Total

X007/301

NATIONAL
QUALIFICATIONS
2000

MONDAY, 29 MAY
9.00 AM – 11.30 AM

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.

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.

(c)   Question 14 is on pages 30, 31 and 32. The additional graph paper is on page 33.
Pages 32 and 33 are fold-out pages.

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 and rough work 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.

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.

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SECTION A

**Sample Question**

Which of the following molecules contains six carbon atoms?

A   Pyruvic acid

B   Glucose

C   Ribulose bisphosphate

D   Acetyl co-enzyme A

The correct answer is **B**—glucose. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown in the example on the answer sheet.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer D to an answer B, your answer sheet would look like this:
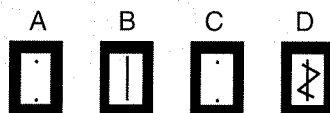
If you want to change back to an answer which has already been scored out, you should enter a tick (✓) to the **right** of the box of your choice, thus:
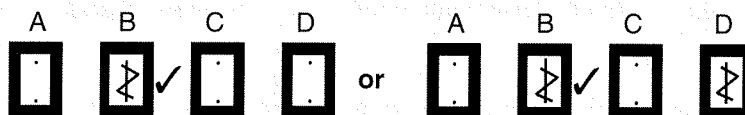
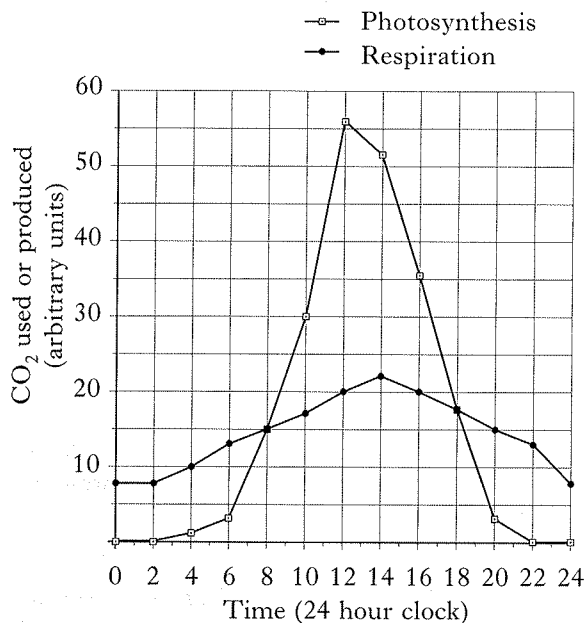**All questions in this section should be attempted.**

Answers should be given on the separate answer sheet provided.

1. The graph shows the rates of respiration and photosynthesis in a plant, over a 24 hour period.

At which of the following times is there the greatest net production of carbohydrate?

A   0800 hours

B   1200 hours

C   1400 hours

D   1800 hours

2. The graph shows the effect of varying carbon dioxide concentration on the rate of photosynthesis in a plant.

Carbon dioxide concentration
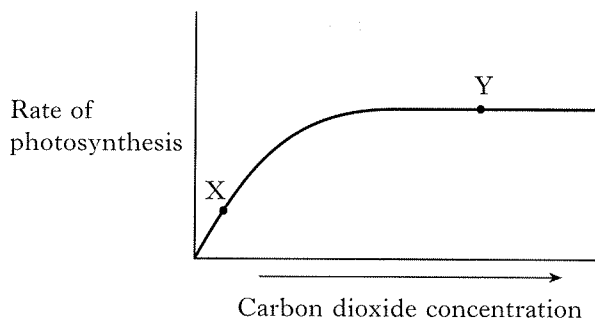
Which line in the table shows factors which could be limiting the rate of photosynthesis at points X and Y?

	Limiting factor at X	Limiting factor at Y
A	temperature	carbon dioxide concentration
B	light intensity	temperature
C	carbon dioxide concentration	temperature
D	carbon dioxide concentration	carbon dioxide concentration

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

A   mitochondria

B   chloroplasts

C   ribosomes

D   vacuoles.

[Turn over

4. Which of the following correctly identifies the sequence in which organelles become involved in the production of a hormone for secretion?

   A   Nucleus → Ribosome → Golgi Apparatus → Rough E.R.

   B   Ribosomes → Rough E.R. → Golgi Apparatus → Vesicles

   C   Nucleus → Rough E.R. → Vesicles → Ribosomes

   D   Ribosomes → Vesicles → Rough E.R. → Golgi Apparatus

5. Cyanogenesis in *Trifolium repens* is a defence mechanism against

   A   grazing

   B   bacterial invasion

   C   fungal infection

   D   water loss.

6. Which of the following is **not** a plant response to invasion by other organisms?

   The production of

   A   resin

   B   nicotine

   C   antibodies

   D   tannins.

7. Lysosomes are involved in the defence of the body as they

   A   carry out phagocytosis to engulf bacteria

   B   produce antibodies to destroy viruses

   C   contain lymphocytes

   D   allow phagocytes to digest bacteria.

8. An enzyme and its substrate were incubated with various concentrations of either copper or magnesium salts.

   The time taken for the complete breakdown of the substrate was measured.

   The results are given in the table.

Metal concentration (mol l^{-1})	Time needed to break down substrate (Seconds)	
	Copper salts	Magnesium salts
0	39	39
1×10^{-8}	42	21
1×10^{-6}	380	49
1×10^{-4}	1480	286

Which line in the table below describes correctly the effects of high concentrations of these metals on enzyme activity?

	High concentration of copper salts	High concentration of magnesium salts
A	promoted	promoted
B	promoted	inhibited
C	inhibited	inhibited
D	inhibited	promoted

Questions 9 and 10 refer to the information below.

In tomato plants, dominant allele **P** determines purple stem and allele **p** determines green stem. In addition, dominant allele **F** determines a cut-edged leaf and allele **f** determines a smooth-edged leaf.

The following table shows two crosses of tomato plants.

PARENT CROSSES	NUMBER OF PROGENY			
	Purple and cut	Purple and smooth	Green and cut	Green and smooth
1 Purple, cut × purple, smooth	219	207	64	71
2 Purple, cut × green, cut	722	231	0	0

9. What are the most probable genotypes for the parents in cross 1?

   A PpFF × PPff

   B PpFF × Ppff

   C PpFf × PPff

   D PpFf × Ppff

10. What are the most probable genotypes for the parents in cross 2?

   A PPFf × ppFF

   B PPFf × ppFf

   C PpFf × ppFF

   D PpFf × ppFf

11. Huntington's chorea is a non-sex-linked dominant condition in which muscle coordination and mental abilities are gradually lost. Usually the symptoms do not appear until the person is approaching middle age.

   A woman's father is heterozygous for this condition. Her mother is normal. What are the chances of her inheriting this condition?

   A 1 in 1

   B 1 in 2

   C 1 in 3

   D 1 in 4

12. Which of the following describes the chromosome complement of a white blood cell?

   A Polyploid

   B Diploid

   C Haploid

   D Nil

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

Cell type	Mass of DNA/cell $(\times 10^{-12} g)$
liver	6·6
lung	6·6
P	3·3
Q	0·0

From the information in the table, cell types P and Q are, respectively

   A a kidney cell and an ovum

   B a nerve cell and a mature red blood cell

   C a mature red blood cell and an ovum

   D an ovum and a mature red blood cell.

14. The table below shows the number of chromosomes in human gametes from both normal and abnormal meiosis.

An autosome is any chromosome other than a sex chromosome.

Gamete	Number of autosomes	Type of sex chromosome
A	23	X
B	22	X
C	22	Y
D	23	Y

Which ovum, when fertilised with a normal sperm, will result in a child with Down's Syndrome?

15. The diagram below represents the areas of interbreeding of 4 groups of birds. Interbreeding takes place in the shaded areas.
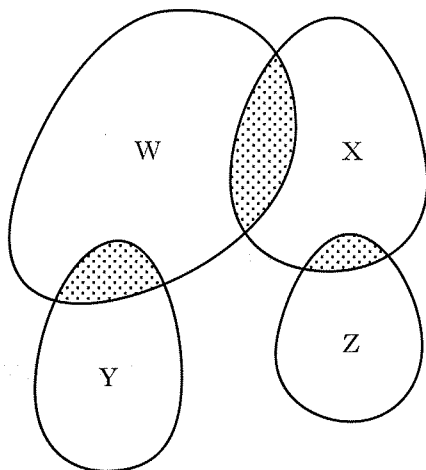
How many species are present?

A   1

B   2

C   3

D   4

16. In an investigation into the population size of peppered moths, 50 moths were captured in a woodland area, marked and released. One day later, another 50 moths were captured and 10 of these were found to be marked.

All the marked moths had survived in the area during the 24 hour period. What is the estimated moth population in the woodland area?

A   60

B   90

C   250

D   500

17. Which of the following adaptations are likely to occur in a desert mammal?

A   Short loops of Henlé and a low concentration of ADH

B   Short loops of Henlé and a high concentration of ADH

C   Long loops of Henlé and a low concentration of ADH

D   Long loops of Henlé and a high concentration of ADH

18. Which of the following is an example of competition within a species?

A   Poppies growing amongst wheat

B   Maize plants growing in a field

C   Bracken growing around seedling pine trees

D   Rabbits and sheep feeding on grass in the same field

19. Which of the following statements about habituation is correct?

A   It is a temporary change in behaviour.

B   It occurs only in young animals.

C   It is an example of social behaviour.

D   It is a permanent change in behaviour.

20. Two plants of different species had their carbon dioxide (CO_2) uptake and output measured in relation to light intensity. The results are shown below.
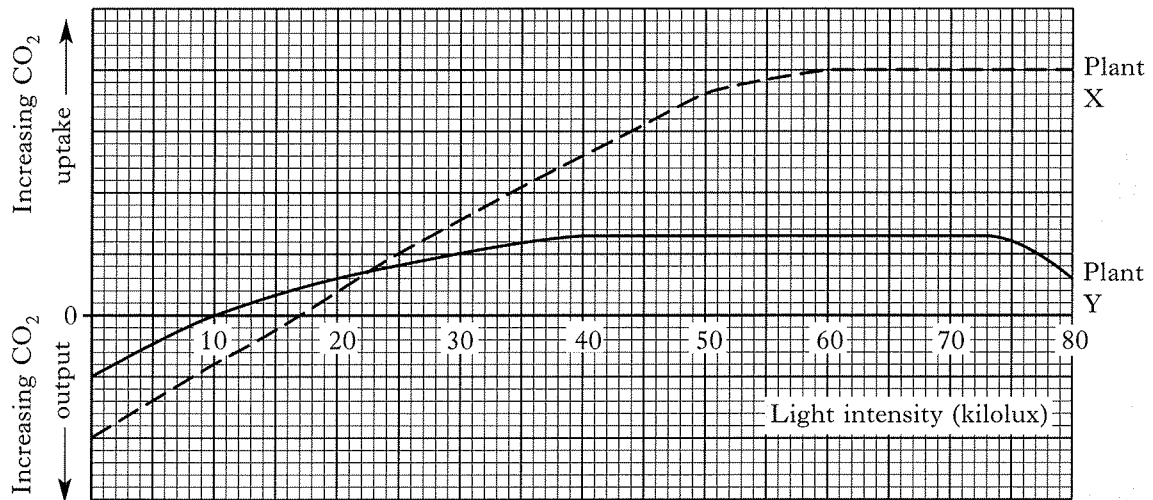
Which of the conclusions in the table below would be a correct interpretation of the graphs?
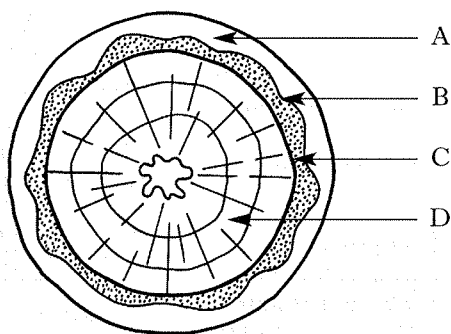
	Type of plant	Light intensity at which Compensation Point is reached
A	Plant X is a shade plant.	17 kilolux
B	Plant X is a sun plant.	60 kilolux
C	Plant Y is a sun plant.	40 kilolux
D	Plant Y is a shade plant.	10 kilolux

Questions 21 and 22 refer to the diagram of a transverse section through a dicotyledon stem shown below.

21. In the diagram of a transverse section of a dicotyledon stem shown above, where is a meristematic layer to be found?

22. In which region of the stem would the structure shown in the diagram below be found?
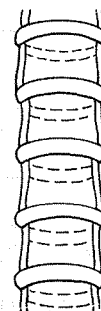
23. Which of the following plant cells is **not** formed as a result of differentiation?

A Cambium cell

B Companion cell

C Phloem sieve tube

D Xylem vessel

24. Part of the *E. coli* chromosome is shown in the diagram below.

Regulator Gene		Operator	Gene R	Gene S	

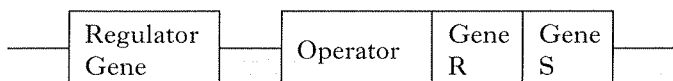The product of the regulator gene normally binds with the operator. If a mutation occurs in the regulator gene such that its product can no longer bind with the operator, which of the following occurs?

A Transcription of genes R and S only when the appropriate substrate is present

B No transcription of genes R and S at any time

C Continuous transcription of genes R and S

D Intermittent transcription of genes R and S

25. An investigation into the influence of different concentrations of IAA on the development of certain plant organs was carried out. The growth-inhibiting or growth-promoting effects are shown below.
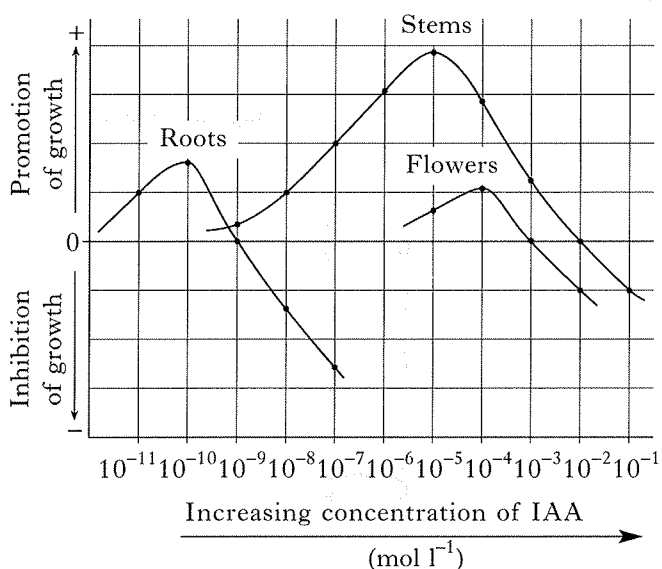
The graph shows that an IAA concentration of

A 10^{-3} mol l^{-1} promotes flowering and stem growth

B 10^{-5} mol l^{-1} causes increase in stem length and flower production

C 10^{-7} mol l^{-1} increases growth in roots and stems

D 10^{-9} mol l^{-1} inhibits stem growth and promotes root growth.

26. The flow diagram below outlines the processes which occur in the human body to speed up the metabolic rate.
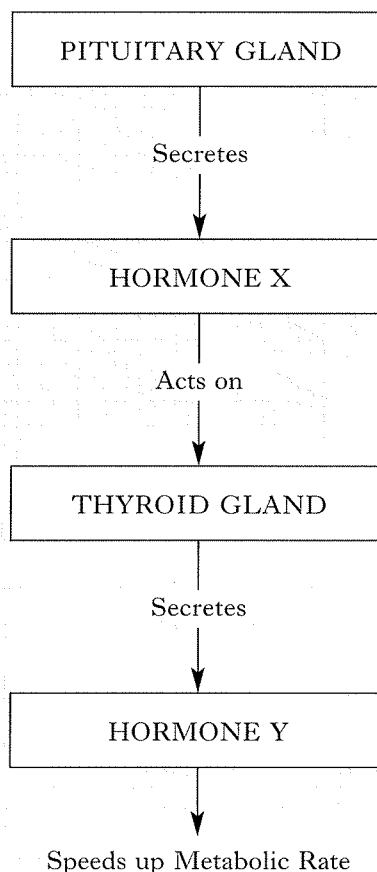
Hormones X and Y are

	X	Y
A	Thyroid Stimulating Hormone (TSH)	Thyroxine
B	Growth Hormone	Thyroid Stimulating Hormone (TSH)
C	Thyroxine	Thyroid Stimulating Hormone (TSH)
D	Thyroid Stimulating Hormone (TSH)	Growth Hormone

27. In a germinating barley grain, gibberellic acid stimulates the production of

A soluble sugar by the endosperm

B amylase by the endosperm

C soluble sugar by the aleurone layer

D amylase by the aleurone layer.

28. The table below gives information concerning three macro-elements X, Y and Z.

Macro-elements	Symptom of deficiency	Role of the macro-element
X	Chlorotic leaves Reduced growth	Required for chlorophyll production
Y	Reduced growth Leaf bases red	Required for ATP and nucleic acids
Z	Chlorotic leaves Reduced growth	Formation of proteins and nucleic acids

Which of the following correctly identifies X, Y and Z?

	X	Y	Z
A	Magnesium	Nitrogen	Phosphorus
B	Nitrogen	Potassium	Magnesium
C	Magnesium	Phosphorus	Nitrogen
D	Nitrogen	Magnesium	Potassium

29. Drinking a large volume of water will lead to

A   increased production of ADH and kidney tubules becoming more permeable

B   decreased production of ADH and kidney tubules becoming more permeable

C   decreased production of ADH and kidney tubules becoming less permeable

D   increased production of ADH and kidney tubules becoming less permeable.

30. The graph below shows the variation in prey and predator numbers recorded over a ten week period.
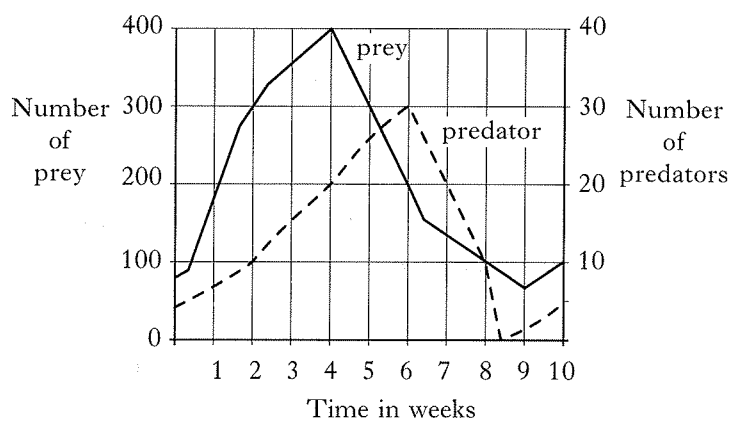
In which week is the prey to predator ratio largest?

A   Week 2

B   Week 4

C   Week 6

D   Week 8

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 ten*

SECTION B

All questions in this section should be attempted.

1. The pathway below represents an outline of stages in respiration in a mammalian cell.
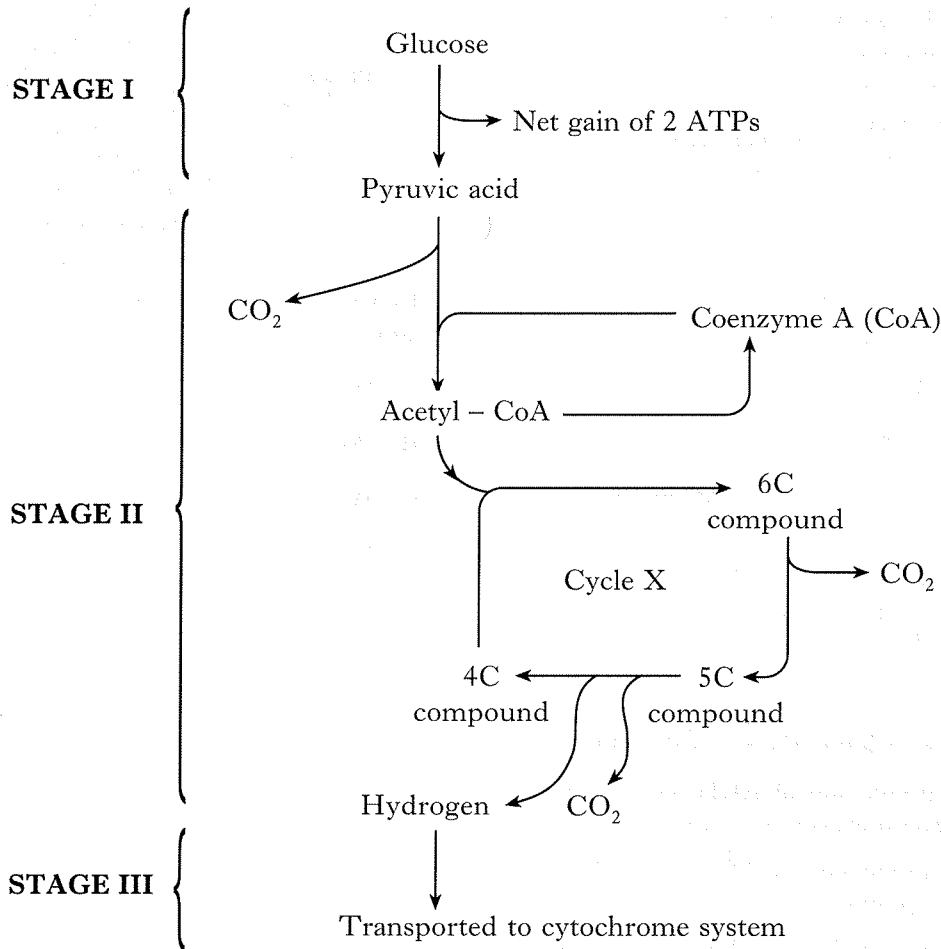
(a) Complete the table below by inserting the number of carbon atoms present in each substance.

Substance	Number of carbon atoms
Glucose	
Pyruvic acid	
Acetyl group	

2

(b) Explain why the gain of 2ATPs in **STAGE I** is described as being a **net** gain.

_____

_____

1

Marks

1.   (continued)

(c)   Name cycle X in **STAGE II**.

Name _____

1

(d)   Name the carrier that transfers hydrogen to the cytochrome system.

Name _____

1

(e)   Name the final hydrogen acceptor in **STAGE III**.

Name _____

1

[Turn over

2. (*a*)   Slices of beetroot, rhubarb and celery tissues were immersed in sugar *Marks*
solutions of different concentrations.   After 30 minutes the number of
plasmolysed cells in a sample of 50 cells was counted under a microscope.

Concentration of sugar solution (mol l^{-1})	Number of plasmolysed cells in a sample of 50 cells after 30 minutes		
	Beetroot tissue	Rhubarb tissue	Celery tissue
0·30	0	10	5
0·35	4	16	8
0·40	10	25	14
0·45	20	40	30
0·50	35	45	40
0·55	50	50	50

(i)   From the table, identify the solute concentration of the cell contents of
rhubarb tissue in which 50% of the tissue cells show plasmolysis.

_____ mol l^{-1} **1**

(ii)   Explain how the results for celery tissue at a concentration of
0·35 mol l^{-1} suggest that the cells do not all have the same cell sap
concentration.

_____

_____   **1**

(iii)   Which of the tissues has cells with the highest solute concentration?

Tissue _____   **1**

(iv)   From the results, calculate the percentage increase in the number of
plasmolysed cells which would occur in beetroot tissue when moved
from a 0·45 mol l^{-1} to a 0·50 mol l^{-1} sugar solution.
Space for calculation

Answer _____ %   **1**

Marks

2. (continued)

(*b*) The descriptions in the list below refer to either the cell wall or the cell membrane.

Complete the table, using the letter **W** for descriptions of the cell wall and **M** for descriptions of the cell membrane.

Description	Letter
Destroyed by boiling	
Made up of fibres	
Fully permeable	
A fluid mosaic	
Contains proteins	

2

(*c*) The graph shows the effect of change in the oxygen concentration on the rate of absorption of potassium ions from solution by the roots of barley seedlings.

Units of potassium absorbed per hour

Increasing oxygen concentration
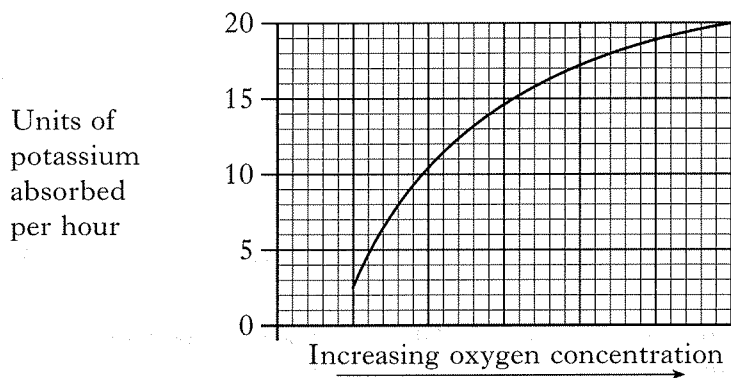
Account for the effect of increased oxygen concentration on the absorption of potassium ions from solution.

_____

_____

_____   **2**

[Turn over

3. (a) In an investigation into the sequence of reactions that occur in photosynthesis, unicellular green algae were kept in the dark for 24 hours and then exposed to light for varying periods. After each period of illumination an extract of the algal cells was obtained. The chromatograms developed from these extracts are shown below together with the length of the period of illumination.

After 2 seconds of illumination　　After 5 seconds of illumination　　After 10 seconds of illumination　　After 30 seconds of illumination
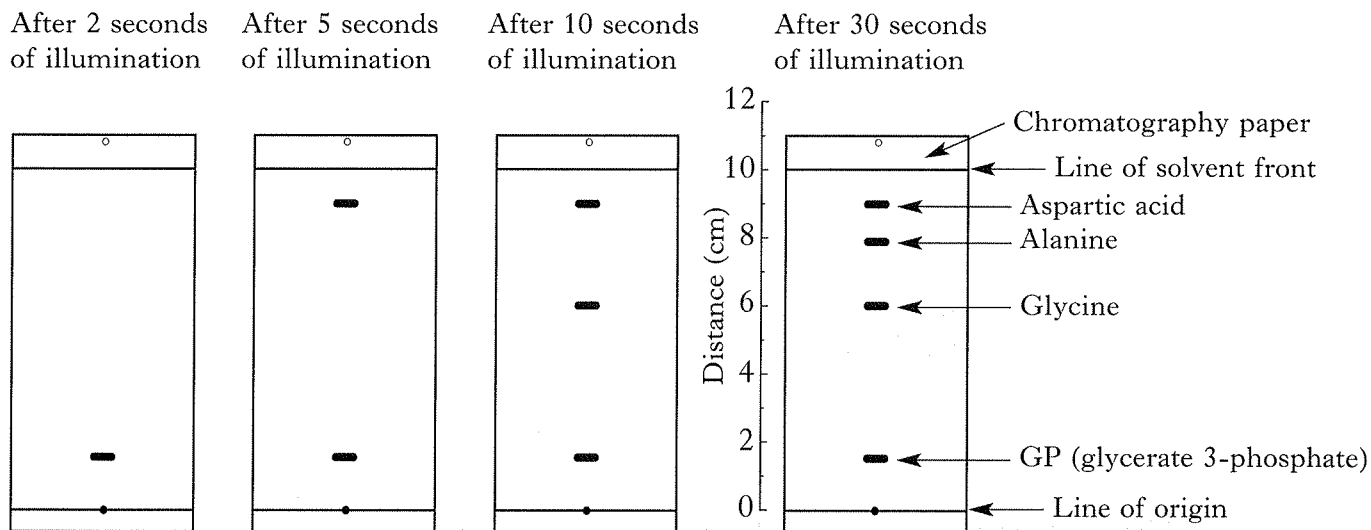

Chromatography paper
Line of solvent front
Aspartic acid
Alanine
Glycine
GP (glycerate 3-phosphate)
Line of origin

Distance (cm)

Marks

(i) From the chromatograms, state the sequence in which these chemical compounds were formed.

Sequence _____ → _____ → _____ → _____   **1**

(ii) The Rf value of a compound can be calculated from a chromatogram and then used to identify the compound. The formula for calculating the Rf value is shown below.

$$\text{Rf value} = \frac{\text{Distance travelled by compound from origir}}{\text{Distance travelled by solvent from origin}}$$

From the chromatogram, using the formula, calculate the Rf value of glycine.

Space for calculation

Rf value for glycine = _____   **1**

Marks

3. (continued)

(*b*) The graph below shows the relative concentrations of glycerate 3-phosphate (GP) and ribulose 1, 5-bisphosphate (RuBP) in a chloroplast during changes in light and dark conditions.

Relative concentrations of GP and RuBP

GP

RuBP

Light period   Dark period   Light period
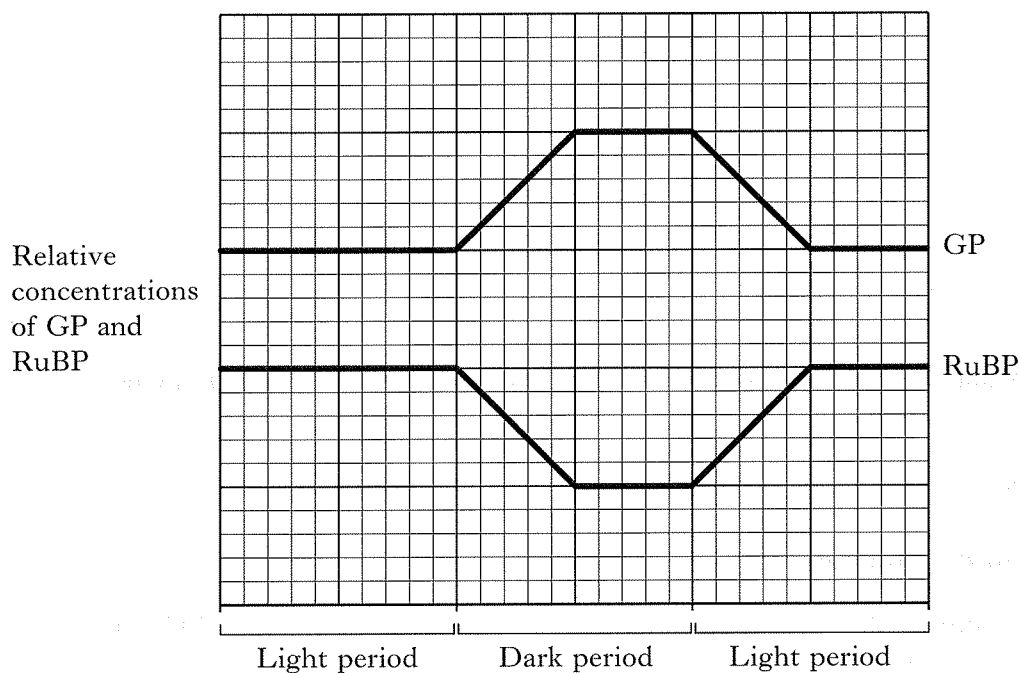
(i) What evidence from the graph supports the statement that GP can be converted to RuBP in the light?

_____

_____ **1**

(ii) Name the **two** chemical compounds produced in the light dependent stage that are required for the conversion of GP to RuBP.

Compound 1 _____   Compound 2 _____ **1**

(iii) Other than being converted to RuBP, GP is also converted to a 6 carbon sugar. Name this 6 carbon sugar.

Name _____ **1**

(iv) Within which region of the chloroplast does the inter-conversion of GP and RuBP occur?

Region _____ **1**

[Turn over

4. (*a*) The diagram below represents the four different nucleotides of DNA. The bases of the nucleotides are bonded in pairs.

Marks
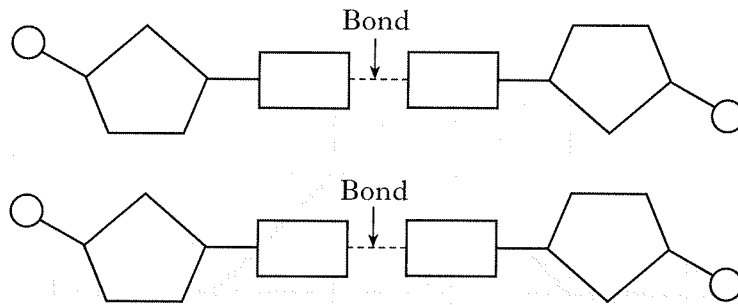
(i) Name the type of bond which links the base of one nucleotide to the base of another.

Name _____

1

(ii) **On the diagram**:

1 insert the appropriate letters or names of the four different nucleotides;

1

2 draw lines to show how adjacent nucleotides are bonded in a DNA molecule.

1

(*b*) Complete the table below to show structural differences between the nucleic acids DNA and RNA.

	Type of nucleic acid	
Structure	*DNA*	*RNA*
Number of strands present		
Type of sugar in nucleotide		

1

Marks

4. (continued)

(c) The diagram below shows part of one strand of a DNA molecule and the results of four different types of gene mutation which can occur within this molecule.

Part of DNA molecule →

C T G A A C G

Mutation 1 ⟶ C T T A A C G

Mutation 2 ⟶ C T G A G C A

Mutation 3 ⟶ C T G A C G

Mutation 4 ⟶ C T G A C A C G
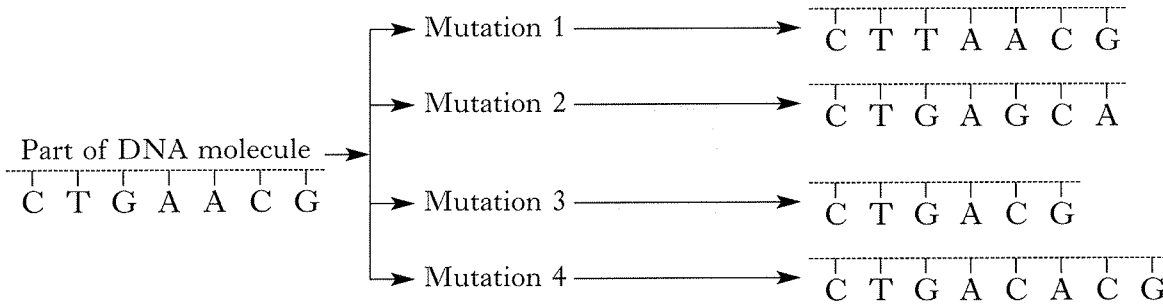
Complete the table below by naming the type of gene mutation which has occurred in each case.

Mutation number	Type of gene mutation
1	
2	
3	
4	

2

(d) Name **one** mutagenic agent.

_____

1

(e) Haemophilia in humans results from a gene mutation.

The allele for haemophilia (**h**) is sex-linked and recessive to the normal allele (**H**) for blood clotting.

The family tree below shows inheritance of the condition.

Key

■ male with haemophilia

□ male without haemophilia

○ female without haemophilia

Andrew   Mairi

Conor   Douglas   Margaret   Hugh

Jack
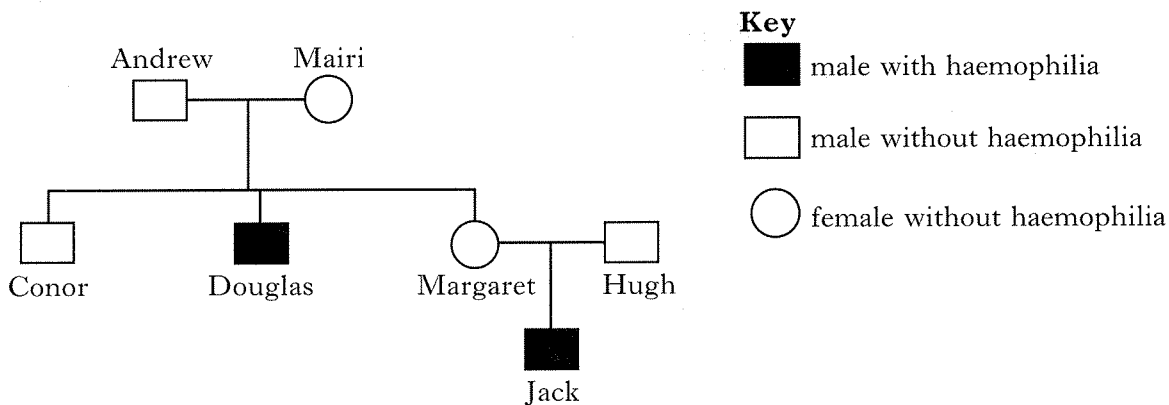
Give the genotype of each of the following individuals.

Conor _____   Douglas _____   Margaret _____

2

Marks

5. The diagram below shows the structure of a virus that invades and replicates within plant cells.

nucleic acid ⎯⎯⎯
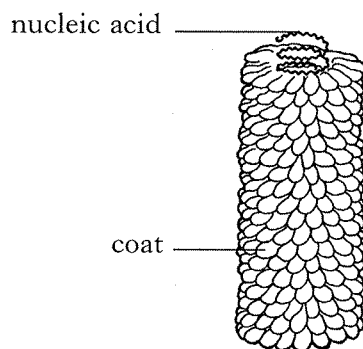
coat ⎯⎯⎯

(a) Name the type of chemical substance that forms the viral coat.

Name _____ **1**

(b) Stages in the invasion of a plant cell by a virus are listed below.
Using the appropriate letters, place the stages in the correct sequence.

Letter	*Stages*
A	Assembly of new viruses
B	Synthesis of viral coat
C	Entry of viral nucleic acid into cell
D	Replication of viral nucleic acid

Sequence _____ → _____ → _____ → _____ **1**

(c) The sequence below shows transmission of a virus through **two** generations.

1 Virus infects a plant cell.
2 First generation of viruses released.
3 New plant cells infected.
4 Second generation of viruses released.

The figures for transmission success of the virus to new plant cells are shown below.

50 viruses are released from any infected plant cell.
30% of released viruses infect new plant cells.

If a single virus infected a plant cell, calculate the number of viruses expected to be released in the second generation.

Space for calculation

Number _____ **1**

6. Read these statements about enzymes and answer the questions which follow.

Marks

1. Enzymes play a vital role in the life of all organisms. Their activity can be affected by environmental factors such as the presence of lead.

2. Enzymes are proteins and are coded for by genes.

3. Occasionally a gene mutation occurs and the effect of this is the production of an abnormal enzyme.

4. An abnormal enzyme may cause a block in a metabolic pathway.

5. Certain bacteria produce the enzyme β-galactosidase which breaks down lactose.

6. Production of this enzyme is normally prevented by the activity of a regulator gene.

(a) What is the effect of lead referred to in statement 1?

_____

_____ 1

(b) To which class of proteins do enzymes belong (statement 2)?

_____ 1

(c) Explain how a gene mutation would lead to production of an abnormal enzyme (statement 3).

_____

_____

_____ 1

(d) Explain how the activity of the regulator gene has the effect described in statement 6.

_____

_____ 1

(e) Which statements describe the cause of a disorder such as phenylketonuria?

_____ 1

[Turn over

Marks

7. The diagram below represents a stage in the process of meiosis.

   The letters E or e, F or f and G or g show the positions of the alleles of three genes.

   Homologous pairs of chromosomes align and form points of contact as shown by X and Y.
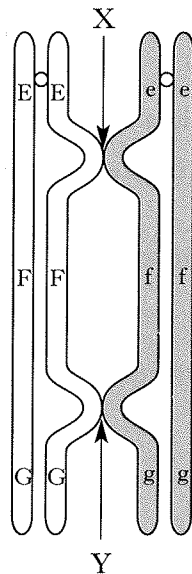
   (*a*) What name is given to points X and Y?

   _____ 1

   (*b*) Crossing over may take place at points X and Y.

   In the table below tick (✓) the boxes to identify which combinations of alleles would result from crossing over at point X only, and crossing over at both points X and Y.

Combination of alleles	Crossing over at point X only	Crossing over at points X and Y
eFg		
EfG		
eFG		
Efg		
EFg		
efG		

   2

   (*c*) Crossing over is a feature of meiosis that leads to variation.

   Name **one** other feature of meiosis that leads to variation.

   _____

   _____ 1

7. (continued)

Marks

(*d*) In a certain organism, the genes P, Q, R and S are located on the same chromosome. The table below shows the frequency of recombination between different pairs of genes.

Gene pairs	Frequency of recombination %
P and Q	8
P and R	14
Q and R	22
Q and S	4
S and P	12

Use the information in the above table to show the positions of genes P, Q, R and S in relation to each other on the chromosome diagram below.

Chromosome --

1

[Turn over

Marks

8. (*a*) A salmon was transferred from fresh water to salt water.

The graph below shows the changes in the drinking rate of the salmon.
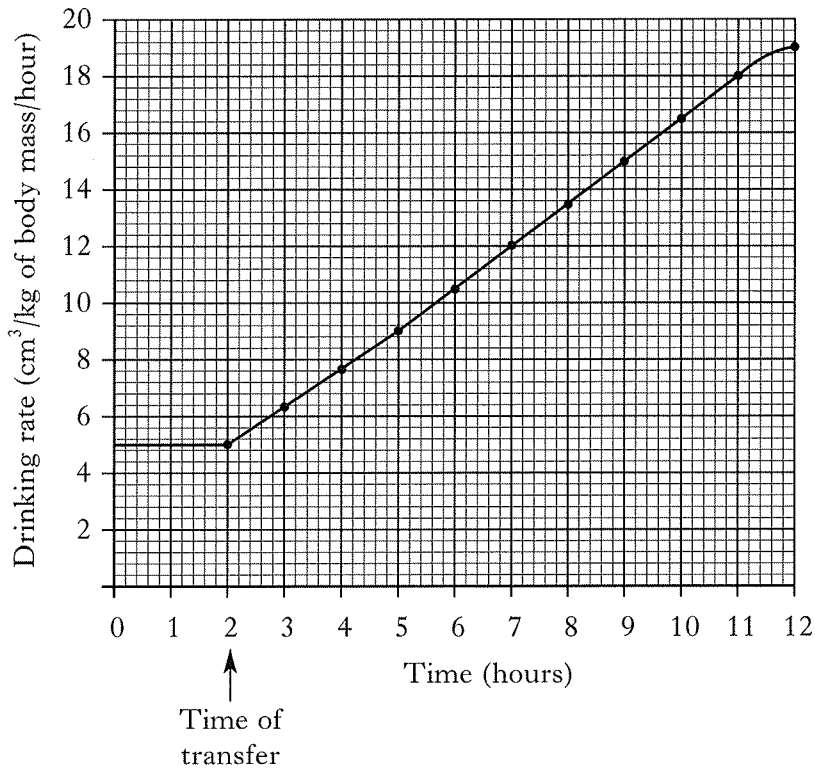
(i) Calculate the volume of water drunk by a salmon weighing 2·5 kg over the two hour period before it was transferred to salt water.

Space for calculation

_____ cm^3 **1**

(ii) Calculate the percentage increase in the drinking rate nine hours after transfer.

Space for calculation

_____ % **1**

(iii) Describe the activity of the chloride secretory cells of the gills while the salmon is in the fresh water environment.

_____

_____ **1**

Marks

8. **(*a*) (continued)**

    (iv) Complete the following sentences by **underlining** one of the words from each pair.

When the salmon is in salt water, water $\begin{Bmatrix} \text{leaves} \\ \text{enters} \end{Bmatrix}$ by osmosis.

The reason for this is that its tissues are $\begin{Bmatrix} \text{hypertonic} \\ \text{hypotonic} \end{Bmatrix}$ to the salt water.   **1**

    (v) In the table below tick (✓) the boxes which show the changes in kidney function which occur when the salmon is transferred to salt water.

Kidney function	*Increase*	*Decrease*	*Stays the same*
Rate of filtration			
Rate of production of urine			

1

(*b*) The diagram below represents a cross section through a leaf that has sunken stomata.
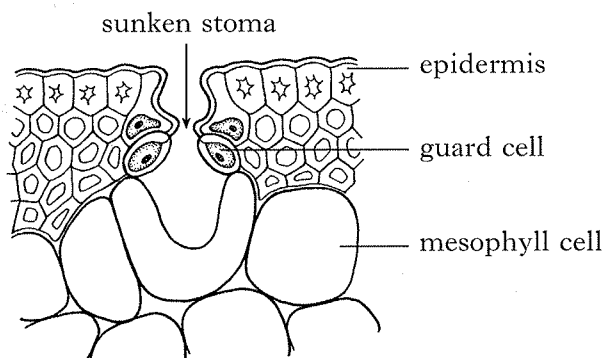
    (i) Describe the conditions of the environment in which plants with sunken stomata may be found.

Explain how this adaptation would be advantageous to survival in these conditions.

Conditions _____

Explanation _____

_____

2

    (ii) Explain the effect of an increase in turgor of the guard cells on the rate of transpiration.

_____

_____

1

[Turn over

9. The apparatus shown below was used to measure the rate of transpiration of a leafy *Marks* twig at different temperatures.
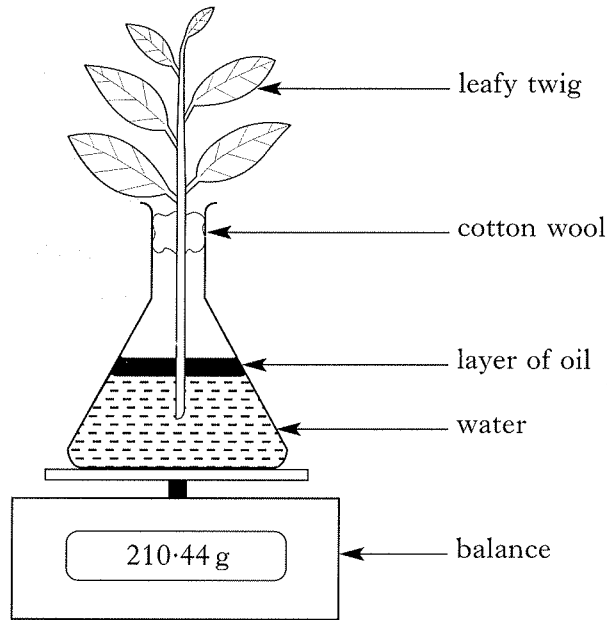
The changes in mass recorded can be used to calculate the mass of water lost in transpiration over a 10 minute period of time.

(a) Explain why the twig was cut off under water when the apparatus was being set up.

_____

_____ **1**

(b) The apparatus was left at each temperature for 15 minutes before starting to measure the transpiration rate.
Explain why this precaution was good experimental procedure.

_____

_____ **1**

(c) Identify **one** environmental factor that must be kept the same at each temperature in order to make the results obtained valid.
Explain why this factor must be kept constant.

Environmental factor _____

Explanation _____

_____ **1**

9. **(continued)**

The table below shows the results of the investigation.

Temperature (°C)	Change in mass per 10 minutes (g)
5	1·5
10	3·0
15	4·5
20	5·5
25	6·0

(d) Using the results, plot a line graph of change in mass per 10 minutes against temperature in the grid below.

(Additional graph paper, if required, can be found on page 33.)
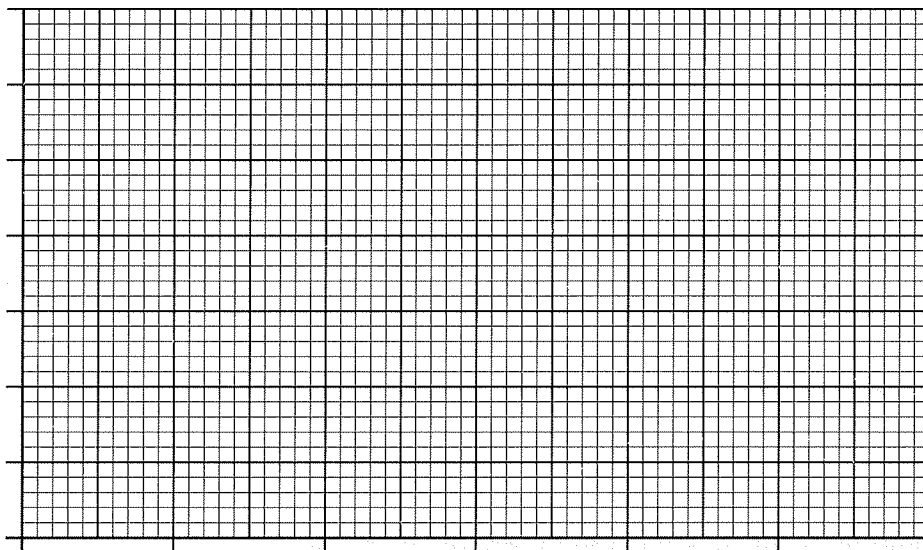
2

(e) From the results, predict the change in mass for 10 minutes at 30 °C and justify your prediction.

Predicted change in mass _____

Justification _____

_____

2

[Turn over

10. Indole acetic acid (IAA) and gibberellic acid (GA) are plant growth substances which have effects on the growth and development of flowering plants.

Location	Role of IAA
shoot tip	

Location	Role of IAA
ovary of fertilised flower	

Location	Role of GA
internode	
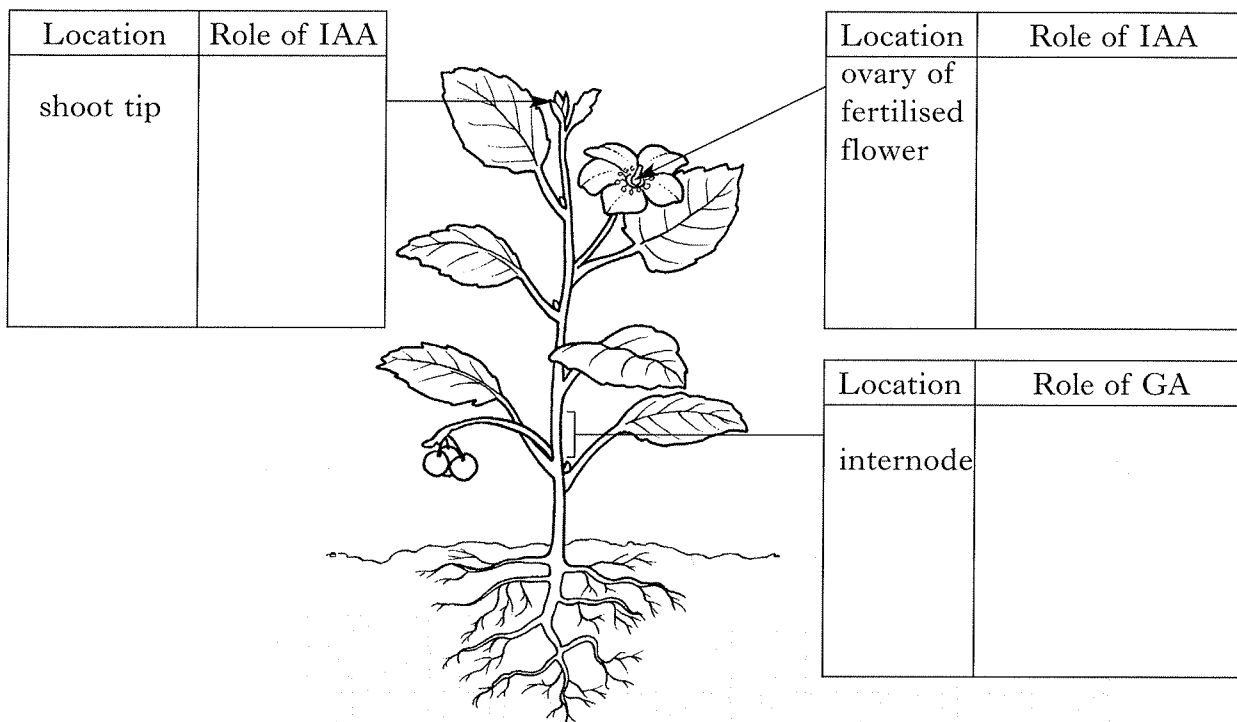
Marks

(a) Complete the boxes above to describe the roles of IAA and GA in the locations shown in the diagram.

2

(b) Give **one** application of a plant growth substance in horticultural practice.

_____

1

(c) A change in the photoperiod can initiate the flowering process.

(i) What is meant by the term photoperiod?

_____

_____

1

(ii) State **one** way in which a change in photoperiod affects behaviour in birds.

_____

_____

1

11. After an area of farmland was abandoned it was colonised initially by herbs and grasses. In the following 80 years there were changes in the plant community as shown in the graphs below. Changes in the depth of organic material in the soil are also shown.
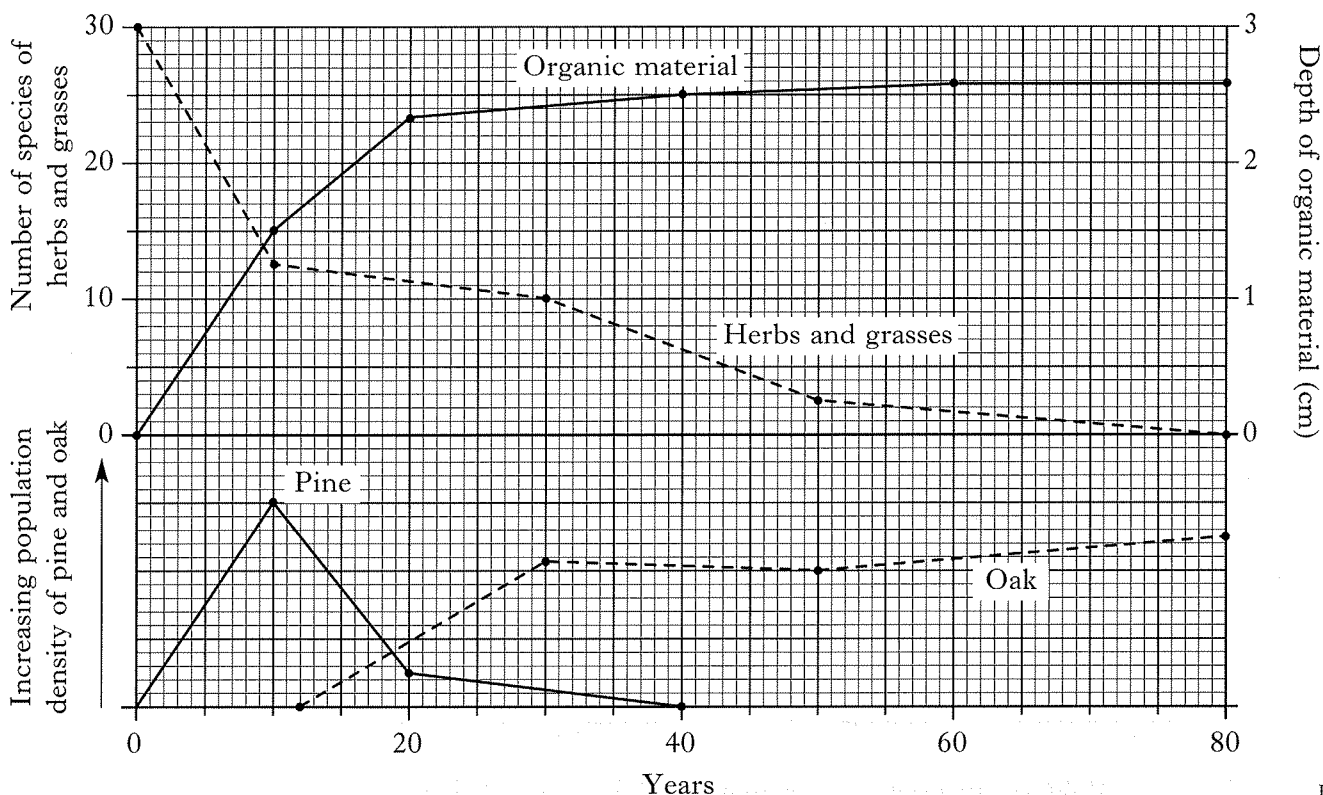
(a) What evidence in the data indicates that succession has taken place?

_____

_____   1

(b) Oak seeds can only germinate successfully if there is enough organic material to protect them from drying out.

On the basis of the data given, what is the minimum depth of organic material required by the oak seeds?

Depth _____ cm   1

(c) Oak woodland forms the final community in this succession.

State the name given to this community and describe a feature of such a community.

Name _____

Feature _____

_____   2

Marks

12. Until the 1970s, whales in the Antarctic Ocean were hunted as a source of food and other raw materials. Amongst those hunted were the Blue whale (20–30 metres long), Fin whale (15–25 metres long), Sei whale (10–15 metres long) and Minke whale (7–10 metres long).

The profit from larger whales is greater than from smaller whales.

Changes in whale population can be monitored by examining records of the number of whales caught each year. The information is shown in the table below.

Year	Number of whales caught (thousands)			
	Blue	Fin	Sei	Minke
1930	27	10	0	0
1940	11	18	0	0
1955	3	6	8	0
1965	0	0	18	0
1975	0	0	2	12

(a) Whalers targeted less profitable species of whale when the numbers of the more profitable species declined.

What evidence in the data supports this statement?

_____

_____ **1**

(b) (i) Wild populations can be monitored because of their importance as a source of food or raw materials.

State **one** other reason why wild populations are monitored.

_____

_____ **1**

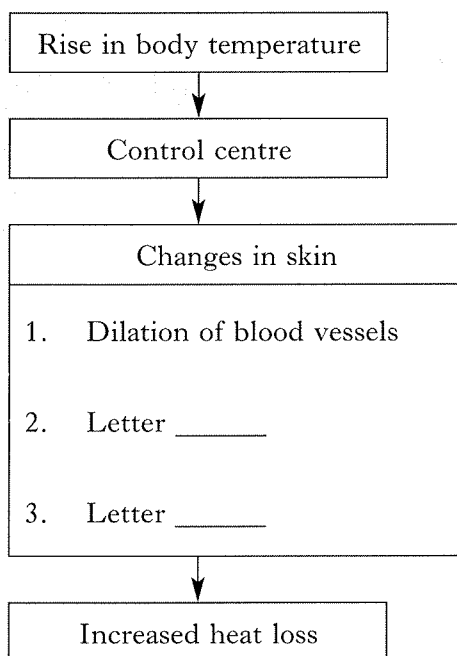(ii) Name **two** density dependent factors which may affect the numbers in a wild population.

Factor 1 _____

Factor 2 _____ **1**

Marks

13. The list below shows some changes which occur in animals as a result of changes *Marks* in body temperature.

A fall in body temperature   E increase in metabolic rate

B increase in sweat production F erection of hair

C decrease in metabolic rate   G constriction of blood vessels

D hair flattening   H decrease in sweat production

The diagram below shows part of the control system for body temperature in a mammal.

```
        ┌─────────────────────────────┐
        │   Rise in body temperature  │
        └─────────────────────────────┘
                      │
                      ▼
        ┌─────────────────────────────┐
        │       Control centre        │
        └─────────────────────────────┘
                      │
                      ▼
        ┌─────────────────────────────┐
        │       Changes in skin       │
        ├─────────────────────────────┤
        │ 1.  Dilation of blood vessels│
        │                             │
        │ 2.  Letter _____          │
        │                             │
        │ 3.  Letter _____          │
        └─────────────────────────────┘
                      │
                      ▼
        ┌─────────────────────────────┐
        │     Increased heat loss     │
        └─────────────────────────────┘
```

(*a*) Complete the diagram by inserting the appropriate letters from the list to show the changes which occur in the skin as a result of a rise in body temperature.   1

(*b*) Choose a letter from the list to show the effect of an increase in environmental temperature in an ectotherm.

Letter _____   1

(*c*) State how instructions are passed from the control centre to the skin.

_____ 1

[Turn over

14. When the concentration of glucose in the blood rises, there is an increase in the concentration of insulin in the blood. As the insulin concentration increases, the rate of glucose uptake by liver cells increases.

These relationships are shown in **Graph 1** and **Graph 2**.

Graph 1

Rate of glucose uptake by liver (µg/g of liver/hour)

Concentration of insulin in the blood (units/cm³)

Graph 2

Concentration of insulin in the blood (units/cm³)

Concentration of glucose in the blood (mg/100 cm³)

Marks
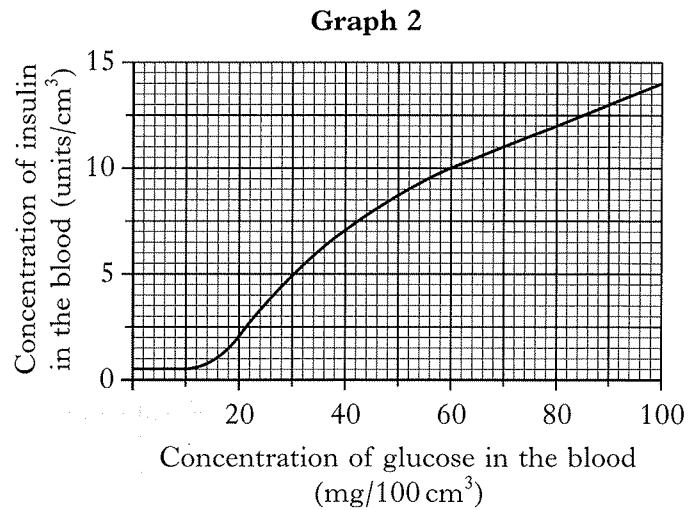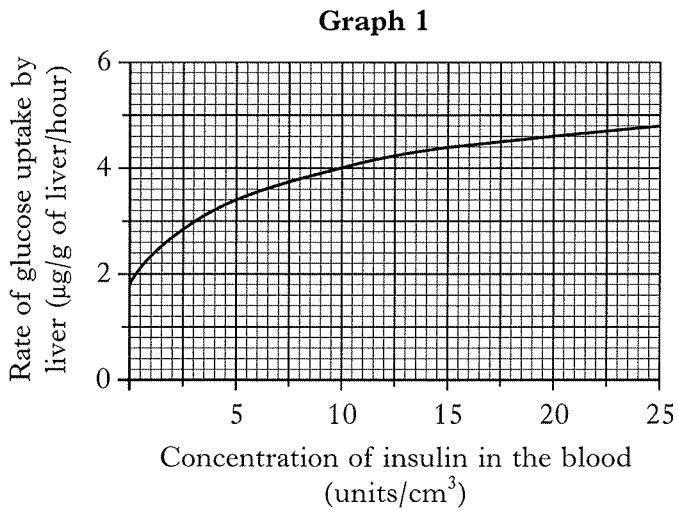
(*a*) From **Graph 1**, which change in the concentration of insulin in the blood caused the greatest increase in the rate of glucose uptake by the liver?

Tick (✓) the correct box.

From 0–5 units/cm³ ☐   From 5–10 units/cm³ ☐

From 10–15 units/cm³ ☐   From 15–20 units/cm³ ☐   **1**

(*b*) The volume of blood in a normal, healthy individual is 5 litres.

From **Graph 2**, calculate the mass of glucose present in the blood at an insulin concentration which remains constant at 10 units/cm³.

Space for calculation

_____ mg   **1**

(*c*) From **Graph 1**, calculate the percentage change in the rate of glucose uptake by the liver when the concentration of insulin in the blood increases from 10 units/cm³ to 20 units/cm³.
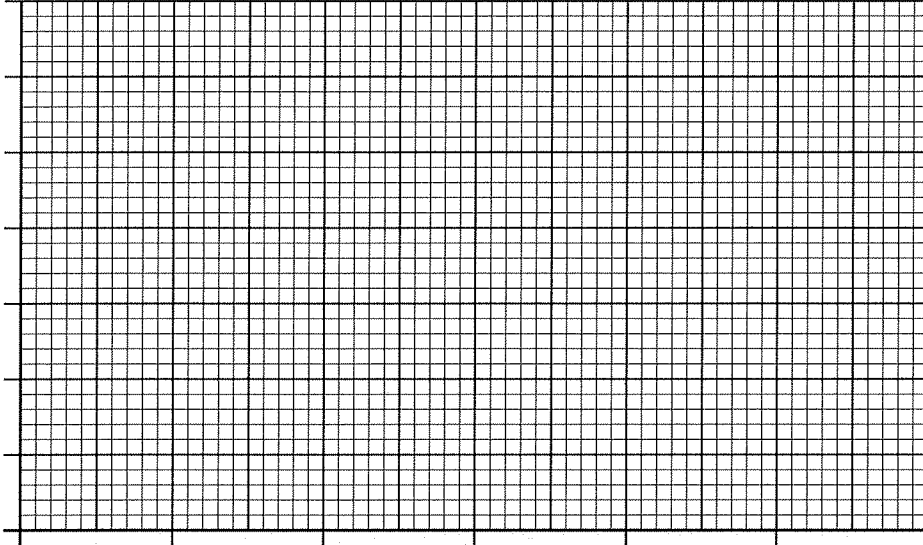
Space for calculation

_____ %   **1**

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 9(*d*)

SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Marks

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

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

Labelled diagrams may be used where appropriate.

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

   A.   Write notes on each of the following:

      (i)   insulin production by genetic engineering;   **6**

      (ii)   the technique of somatic fusion in plants and one of its benefits.   **4**

                                                                                        (10)

   OR

   B.   Write notes on each of the following:

      (i)   foraging behaviour in animals;   **4**

      (ii)   social mechanisms in animals for obtaining food and for defence.   **6**

                                                                                        (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 *m*RNA synthesis and the role of *m*RNA in protein synthesis.   **(10)**

   OR

   B.   Give an account of the role of isolation mechanisms in the evolution of new species.   **(10)**

[END OF QUESTION PAPER]