

Langholm Academy



National 5 Biology

Unit 3: Life on Earth Homework Booklet

Name: _____ Class: _____

<i>Homework title</i>	<i>Due date</i>	<i>On time/Complete?</i>	<i>Mark</i>
Ecosystems			/32
Distribution of Organisms			/26
Photosynthesis			/48
Energy in Ecosystems			/10
Food Production			/36
Evolution of Species			/24

Ecosystems

1. Which of the following describes interspecific competition?
 - A Individuals of different species requiring different resources.
 - B Individuals of different species requiring similar resources.
 - C Individuals of the same species requiring different resources.
 - D Individuals of the same species requiring similar resources.

2. The total variety of all living things on Earth is described as
 - A an ecosystem
 - B biodiversity
 - C a population
 - D competition.

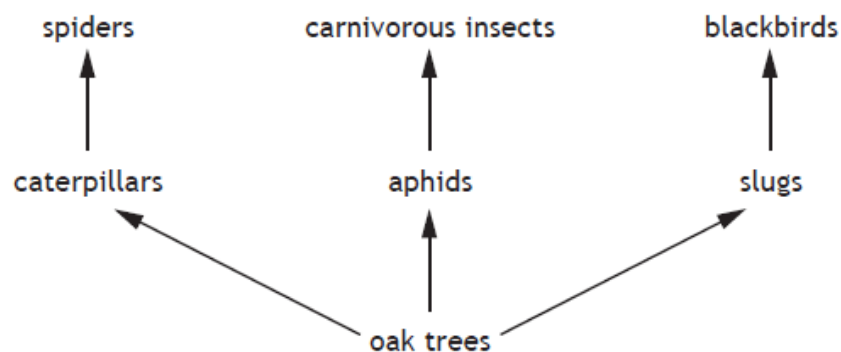
3. Which of the following statements about a woodland describes a community?
 - A All the oak trees
 - B All the plants
 - C All the oak trees and blackbirds
 - D All the plants and animals

4. A rabbit feeds on grass, is eaten by foxes and is a habitat for fleas.
The statement above describes the rabbit's
 - A ecosystem
 - B community
 - C niche
 - D prey.

5. In which of the following would competition not occur?

- A Rabbits grazing in a field
- B Owls and foxes hunting for mice
- C Daisies and dandelions growing in a lawn
- D Algae and fish in a loch

6. The diagram below shows part of a food web in an oak woodland.

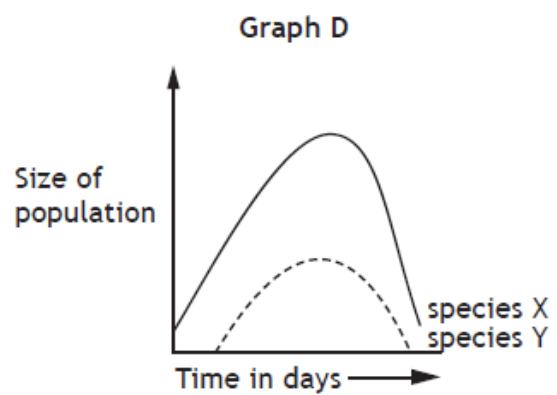
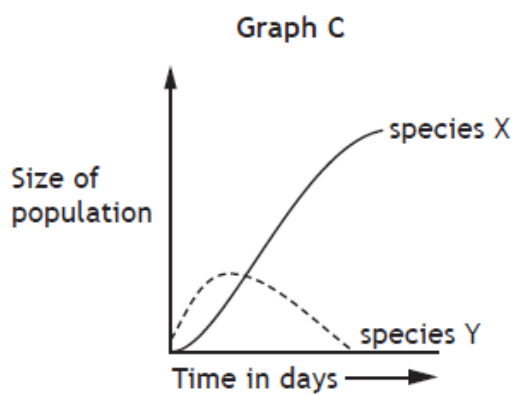
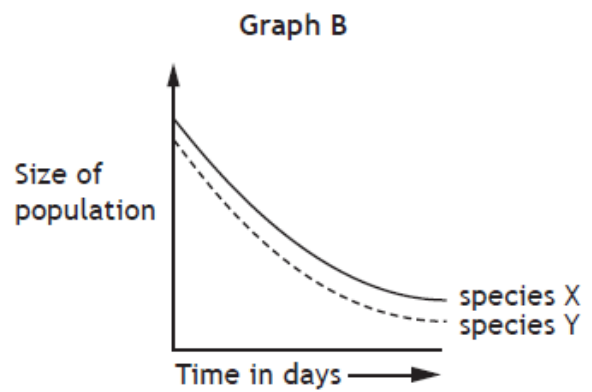
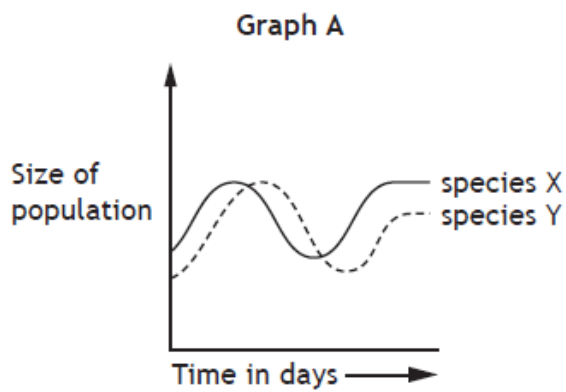


The use of insecticides in a nearby field resulted in the death of most aphids and caterpillars.

Which line in the table identifies the effect on the numbers of slugs and carnivorous insects?

	<i>Number of slugs</i>	<i>Number of carnivorous insects</i>
A	decreases	stays the same
B	increases	decreases
C	decreases	increases
D	increases	stays the same

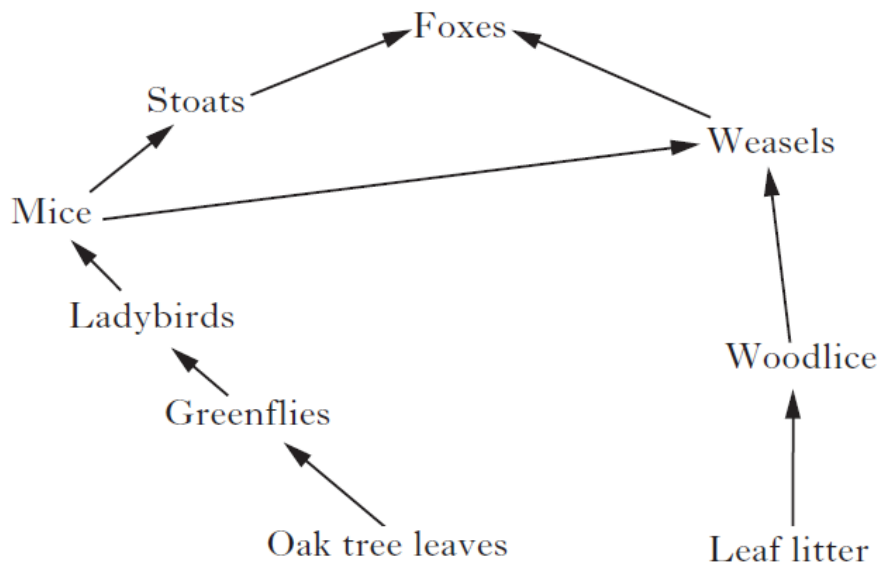
7. Which one of the following graphs shows the effects of competition for the same food between a successful species and an unsuccessful species?



8. The Treecreeper is a bird which feeds on small insects on the bark of trees during the day.
- What is the correct description of the Treecreeper's niche?
- A The place where it lives
 - B The insects on which it feeds
 - C The plants and animals in the woodland environment
 - D Its role within the woodland ecosystem

9. (a) The diagram below shows part of a woodland food web.

Mar



Use the words ***increase***, ***decrease*** or ***stay the same*** to describe the effect on the populations of greenflies and stoats if all the mice were killed by a disease.

Give a reason for your answer.

- (i) Effect on greenfly population _____

Reason _____

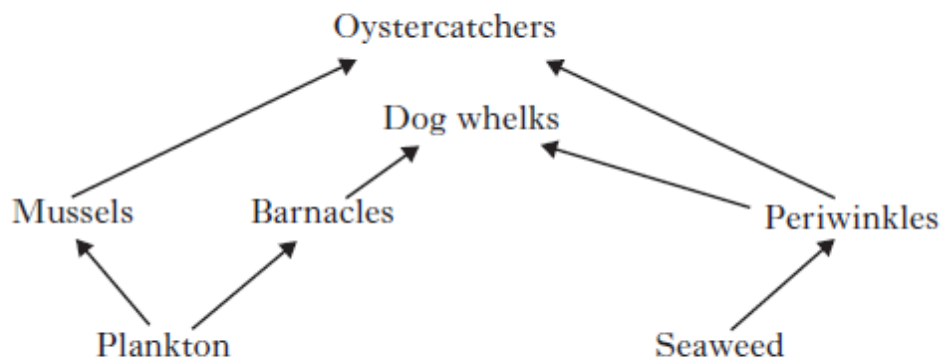
1

- (ii) Effect on stoat population _____

Reason _____

1

10. Part of the food web from the shore is shown below.



The numbers of mussels and periwinkles may be affected if the barnacles were removed from the food web.

- (i) Underline one answer in the brackets and give an explanation for it.

The mussel population would $\left\{ \begin{array}{l} \text{increase} \\ \text{decrease} \\ \text{stay the same} \end{array} \right\}$.

Explanation _____

1

- (ii) Underline one answer in the brackets and give an explanation for it.

The periwinkle population would $\left\{ \begin{array}{l} \text{increase} \\ \text{decrease} \\ \text{stay the same} \end{array} \right\}$.

Explanation _____

1

11. (a) The Cichlid fish below are all found in Lake Malawi in Africa.

	Species A eats fish scales and fins
	Species B eats small fish and eggs
	Species C eats molluscs
	Species D eats small fish
	Species E eats insect larvae

- (i) Using the information shown, identify the feature which enables the fish to have different diets.

1

- (ii) Predict two species of Cichlid which would be in competition with each other if there was a shortage of fish eggs. Give a reason for your answer.

1

Species _____ and _____

Reason _____

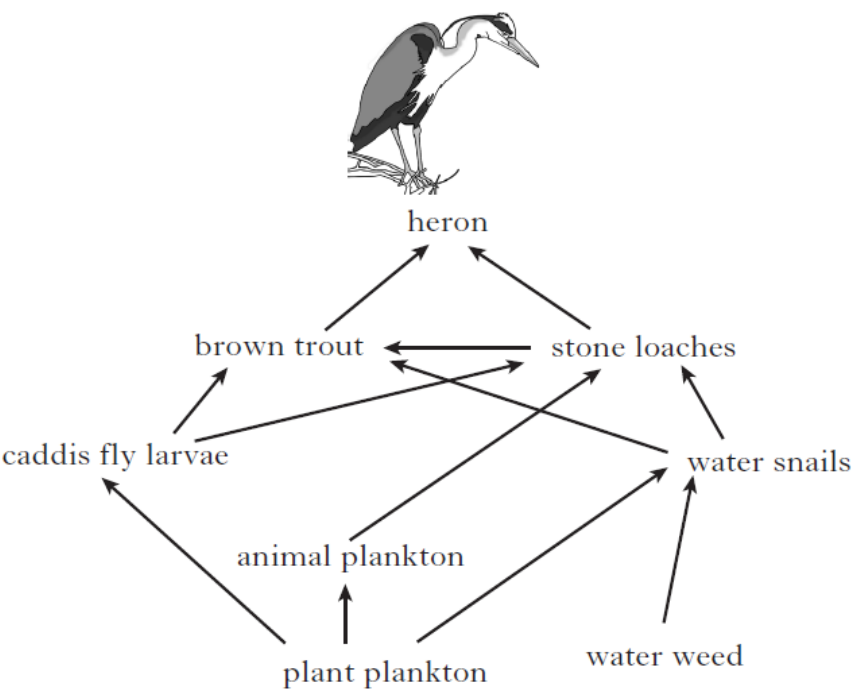
- (b) State the term which describes the role that an organism, such as the Cichlid, plays within its community.

1

12.

The diagram below represents a food web from a Scottish river ecosystem.

Mark:



- (a) Decide if each of the following statements about this food web is **True** or **False**, and tick (✓) the appropriate box.
- If the statement is **False**, write the correct word in the **Correction** box to replace the word underlined in the statement.

Statement	True	False	Correction
The stone loaches are the <u>predators</u> of the brown trout.			
There are <u>three</u> producers in this food web.			
The caddis fly larvae are <u>herbivores</u> .			

3

- (b) (i) Complete the food chain below with four organisms from this food web.

water weed →

_____ →

_____ →

_____ →

1

- (ii) What do the arrows in the food chain represent?

1

13. A study has shown that Scotland's river otter population is increasing after falling sharply over the last 40 years.



Otters live along the banks of rivers, usually in reeds and gaps between tree roots. Fish are their main food.

- (a) What term is used for the place where otters live?

1

- (b) What disadvantage might otters have if reeds are removed from riverbanks?

1

- (c) Mink are North American animals introduced into Scotland. They feed on fish and live in riverbanks.

What effect would the mink have on otter numbers? Explain your answer.

Effect _____

Explanation _____

2

- (d) An ecosystem such as the otters' has several components.

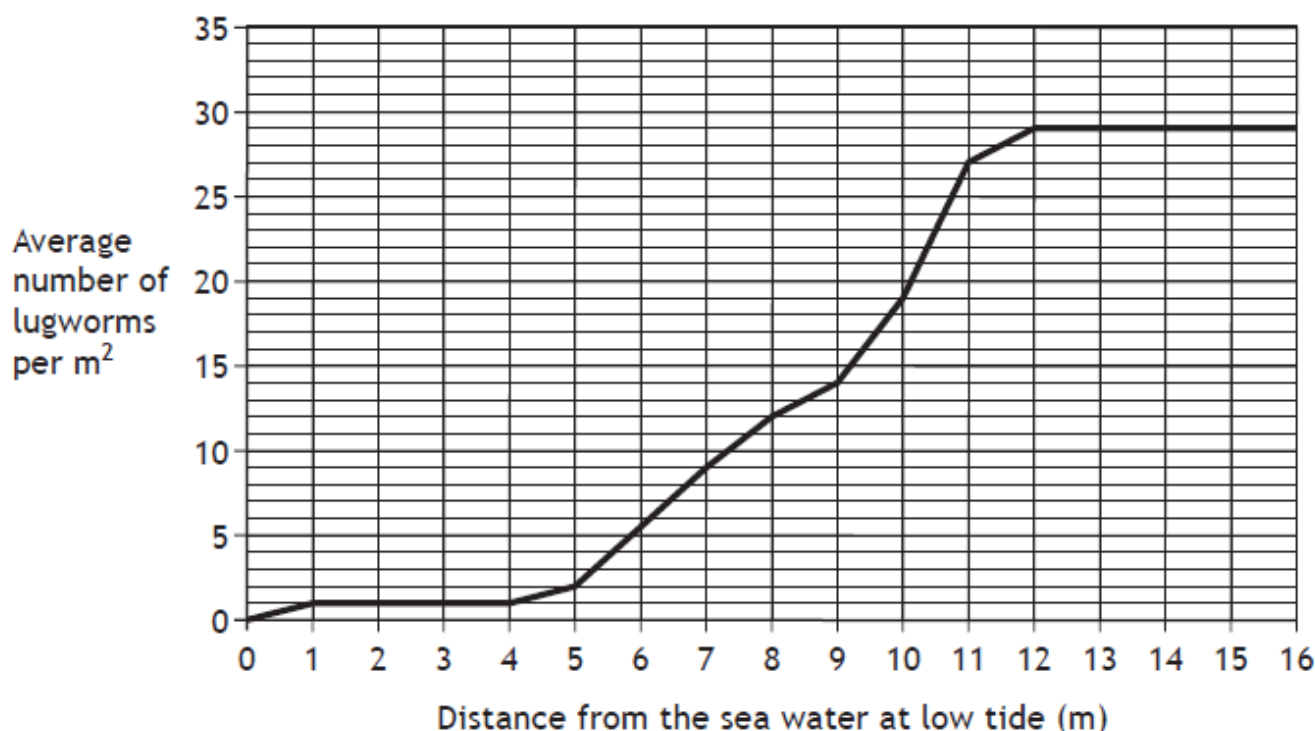
Complete the table below to identify the terms used and their definitions.

<i>Term</i>	<i>Definition</i>
	A green plant that makes its own food.
Carnivore	
Community	

2

14. (a) Lugworms live on the seashore in dark moist burrows under the sand.

The graph below shows the average number of lugworms at different distances from the seawater at low tide.



- (i) Describe the relationship between the distance from the seawater at low tide and the average number of lugworms per m².

2

- (ii) Calculate how many times greater the average number of lugworms at 11 metres is compared to 7 metres from the seawater at low tide.

1

Space for calculation

_____ times greater

- (b) Dover sole and rex sole are different species of flatfish and are predators of lugworms. Curlews, which are a species of wading bird, also feed on lugworms.

- (i) Complete the table below by placing a tick (✓) in the correct box to show the type of competition that would occur between the different predators.

1

<i>Predator</i>	<i>Type of Competition</i>	
	<i>Intraspecific</i>	<i>Interspecific</i>
rex sole and curlew		
curlew and curlew		
rex sole and dover sole		

15. (a) The diagrams below give some information about three species of Darwin's Finches which live on the Galapagos Islands.



Feeds on insects



Feeds on seeds



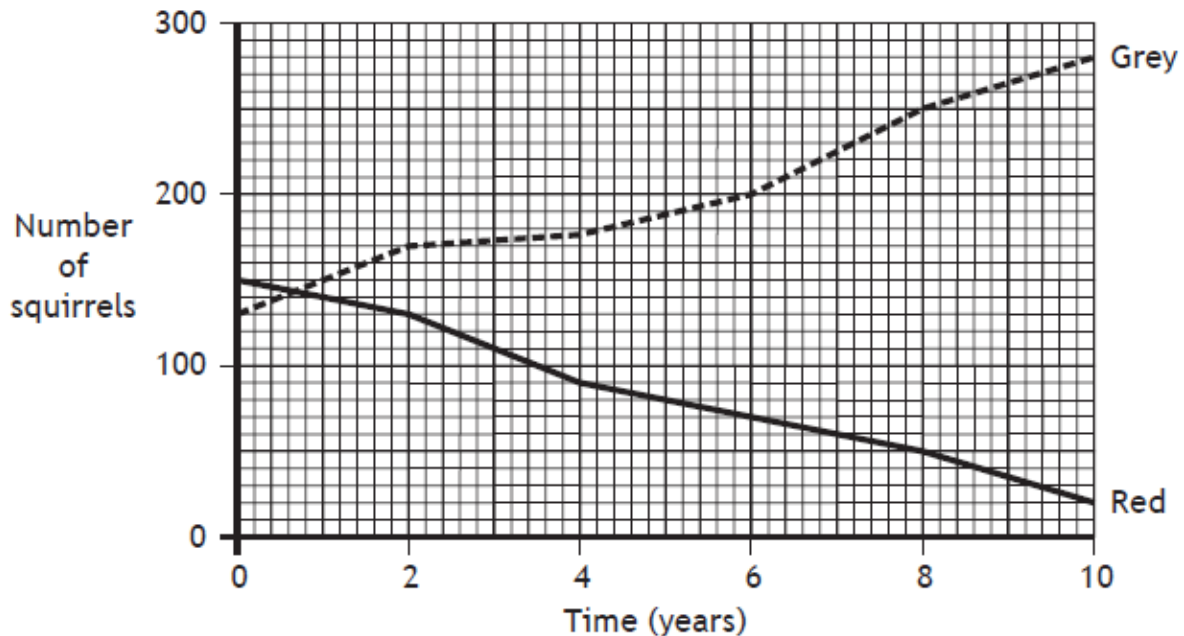
Feeds on seeds

Using evidence from the diagrams, explain why these three finch species occupy different niches.

2

Distribution of Organisms

1. The graph below shows changes in the population of red and grey squirrels in an area of woodland over a 10 year period.



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

- A The total number of squirrels decreased over 10 years.
 - B The population of red squirrels showed a greater change than the grey squirrels.
 - C The population of grey squirrels showed a greater change than the red squirrels.
 - D After 8 years there were 4 times as many grey squirrels as red squirrels.
2. Indicator species can provide information about
- A numbers of organisms in a lake
 - B numbers of predators in a woodland
 - C levels of light in an ecosystem
 - D levels of pollution in a river.

3. The size of a population of snails can be estimated using the following formula.

$$\text{Population} = \frac{\text{Number collected on 1st day} \times \text{Number collected on 2nd day}}{\text{Number of marked individuals found on 2nd day}}$$

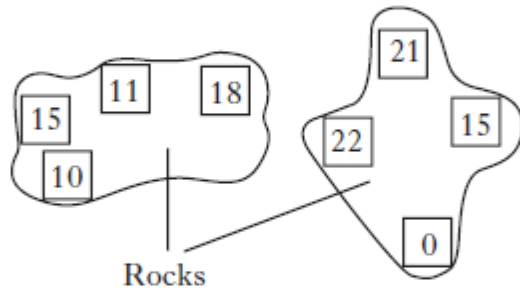
A student investigated the population of snails in a garden. He collected 40 snails, marked their shells and released them. Next day, 35 snails were collected and 14 of these were found to be marked.

The snail population was estimated to be

- A 16
 - B 100
 - C 560
 - D 1400.
4. Students used a quadrat to estimate the number of buttercups in a field. They threw the quadrat randomly three times in the area. In order to improve the reliability of their results they could have
- A asked another group of students to check that they had counted correctly
 - B thrown the quadrat ten times instead of three
 - C only thrown the quadrat when conditions were at an optimum
 - D used a smaller quadrat for each of their samples.

5. A survey was carried out on the number of mussels attached to rocks on a seashore.

The positions of the mussels are shown by squares in the diagram below. The numbers of mussels at each position are shown in the squares.



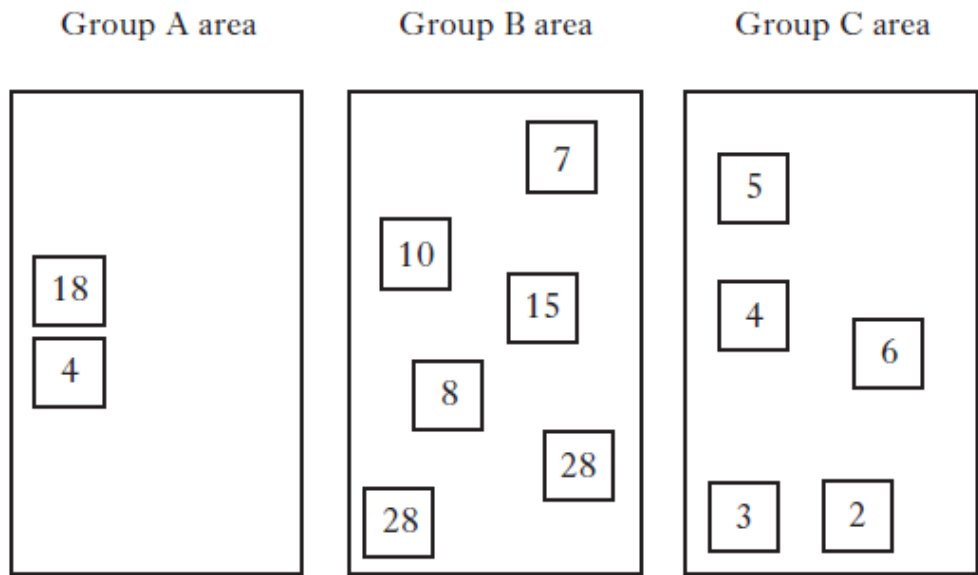
What is the average number of mussels found per square?

- A 14
- B 16
- C 56
- D 112

6. (a) Three groups of students used quadrats to carry out a survey on the distribution of mussels on different areas of a shore.

Each quadrat measured 50 cm × 50 cm. (Four quadrats = 1 m²).

The positions of the quadrats and the number of mussels found is shown below for each group.



- (i) Complete the following table with the results from the area of Group C.
Space for calculation

Group	Average number of mussels per quadrat	Estimated number of mussels per m ²
A	11	44
B	16	64
C		

1

- (ii) Which group has made an error in their sampling technique which makes their results less reliable than the other groups?

State the error this group has made and describe an improvement which would increase the reliability of their results.

Group _____

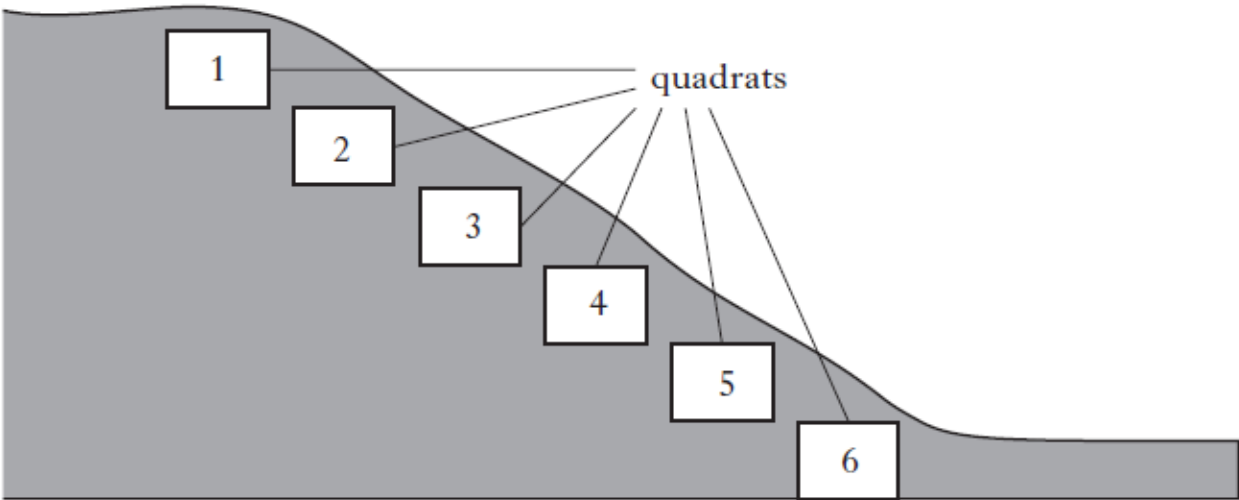
Error _____

1

Improvement _____

1

7. (a) In an investigation into the distribution of heather plants, six quadrats were placed in a line from the top to the bottom of a hill.
- Soil moisture, pH, surface light intensity and heather abundance score were recorded for each quadrat.



The following table shows the results.

<i>Quadrat</i>	<i>Soil moisture (%)</i>	<i>Surface light intensity (lux)</i>	<i>pH</i>	<i>Heather abundance score</i>
1	10	10 000	5.5	25
2	15	11 000	5.4	22
3	40	10 000	5.5	15
4	63	10 500	5.5	9
5	71	12 000	5.6	6
6	81	11 000	5.4	0

- (i) Describe the distribution of heather on the slope of the hill.

1

- (ii) Which of the abiotic factors recorded has the greatest effect on the distribution of the heather plants?

1

- (iii) Which quadrat would be most likely to contain a species of plant which grows best in wet soil with a low pH?

8. (a) In an investigation, students estimated the population and biomass of some organisms found on part of a rocky shore.

The table below shows the results.

<i>Organism</i>	<i>Population</i>	<i>Average mass of one organism (g)</i>	<i>Biomass of population (g)</i>
Seaweed	220	500	110 000
Limpet	1 100		33 000
Crab	100	90	9 000
Gull	5	700	3 500

- (i) Complete the table to show the average mass of one limpet.
Space for calculation

- (b) During the investigation the students found four different species of periwinkles at different positions on the rocky shore.



The highest position that the sea water reaches on the shore is called the high tide level.

The bars in the table below represent the positions on the shore where each species of periwinkle was found.

	<i>Species of periwinkle</i>			
<i>Position on shore</i>	<i>Small</i>	<i>Edible</i>	<i>Rough</i>	<i>Flat</i>
High tide level ↓ Low tide level				

- (i) State which species of periwinkle is least likely to compete with the small periwinkle.

Explain your answer. 1

Species _____

Explanation _____

- (ii) Using the information given, explain why the competition between these periwinkles is described as interspecific. 1

9. A group of students carried out a five year investigation into plant growth in an area of abandoned farmland.

They sampled the area using quadrats.

The results are shown in the table below.

	<i>Average abundance of each plant</i>		
<i>Year</i>	<i>Meadow grass</i>	<i>Ragwort</i>	<i>Pink campion</i>
2011	8	15	9
2012	16	14	7
2013	24	12	4
2014	25	8	2
2015	25	5	1

- (a) (i) Calculate the average decrease per year in the abundance of ragwort over the five-year period.

1

Space for calculation

- (ii) Use information from the table to suggest why the ragwort abundance decreased over the five-year period.

1

- (b) The students also sampled invertebrates such as beetles and spiders.
Name a sampling technique they could have used and describe a possible source of error with this technique.

2

Sampling technique _____

Source of error _____

- (c) The following table gives information about some of the flowering plants found in the area.

<i>Plant</i>	<i>Height range (cm)</i>	<i>Flower colour</i>	<i>Flowering period (months)</i>
Pink Champion	30–90	pink	6
Ragwort	30–200	yellow	6
Meadow Grass	30–70	green	3
Buttercup	5–90	yellow	5

Using the information in the table, complete the three boxes in the paired statement key below.

3

1. Flower colour is yellow

go to 2

Flower colour is not yellow

2. Height of plant can be over 100 cm

Ragwort

Height of plant is under 100 cm

3. Flowering period lasts only 3 months

Meadow Grass

Flowering period is longer than 3 months

10. During a woodland survey, a group of students measured some abiotic factors. Readings they took included the temperature of the soil and the air.

- (a) Name one abiotic factor, other than temperature, which they could have measured in the woodland and describe the method of measuring this factor.

2

Abiotic factor _____

Method _____

- (b) (i) During the survey, the students sampled the leaf litter in the woodland using pitfall traps.

However, when they checked the pitfall traps four days after setting them up, the students discovered that they were all empty.

Describe an error the students might have made which would explain why there were no invertebrates in the traps.

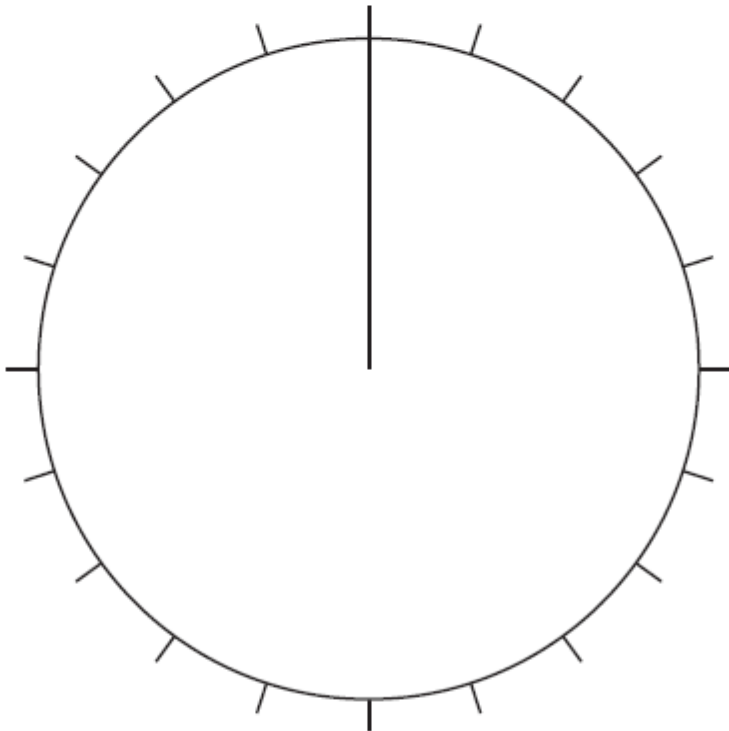
1

(b) (continued)

- (ii) The error was corrected and the students set out the pitfall traps once again. The table below shows the types of invertebrates and numbers found.

<i>Invertebrates</i>	<i>Number found</i>
Woodlice	35
Beetles	20
Slugs	0
Spiders	30
Snails	15

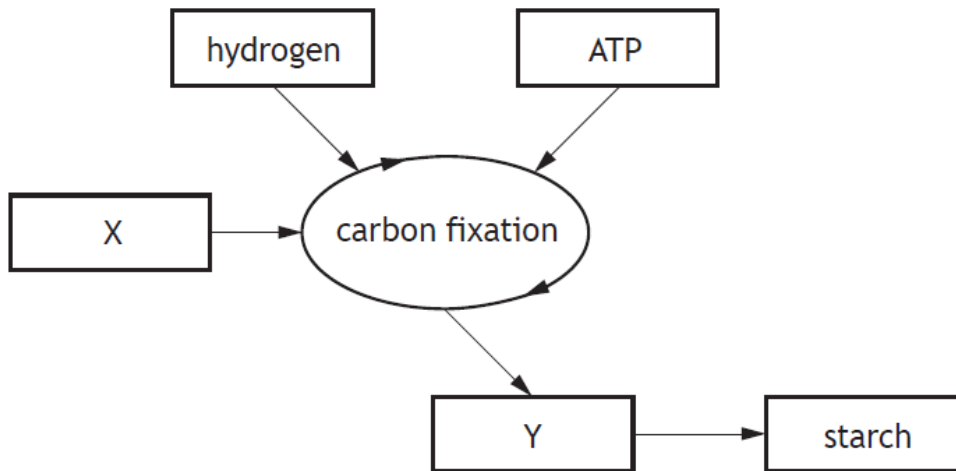
Use the information in the table to complete the pie chart below. 2
(An additional pie chart, if required, can be found on *Page twenty-six.*)



- (c) The students saw a large number of butterflies in the woodland.
Give a reason why no butterflies were collected with the invertebrates. 1

Photosynthesis

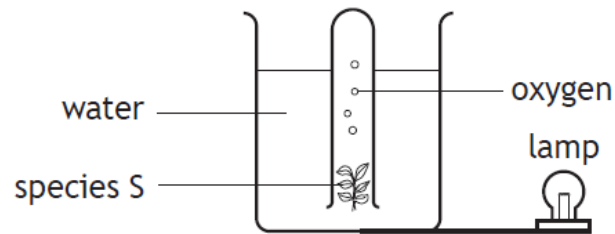
1. The diagram below shows the carbon fixation stage of photosynthesis.



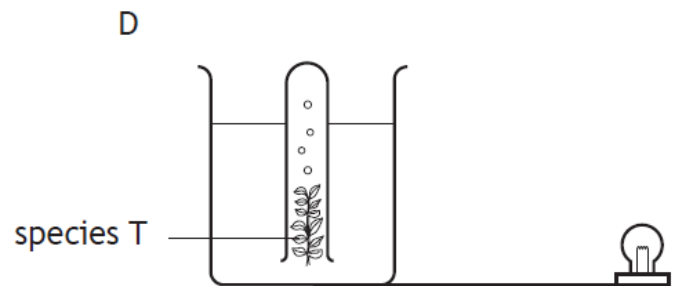
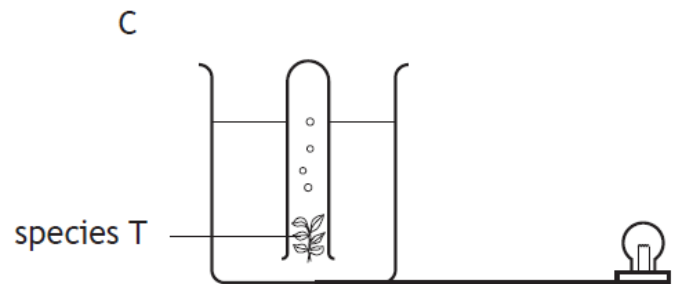
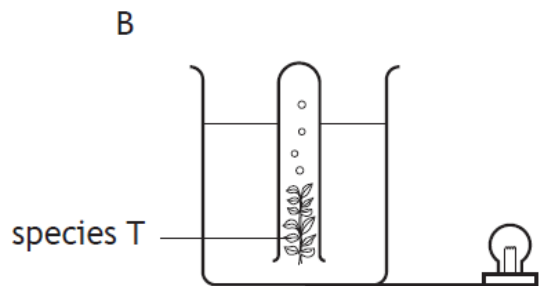
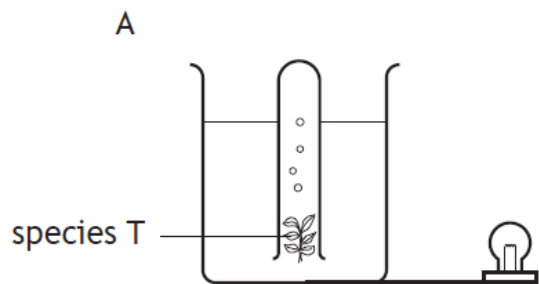
Which row in the table below identifies X and Y?

	X	Y
A	Sugar	Oxygen
B	Water	Carbon dioxide
C	Carbon dioxide	Sugar
D	Water	Oxygen

2. An investigation was carried out to compare the rate of oxygen gas production by two different species of water plant, S and T.



Which diagram below shows the set-up for species T, that would allow a valid comparison in the rate of oxygen production of the two species?



3. The table below shows the rate of photosynthesis in a plant, at 10 °C and 15 °C, in different light intensities.

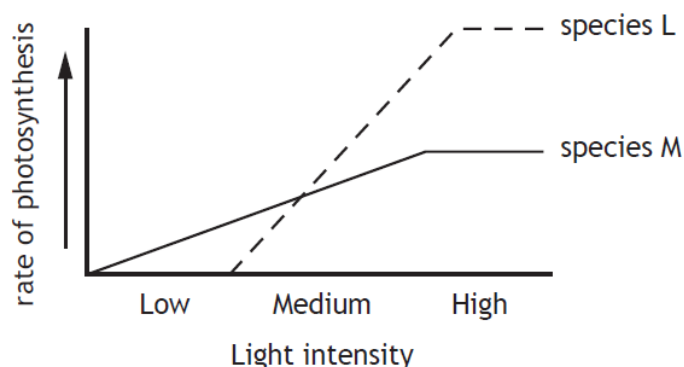
<i>Light Intensity</i> (units)	<i>Rate of Photosynthesis</i>	
	10 °C	15 °C
2	4	5
4	10	15
6	15	30
8	22	45

At which light intensity was the rate of photosynthesis at 15 °C found to be 50% greater than the rate at 10 °C?

- A 2 units
 - B 4 units
 - C 6 units
 - D 8 units
4. The light energy for photosynthesis is captured by
- A water
 - B hydrogen
 - C chlorophyll
 - D oxygen.

5. The effect of light intensity on the rate of photosynthesis was measured for two species of plants, L and M.

The results are shown in the graph below.



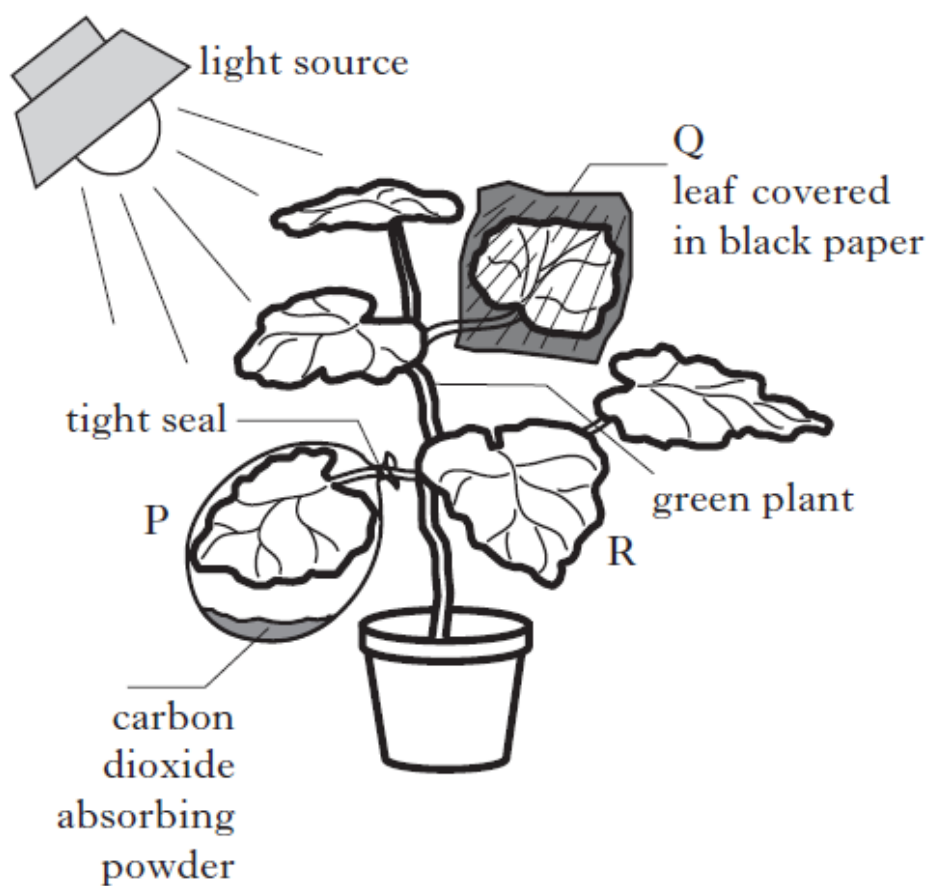
The rate of photosynthesis of species M is

- A slower than L in low light intensities
 - B slower than L in high light intensities
 - C faster than L in medium light intensities
 - D faster than L in high light intensities.
6. Glucose produced during photosynthesis may be converted into starch or cellulose.

Which line in the table below correctly identifies the use of starch and cellulose?

<i>Use of carbohydrate</i>		
	<i>Starch</i>	<i>Cellulose</i>
A	structural	structural
B	structural	storage
C	storage	structural
D	storage	storage

7. The diagram below shows an investigation into photosynthesis.



Which of the following statements is correct?

- A P, Q and R make food
- B P and Q make food
- C Only Q makes food
- D Only R makes food

8. (a) The sentences below give some information about photosynthesis.

Underline one option in each set of brackets to make the sentences correct.

Photosynthesis uses $\left\{ \begin{array}{l} \text{carbon dioxide} \\ \text{oxygen} \end{array} \right\}$ to allow $\left\{ \begin{array}{l} \text{fungi} \\ \text{green plants} \end{array} \right\}$ to make

their own food.

Some of this food is converted to $\left\{ \begin{array}{l} \text{cellulose} \\ \text{starch} \end{array} \right\}$ for making cell walls.

2

- (b) Decide if each of the following statements about photosynthesis is **True** or **False**, and tick (✓) the appropriate box.

If the statement is **False**, write the correct word(s) in the **Correction** box to replace the word(s) underlined in the statement.

<i>Statement</i>	<i>True</i>	<i>False</i>	<i>Correction</i>
The first reaction in photosynthesis is called <u>carbon fixation</u> .			
<u>Hydrogen</u> is transferred from the first reaction to the second reaction.			
<u>ADP</u> is used as the energy source for the second reaction in photosynthesis.			

3

9. Photosynthesis is a two stage process.

Stage 1 — Light reactions

Stage 2 — Carbon fixation

- (a) The table below shows some statements about photosynthesis.

Complete the table to show which stage each statement refers to by placing a tick (✓) in the Stage 1 or Stage 2 box.

The first two statements have been completed for you.

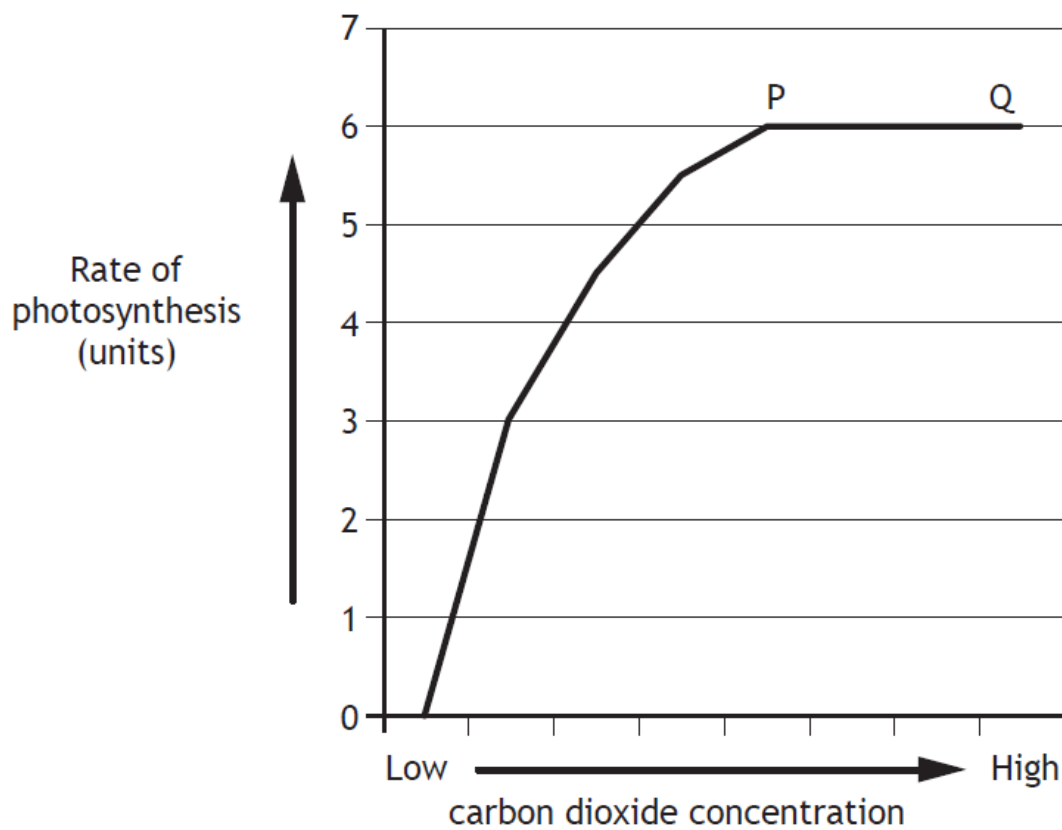
2

<i>Statement</i>	<i>Stage 1</i>	<i>Stage 2</i>
Carbon dioxide required		✓
Light energy required	✓	
Water required		
Sugar produced		
ATP + Hydrogen required		
Oxygen produced		

- (b) Explain why high temperatures (above 50°C) would prevent the photosynthesis reactions from taking place.

2

- (c) The graph below shows how the rate of photosynthesis is affected by the concentration of carbon dioxide.



State two environmental factors which could limit the rate of photosynthesis between points P and Q.

1

1 _____

2 _____

10. Photosynthesis is a two stage process used by green plants to produce food.

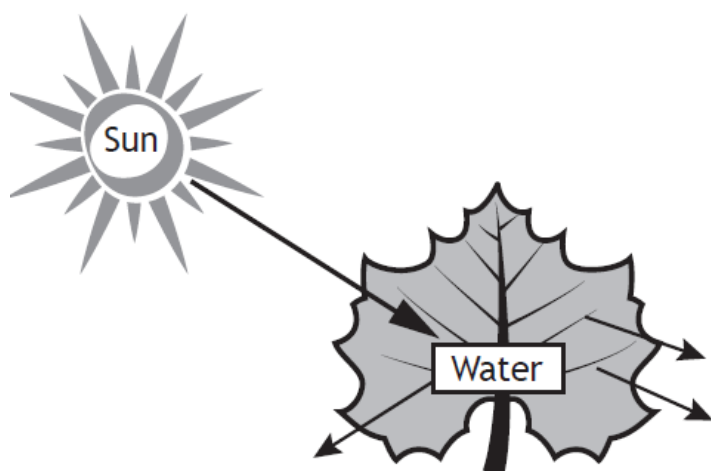
- (a) The diagram below represents a summary of the first stage of photosynthesis.

Complete the diagram by filling in the three boxes, selecting terms from the list in the box below.

3

ATP	carbon dioxide	carbon fixation
sugar	hydrogen	oxygen
		light reactions

Name of the first stage



Diffuses out of the leaf

Two products used in second stage.

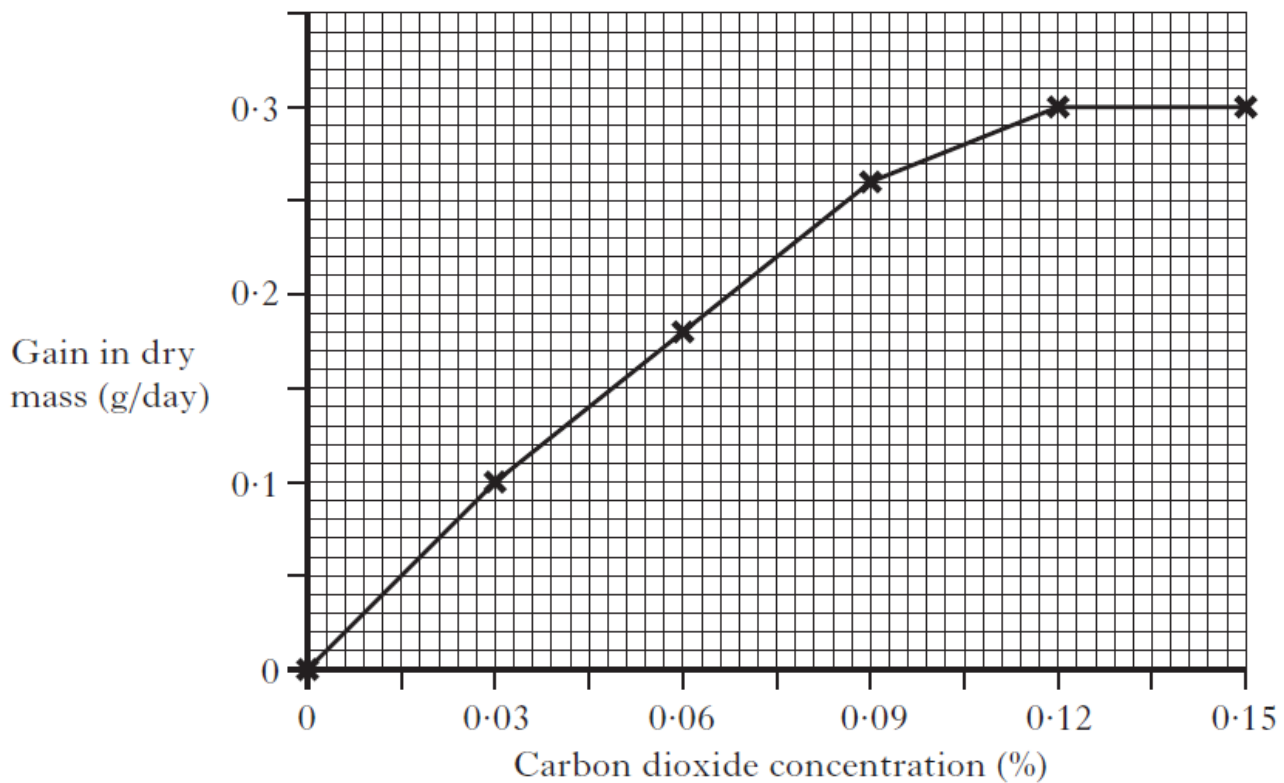
1. _____

2. _____

- (b) Describe the second stage of photosynthesis.

2

11. (a) The graph below shows the effect of carbon dioxide concentration on the growth of plants.



- (i) How was the growth of plants measured in this investigation?

1

- (ii) **Use data from the graph** to describe the relationship between carbon dioxide concentration and the growth of plants.

2

- (b) Carbon dioxide concentration is a limiting factor in photosynthesis. Name **one** other limiting factor.

1

(c) Photosynthesis uses carbon dioxide for the growth of plants.

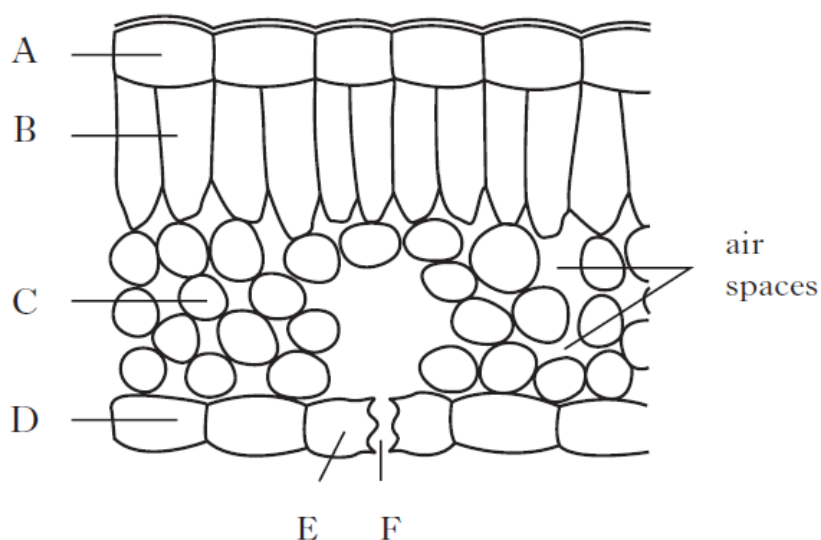
(i) Name the stage of photosynthesis which uses carbon dioxide.

1

(ii) Name one other substance used in this stage.

1

12. (a) The diagram below represents part of a cross section through a leaf.



Identify **one** example of each of the cells described below by using letters from the diagram to complete the boxes.

Each letter may be used **once, more than once** or **not at all**.

Transparent cells

Cells which carry out photosynthesis

Mesophyll cells

Guard cells

2

- (b) The rate of photosynthesis can be affected by several factors.

Underline the correct word in each bracket in the following sentence to explain the term *limiting factor*.

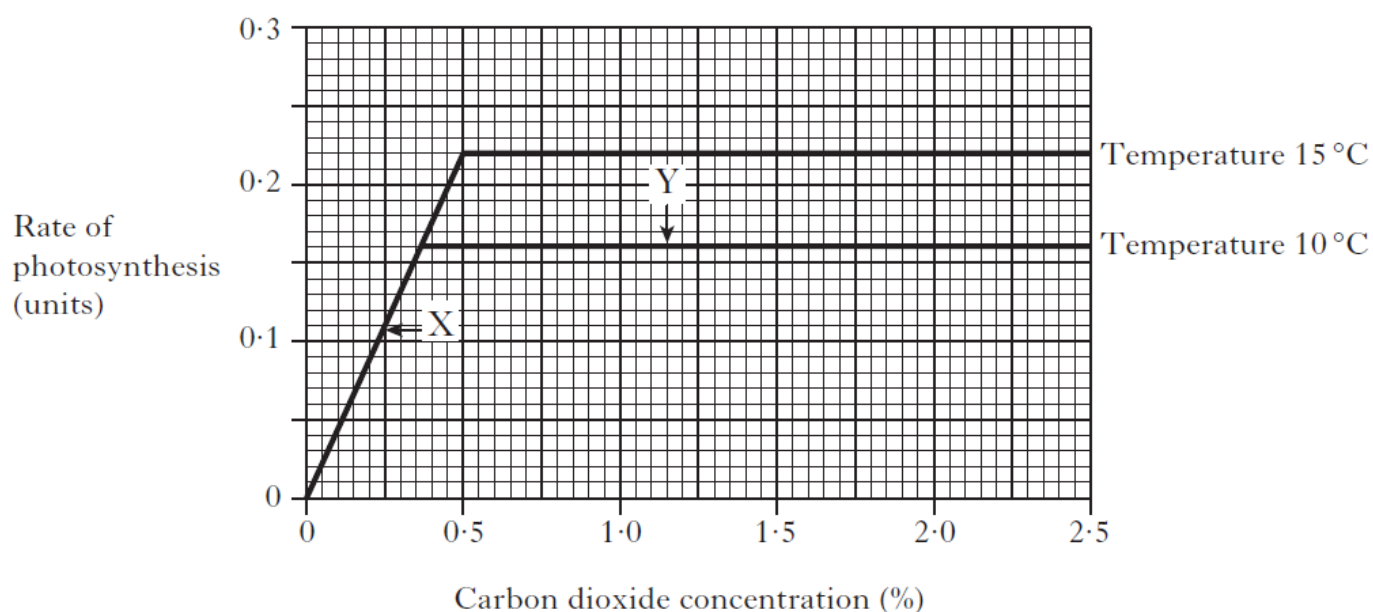
The limiting factor is the factor which is preventing the rate of

photosynthesis from $\left\{ \begin{array}{l} \text{increasing} \\ \text{decreasing} \end{array} \right\}$ unless the supply of that factor

$\left\{ \begin{array}{l} \text{increases} \\ \text{decreases} \end{array} \right\}$.

1

- (c) The following graph shows the effect of increasing carbon dioxide concentration on the rate of photosynthesis at two different temperatures. All other factors were kept constant.



From the evidence in the graph, what are the limiting factors at points X and Y?

X _____

Y _____

1

- (d) Some carbon compounds found in plants are shown in the list below.

List

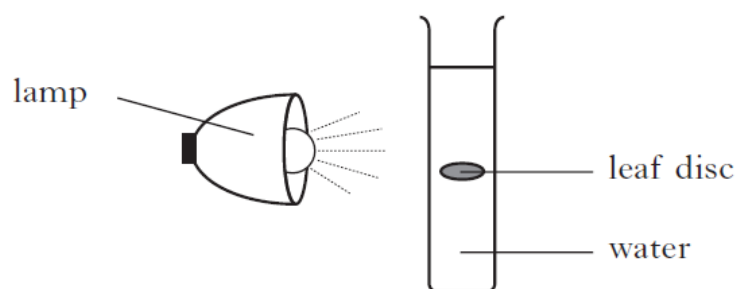
- carbon dioxide
- cellulose
- glucose
- starch

Complete the following table with the correct carbon compound for each of the functions.

<i>Carbon compound</i>	<i>Function</i>
	raw material for photosynthesis
	respiratory substrate
	storage carbohydrate

2

13. (a) An investigation into photosynthesis was carried out using the apparatus shown in the diagram below.



After the lamp was switched on, the leaf disc floated to the surface because oxygen gas was produced in the leaf. The time taken for this to happen was measured.

The experiment was repeated six times and the results are shown in the table below.

<i>Experiment</i>	1	2	3	4	5	6
<i>Time for disc to reach surface (seconds)</i>	18	17	12	15	12	16

- (i) Calculate the average time for the leaf discs to reach the surface.

Space for calculation

_____ seconds

1

- (ii) 1 State **one** feature of the leaf disc which must be kept the same for each experiment.

1

- 2 State **one** other feature, not relating to the leaf disc, which must be kept the same for each experiment.

1

- (iii) Describe how this method could be used to investigate the effect of light intensity on the rate of photosynthesis.

2

- (b) Name the green coloured chemical, present in plants, which is needed for photosynthesis.

1

- (c) Decide whether each of the following statements is **TRUE** or **FALSE**.

If the statement is **TRUE**, tick (✓) the **True** box. If the statement is **FALSE**, tick the **False** box and write the correct word or phrase in the **Correction** box to replace the word or phrase underlined in the statement.

<i>Statement</i>	<i>True</i>	<i>False</i>	<i>Correction</i>
Repeating an investigation several times improves the <u>reliability</u> of the results.			
To calculate <u>a percentage</u> , add up all the values and divide the total by the number of values.			
A control experiment is set up to prove that the result is caused by changing <u>two</u> of the possible variables.			

3

14. (a) Two gardeners compared their tomato crops. Both grew 10 plants of the same variety in a greenhouse.

One gardener altered the environmental conditions in his greenhouse to increase the rate of photosynthesis. His plants yielded 720 tomatoes. The other gardener only produced 480 tomatoes.

- (i) What was the percentage increase in the yield of tomatoes when the rate of photosynthesis was increased?

Space for calculation

_____ %

1

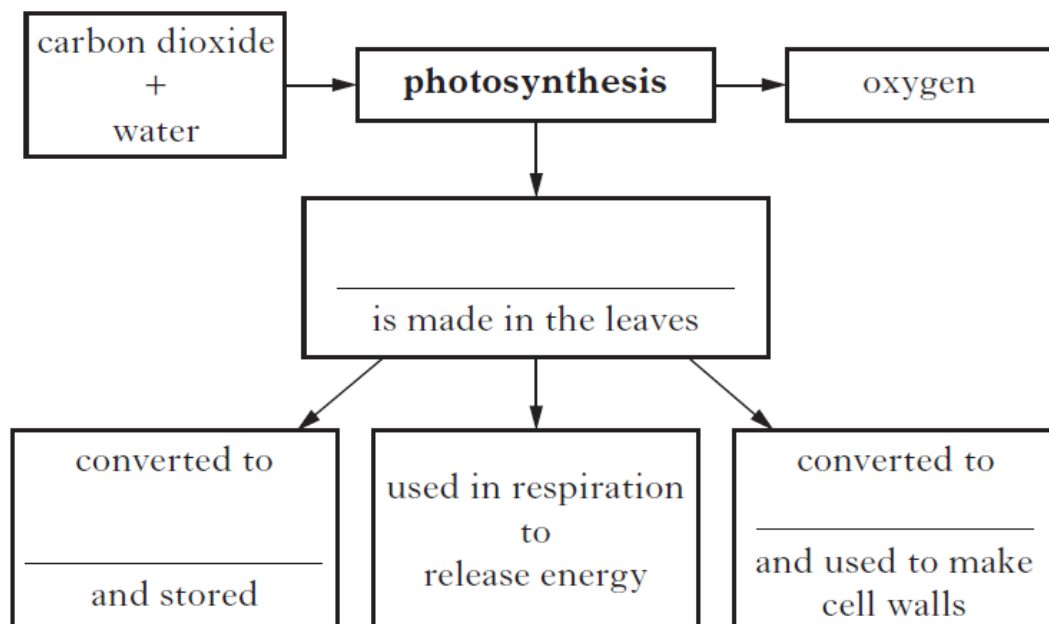
- (ii) Describe **two** changes to the environmental conditions in the greenhouse which could have increased the rate of photosynthesis.

1 _____

2 _____

1

- (b) (i) Complete the diagram below to show how the carbohydrate product of photosynthesis is used in a plant.



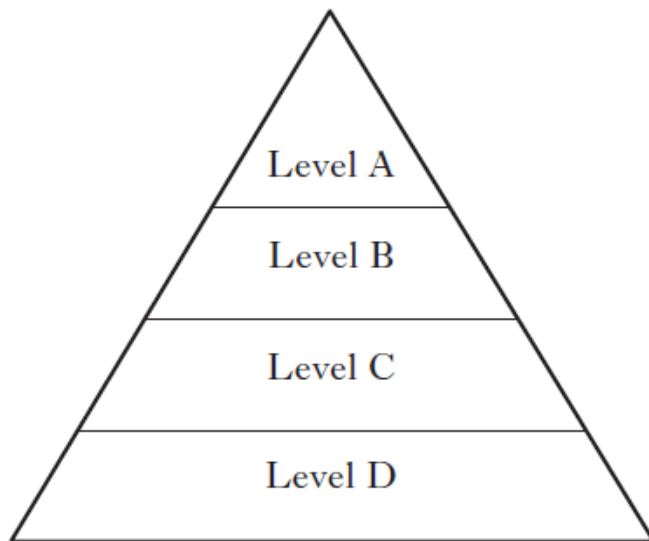
2

- (ii) Name a tissue in the leaves of plants in which photosynthesis takes place.

1

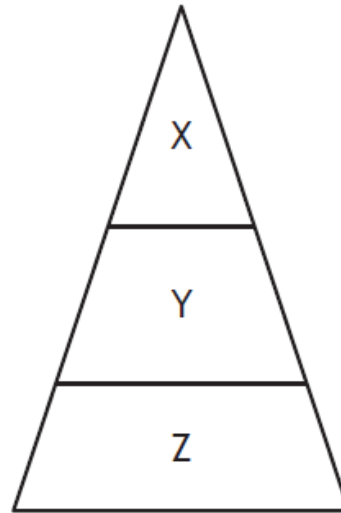
Energy in Ecosystems

1. The diagram below shows the levels in a pyramid of numbers.



Which level in the pyramid contains primary consumers?

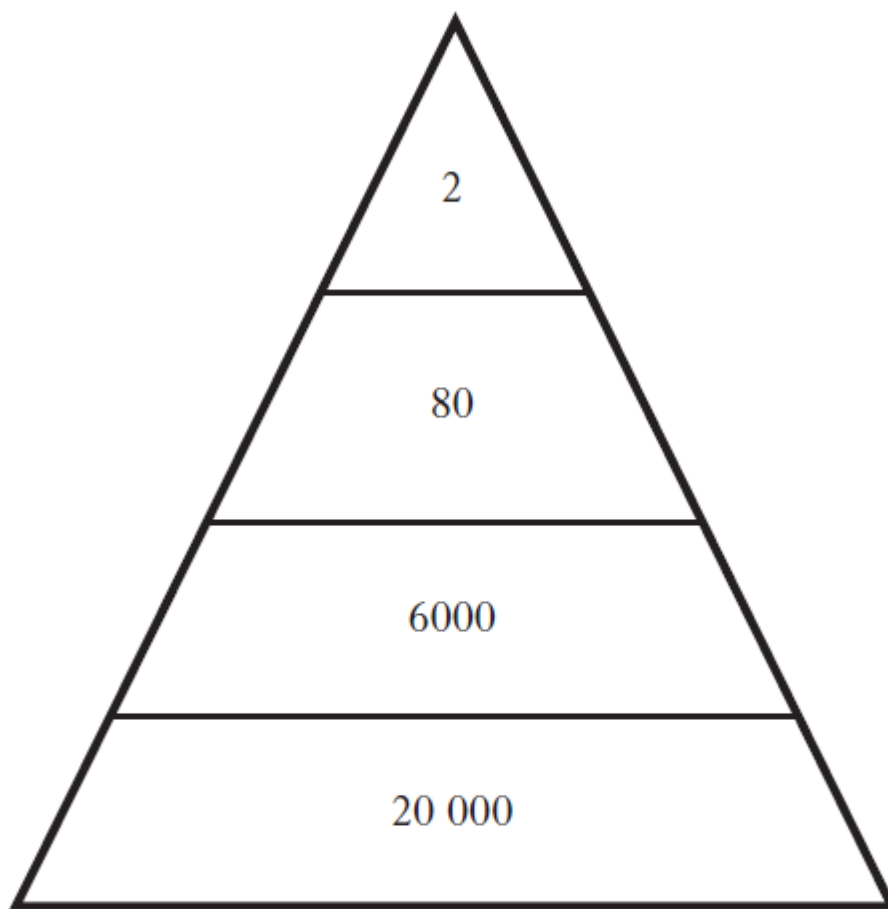
2. The diagram below shows the pyramid of energy for a food chain.



There is a lot less energy at level X in the pyramid because

- A there are fewer organisms at this level
- B energy is stored at each level
- C energy is lost at each level
- D the organisms are bigger at this level.

3. The diagram below shows the number of organisms at each level in a pyramid of numbers.



How many organisms are consumers?

- A 2
- B 82
- C 6000
- D 6082

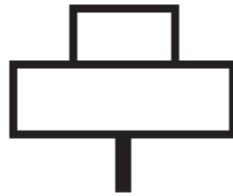
4. Beech tree $\longrightarrow$ greenfly $\longrightarrow$ ladybirds

Which of the following diagrams represents the pyramid of numbers for the above food chain?

A



B



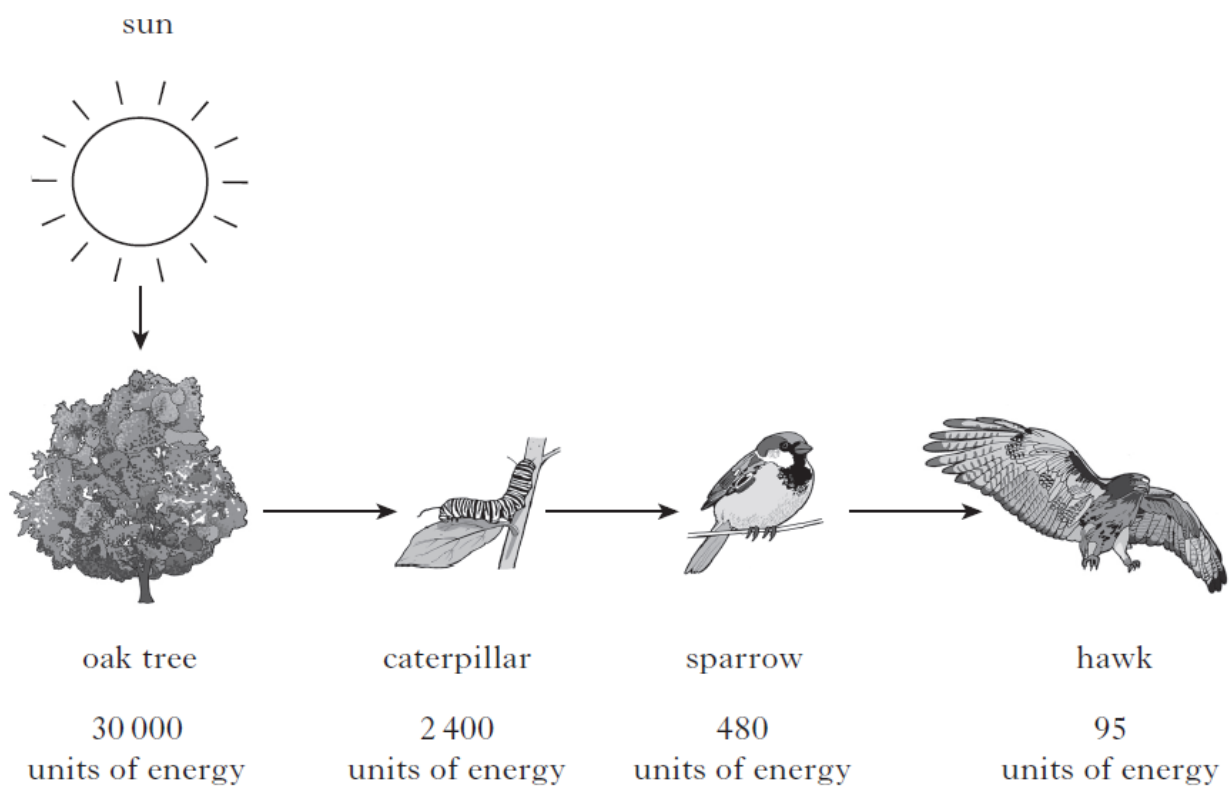
C



D



5. The diagram below shows the transfer of energy through a food chain in a wood. The numbers represent the units of energy in the different populations of the food chain.



(a) (i) Complete the table below using information from the diagram.

<i>Population</i>	<i>Energy content (units)</i>
caterpillar	
	480
hawk	

2

- (ii) 4% of the light energy reaching the oak tree is converted into new plant material.

How much energy did the oak tree receive?

Space for calculation

_____ units

1

(b) Which of the following food chains could be represented by the pyramid of numbers shown below?



Tick (✓) the correct box.

☐

grass → beetle → spider → robin

☐

oak tree → greenfly → ladybird → blackbird

☐

plant plankton → mayfly larvae → water beetle → stickleback

☐

beech tree → squirrel → fox

6. (a) In an investigation, students estimated the population and biomass of some organisms found on part of a rocky shore.

The table below shows the results.

<i>Organism</i>	<i>Population</i>	<i>Average mass of one organism (g)</i>	<i>Biomass of population (g)</i>
Seaweed	220	500	110 000
Limpet	1 100		33 000
Crab	100	90	9 000
Gull	5	700	3 500

- (i) Complete the table to show the average mass of one limpet.

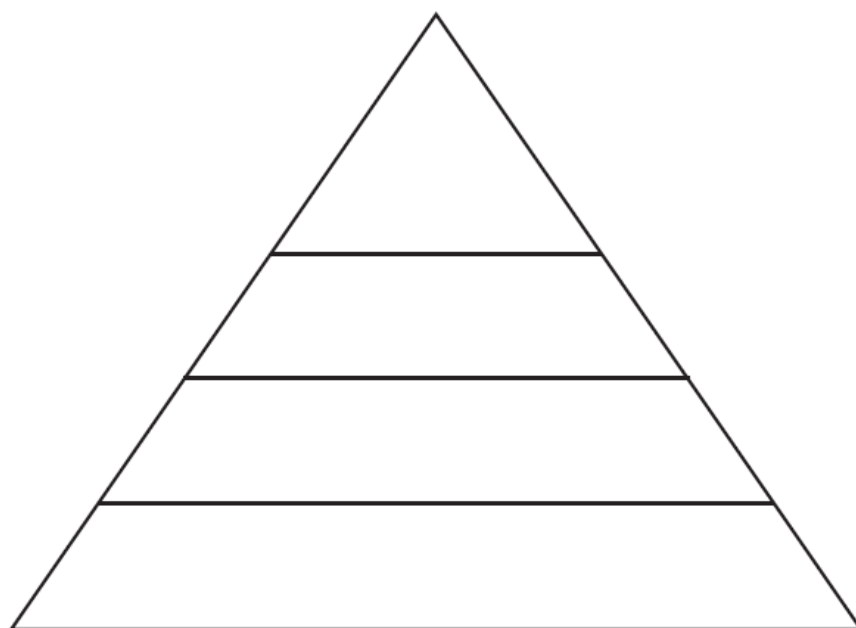
1

Space for calculation

- (ii) The total mass of living material decreases at each level in the food chain. This can be shown as a pyramid of biomass.

Complete the diagram below by entering the names of the organisms from the table into the appropriate section.

1



Food Production

Questions 1 and 2 refer to the following information.

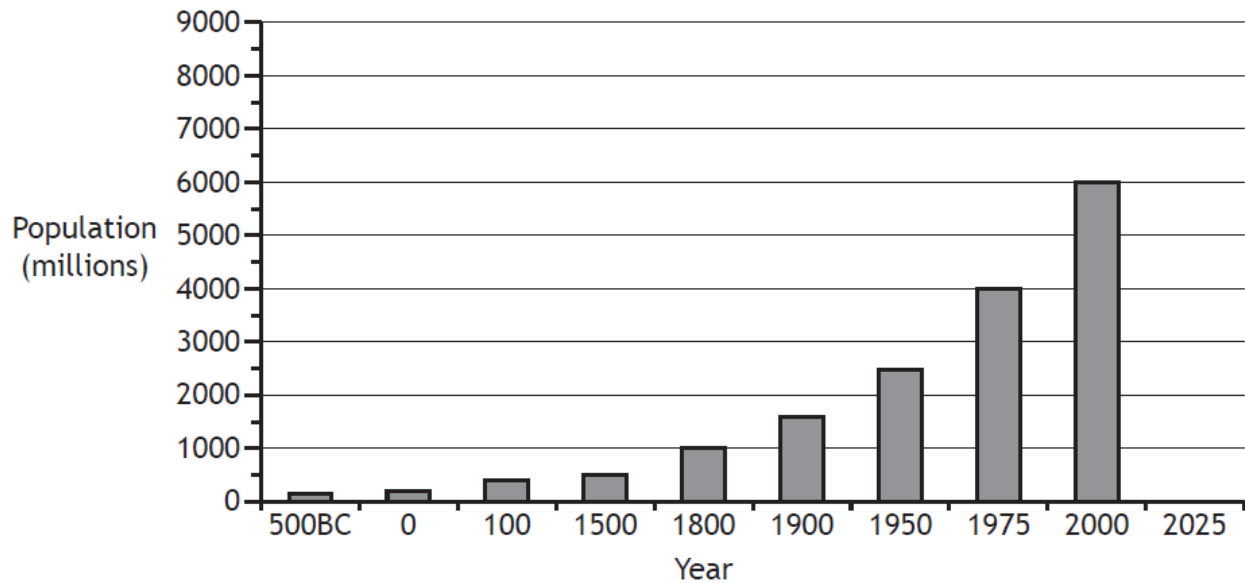
An investigation was carried out into the effect of a hedge on the growth of wheat plants.

Groups of 100 wheat plants were planted at different distances from the hedge. The heights of the plants were measured after six weeks and the results are shown in the table.

<i>Distance planted from hedge (m)</i>	<i>Average height of wheat after six weeks (cm)</i>
2.0	45
2.5	54
3.0	60
3.5	69
4.0	78
4.5	90

- The reliability of the results was increased by
 - measuring the height of plants after six weeks
 - planting groups of 100 wheat plants
 - planting the wheat plants at different distances from the hedge
 - calculating an average height of wheat plants.
- What is the percentage increase in average height of wheat planted between 2.0m and 4.5 m from the hedge?
 - 45%
 - 50%
 - 66%
 - 100%

3. The graph below shows information about the growth of the human population.



If the population continues to increase at the same rate as between 1975 and 2000, predict the population size in 2025.

- A 7000
B 7500
C 8000
D 8500
4. DDT can be sprayed onto crops to kill insects. It can be washed off the crops by rainwater and flow into rivers where it accumulates in food chains.

A typical freshwater food chain and the concentration of DDT in each organism is shown below.

Food chain: algae → stickleback → trout → osprey
DDT concentration: 0.001 2.0 5.0 20.0

The percentage increase in DDT concentration between the trout and osprey is

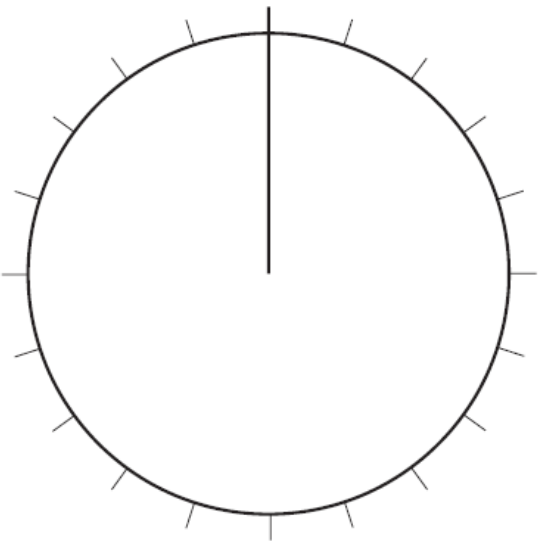
- A 15
B 100
C 300
D 400.

5. Which of the following statements describes the sequence of events when fertiliser leaches into a loch?
- A Algal bloom develops → algae die → oxygen concentration increases
 - B Algal bloom develops → algae die → oxygen concentration decreases
 - C Oxygen concentration increases → algal bloom develops → algae die
 - D Algae die → oxygen concentration decreases → algal bloom develops

6. (a) The table below refers to crop production in Scotland in 2008. It shows the area of the land used to grow the five main crops as a percentage of the total.

<i>Crop</i>	<i>Area of land used (percentage)</i>
oats	5
potatoes	5
oil seed rape	10
wheat	25
barley	55

- (i) Use the information from the table to complete the pie chart below.



2

- (ii) If 50 000 hectares of land is available in Scotland to grow crops, what area of land was used for wheat production?

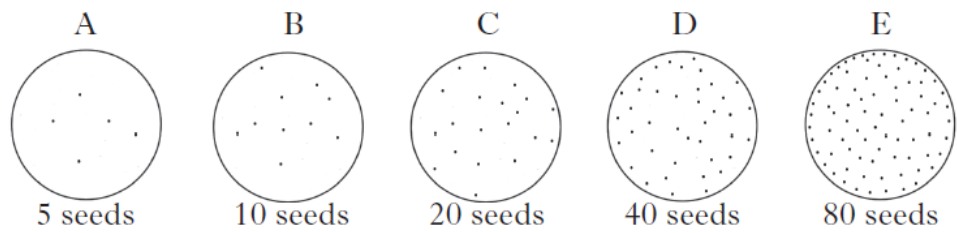
Space for calculation

_____ hectares

1

7. (a) A student set up five petri dishes to investigate the effect of competition on the percentage of seedlings surviving after five days. Each dish contained a thin layer of wet cotton wool with different numbers of seeds placed evenly across its surface, as shown below.

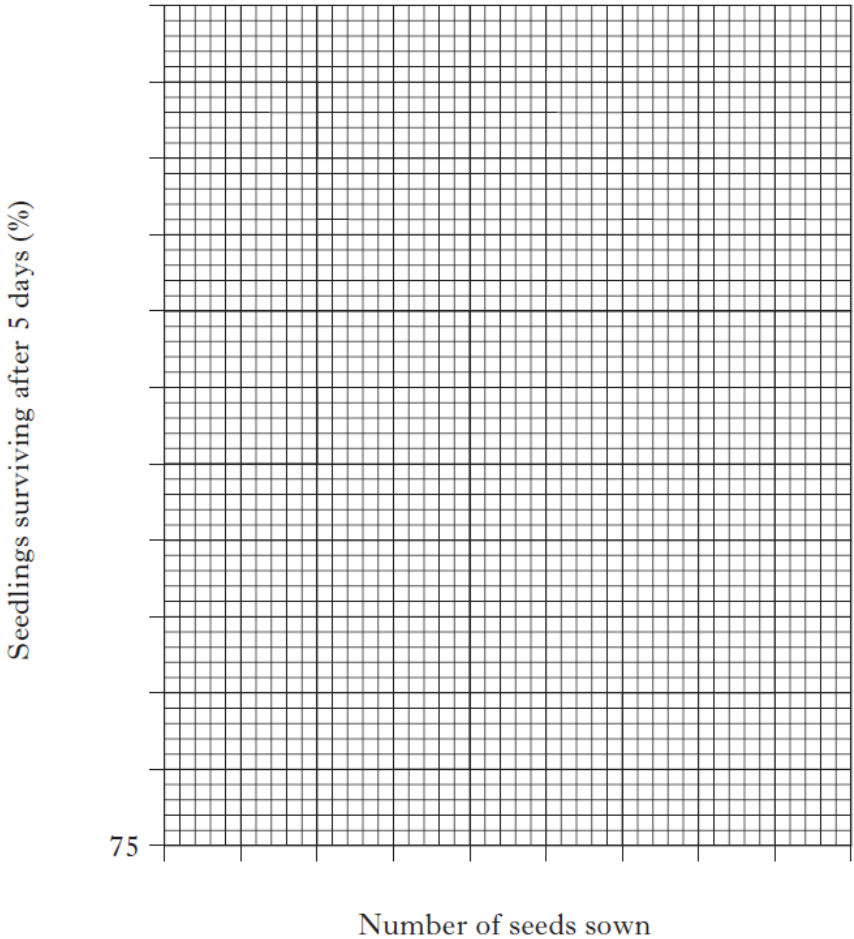
Mark



The table of results for this investigation is shown below.

<i>Dish</i>	<i>Number of seeds sown</i>	<i>Seedlings surviving after five days (%)</i>
A	5	100
B	10	100
C	20	95
D	40	85
E	80	75

- (i) Construct a **line graph** to show the number of seeds sown against percentage of seedlings surviving after five days.



(ii) Name the variable which is altered in this investigation.

1

(iii) What conclusion can be drawn from these results?

1

(iv) Calculate the simple whole number ratio of the percentage of seedlings surviving in dish A compared to dish E.

Space for calculation

_____ : _____
Dish A Dish E

1

(v) Another dish was set up with 160 seeds and 88 seedlings survived for five days.

Calculate the percentage of seedlings surviving in this dish.

Space for calculation

_____ %

1

(b) Name **one** requirement, other than water, for which plants may be in competition.

1

8. One of the advantages of intensive farming is to increase the yield of food crops which can make them more affordable. It also has a number of disadvantages as shown in the list below.

List

- Forests are destroyed to create large open fields and this could lead to soil erosion
- The natural habitats of wild animals are affected
- Loss of biodiversity
- Use of fertilizers can alter the biology of rivers and lochs
- Pesticides sprayed on crops not only destroy pests but also kill beneficial insects
- Toxic effects from pesticides may affect human beings and other organisms when they consume the food crops

Biological control and GM crops are methods used in farming.

Choose one of these methods and explain how it is used to overcome some of the disadvantages of intensive farming listed above.

2

Method _____

9. Read the following passage and answer the questions based on it.

Soils

The type of soil in a particular area has a large effect on the plants growing in it. This affects the animals living there. Soil provides anchorage, nutrients and water for plants. Plant roots and other soil organisms need air to provide them with oxygen for respiration. A good soil will have plenty of air spaces.

Soil has six main constituents; mineral particles, humus, water, nutrient ions, air and living organisms. Soil is formed from rock. When rocks are weathered by wind, freezing and thawing, or by water flowing over them, they are broken down into small mineral particles. These particles are gradually colonised by lichens and mosses, and then by some flowering plants. As plants die and decay, their remains add organic materials to the mineral particles allowing other plants and animals to colonise the soil. Continued death and decay over thousands of years forms a good soil.

The size of the mineral particles in a soil is important. The smallest particles are called clay, while larger ones are called sand.

Clay soil particles pack tightly together. Clay soils do not drain well, but have the ability to retain nutrients for long periods. This stops nutrients from being washed out of the soil by rain water. In wet conditions, the spaces between the particles fill up with water so there is no room for air.

A sandy soil contains larger particles. These cannot pack very closely together, so there are large air spaces between them. As a result, sandy soils are well aerated and drain very quickly. Sand particles do not hold nutrients in the same way that clay particles do. So nutrients are washed out of a sandy soil more quickly.

Loam is a soil which contains a good mixture of sand and clay particles. If the balance is right, it will hold water and nutrient ions very well, but will not get waterlogged too easily.

- (a) Name **three** ways in which soils provide good conditions for plant growth.

1 _____

2 _____

3 _____

- (b) Describe the process by which soil develops from small mineral particles into a good soil.

2

- (c) The table below summarises features of three different types of soil.

Use words from the following list to complete the table.

Each word should be used **once** only.

List small high fast medium
 slow loam mixed low

<i>Soil type</i>	<i>Particle size</i>	<i>Drainage</i>	<i>Nutrient content</i>
Sandy	large		
Clay			
		medium	

2

- (d) Give a reason why a good soil cannot be described as an abiotic factor.

1

- (c) Photosynthesis uses carbon dioxide for the growth of plants.

- (i) Name the stage of photosynthesis which uses carbon dioxide.

1

- (ii) Name one other substance used in this stage.

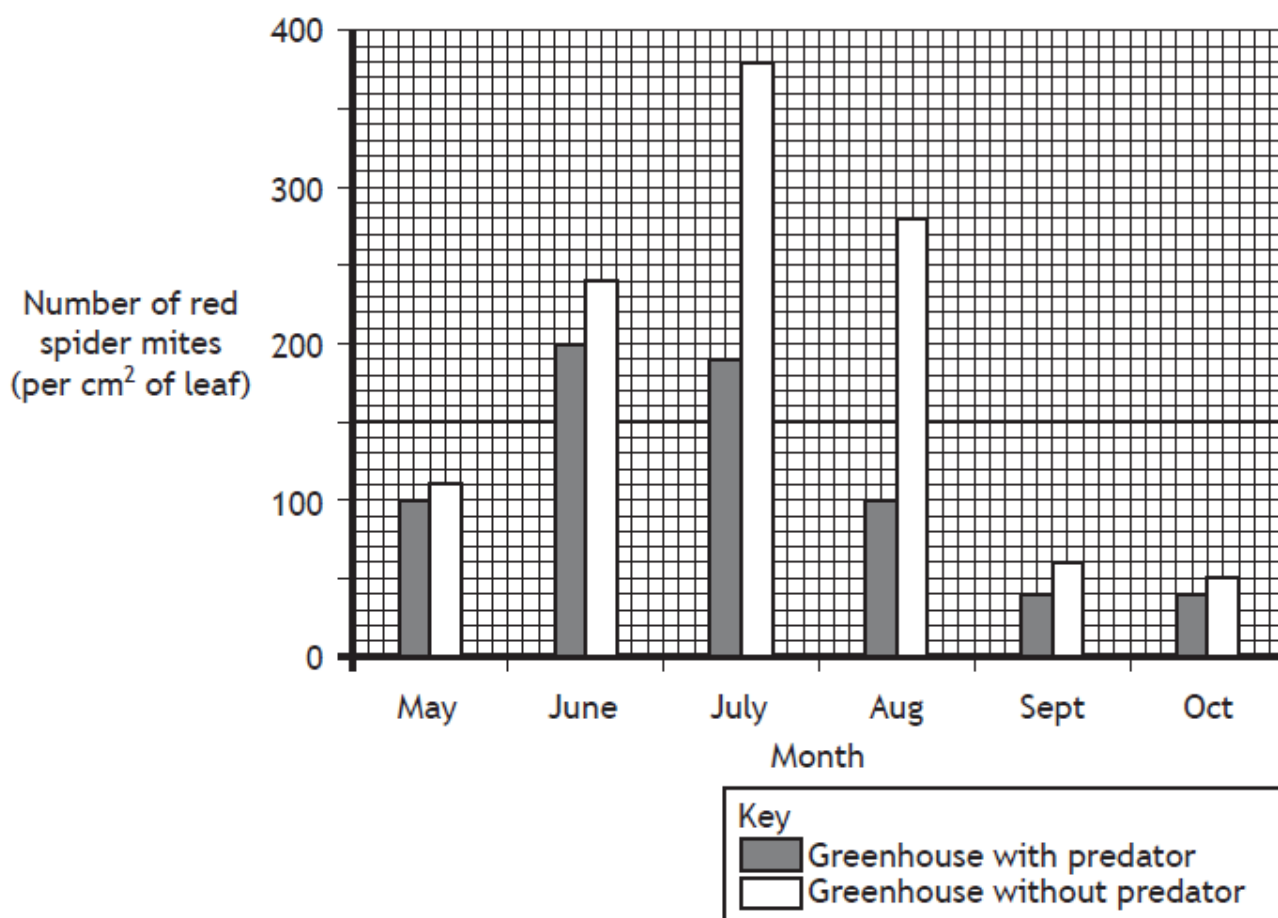
1

10. Red spider mites are a common pest which destroy tomato plants. Some of the mites are resistant to chemical pesticides.



Tomato growers aimed to investigate whether a predator would reduce the spider mite numbers in their greenhouses. Two identical greenhouses were used and the predator was released into only one greenhouse.

The results are shown in the graph below.



- (a) (i) With reference to the aim of this investigation, give the conclusion that the tomato growers would have drawn from these results.

- (ii) The greenhouse containing tomato plants without predators was included as a control experiment.

State the purpose of the control in this investigation.

1

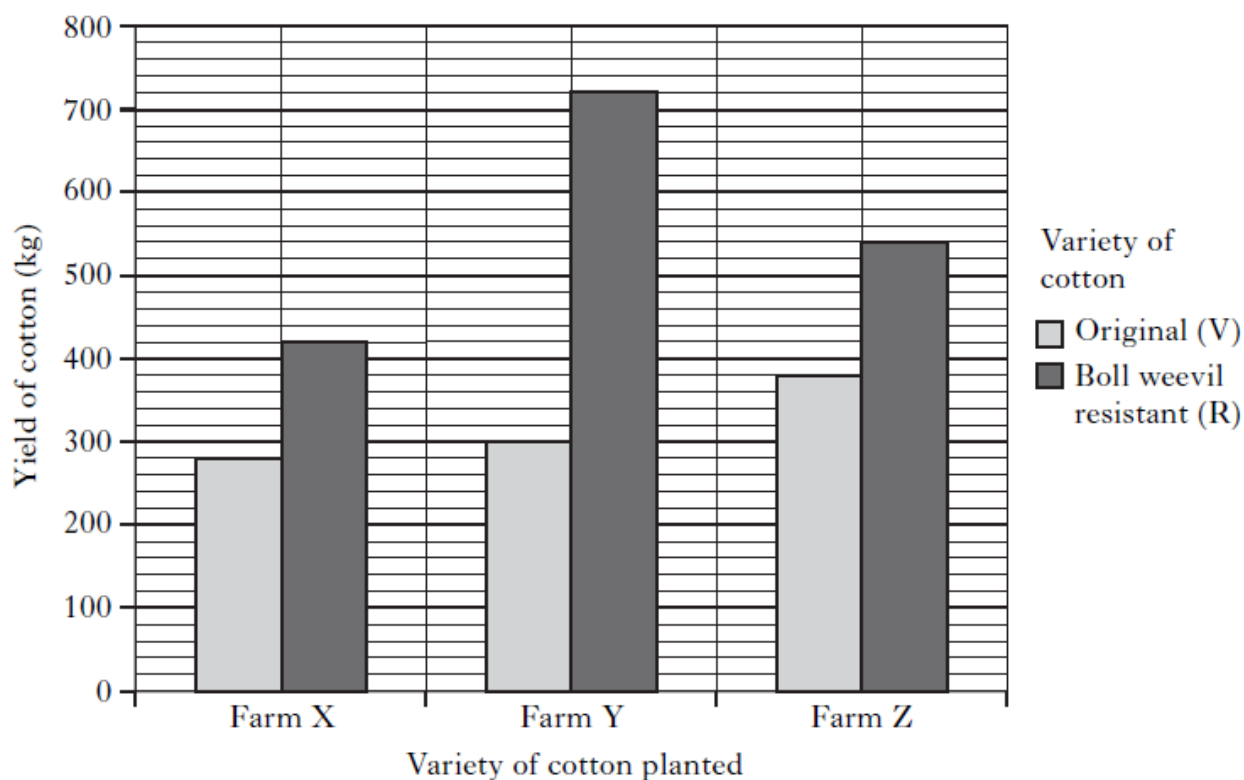
- (b) State the term which describes the use of a predator as an alternative to pesticides.

1

11. Boll weevil insects, shown in the picture below, feed on cotton plants. There are two varieties of cotton plant, original variety (V) and boll weevil resistant variety (R).



Three farms were used to compare the yield of the two varieties. Each farmer planted two fields, one of each variety. All fields were treated identically. The yield of cotton from each field was weighed. The results are shown in the bar graph below.



- (a) Calculate the average yield of V cotton.

Space for calculation

- (b) Calculate the percentage difference in yield between the two varieties of cotton grown at Farm X.

Space for calculation

_____ % **1**

- (c) (i) Name the variable altered in this investigation.

_____ **1**

- (ii) The fields planted with V cotton were used as a control.

Give a reason for using this control.

_____ **1**

- (iii) Explain why using ten farms instead of three would have improved this investigation.

_____ **1**

- (d) What conclusion can be drawn from these results?

_____ **1**

- (e) The farmers use pesticides to kill insects which damage their crops.

- (i) Explain why less pesticide is needed when growing R cotton.

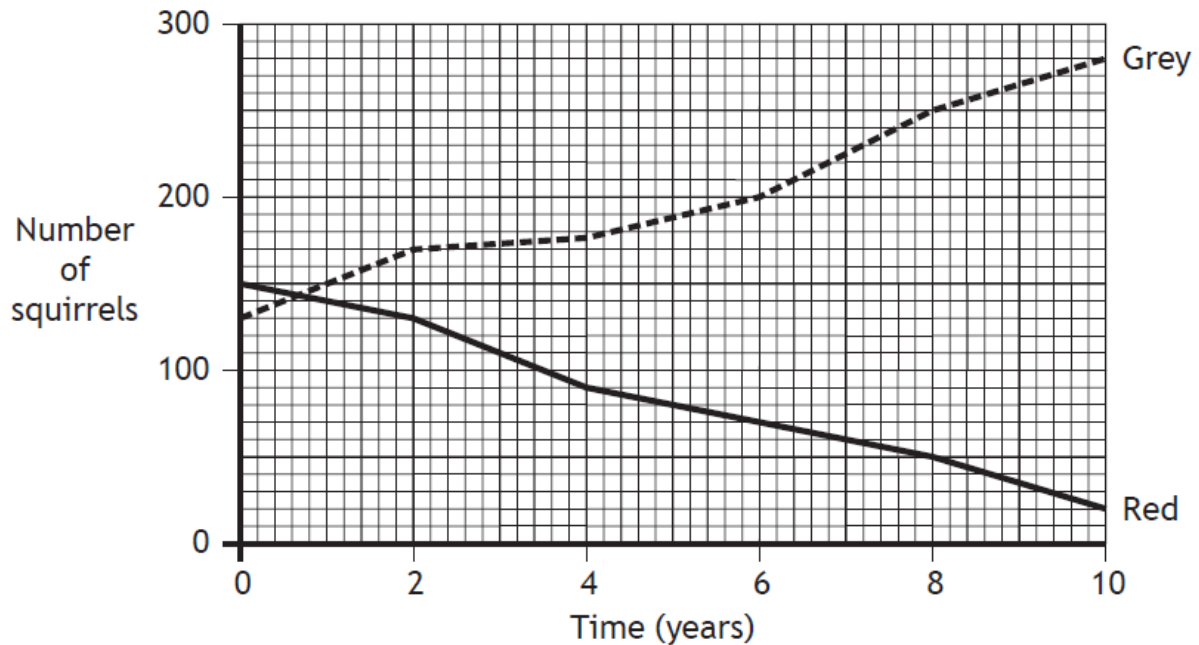
_____ **1**

- (ii) Explain why growing R cotton is less likely to affect insect biodiversity.

_____ **1**

Evolution of Species

1. The graph below shows changes in the population of red and grey squirrels in an area of woodland over a 10 year period.



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

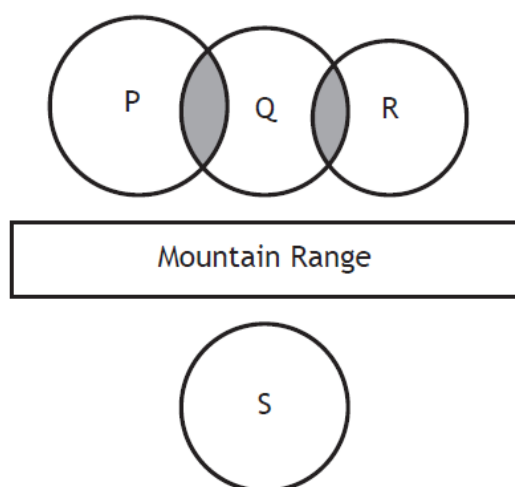
- A The total number of squirrels decreased over 10 years.
 - B The population of red squirrels showed a greater change than the grey squirrels.
 - C The population of grey squirrels showed a greater change than the red squirrels.
 - D After 8 years there were 4 times as many grey squirrels as red squirrels.
2. Which of the following is a source of new alleles in a population?
- A Mutation
 - B Isolation
 - C Natural selection
 - D Environmental conditions

3. The table below compares the rate of extinction of mammal species over two different time periods.

<i>Time period (years)</i>	<i>Rate of extinction per 100 years</i>
1500 – 1900	4.5
1900 – 2000	90

The ratio of extinction rates between 1900 – 2000 compared to 1500 – 1900 is

- A 1:20
B 1:2
C 2:1
D 20:1.
4. The diagram below represents four populations of animals P, Q, R and S and areas of interbreeding. Interbreeding takes place in the shaded areas.

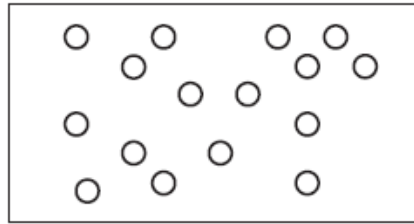


How many species may evolve over time?

- A 1
B 2
C 3
D 4

5. Antibiotic resistance in bacteria is an example of evolution. Which of the following shows the sequence of events leading to this?
- A Natural selection → mutation → use of antibiotic
 - B Mutation → natural selection → use of antibiotic
 - C Mutation → use of antibiotic → natural selection
 - D Natural selection → use of antibiotic → mutation

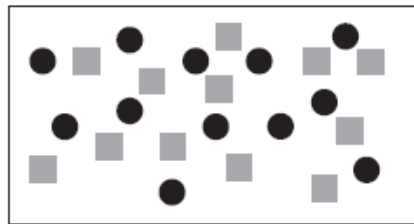
6. The diagram below represents a population of animals.



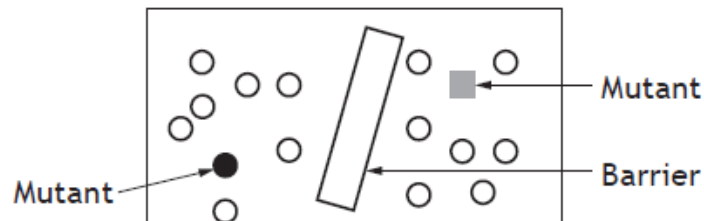
The following diagrams show the stages of speciation occurring from this population.

Stage

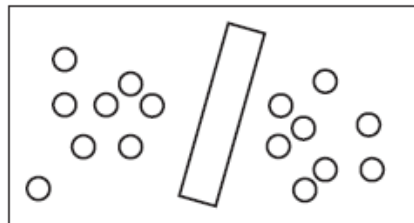
W



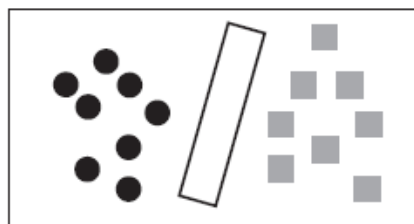
X



Y



Z

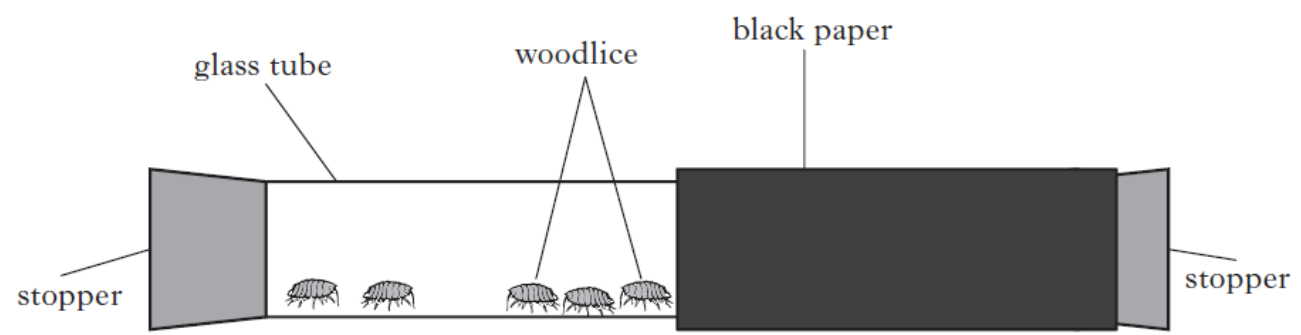


The correct order of the stages of speciation is

- A Z, W, X, Y
- B Z, X, W, Y
- C Y, X, Z, W
- D Y, Z, X, W.

7. An experiment was set up to study the response of woodlice to light. Ten woodlice were placed in a glass tube. After five minutes one end of the tube was covered with black paper to make it dark. The number of woodlice in light and dark was then recorded every minute for five minutes.

The diagram below shows the apparatus used.



The table below shows the results of the experiment.

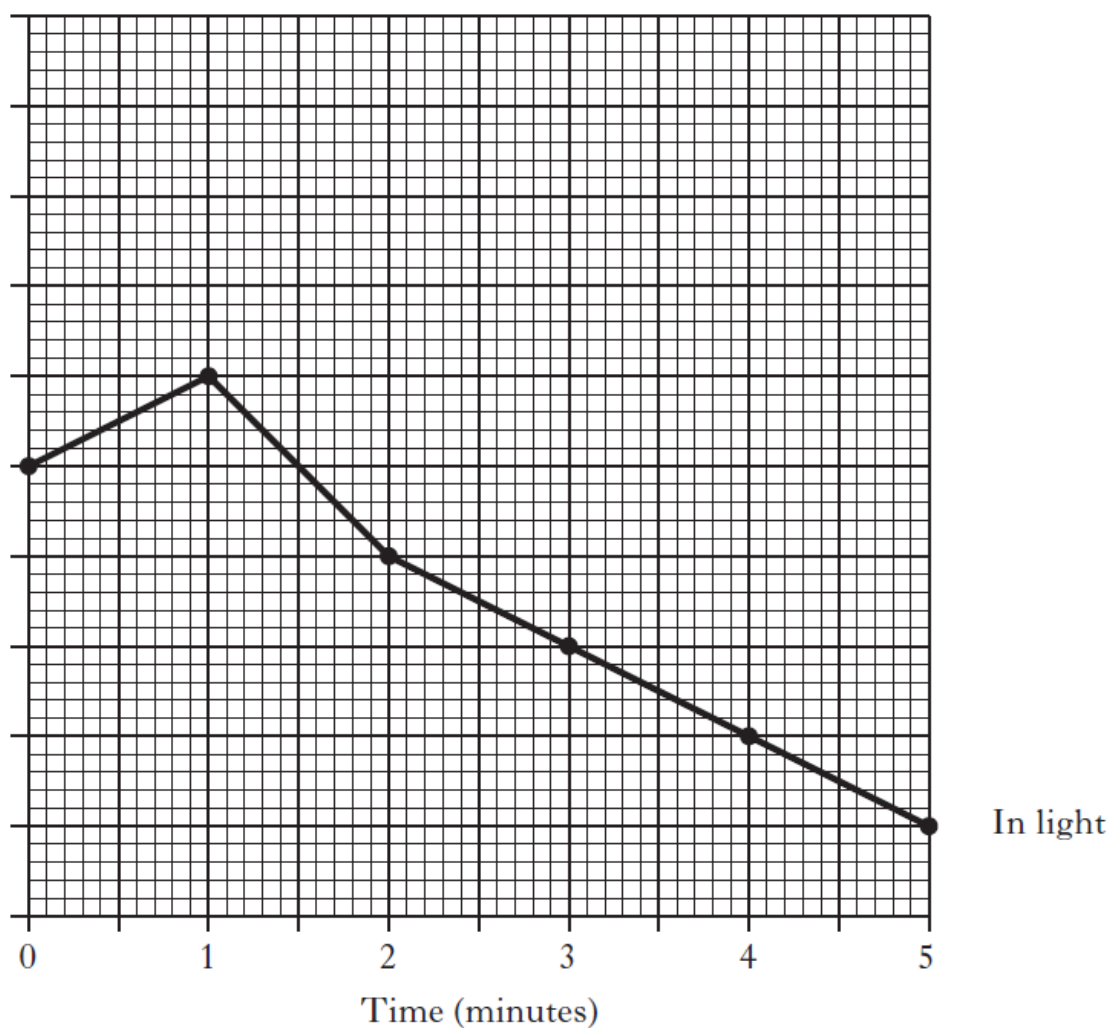
<i>Time (minutes)</i>	<i>Number of woodlice</i>	
	<i>In light</i>	<i>In dark</i>
0	5	5
1	6	4
2	4	6
3	3	7
4	2	8
5	1	9

- (a) Why were the woodlice left for five minutes before the black paper was placed on the tube?

- (b) Complete the line graph on the grid below to show the number of woodlice found in the dark at each minute during the experiment.

The results for woodlice in light have already been plotted.

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



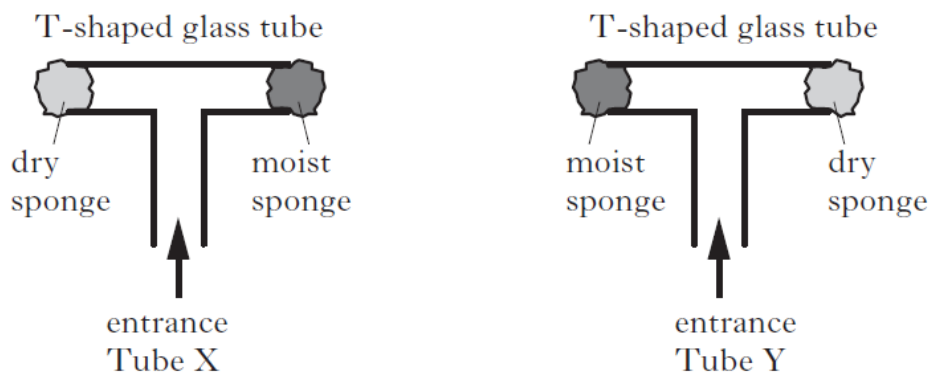
- (c) State a conclusion which can be drawn from the results of this experiment.

- (d) A student repeated this experiment.

- (i) How could the design be changed to make the results more reliable?

- (ii) State one environmental factor which would be kept the same to allow a valid comparison with the first experiment.

8. An investigation was carried out into the response of flour beetles to humidity. Two T-shaped glass tubes were set up as shown below.



Each T-shaped tube was left for 10 minutes before one beetle was placed at the entrance.

The direction in which the beetle turned was recorded.

This was repeated for a total of 25 beetles using a different beetle and a new T-shaped tube each time.

The results for the investigation are shown in the table below.

	<i>Tube</i>			
	X		Y	
Direction turned	left	right	left	right
Humidity	dry	moist	moist	dry
Number of beetles	21	4	5	20

(a) Which of the following is the best conclusion to draw from this investigation?

Tick (✓) the correct box.

- ☐ Most flour beetles turn left.
- ☐ Most flour beetles turn right.
- ☐ Most flour beetles turn to dry areas.
- ☐ Most flour beetles turn to moist areas.

1

(b) The diagram shows that tubes X and Y were set up differently.

How does this improve the validity of the investigation?

1

- (c) What was the purpose of leaving each tube for 10 minutes before placing a beetle at the entrance?

1

- (d) Suggest a reason why a new T-tube was used for each beetle, rather than using the same tube repeatedly.

1

- (e) Calculate the **total** percentage of beetles which turned towards the moist end in the investigation.

Space for calculation

_____ %

1

9. The diagrams below show the light and dark varieties of a moth which can be found in woodland areas. These moths rest on the bark of trees during the day and can be eaten by birds. Normally the bark of trees in the woodland is light coloured. However in industrial areas, pollutants cause the tree bark to darken.

Woodland area



Industrial area



- (a) The dark variety of the moth is the result of a random change in the genetic information.

State the term used to describe this change.

1

- (b) An investigation into the population of these moths in a woodland was carried out. The moths were captured, marked and released. 24 hours later the moths were recaptured.

The results are shown in the following table.

<i>Variety of moth</i>	<i>Number of moths marked and released</i>	<i>Number of marked moths recaptured</i>	<i>Marked moths recaptured (%)</i>
Light	480	264	55
Dark	520	208	40

- (i) Suggest a reason why the number of the marked moths recaptured was worked out as a percentage.

1

(ii) The woodland was in a non-industrial area.

Explain why the percentage of light moths recaptured was higher than dark moths.

1

(iii) Name the process which results in the better adapted variety of moth being more likely to survive and reproduce.

1

10. Researchers have discovered an advantageous genetic mutation that causes high bone density in humans.

One man in the USA was discovered to possess this mutation after he walked away without injury from a serious car crash. Further studies have found several members of the same extended family with this mutation.



20 members of the family provided blood samples for DNA and biochemical testing. 7 of them were found to have high bone density. The same tests were performed on another group of 20 unrelated individuals with normal bone density.

The location of the gene mutation was able to be identified and it is hoped that the findings will help in developing medications to increase bone density for the treatment of conditions such as osteoporosis.

- (a) (i) Calculate the percentage of the family who did **not** have the mutation for high bone density. 1

Space for calculation

_____ %

- (ii) Explain why the biochemical tests were also performed on the 20 individuals with normal bone density. 1

- (b) Name **one** factor which can increase the rate of mutation. 1

- (c) Mutations are the only source of new alleles.

Explain why it is important that new alleles arise in a species. 1
