SECTION 1 ANSWER GRID

Mark the correct answer as shown ✔

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○

SECTION 1

1. Red blood cells were placed into a salt solution more concentrated than blood plasma.

Which word best describes the predicted appearance of the cells after a few seconds in this solution?

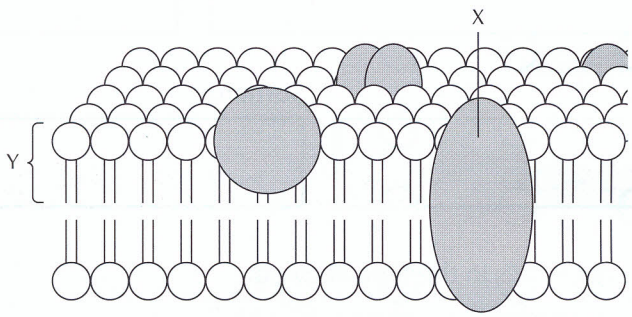
A Burst

B Plasmolysed

C Turgid

D Shrunken.

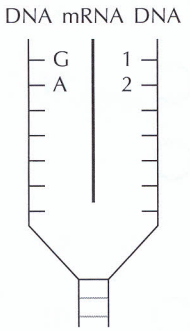
2. The diagram below shows molecules present in the cell membrane.



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

	Molecule X	***Molecule Y***
A	protein	lipid
B	protein	phosphate
C	lipid	protein
D	lipid	phosphate

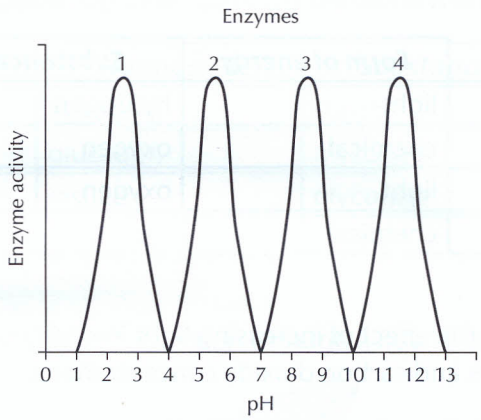
3. The diagram below shows a stage in the formation of a molecule of messenger RNA (mRNA).



Which line in the table below shows letters that identify correctly Bases 1 and 2?

	Base 1	*Base 2*
A	C	A
B	G	A
C	C	T
D	G	T

4. The graph below shows the effect of pH on the activity of four human digestive enzymes.



Which enzyme(s) work best in acid pH?

A 1 only

B 1 and 2

C 3 and 4

D 4 only.

5. The descriptions below refer to events in mitosis.

1 Spindle forms

2 Chromatids separate

3 Chromosomes move to equator

4 Nuclei form

Which is the correct order of these events?

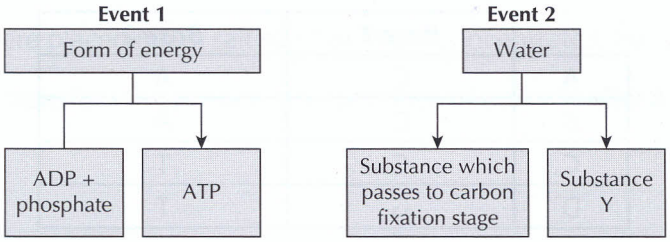
A 4→3→2→1

B 1→3→2→4

C 4→2→3→1

D 1→2→3→4.

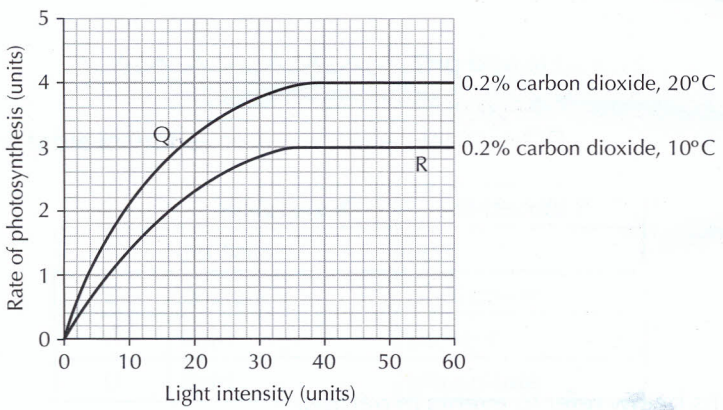
6. The diagram below shows two events in the first stage of photosynthesis in a leaf cell.



Which line in the table below identifies correctly the form of energy in event 1 and substance Y?

	Form of energy	***Substance Y***
A	light	hydrogen
B	chemical	oxygen
C	light	oxygen
D	chemical	hydrogen

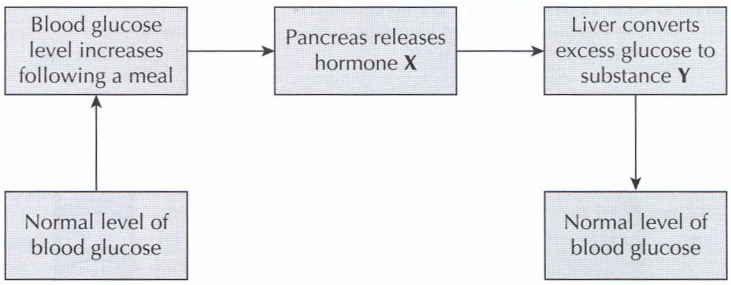
7. The graph below shows the effect of increasing light intensity on the rate of photosynthesis at different temperatures and carbon dioxide concentrations.



Which line in the table shows correctly the factors that are limiting photosynthesis at points Q and R on the graph?

	Q	***R***
A	light intensity	temperature
B	carbon dioxide concentration	temperature
C	light intensity	carbon dioxide concentration
D	temperature	light intensity

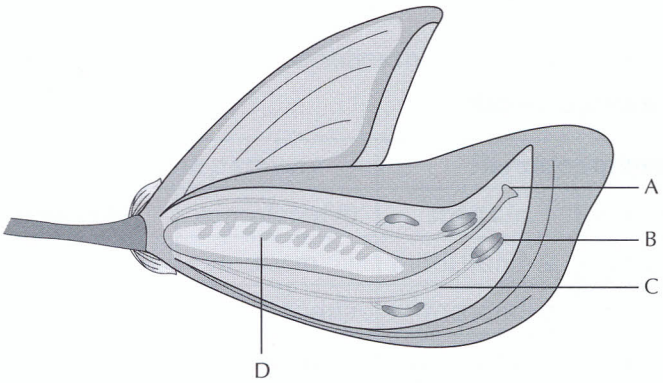
8. The flow chart below shows information about the regulation of blood glucose in humans.



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

	Hormone X	***Substance Y***
A	insulin	starch
B	glucagon	glycogen
C	insulin	glycogen
D	glucagon	starch

9. The diagram below shows a vertical section through a flower of the pea family.



In which structure are female gametes produced?

10. A pea plant with yellow seeds was crossed with a pea plant with green seeds. All of the F_1 plants produced had yellow seeds.

The genotype of the parent plant with green seeds could be described as

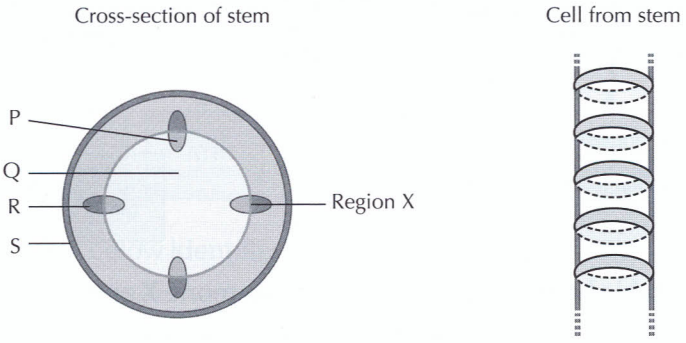
A heterozygous and recessive

B homozygous and dominant

C heterozygous and dominant

D homozygous and recessive.

Questions 11 and 12 refer to the diagram below, which shows a cross-section through a young plant stem and a cell from a part of the stem.



11. In which part of the cross-section would the cell shown be found?

A P

B Q

C R

D S.

12. Cells in region X undergo mitosis.

What name is given to region X?

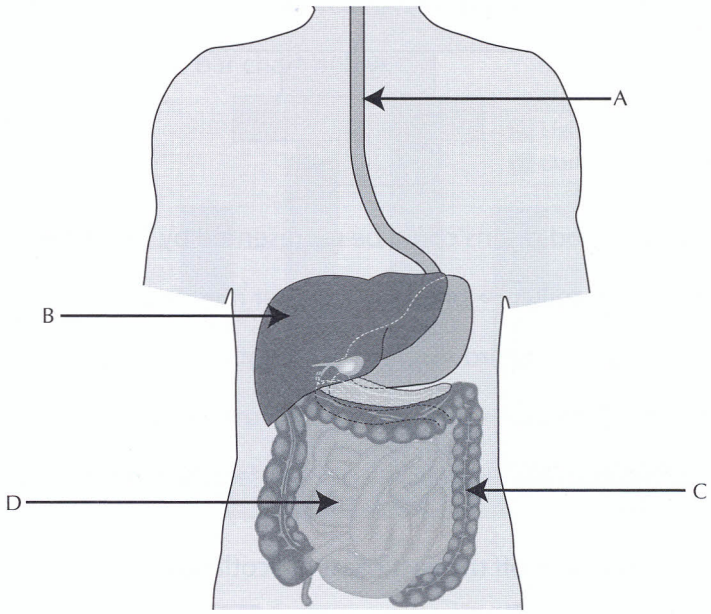
A Stem cell

B Mesophyll

C Meristem

D Anther.

13. The diagram below shows part of the human digestive system.



In which region of the diagram would villi be found?

14. Which line in the table below correctly identifies the location of the start and the completion of the respiration pathways shown?

	Fermentation pathway		***Aerobic pathway***	
	starts in	***completed in***	***starts in***	***completed in***
A	mitochondria	cytoplasm	mitochondria	cytoplasm
B	mitochondria	mitochondria	mitochondria	cytoplasm
C	cytoplasm	cytoplasm	cytoplasm	mitochondria
D	cytoplasm	mitochondria	cytoplasm	mitochondria

15. Which term describes all the organisms living in an area and the non-living factors with which the organisms interact?

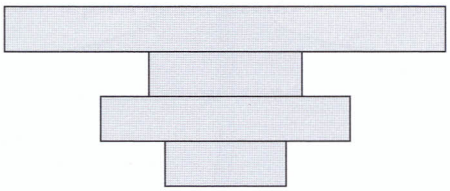
A Habitat

B Ecosystem

C Biome

D Niche.

16. The diagram below shows a pyramid of numbers representing a food chain.



Which of the following food chains could be represented by this pyramid?

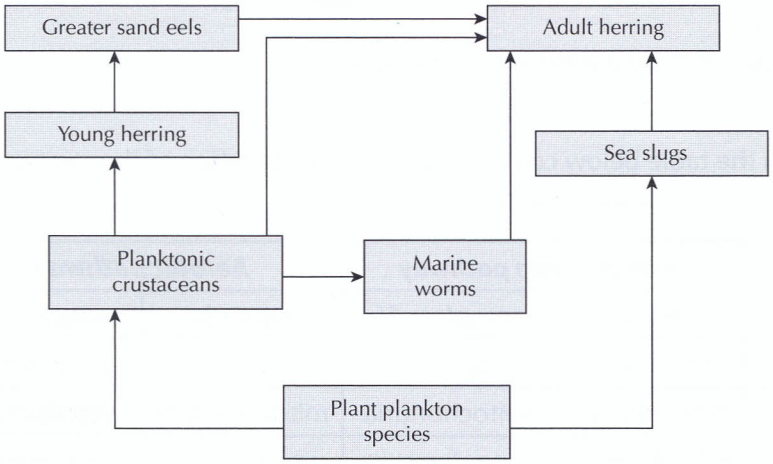
A oak tree → moth caterpillar → blue tit → feather mite (a parasite)

B oak tree → greenfly → ladybird → blue tit (predator)

C heather → moth caterpillar → meadow pipit → merlin (a predator)

D heather → moth caterpillar → meadow pipit → feather mite (a parasite).

17. Some organisms living in seas off the east coast of Scotland are shown in the food web below.

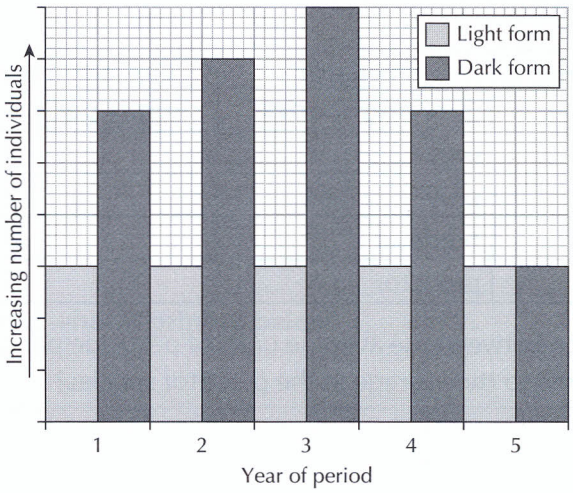


Which line in the table below shows correctly pairs of organisms that are involved in the types of competition shown?

	Type of competition	
	interspecific	***intraspecific***
A	planktonic crustaceans and sea slugs	young and adult herring
B	young and adult herring	greater sand eels and planktonic crustaceans
C	young and adult herring	marine worms and sea slugs
D	planktonic crustaceans and sea slugs	two species of plant plankton

18. In an investigation, the average numbers of individuals of two forms of the peppered moth in city woodland were estimated every year over a five-year period.

The results are shown on the bar chart below.



Between which two years of the period did the greatest change in the ratio of light to dark moths occur?

A 1 and 2

B 2 and 3

C 3 and 4

D 4 and 5.

19. An indirect effect of fertiliser leaching from cereal crop fields into fresh water is reduction in oxygen levels in the water.

Which group of organisms deoxygenates the water?

A Algae

B Bacteria

C Cereal crops

D Freshwater plants.

20. In an investigation, the concentration of a pesticide in the bodies of four individual birds found dead in a farmland area was measured. Two of the birds were predators, and two were prey species.

The results are shown in the table below.

Bird species	***Predator or prey species***	***Concentration of pesticide* (units per gram of muscle)**
wood pigeon	prey	4
skylark	prey	2
sparrowhawk	predator	26
barn owl	predator	16

What is the difference between the average units of pesticide per gram of muscle in the prey species compared to the average in the predator species?

A 12

B 18

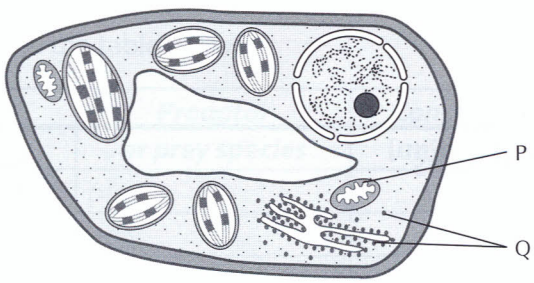
C 36

D 39.

MARKS
Do not write in this margin

SECTION 2

1. The diagram below represents a cell from a green plant.



(a) Give evidence from the diagram that suggests that this cell can carry out photosynthesis.

_____ 1

(b) Give the function of structure P.

_____ 1

(c) Name structures Q.

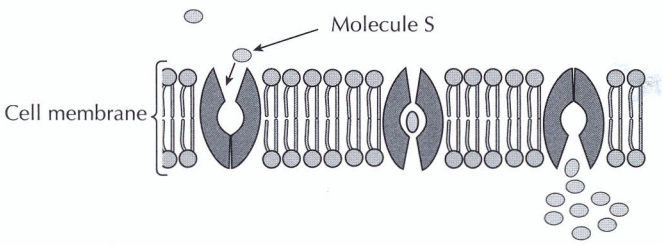
_____ 1

(d) Give **one** structural difference that would be expected between this cell and a fungal cell.

_____ 1

Total marks 4

2. The diagram below shows the transport of molecule S through a cell membrane.



(a) Name the method shown in the diagram by which molecule S is being moved across the membrane. Give **one** reason for your answer.

Method _____ 1

Reason _____ 1

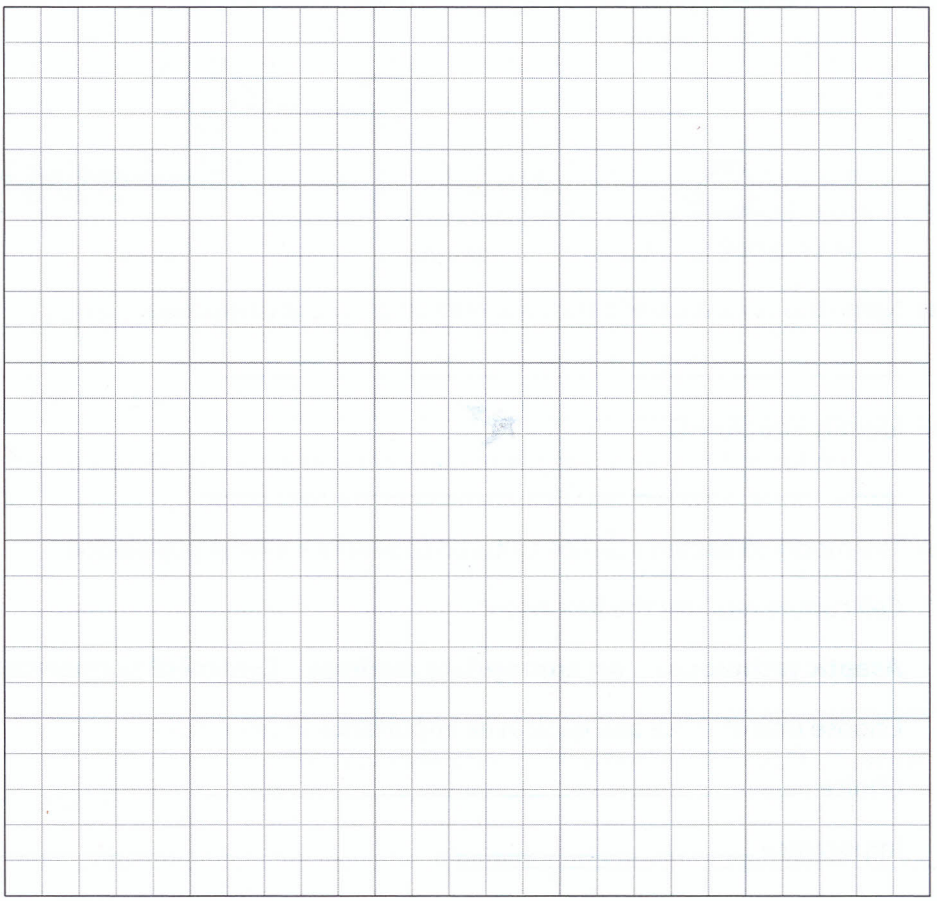
MARKS
Do not write in this margin

(b) In an investigation, small pieces of tissue of known mass were taken from a water plant submerged in pond water. They were placed into different concentrations of sucrose solution for one hour. After this time, the mass of each piece of tissue was re-measured and expressed as a percentage of its original volume.

The results are shown in the table below.

Concentration of sucrose solution **(grams per litre)**	***Final mass of tissue*** **(% of its mass in pond water)**
0	100.0
5	98.5
10	95.0
15	92.5
20	90.5
25	90.0

(i) On the grid below, complete the vertical axis and plot a line graph to show the effect of sucrose concentration on the mass of the water plant tissue. (A spare grid, if required, can be found on page 81)



2

MARKS
Do not write in this margin

(ii) Name the process that causes the mass changes in the water plant tissue.

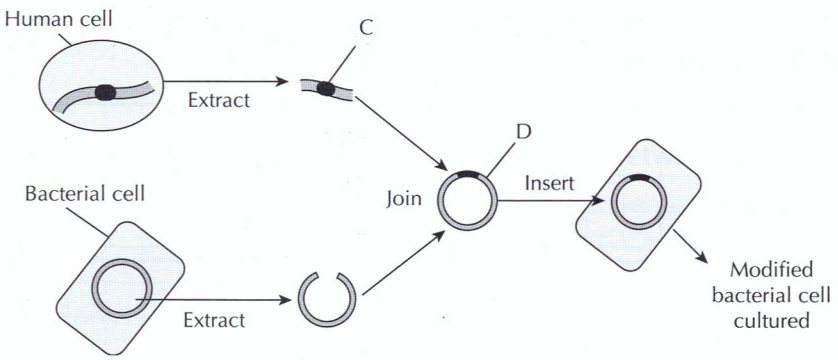
_____ 1

(iii) Using the information available in the table, predict the final mass of a piece of water plant tissue with a starting mass of 2.0 g after it has been immersed in a 25% sucrose solution for one hour.

Final mass = _____ g 1

Total marks 6

3. The diagram below shows the genetic modification of a bacterial cell by the transfer of a human gene.



(a) Name the substance of which the human gene C is composed.

_____ 1

(b) Identify structure D.

_____ 1

(c) The modified bacteria can be cultured to produce a large population.

Cell culture requires the following:

Aseptic techniques **An appropriate medium** **Control of temperature and pH**

Choose **one** of these and explain its importance in cell culture.

Choice _____

Importance _____

_____ 1

MARKS
Do not write in this margin

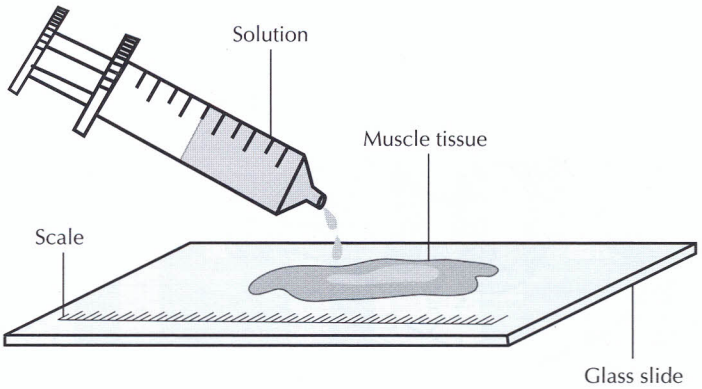
(d) Give **one** example of a substance produced by the expression of a human gene that has been obtained by this method.

_____ 1

Total marks 4

4. When mammalian muscle tissue contracts, it decreases in length.

The **diagram** below shows the procedure involved in an investigation into the effect of different solutions on the lengths of pieces of mammalian muscle tissue. Each piece of muscle tissue was measured before and after five minutes of immersion in the solutions.



The results are shown in the **table** below.

Muscle tissue	Solution	Length of muscle tissue (mm)			Percentage difference in length (%)
		at start	after five minutes	difference in length	
A	1% glucose	45	45	0	0
B	1% ATP	50	46	4	
C	distilled water	48	48	0	0

(a) **Complete the table** by calculating the percentage decrease in length of muscle tissue B.

_____% 1

(b) Explain why glucose has no effect on muscle tissue A, whereas ATP causes muscle tissue B to contract.

_____

_____ 2

(c) Describe why muscle tissue C was included in the experimental design.

_____

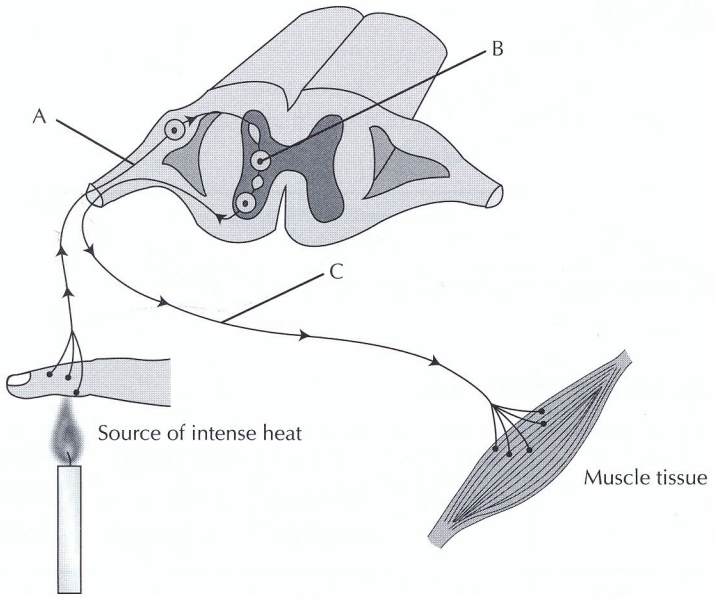
_____ 1

(d) State what is meant by the term **tissue** in this example.

_____ 1

Total marks 5

5. The diagram below shows some structures involved in an example of a rapid reflex action in humans.



(a) Neurons A, B and C form the reflex arc.

Name each of these neurons.

A _____

B _____

C _____ 2

(b) Identify the stimulus and describe the expected response in this example.

Stimulus _____ 1

Description of response _____

_____ 1

MARKS Do not write in this margin

(c) Explain the importance of rapid reflex actions in general.

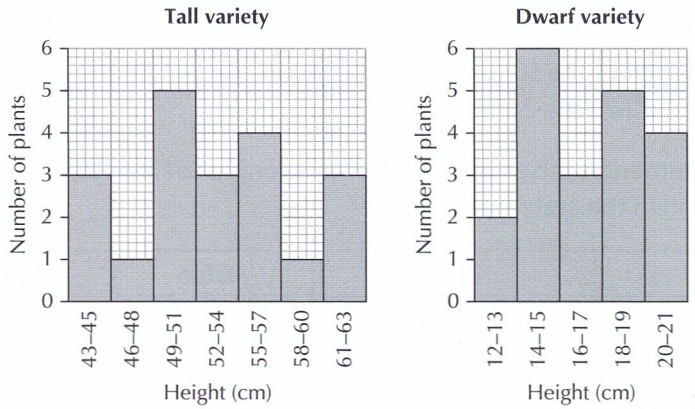
_____ 1

Total marks 5

6. Garden pea plants that carry the allele **T** have a tall phenotype.

Plants with the genotype **tt** are dwarf.

20 seeds of a tall variety and 20 seeds of a dwarf variety were germinated and grown for 15 weeks in a greenhouse. After this time the height of each plant was measured, and the results are shown in the charts below.



(a) Other than growing the same number of plants for the same time, give **two** variables that should have been kept constant to ensure that comparison of the two varieties was valid.

Variable 1 _____ 1

Variable 2 _____ 1

(b) Give the range of heights in the tall variety.

_____ 1

(c) For the information provided, give evidence that shows that height in pea plants, shows both discrete **and** continuous variation.

Evidence for discrete variation _____

_____ 1

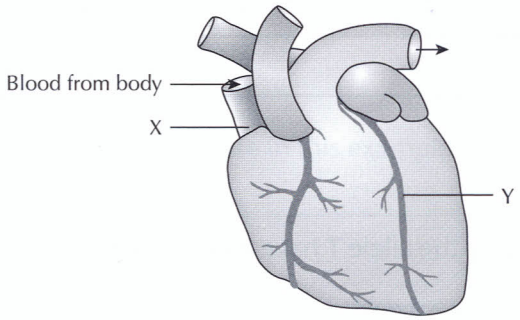
Evidence for continuous variation _____

_____ 1

Total marks 5

MARKS
Do not write in this margin

7. (a) The diagram below shows an external view of the human heart.



(i) Identify blood vessels X and Y.

X _____ 1

Y _____ 1

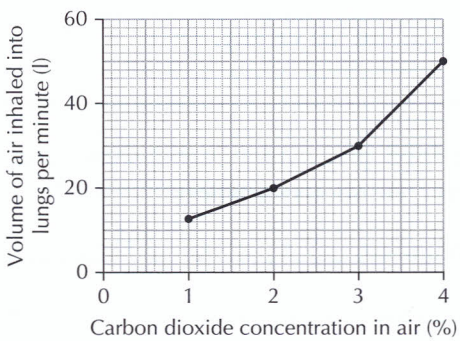
(ii) Decide if each of the statements about blood vessels in the grid below is true or false and tick (✔) the correct box.

If the statement is false write the correct word in the box to replace the word underlined in the statement.

Statement	*True*	*False*	*Correction*
Arteries carry blood <u>from</u> the heart.			
<u>Veins</u> exchange materials with the tissues.			
<u>Capillaries</u> have valves.			

2

(b) The graph below shows the effect of carbon dioxide concentration in the air on the volume of air inhaled into the lungs of an individual at rest.



(i) Calculate the volume of carbon dioxide entering the individual's lungs each minute when the volume of air inhaled is 20 litres per minute.

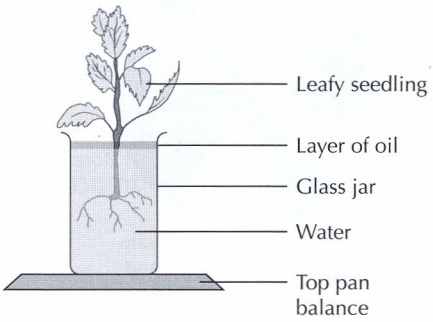
_____ litres 1

(ii) Calculate the increase in volume of air entering the lungs per minute when the concentration of carbon dioxide in the air increases from 1% to 4%.

_____ litres 1

Total marks 6

8. In an investigation into the effects of temperature on rate of transpiration in a leafy seedling, the apparatus below was set up.



Transpiration rate was measured at different temperatures. The results are shown in the table below.

Temperature **(°C)**	***Transpiration rate*** **(grams of water per cm² of leaf per minute)**
10	0.2
15	0.3
20	0.4
25	0.5

(a) Identify the observations or measurements that would have to be made to obtain the values for rate of transpiration shown in the table.

_____

_____

_____ 3

MARKS
Do not write in this margin

(b) The following factors can affect transpiration rate in plants.

Light intensity **Atmospheric humidity** **Air movements**

Choose **one** of these factors and describe how the apparatus above could be modified to investigate this factor.

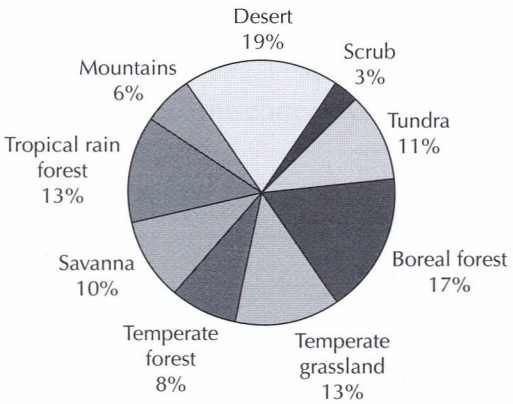
Factor _____

Description _____

_____ 2

Total marks 5

9. The pie chart below shows one estimate of the percentage of the Earth's land area occupied by different biomes.



(a) The temperate grassland biome is found in many parts of the world. Describe the characteristics which distinguish a biome regardless of where on Earth it occurs

_____

_____

_____ 3

(b) Calculate the total percentage of land surface occupied by the various types of forest biomes.

Space for calculations

_____% 1

MARKS
Do not write in this margin

(c) Within biomes, organisms live in communities, and each species occupies its own niche.

Describe what is meant by the term niche.

_____

_____ 1

Total marks 5

10. In an investigation to compare the populations of a species of ground beetle living on the soil surface in two different areas of grassland, sampling was carried out using pitfall traps.

(a) Give **two** precautions that would have to be taken to ensure that the sampling method allowed valid **comparison** of the two areas.

1 _____

2 _____ 2

(b) Describe a source of error that can arise when using pitfall traps.

_____ 1

(c) During the investigation, a number of abiotic factors related to the soil were also measured.

Name **one** abiotic factor that is related to soil and describe how it could be measured.

Abiotic factor _____ 1

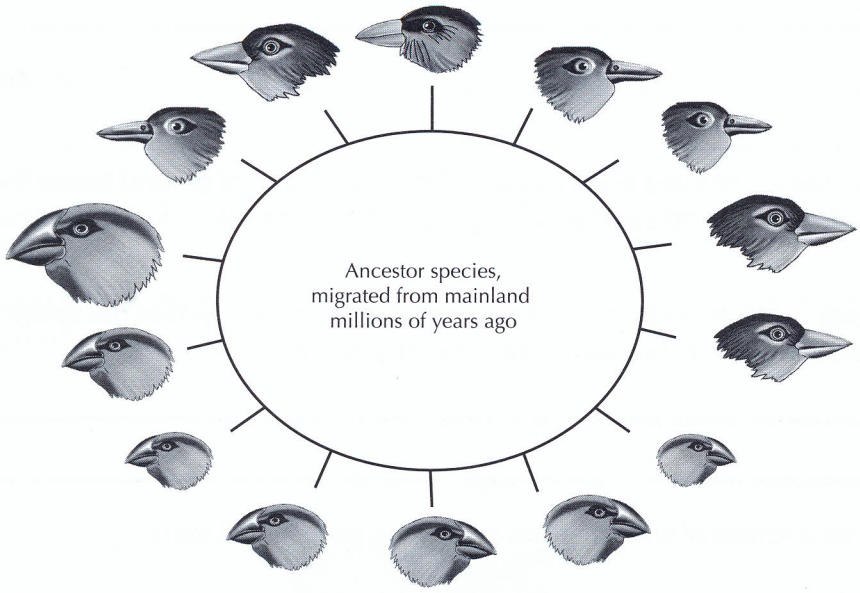
Method of measurement _____

_____ 1

Total marks 5

MARKS
Do not write in this margin

11. On the Galapagos Islands of the Pacific Ocean, speciation has produced a group of similar finch species, as shown in the diagram below. The group arose from a single ancestor species, which reached the islands from the South American mainland millions of years ago.



(a) The list below shows processes involved in speciation.

mutation **isolation** **natural selection**

Describe how these processes have led to the production of the group of finch species in the diagram above.

_____

_____

_____

_____

_____ 3

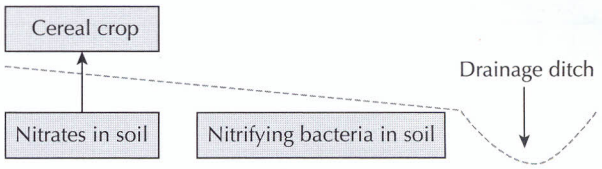
(b) Give the term applied to mutations that confer neither advantage nor disadvantage.

_____ 1

Total marks 4

MARKS
Do not write in this margin

12. The diagram below shows part of the nitrogen cycle in a field in which a cereal crop was grown.



(a) Describe the role of nitrifying bacteria in soil.

_____ 1

(b) Other than the action of denitrifying bacteria, give **two** ways in which nitrogen could be lost from the nitrogen cycle in this field.

1 _____ 1

2 _____ 1

(c) Farmers replace nitrogen lost from their soils.

(i) State how nitrogen can be replaced as part of intensive farming practices.

_____ 1

(ii) Nitrogen can be replaced as part of organic farming practices using plants such as clover, which have root-nodule bacteria.

Explain how planting clover can replace lost nitrogen.

_____

_____ 1

(d) Describe **one** way in which the environmental impact of cereal production by intensive farming could be reduced.

_____ 1

Total marks 6

[END OF QUESTION PAPER]