygous for this condition?

A 3 and 5

B 4 and 6

C 1 and 2

D 2 and 6

14. In *Drosophila*, wings can be straight or curly and body colour can be black or grey.

Heterozygous flies with straight wings and black bodies were crossed with curly-winged and grey bodied flies.

The following results were obtained.

Number	797	806	85	89
Phenotype	straight wings and black bodies	curly wings and grey bodies	straight wings and grey bodies	curly wings and black bodies

These proportions of offspring suggest that

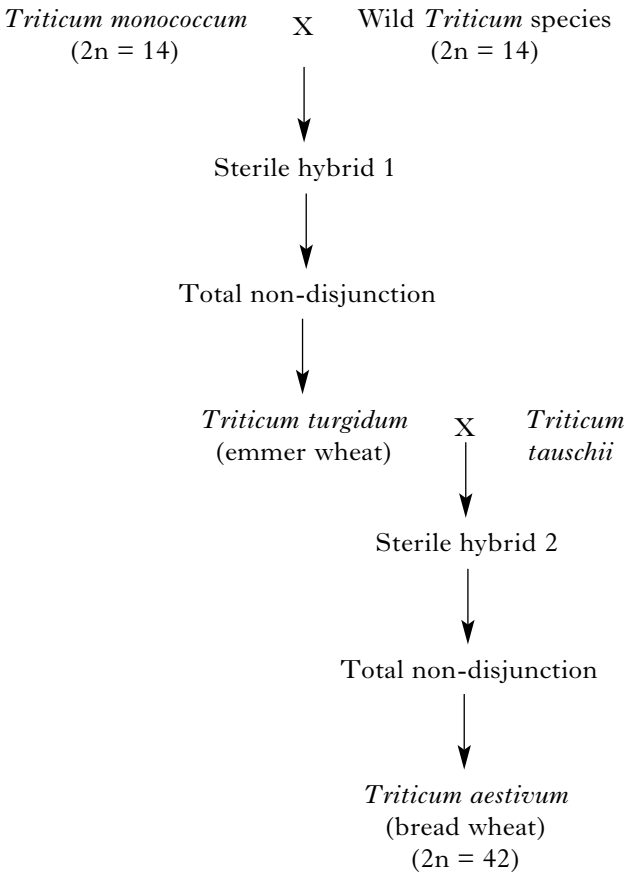
A genes for body colour and wing shape are on separate chromosomes

B crossing over has caused linked genes to separate

C the genes show independent assortment

D the genes must be carried on the sex chromosomes.

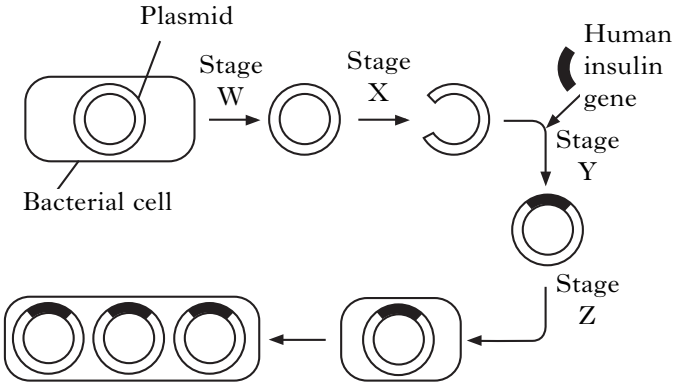
15. The diagram below represents the evolution of bread wheat. The diploid chromosome numbers of the species involved are given.



Which line in the table below identifies correctly the diploid chromosome numbers of *Triticum turgidum* (emmer wheat) and *Triticum tauschii*?

	Triticum turgidum	*Triticum tauschii*
A	14	14
B	28	14
C	14	28
D	28	28

16. The flow chart below represents the programming of *E. coli* bacteria to produce human insulin.



Which line in the table below identifies correctly the stages at which an endonuclease and a ligase are used?

	Endonuclease	*Ligase*
A	Stage X	Stage W
B	Stage Y	Stage Z
C	Stage X	Stage Y
D	Stage Y	Stage X

17. Which of the following statements could be **true** of cooperative hunting?

1 Individuals gain more energy than from hunting alone.

2 Both dominant and subordinate animals benefit.

3 Much larger prey may be killed than by hunting alone.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

[Turn over

18. The table below shows the mass of water gained and lost by a small mammal over a 24-hour period.

	Mass of water lost or gained (g)
Food	6
Metabolic water	54
Exhaled air	45
Urine	12
Faeces	3

What percentage of water gained comes from metabolic water?

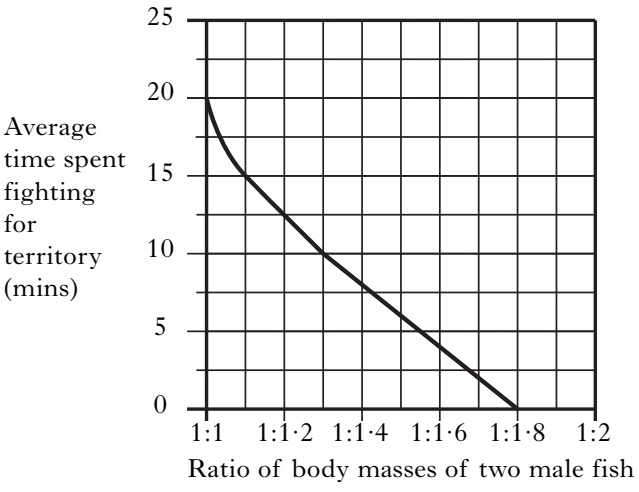
A 9%

B 45%

C 54%

D 90%

19. The graph below shows the relationship between the ratio of body masses of two male fish and the average time they spend fighting for territory.



For how long will a fight between two fish, weighing 6 g and 9 g respectively, be expected to last?

A 6 minutes

B 10 minutes

C 15 minutes

D 17 minutes

20. Increased grazing by herbivores in a grassland habitat can result in an increase in the number of different plant species present in the habitat.

This is because

A some plants tolerate grazing because they have low meristems

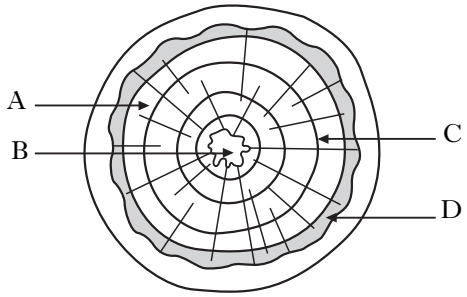
B damage to dominant grasses by grazing allows the survival of other species

C grasses can regenerate quickly following damage by herbivores

D many grassland species produce toxins in response to grazing.

21. The diagram below shows a section of a woody twig.

Which is a region of summer wood?



22. According to the Jacob-Monod hypothesis, a regulator gene is responsible for

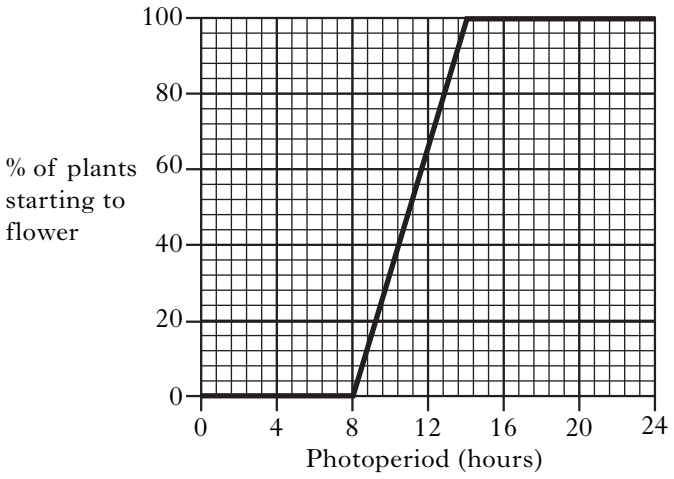
A coding for the production of an inducer molecule

B switching on an operator

C coding for the production of a repressor molecule

D switching on a structural gene.

23. The graph below shows the effect of photoperiod on the onset of flowering in a species of plant.



The graph shows that the plant is a

A long day species with a critical photoperiod of 8 hours

B long day species with a critical photoperiod of 14 hours

C short day species with a critical photoperiod of 8 hours

D short day species with a critical photoperiod of 14 hours.

24. The following list shows the effects of drugs on fetal development in humans.

1 Limb deformation

2 Overall reduction of growth

3 Slowing of mental development

Which line in the table below correctly matches alcohol, nicotine and thalidomide with their effects on fetal development?

	Alcohol	*Nicotine*	*Thalidomide*
A	2 only	2 and 3 only	1 and 3 only
B	3 only	2 and 3 only	1 only
C	2 and 3 only	2 only	1 and 3 only
D	2 and 3 only	2 and 3 only	1 only

25. Which line in the table below identifies correctly the hormones which stimulate the conversion of glucose and glycogen?

	glycogen → glucose	*glucose → glycogen*
A	glucagon and adrenalin	insulin
B	adrenalin	glucagon and insulin
C	insulin	adrenalin and glucagon
D	glucagon and insulin	adrenalin

26. Drinking a large volume of water will lead to

A increased production of ADH and kidney tubules becoming more permeable to water

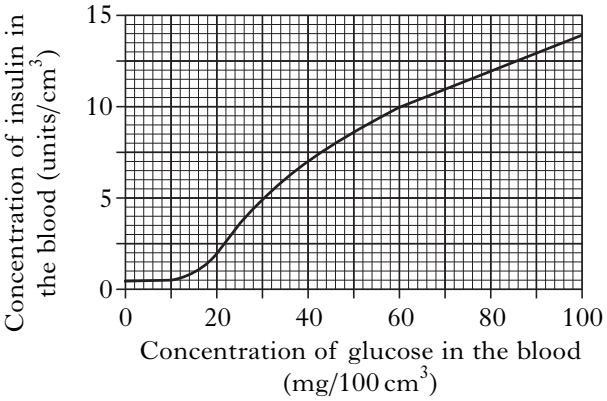
B decreased production of ADH and kidney tubules becoming less permeable to water

C increased production of ADH and kidney tubules becoming less permeable to water

D decreased production of ADH and kidney tubules becoming more permeable to water.

[Turn over

27. The graph below shows how the concentration of insulin in the blood varies with the concentration of glucose in the blood.



What total mass of glucose would be present at an insulin concentration of 10 units/cm^3, in an individual with 5 litres of blood?

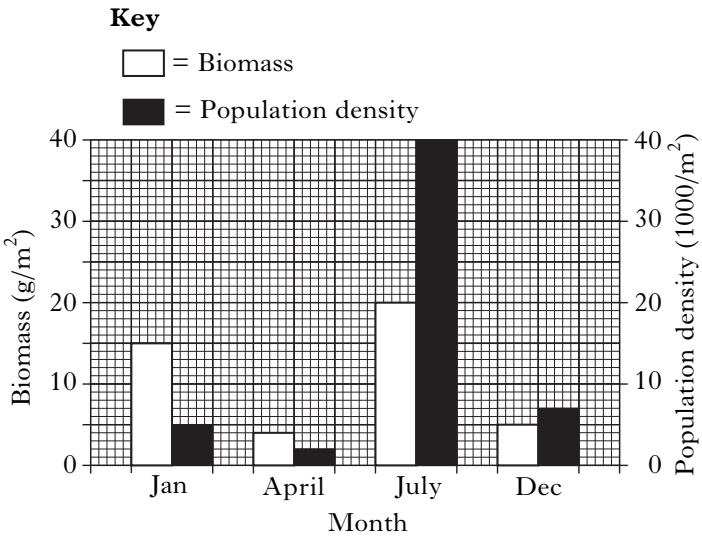
A 60 mg

B 300 mg

C 3000 mg

D 6000 mg

28. The graph below shows the annual variation in the biomass and population density of *Corophium*, a small burrowing invertebrate found in the mud of most Scottish estuaries.



During which month do individual *Corophium* have the greatest average mass?

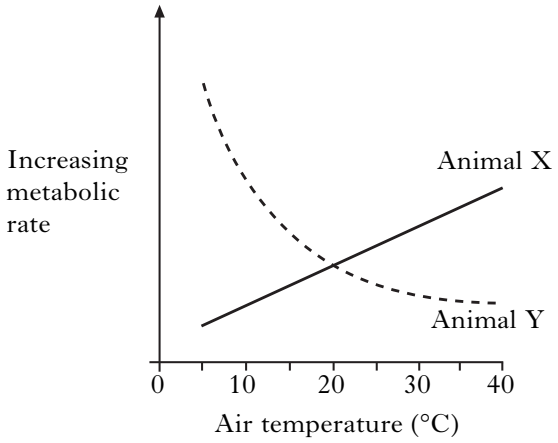
A January

B April

C July

D December

29. The graph below shows the effect of air temperature on the metabolic rate of two different animals.



Which line in the table below identifies correctly the temperatures at which oxygen consumption will be greatest in the tissues of each animal?

	Animal X	*Animal Y*
A	20 °C	20 °C
B	40 °C	40 °C
C	40 °C	5 °C
D	5 °C	40 °C

30. Which of the following comparisons of early and late succession in plant communities in their habitat is correct?

	Early succession	*Late succession*
A	low biomass	high biomass
B	complex food webs	simple food webs
C	soil is deep	soil is shallow
D	high species diversity	low species diversity

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

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

SECTION B

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. (*a*) The following sentences give information about the plasma membrane of beetroot cells.

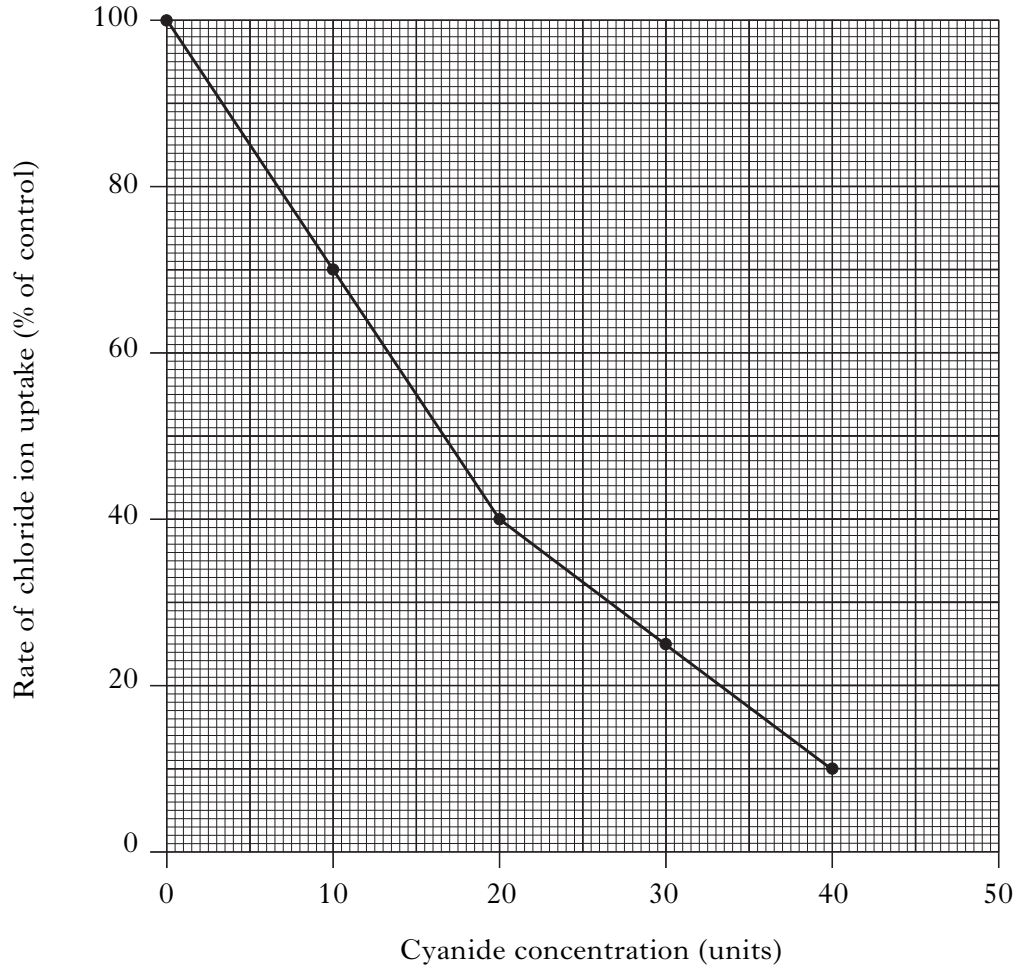
Underline one alternative in each pair to make the sentences correct.

The plasma membrane contains { cellulose / protein } and { phospholipids / carbohydrate } and has a { fibrous / porous } nature. As a result, the membrane is { fully / selectively } permeable. **2**

(*b*) Cyanide is a poison that inhibits enzymes involved in aerobic respiration.

The graph below shows how cyanide concentration affects the uptake of chloride ions by beetroot cells.

The rates of chloride ion uptake are given as percentages of those obtained in a control experiment with no cyanide.



DO NOT WRITE IN THIS MARGIN

Marks

1. (*b*) (continued)

(i) Predict the cyanide concentration at which chloride ion uptake would stop.

_____ units **1**

(ii) The rate of chloride ion uptake by beetroot at 30 units of cyanide was 200 μg per hour.

Calculate the rate of uptake in the control experiment.

Space for calculation

_____ μg per hour **1**

(iii) The uptake of chloride ions occurs by active transport.

Explain how the information given supports this statement.

_____

_____

_____

_____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

2. (*a*) State the **exact** location of photosynthetic pigments in plant leaf cells.

_____ **1**

(*b*) The table below shows the mass of photosynthetic pigments in the leaves of two plant species.

Photosynthetic pigment	*Mass of photosynthetic pigment in the leaves* (μg per cm^3 of leaf)	
	Species A	*Species B*
chlorophyll a	0·92	0·93
chlorophyll b	0·34	0·35
carotene	0·32	0·65
xanthophyll	0·28	0·55

Which species is best adapted to grow in the shade of taller plants?

Explain your choice.

Species _____

Explanation _____

_____

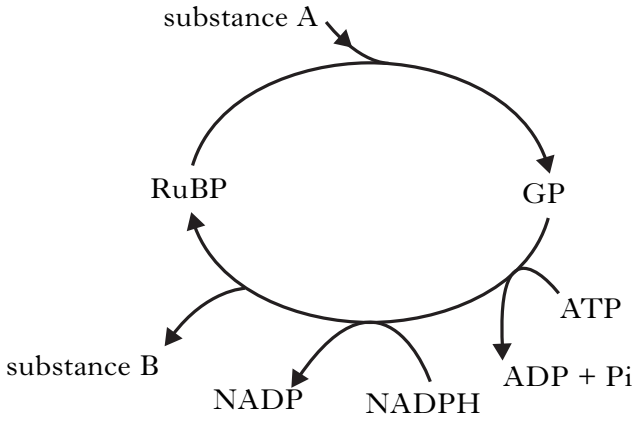
_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

2. (continued)

(*c*) The diagram below shows some events in the carbon fixation stage (Calvin cycle) of photosynthesis in a plant kept in bright light.



(i) Name substances A and B.

A _____

B _____ **2**

(ii) NADP carries hydrogen to the carbon fixation stage.

Describe the role of hydrogen in the carbon fixation stage.

_____

_____ **1**

(iii) Complete the table below to show the number of carbon atoms in one molecule of each compound.

Compound	*Number of carbon atoms per molecule*
RuBP	
GP	

1

(iv) Predict what would happen to the concentrations of RuBP and GP in leaf cells if the plant was moved from bright light into dark conditions.

Explain your answer.

RuBP _____

GP _____ **1**

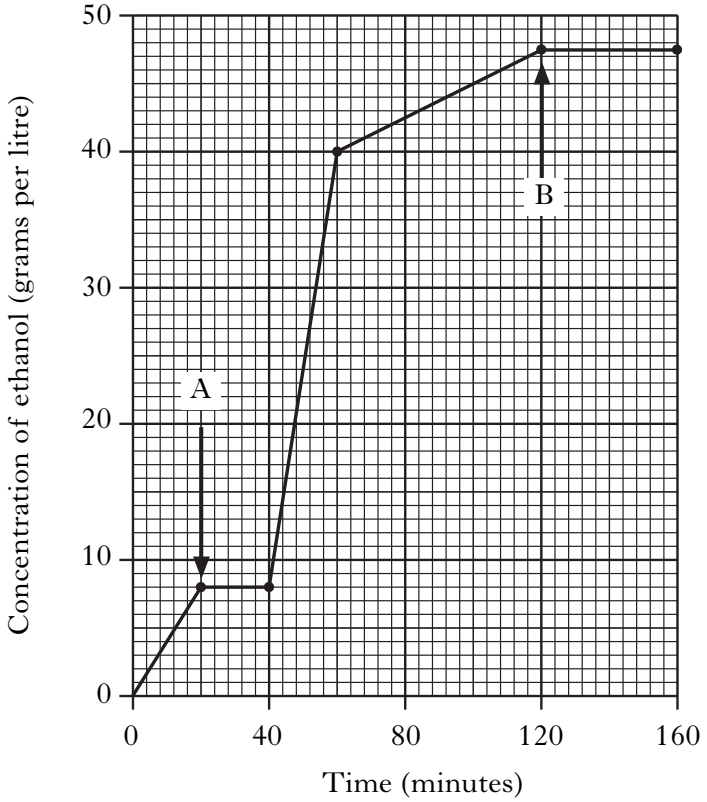
Explanation _____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

3. In an investigation, yeast was grown in a glucose solution for 160 minutes in a sterilised fermenter. Temperature was kept constant and anaerobic conditions were maintained. The graph below shows the changes in concentration of ethanol in the fermenter during the period.



(*a*) (i) Calculate the increase in concentration of ethanol between 60 and 140 minutes.

Space for calculation

_____ grams per litre **1**

(ii) Calculate the average increase in ethanol concentration per minute during the first 40 minutes.

Space for calculation

_____ grams per litre per minute **1**

(*b*) (i) At point A on the graph, the ethanol concentration stopped increasing when air temporarily leaked into the fermenter.

Explain this result.

_____

_____ **2**

(ii) Assuming no further air leaks, explain why the ethanol concentration stopped increasing at point B.

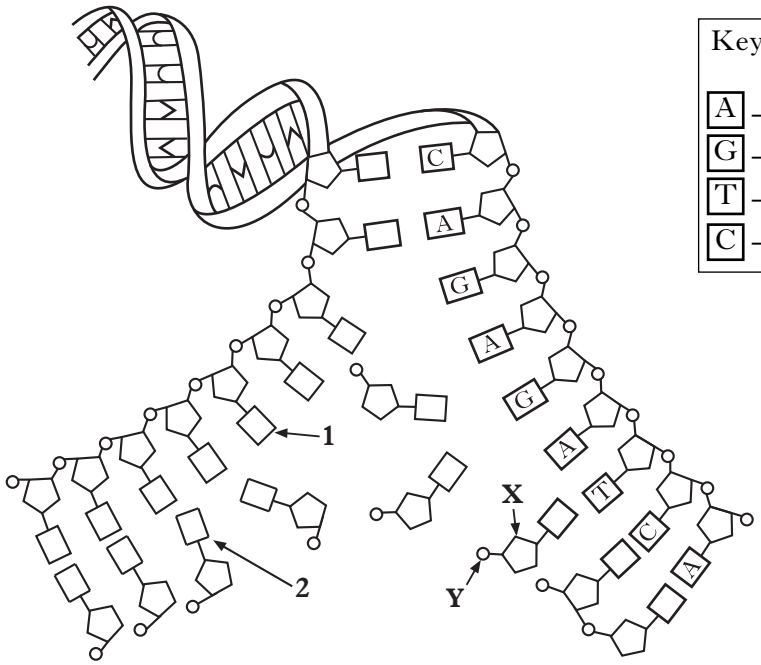
_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

4. (*a*) The diagram below shows part of a DNA molecule during replication.



(i) Identify parts X and Y.

X_____

Y_____ **1**

(ii) Name bases 1 and 2.

1 _____

2 _____ **1**

(iii) Name **two** substances, not shown on the diagram, which are necessary for DNA replication.

1 _____

2 _____ **2**

(iv) Name a cellular process for which DNA replication is essential.

_____ **1**

(*b*) DNA is also involved in protein synthesis.

During protein synthesis, tRNA molecules with the anticodon UAG attach to the amino acid isoleucine.

Identify the DNA base triplet which codes for isoleucine.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

5. (*a*) Tuberculosis is a disease caused by the bacterium *Mycobacterium tuberculosis*.

When the tuberculosis bacterium enters the human body it stimulates the production of antibodies.

(i) Name the type of cells which produce antibodies.

_____ **1**

(ii) What term is given to any substance that stimulates antibody production?

_____ **1**

(*b*) Leaf rust is a fungus which grows when its spores land on leaves. The fungus spreads over leaf surfaces causing damage.

Single leaves from four different species of cottonwood tree were sprayed with identical volumes of a suspension of rust fungus spores. After 3 days the percentage of leaf area with fungal growth was measured.

The tannin content in these leaves was also measured.

The results are shown in the table below.

Cottonwood species	*Percentage leaf area with fungal growth after 3 days*	*Tannin content in leaves* (mg per g of leaf dry mass)
Black	2·4	40·6
Eastern	11·4	3·9
Narrow-leafed	4·3	11·7
Swamp	3·2	15·6

(i) Express as the simplest whole number ratio, the tannin content in the leaves of the eastern cottonwood, narrow-leafed cottonwood and swamp cottonwood.

Space for calculation

_____ : _____ : _____ **1**

eastern narrow-leafed swamp

(ii) Which species of cottonwood appears most resistant to attack by leaf rust fungus?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

5. (*b*) continued

(iii) What evidence is there that tannins give protection against leaf rust fungus?

_____

_____

_____ **1**

(iv) Why was the tannin content of the leaves measured in mg per g of leaf dry mass and not fresh mass?

_____

_____ **1**

[Turn over

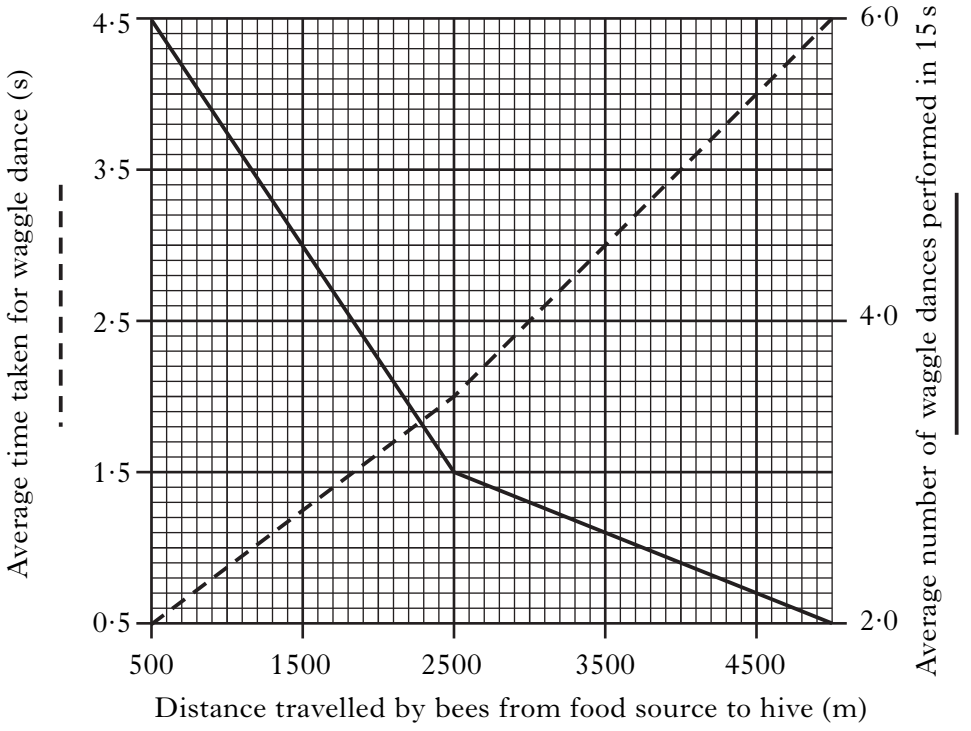
DO NOT WRITE IN THIS MARGIN

Marks

6. Honey bees are social insects. They forage for food at various distances from their hive. When a bee finds a food source, it returns to the hive and communicates the location of the food to other bees using body movements called waggle dances. These are performed several times with short intervals between them.

In an investigation, bees were fitted with radio tracking devices which allowed the distances they travelled from the hive to be measured. The waggle dances performed by each returning bee were studied. The average time taken for its waggle dance was recorded and the number of times it was performed in 15 seconds was counted.

The results are shown in the graph below.



(*a*) (i) **Use values from the graph** to describe the relationship between the distance travelled by a bee from the food source and the number of waggle dances performed in 15 s.

_____

_____

_____ **2**

(ii) State the average time taken for a waggle dance when the distance travelled by a bee from the food source is 1500 m.

_____ s **1**

Marks

6. (*a*) (continued)

(iii) Calculate the percentage increase in the average time taken for a waggle dance when the distance from the food source to the hive increases from 500 to 3500 metres.

Space for calculation

_____% **1**

(iv) Predict the total time a bee would spend in the waggle dances in a 15 s period when the food source is 2500 m away from the hive.

_____ s **1**

(*b*) In another investigation, the waggle dances of six bees from another hive were observed.

The results are shown in the table below.

BEE	*Number of times waggle dance was performed in 15 s*
1	2·65
2	2·20
3	2·30
4	2·55
5	2·70
6	2·60
Average	

(i) Complete the table by calculating the average number of times the waggle dance was performed in 15 s.

Space for calculation

1

(ii) Using information from the table and the graph, predict the distance that was travelled by bee 6 to its food source.

_____ m **1**

(*c*) (i) Apart from its distance from the hive, what other information about food sources would be useful to the bees?

_____ **1**

(ii) In terms of the economics of foraging, explain the advantage of waggle dances to bees.

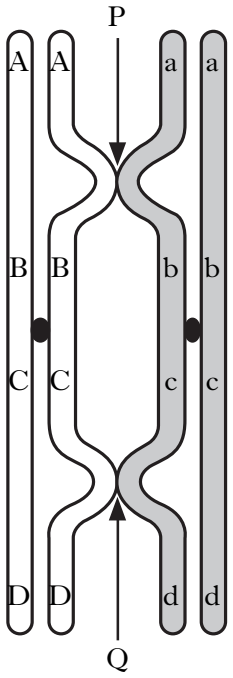
_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

7. The diagram below shows a pair of homologous chromosomes during meiosis. P and Q show points where crossing over **may** occur. The other letters show the positions of the alleles of four genes.



(*a*) What evidence confirms that these chromosomes are homologous?

_____

_____ **1**

(*b*) (i) What name is given to points P and Q?

_____ **1**

(ii) State the importance of crossing over in meiosis.

_____

_____ **1**

Marks

7. (continued)

(*c*) (i) In the table below, tick (✓) the boxes to identify which combination of alleles would result from crossing over at point P only or crossing over at both points P and Q on the diagram.

Combination of alleles	*Crossing over at*	
	point P only	*both points P and Q*
Abcd		
aBCD		
AbcD		
aBCd		

1

(ii) Give **one** possible sequence of alleles which could be found in a recombinant gamete formed if crossing over occurred at point Q only.

_____

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

8. (*a*) A rare form of rickets in humans is caused by a sex-linked allele **R** which is **dominant** to the allele **r**.

(i) Complete the table below by inserting **all** possible genotypes of the female phenotypes of this allele.

Phenotype	*Genotype*(*s*)
Affected female	
Unaffected female	
Affected male	X^RY
Unaffected male	X^rY

2

(ii) An affected female, whose father was unaffected, and an unaffected male have a son.

What is the percentage chance that their son will be unaffected?

Space for working

_____ % chance **1**

(iii) The occurrence of allele **R** is due to a mutation in which the DNA triplet CAG is altered to TAG.

Name this type of gene mutation and describe its effect on the structure of the protein it codes for.

Name _____ **1**

Description _____

_____ **1**

(*b*) Rickets can also result from a deficiency of vitamin D in the diet.

State the role of vitamin D in humans.

_____

_____ **1**

Marks

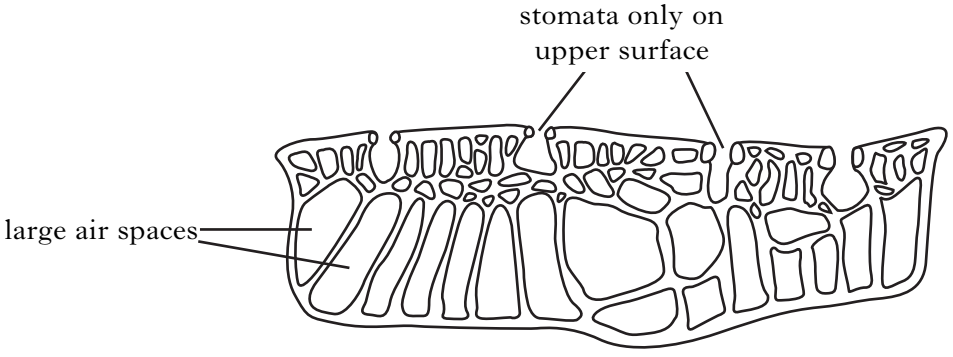
9. (*a*) The table below refers to environmental problems that salt water bony fish and desert rats have in osmoregulation and adaptations that these animals use to maintain their water balance.

Complete the table by giving an environmental problem faced by salt water bony fish and adding **one** adaptation to each empty box.

Animal	*Environmental problem*	*Adaptations for maintaining water balance*	
		behavioural	*physiological*
Salt water bony fish		drinks sea water	
Desert rat	little drinking water available		

2

(*b*) The diagram below shows a section through a floating leaf of a hydrophyte plant.



Explain how the large air spaces allow this plant to survive in its environment.

_____

_____

_____

2

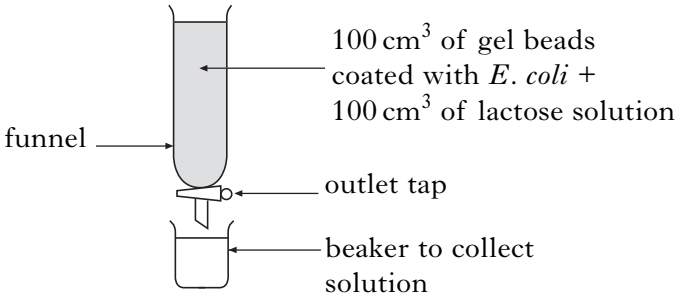
Marks

10. The Jacob-Monod hypothesis describes lactose metabolism in the bacterium *Escherichia coli*. Lactose acts as an inducer of the enzyme β-galactosidase in the bacterium. This enzyme breaks down lactose as shown.

$$\text{lactose} \xrightarrow{\beta\text{-galactosidase}} \text{glucose} + \text{galactose}$$

An investigation of this reaction in *E. coli* at 25 °C was carried out as described below.

- 100 cm^3 of gel beads coated with *E. coli* were placed into each of seven identical funnels fitted with outlet taps.
- 100 cm^3 of solution containing 2 grams of lactose was poured into each funnel.
- At each time shown in the table, the solution from one of the funnels was collected.
- The mass of lactose in each solution was measured.



The results are shown in the table below.

Funnel	*Time* (minutes)	*Mass of lactose in the solution collected* (g)
1	0	2·00
2	10	2·00
3	20	1·48
4	30	0·92
5	40	0·40
6	50	0·12
7	60	0·04

(*a*) (i) Identify **one** variable, not already mentioned, that should have been controlled to ensure that the experimental procedure was valid.

_____ **1**

(ii) A control experiment would be needed for each funnel.

Describe such a control and explain its purpose in the investigation.

Description _____

_____

Purpose _____

_____ **2**

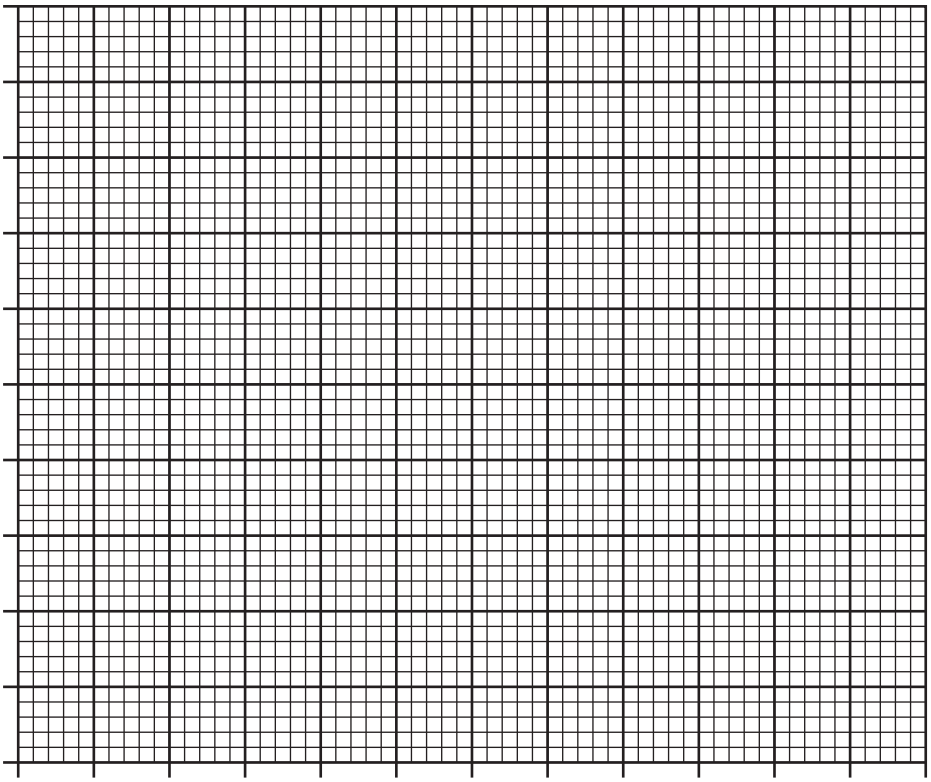
Marks

10. (continued)

(*b*) On the grid provided below, draw a line graph to show the mass of lactose in the solution collected against time.

Use an appropriate scale to fill most of the grid.

(Additional graph paper, if required, will be found on *Page thirty-six*.)



2

(*c*) Calculate the average mass of lactose broken down per minute in funnel 5.

Space for calculation

_____ g per minute **1**

(*d*) Use the information given to explain why *E. coli* had not broken down any lactose in the first 10 minutes.

_____

_____

_____ **2**

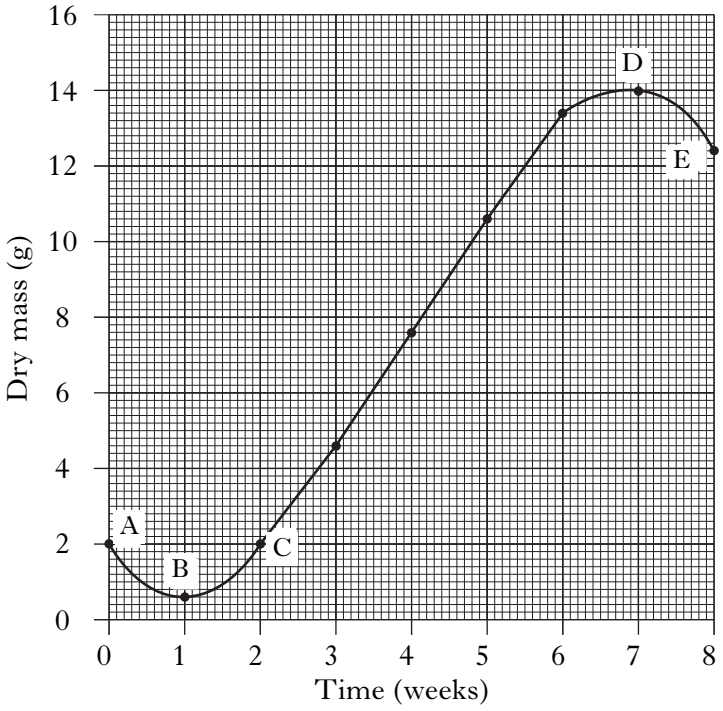
(*e*) State **one** advantage to *E. coli* of controlling lactose metabolism as described by the Jacob-Monod hypothesis.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

11. (*a*) The graph below shows the change in the dry mass of an annual plant as it grows from a seed over an eight week period.



(i) Tick (✓) **two** boxes to identify periods when the rate of growth was the same.

☐	☐	☐	☐	☐	☐	☐	☐
0–1 weeks	1–2 weeks	2–3 weeks	3–4 weeks	4–5 weeks	5–6 weeks	6–7 weeks	7–8 weeks

1

(ii) Which letter indicates the beginning of germination?

Letter _____ **1**

(iii) Which process accounts for the rise in dry mass between B and C?

_____ **1**

(iv) Suggest a reason for the decrease in dry mass between D and E.

_____ **1**

(*b*) Apart from the increase in mass, state **one** other way in which the growth of an annual plant could be measured.

_____ **1**

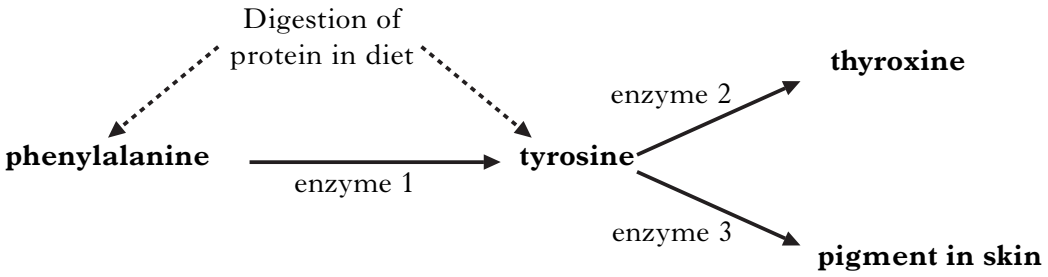
(*c*) Name the region of a shoot or root tip of an annual plant in which cell division occurs.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

12. Phenylalanine and tyrosine are amino acids produced from the digestion of protein in the human diet. Once absorbed, they are involved in the metabolic pathway shown below.



The condition phenylketonuria (PKU) can be caused by the absence of enzyme 1.

(*a*) Describe what leads to the absence of enzyme 1 in this condition.

_____

_____ **1**

(*b*) Explain why individuals with PKU still develop some pigment in their skin.

_____

_____ **1**

(*c*) State the role of thyroxine in the human body.

_____

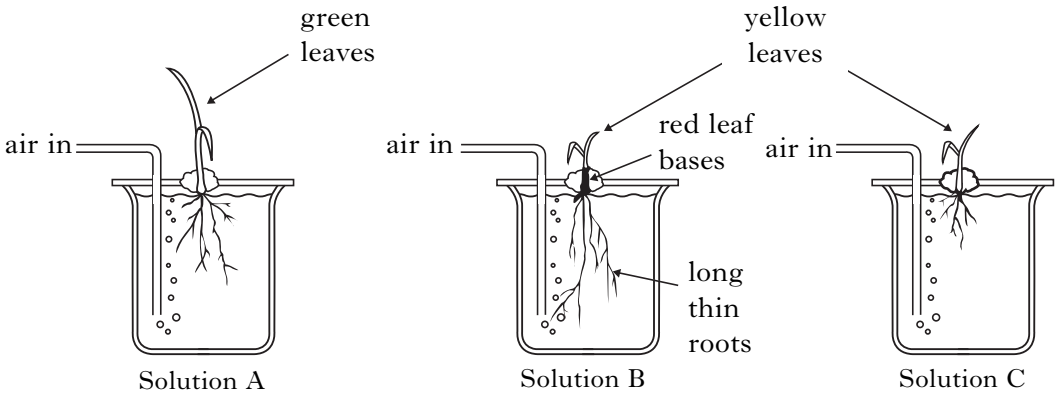
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

13. The diagrams show three barley seedlings which were grown in culture solutions. Solution A had all elements required for plant growth. Solutions B and C were each missing in one element required for normal plant growth. The seedlings were kept under a lamp which provided constant bright light conditions.



(*a*) Complete the table below by naming the element that was missing from culture solutions B and C and by giving a role for the element missing from solution B.

Solution	*Element missing from solution*	*Role of element in plants*
B		
C		component of chlorophyll

2

(*b*) In a further experiment, the seedling in solution A was grown in complete darkness for a week.

Give the term which would describe the seedling after this period and describe how the treatment would have affected its appearance.

Term _____ **1**

Description _____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

14. (*a*) The Colorado beetle is a pest of potato crops. In an investigation, the population of beetles in a 2000 m^2 potato field was estimated as described below.

A sample of the beetles from the field was collected and counted.

Each beetle was marked with a spot of paint then released back into the field.

Three days later a second sample of beetles was collected and counted.

The number of marked beetles in this second sample was noted.

The results are shown in the table below.

Number of beetles that were marked and released	*Number of beetles in second sample*	*Number of marked beetles in second sample*
500	450	5

The population of beetles can be estimated using the following formula.

$$\text{Population} = \frac{\text{number of beetles marked and released} \times \text{number of beetles in second sample}}{\text{number of marked beetles in second sample}}$$

(i) Calculate the **population density** of beetles in the field.

Space for calculation

_____ beetles per m^2 **1**

(ii) The beetle population is affected by both density-dependent and density-independent factors.

Name a density-dependent and a density-independent factor that could affect the population of beetles in the field.

Density-dependent factor _____

Density-independent factor _____ **1**

(*b*) A population of a species may be monitored to gain data for use in pest control.

State **two** further reasons why a wild population may be monitored.

1 _____

2 _____ **1**

[Turn over for Section C on *Page thirty-two*

Marks

SECTION C

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. Write notes on plant growth and development under the following headings:

(i) the effects of indole acetic acid (IAA); **6**

(ii) the role of gibberellic acid (GA) in the germination of barley grains. **4**

(10)

OR

B. Write notes on the following :

(i) endotherms and ectotherms; **2**

(ii) temperature regulation in mammals. **8**

(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 importance of isolating mechanisms, mutations and natural selection in the evolution of new species. **(10)**

OR

B. Give an account of the transpiration stream and its importance to plants. **(10)**

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 10(*b*)