Exampro GCSE Biology

B2.2 Photosynthesis
Foundation tier

Name:

Class:

Author:

Date:

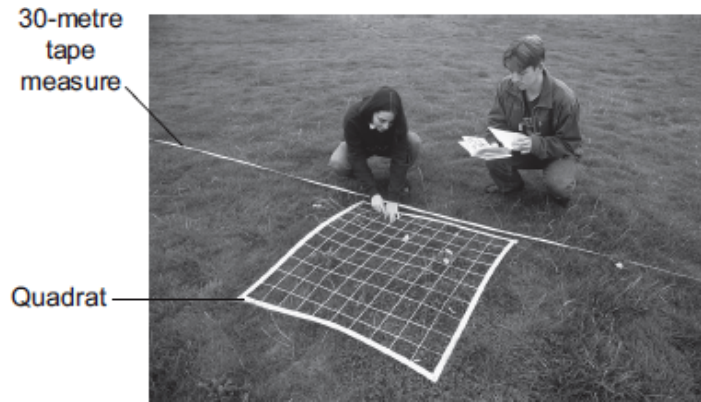Time: 76

Marks: 76

Comments:

Q1. Some students investigated the distribution of dandelion plants in a grassy field. The grassy field was between two areas of woodland.

Figure 1 shows two students recording how many dandelion plants there are in a 1 metre x 1 metre quadrat.

Figure 1

© Science Photo Library

Figure 2 shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.
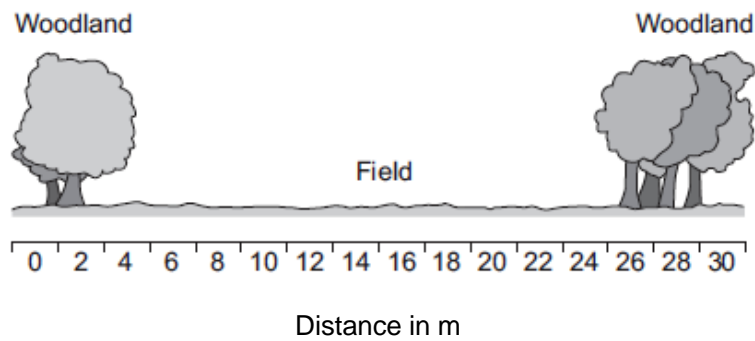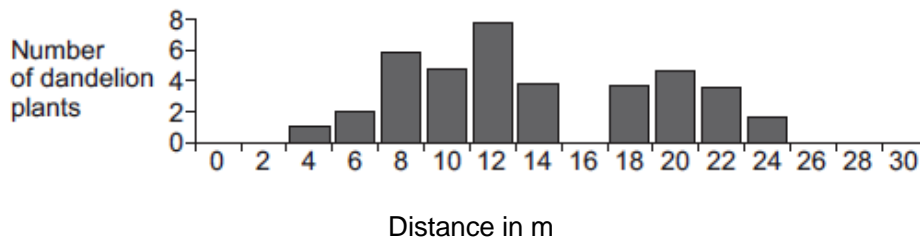
Figure 2

Distance in m

Figure 3

Distance in m

(a) How did the students use the quadrat and the 30-metre tape measure to get the results in **Figure 3**?

Use information from **Figure 1**.

....

....

....

....

....

....

(3)

(b) (i) Suggest **one** reason why the students found no dandelion plants under the trees.

....

....

(1)

(ii) Suggest **one** reason why the students found no dandelion plants at 16 metres.

....

....

(1)

(c) The teacher suggested that it was **not** possible to make a valid conclusion from these results.

Describe how the students could improve the investigation so that they could make a valid conclusion.

....

....

....

....

(2)
(Total 7 marks)

Q2. Some students wanted to find the number of thistle plants growing on a lawn.
The students placed 10 quadrats at different positions on the lawn.
Each quadrat measured 1 metre × 1 metre.
The students counted the number of thistle plants in each quadrat.

(a) Which method should the students use to decide where to place the 10 quadrats?
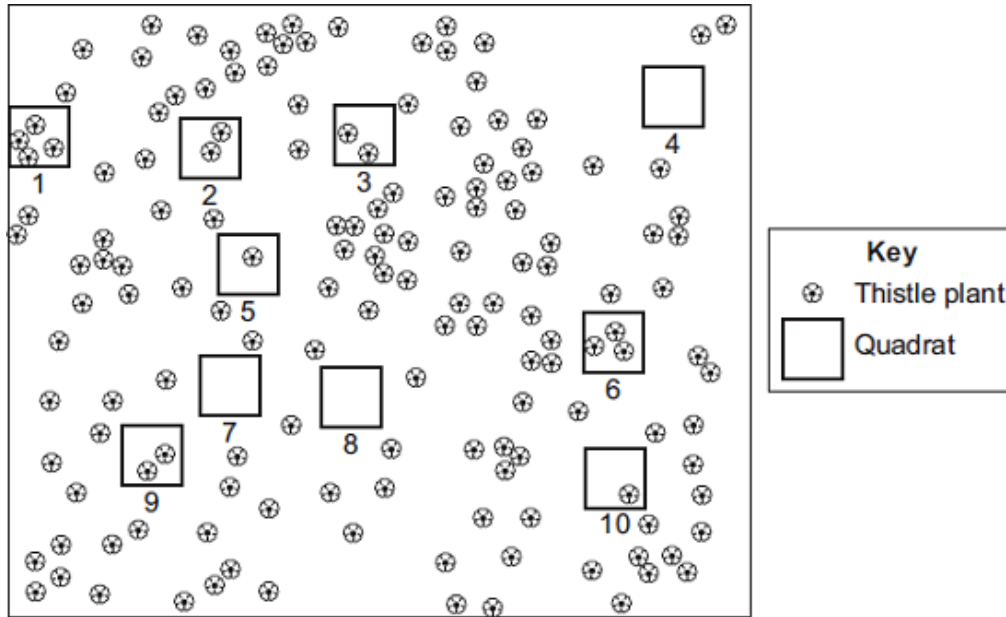
Tick (✓) **one** box.

Place the quadrats as evenly as possible around the lawn. ☐

Place 5 quadrats in areas with many thistle plants and 5
quadrats in areas with only a few thistle plants. ☐

Place all the quadrats randomly on the lawn. ☐

(1)

(b) The diagram shows the lawn with the positions of the thistle plants and the students' 10 quadrats.

(i) Complete the table to show:

- how many thistle plants the students found in each of the first four quadrats

- the total number of thistle plants found in all 10 quadrats.

Quadrat number	Number of thistle plants in each quadrat
1	
2	
3	
4	
5	1
6	3
7	0
8	0
9	2
10	1
Total	

(2)

(ii)   Calculate the mean number of thistle plants in one quadrat.

....

Mean = ...

(1)

(iii)   The lawn measured 12 metres long and 10 metres wide.

Use your answer from part (b)(ii) to estimate the number of thistle plants on the lawn.

....

....

Estimated number of thistle plants = ...

(2)

(c)   How could the students make their estimate more accurate?

....

....
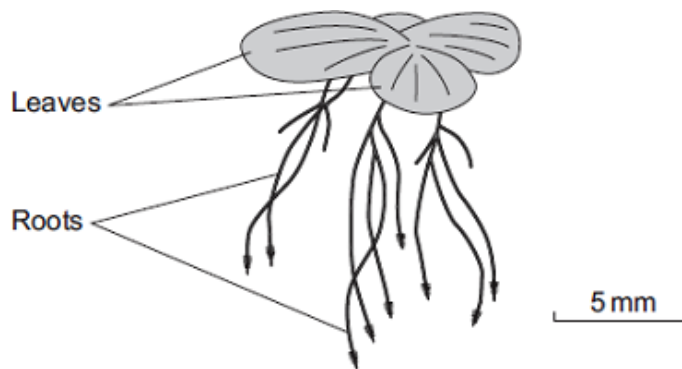
(1)
(Total 7 marks)

Q3.   Duckweed is a plant. Duckweed grows in ponds. The leaves of duckweed float on the surface of the water and its roots hang down in the water.

The drawing shows a duckweed plant.

(a)   Duckweed roots absorb nitrate ions from the water.
The nitrate ions help the duckweed to grow.

Draw a ring around the correct answer to complete the sentence.

	carbohydrate.
Duckweed needs nitrate ions to make	fat.
	protein.

(1)

(b) Some students grew duckweed plants in three different solutions of mineral ions, **A**, **B** and **C**, and in distilled water (**D**).

Table 1 shows the concentrations of mineral ions in each of **A**, **B**, **C** and **D** at the start of the investigation.

Table 1

Mineral ion	Concentration of mineral ions in mg per dm ^{3} at the start of the investigation			
	A	**B**	**C**	**D**
Nitrate	1000	4	4	0
Phosphate	300	0	0	0
Magnesium	200	84	24	0

The students counted the number of duckweed leaves in **A**, **B**, **C** and **D** at the start of the investigation and after 28 days.

Table 2 shows their results.

Table 2

	A	**B**	**C**	**D**
Number of leaves at start	4	4	4	4
Number of leaves after 28 days	50	27	14	6

(i) Using **Table 1** and **Table 2**, describe the effect of magnesium ions on the growth of duckweed.

....

....

(1)

(ii) Solution **A** contained the highest concentration of nitrate ions.

One student said, 'The results show that nitrate ions are needed for the growth of duckweed.'

What evidence in **Table 2** supports what the student said?

....

....

(1)

(c) The students measured the growth of the duckweed by counting the number of leaves.

(i) Suggest a better method of measuring the growth of the duckweed.

....

....

(1)

(ii) Suggest why your method is better than the students' method.

....

....
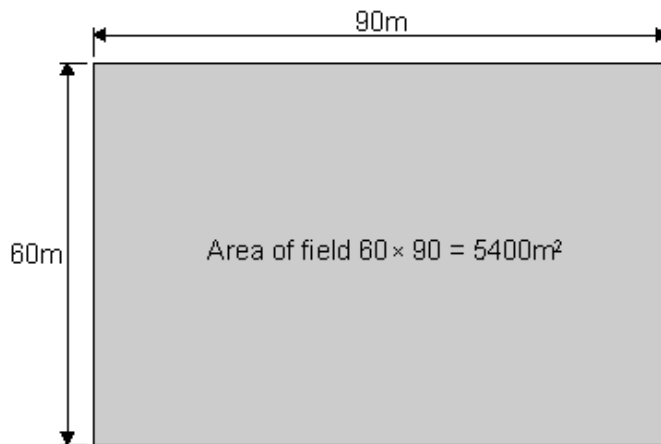
(1)
(Total 5 marks)

Q4. A class of students was set the task of estimating the number of dandelions on the school field.

To do this, they decided to use sampling squares called quadrats.
Each quadrat had an area of 1 m^2.

The diagram shows the dimensions of the school field.

90m

60m   Area of field 60 × 90 = 5400m²

(a) Which is the best way of using quadrats in this investigation?

Tick (✔) **one** box.

Statement	Tick (✔)
Place all the quadrats where there are lots of plants.	
Place all the quadrats randomly in two different sample areas.	
Place all the quadrats where all four types of plant are growing.	

(1)

(b) Each student collected data by using 10 quadrats.

These are the results for one student, Mary.

Quadrat number	Number of dandelions
1	3
2	3
3	6
4	2
5	1
6	2
7	0
8	3
9	2
10	0

Calculate the mean number of dandelions per quadrat counted by Mary.
Show clearly how you work out your answer.

....

....

Mean number of dandelions ....

(2)

(c) Another student, Sharon, calculated a mean of 2.8 dandelions per quadrat from her results.

Estimate the number of dandelions in the whole field by using:

• a mean of 2.8 dandelions per quadrat

• information from the diagram on the opposite page

• the equation below.

Show clearly how you work out your answer.

estimated number of dandelions on field	=	mean number of dandelions per quadrat	×	number of quadrats that would fit into the field

....

....

Estimated number of dandelions ....

(2)
(Total 5 marks)

Q5.   A gardener grows tomato plants.

The tomato plants develop yellow leaves.

(a)   What would be the best way of improving the growth of these plants?

Tick (✓) **one** box.

Add mineral ions to the soil

Water the plants more

Add glucose to the soil

(1)

(b)   Most tomatoes are grown in greenhouses.

Tomato growers alter the conditions in greenhouses to make tomato plants grow faster.

Which changes in conditions will make tomato plants grow faster?

Tick (✓) **two** boxes.

Increasing the temperature ☐

Increasing the oxygen concentration in the air ☐

Increasing the nitrogen concentration in the air ☐

Turning lights on at night ☐

(2)
(Total 3 marks)

Q6.   (a)   A student carried out the following investigation using a plant with variegated leaves. A variegated leaf has green and white stripes.

The student:

- left the plant in the dark for 3 days to remove the starch

- fixed two pieces of card to a leaf on the plant

- left the plant in the light for 2 days

- removed the leaf from the plant

- tested the leaf for starch.

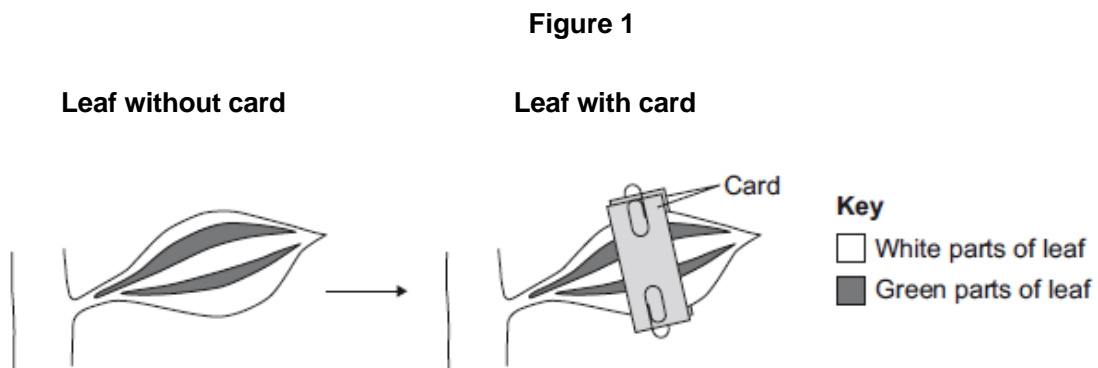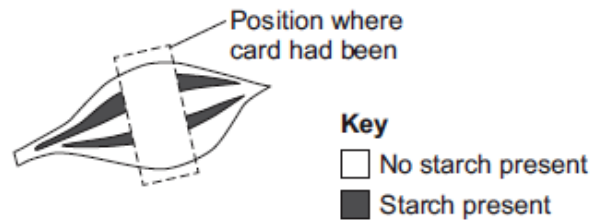**Figure 1** shows how the two pieces of card were attached to the leaf.

Figure 1

Leaf without card   **Leaf with card**

Key
☐ White parts of leaf
■ Green parts of leaf

Figure 2 shows the same leaf after 2 days in the light.
The leaf has been tested for starch.

Figure 2

Key
☐ No starch present
■ Starch present

Give **two** conclusions from this investigation.

Tick (✓) **two** boxes.

Carbon dioxide is needed for photosynthesis. ☐

Chlorophyll is needed for photosynthesis. ☐

Light is needed for photosynthesis. ☐

Water is needed for photosynthesis. ☐

(2)

(b)   Scientists investigated the effect of light intensity on the rate of photosynthesis.

Figure 3 shows the scientists' results.

Figure 3

Rate of photosynthesis in arbitrary units

Light intensity in arbitrary units
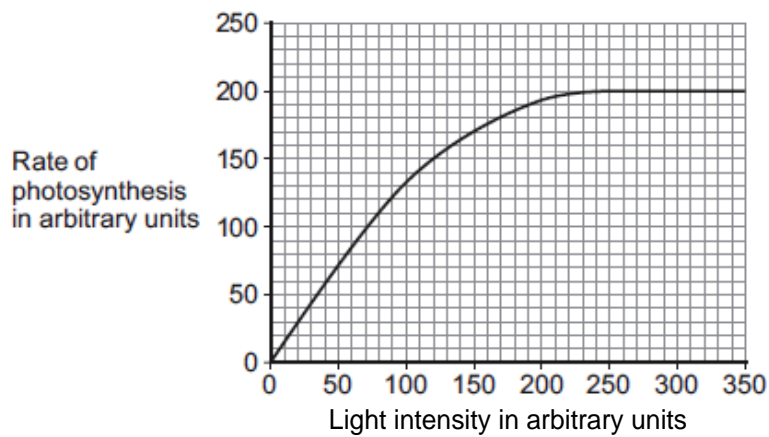
Describe the effect of increasing light intensity on the rate of photosynthesis.
You should include numbers from **Figure 3** in your description.

....

....

....

....

....

....

(3)

(c)   At a light intensity of 250 arbitrary units, light is **not** a limiting factor of photosynthesis.

(i)   What is the evidence for this in **Figure 3**?

....

....

(1)

(ii)   Give **two** factors that could be limiting the rate of photosynthesis at a light intensity of 250 arbitrary units.

1 ....

2 ....
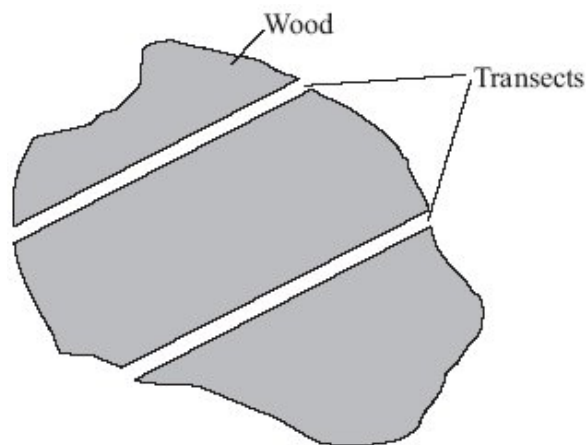
(2)
(Total 8 marks)

Q7.   Red squirrels live in trees. They eat seeds from the cones of conifer trees. Squirrels store cones in 'larders' on the ground. These larders provide food through the winter. Each red squirrel makes and defends one larder.

Scientists monitor squirrel numbers to find the best habitats for the squirrel's survival. In one investigation, scientists estimated the numbers of squirrels in different types of woodland. Each woodland contains a different species of conifer tree.

Here is their method.

- Ten woods of each type of woodland were surveyed.

- In each wood scientists measured out two transects (strips), each 600 m long and 10 m wide.

- A scientist walked slowly down the centre of each transect, recording the number of squirrel larders he could see.

(a)   (i)   How many transects all together did the scientists survey in each **type** of woodland?

Number of transects ....

(1)

(ii)   What was the total area surveyed in **one** wood?

....

Area .... m^2

(1)

(b)   Name **one** variable that was controlled in this investigation.

....

(1)

(c)   (i)   The scientists recorded the number of larders instead of the number of squirrels they saw.

Explain how this could have increased the accuracy of the investigation.

....

....

(1)

(ii) This method of counting the number of larders could have led to an inaccurate estimate of the number of squirrels.

Explain how.

....

....

....

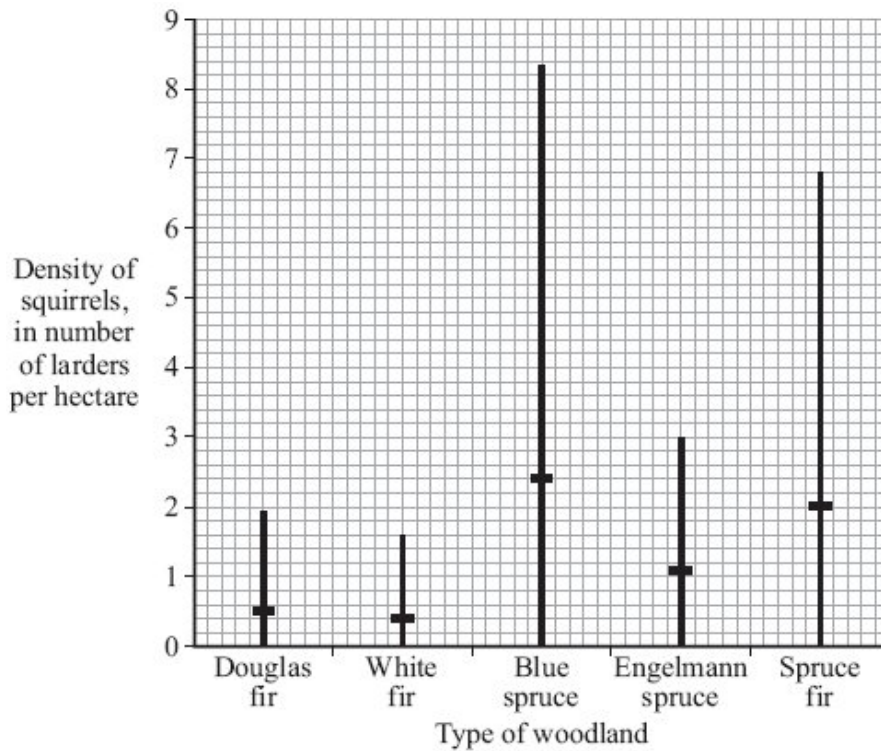...

(2)

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

The horizontal mark on each bar represents the mean number of larders per hectare of woodland.

The range of the number of larders observed for Douglas fir woodland was 0 to 1.9 per hectare.

(i) What was the range of the number of larders per hectare in the Spruce fir woodland?

....

(1)

(ii)   The highest mean number of larders per hectare was found in Blue spruce woodland.

Suggest **one** explanation for this.

....

....

(1)
(Total 8 marks)

Q8.   Some students were asked to investigate the distribution of clover in a field of grass. They noticed that the clover grew in patches amongst the grass.
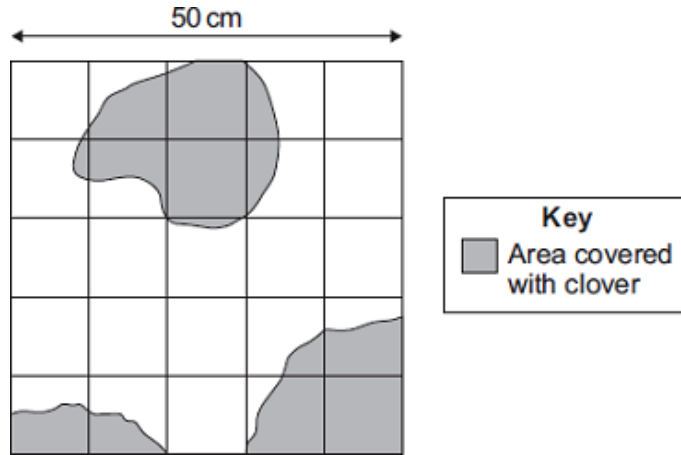
(a)   The students decided to use quadrats.

Describe how the students should decide where to place the quadrats to investigate the distribution of the clover.

....

....

....

....

(2)

(b)   The diagram shows one of the quadrats the students used.

(i)   Estimate the number of squares of the quadrat covered with clover.

....

....

Number of squares = ...

(1)

(ii)   Describe how you worked out your answer to part (b)(i).

....

....

....

(1)

(iii)   Use your answer from part **(b)(i)** to calculate the percentage of the quadrat covered
by the clover.

....

....

....

Answer = ... %

(2)

(c)   Suggest **one** factor that could account for the distribution of the clover plants.

....

(1)
(Total 7 marks)

Q9.   Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1
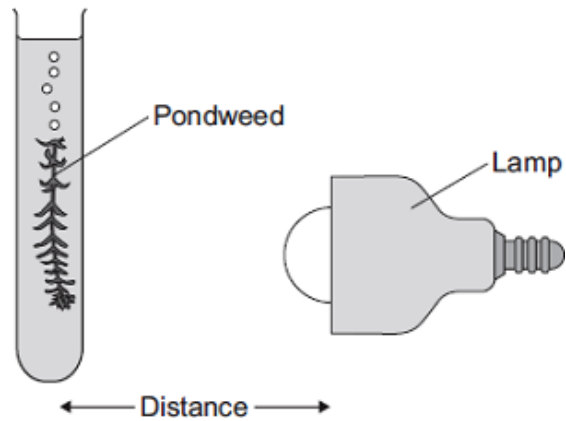
The students:

- placed the lamp 10 cm from the pondweed

- counted the number of bubbles of gas released from the pondweed in 1 minute

- repeated this for different distances between the lamp and the pondweed.

(a)   The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

....

....

(1)

(b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

(i) At distances between 15 cm and 50 cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

....

....

(1)

(ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10 cm and 15 cm.

....

(1)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2
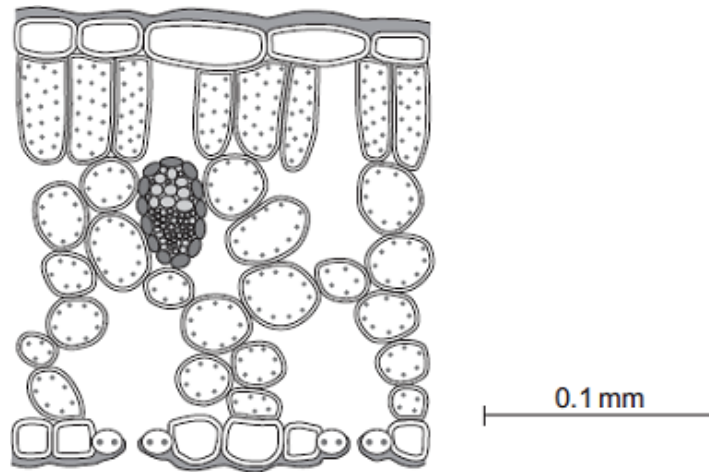
Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

....

....

....

....

....

....

....

....

....

....

....

....

(6)
(Total 9 marks)

Q10. This question is about photosynthesis.

(a) Plants make glucose during photosynthesis. Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick (✓) **one** box.

The starch is converted into oxygen. ☐

The starch is stored for use later. ☐

The starch is used to make the leaf green. ☐

(1)

(b) A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The diagram shows the way the experiment was set up.
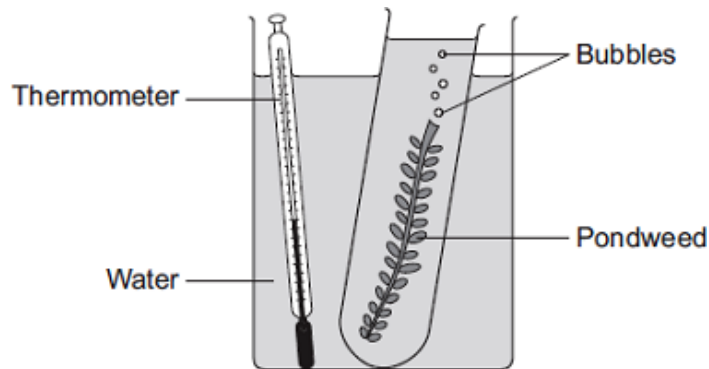
(i) The student needed to control some variables to make the investigation fair.

State **two** variables the student needed to control in this investigation.

1..

2..

(2)

(ii) The bubbles of gas are only produced while photosynthesis is taking place.

What **two** measurements would the student make to calculate the rate of photosynthesis?

1..

2..

(2)

(c)   The graph shows the effect of temperature on the rate of photosynthesis in the pondweed.

Temperature in °C
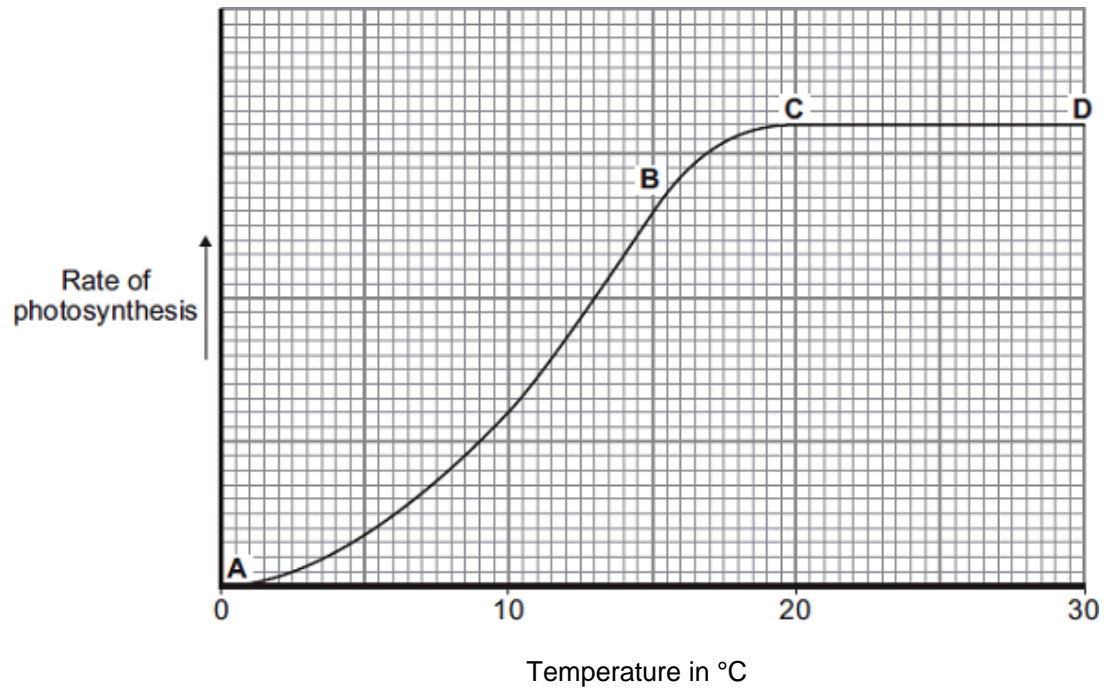
(i)   Name the factor that limits the rate of photosynthesis between the points labelled **A** and **B** on the graph.

....

(1)

(ii) Suggest which factor, carbon dioxide, oxygen or water, might limit the rate of photosynthesis between the points labelled **C** and **D** on the graph.

....

(1)
(Total 7 marks)

Q11. Red squirrels live in trees. They eat seeds from the cones of conifer trees. Squirrels store cones in 'larders' on the ground. These larders provide food through the winter. Each red squirrel makes and defends one larder.

Scientists monitor squirrel numbers to find the best habitats for the squirrel's survival. In one investigation, scientists estimated the numbers of squirrels in different types of woodland. Each woodland contains a different species of conifer tree.

Here is their method.

- Ten woods of each type of woodland were surveyed.

- In each wood scientists measured out two transects (strips), each 600 m long and 10 m wide.

- A scientist walked slowly down the centre of each transect, recording the number of squirrel larders he could see.

(a) Name **one** variable that was controlled in this investigation.

....

(1)

(b) (i) The scientists recorded the number of larders instead of the number of squirrels they saw.

How could this have increased the accuracy of the investigation?

....

....

(1)

(ii) This method of counting the number of larders could have led to an inaccurate estimate of the number of squirrels.

Explain how.

....

....

....

....

(2)

(c) The results of the investigation are shown on the graph.
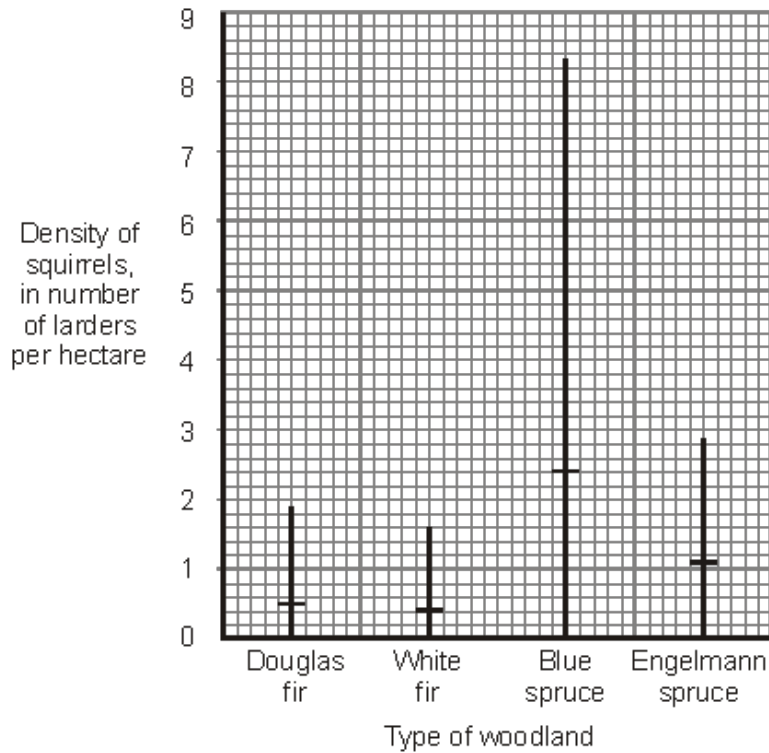
Each bar represents the range of the number of larders in each type of woodland.

The horizontal mark on each bar represents the mean number of larders per hectare of woodland.

(c) A student concluded *'You will always find more squirrels in spruce woodland than in fir woodland.'*

Is the student's conclusion justified by the data in the graph?
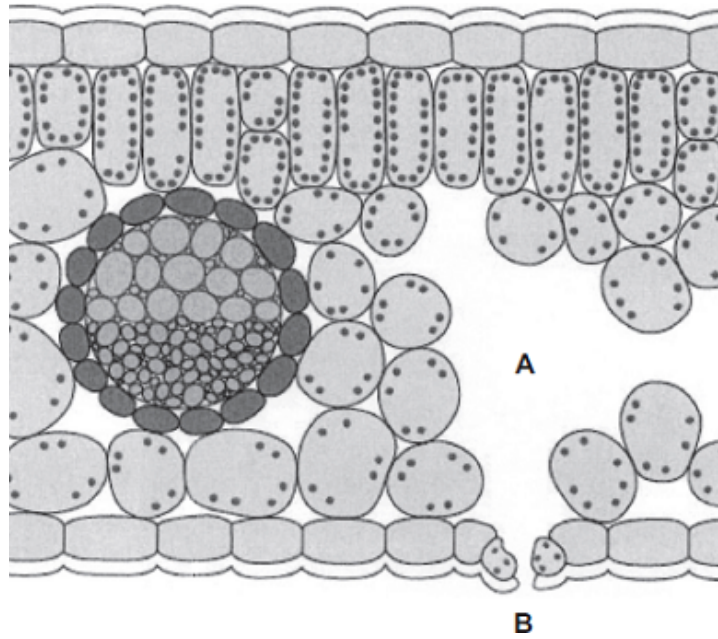
Explain the reasons for your answer.

....

....

....

....

....

(2)
(Total 6 marks)

Q12.   The diagram shows a section through a plant leaf.

(a)   Use words from the box to name **two** tissues in the leaf that transport substances around the plant.

| epidermis | mesophyll | phloem | xylem |

.... and ....

(1)

(b)   Gases *diffuse* between the leaf and the surrounding air.

(i)   What is *diffusion*?

....

....

....

....

(2)

(ii)   Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day.

....

(1)
(Total 4 marks)

M1. (a) any **three** from:

- place 30-m tape measure across field / from one wood to the other
- place quadrat(s) next to the tape
- count / record the number / amount of dandelions / plants in the quadrat

    ignore 'record the results'

    ignore measures / estimates dandelions
- repeat every 2 metres

    allow every metre / at regular intervals

3

(b) (i) low light / it is shady

allow no light

ignore sun / rays

or

not enough water / ions / nutrients

accept correct named ion

ignore no water / ions / nutrients

or

wrong pH of soil

accept competition with trees for light / water / ions

ignore competition for space and competition unqualified

accept soil too acidic / too alkaline

ignore temperature

1

(ii) sensible suggestion for a small area, eg chance variation / anomaly / poisoned by animal waste / wrong pH of soil / eaten (by animals) / cut down / footpath

1

(c) repeat (transect) / compare with the results of other groups

allow 'do it in two different locations' for 2 marks

1

at different / random location(s) / elsewhere (across the field)

*do **not** allow 'in other fields'*

1

[7]

M2. (a) place all the quadrats randomly on the lawn

1

(b) (i) 1 4

2 2

3 2

4 0

all 4 counts correct

1

Total = 15

total correct for their figures

1

(ii) 1.5

allow ecf from (b)(i)

1

(iii) 180

correct answer with or without working

*if answer incorrect, allow **1** mark for $\frac{15}{10}$ x 120 **or** 15 x 20*

or $\frac{15}{10}$ x 12 x 10

*or 1.5 x 12 x 10 **or** 1.5 x 120*

allow ecf from (b)(ii)

*allow **1** mark if only 1 error*

2

(c) use a larger sample size / more quadrats

ignore repeats but allow repeat in different places

ignore 'count them all'

or

use bigger quadrats

1

[7]

M3. (a) protein

1

(b) (i) (more) magnesium gives more growth / more leaves / more duckweed

if converse must be clear that less magnesium gives less growth

1

(ii) **A** gave highest number of leaves / plants **or** more than others

> *it equals 'A'*
>
> *use of numbers must compare **A** with at least one other*

or

A gave most growth / most duckweed **or** more than others

> *allow faster / fastest / better / best growth*
>
> *allow more growth with nitrate / less growth without nitrate*
>
> *do not allow 'no' growth without nitrate*

(c) (i) mark (c) as a whole

sensible method:

e.g. mass / weighing

> *ignore dry or fresh*
>
> *allow other sensible method involving measuring eg length of roots
> – ignore 'size' of roots or measure roots unqualified*

1

(ii) corresponding explanation:

> *ignore accuracy*

e.g. includes roots / includes <u>whole</u> plant
or
leaves vary in size
or
(length / mass / surface area given in c(i)) is a continuous variable

1

[5]

M4. (a) place all the quadrats randomly in two different sample areas.

> *extra boxes ticked cancels the mark*

1

(b) 2.2

> *correct answer gains **2** marks*
>
> *if answer incorrect, evidence of correct method gains **1** mark*
>
> *allow only **1** mark for a rounded mean*

2

(c) 15 120

> *correct answer gains **2** marks*
>
> *if answer incorrect, evidence of correct substitution gains **1** mark*

2

[5]

M5. (a) add mineral ions to the soil

> *extra box ticked cancels the mark*

1

(b) increasing the temperature
               *each extra box ticked cancels **1** mark*

1

      turning lights on at night

1

[3]

M6.   (a)   chlorophyll is needed for photosynthesis

1

      light is needed for photosynthesis

1

    (b)   increases

1

      levels off / reaches a maximum / remains constant / stays the same / plateaus
             *do **not** allow stops / stationary / peaks*
             allow stops increasing

1

      goes up to / reaches a maximum / levels off at (a rate of) 200 (arbitrary units)
      or
      levels off at 225 – 240 (light units)
             ignore references to other numerical values

1

    (c)   (i)   higher light intensity does not increase rate of photosynthesis
               accept the graph stays level (above this value)
               allow stops increasing
               allow the rate of photosynthesis stays the same (above this value)

1

        (ii) any **two** from:

           •   carbon dioxide (concentration)
           •   temperature / heat
           •   (amount of) chlorophyll / chloroplasts
              allow water
              allow ions / nutrients
              ignore ref to surface area of the leaf

2

[8]

M7.   (a)   (i)   20

1

        (ii)   12000

1

(b)   area of strips

        or

        length / width / size of transect

        or

        number of transects

        1

(c)   (i)   since squirrels mobile

            or

            squirrels could be counted twice

            or

            squirrels hide

        1

     (ii)   any **two** from:

- numbers of larders observed likely to be lower than actual
  *do **not** accept squirrels share larders
  or squirrels have more than one larder*

- since unlikely that all could be spotted if 5 m away

- old larder

- squirrels moved on / died

- young squirrels

- haven't made a larder

        2

(d)   (i)   0 to 6.8

        1

     (ii)   any **one** from:
          *do **not** accept squirrels prefer blue spruce*

- squirrels prefer blue spruce cones / seeds / nuts as food

- <u>more</u> cones / food

- <u>more</u> nesting sites

- <u>fewer</u> predators / competitors

        1

        [8]

M8.   (a)   chose places <u>randomly</u>

        1

method of obtaining randomness, e.g. (grid and) random numbers

allow thrown qualified e.g. over shoulder, eyes shut

allow max 1 for mention of a transect with sampling at regular or random intervals

1

(b)　(i)　7 **or** 8

allow fractions / decimals between 7 and 8

1

(ii)　count number of whole squares and add estimate of area covered by part squares

allow reference to counting squares with ½ cover or more

allow clear working on diagram and / or (b)(i)

1

(iii)　28 – 32 (in range)

allow ecf

*if answer incorrect allow **1** mark for reasonable reference to divided by 25 or multiplied by 4*

2

(c)　nutrients / minerals / ions / fertiliser / water

allow light / pH / trampling / soil texture / grazing / mowing / weed killer / where seeds originally fell

ignore pollution / soil / competition if unqualified

ignore temperature / wind

1

[7]

M9.　(a)　any **one** from:

ignore 'check temperature'

- add a water bath

- heat screen

- use LED

- low energy bulb / described

1

(b)　(i)　rate / number of bubbles decreases

*accept converse with reference to increasing light **or** shorter distance*

or

less oxygen / gas released

ignore reference to rate of photosynthesis

1

(ii)   temperature / CO_2 (concentration)

> *accept 'it was too cool' **or** not enough CO_2*
>
> *accept number of chloroplasts / amount of chlorophyll*
> *allow heat*
> *allow CO2*
> *do **not** allow CO^2*

1

(c)   Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a brief description of at least 1 tissue **or** at least 1 function of an indicated part of the leaf.

The account lacks clarity or detail.

Level 2 (3-4 marks)
There is a clear description which includes at least 1 named tissue and at least 1 correct function described for an indicated part of the leaf.

Level 3 (5-6 marks)
There is a detailed description of most of the structures and their functions.

Examples of responses:

- epidermis

- cover the plant

- mesophyll / palisade

- photosynthesises

- phloem

- xylem

- transport.

The following points are all acceptable but beyond the scope of the specification:

- (waxy) cuticle – reduce water loss

- epidermis – no chloroplasts so allows light to penetrate

- stomata / guard cells – allow CO_2 in (and O_2 out) **or** controls water loss

- palisade (mesophyll) – <u>many</u> chloroplasts to trap light

    – near top of leaf for receiving more light

- spongy (mesophyll) – air spaces for rapid movement of gases

6

[9]

M10. (a) The starch is stored for use later

no mark if more than one box is ticked

1

(b)　(i)　any **two** from:

*do **not** accept temperature*
apply list principle
ignore reference to time

- carbon dioxide (concentration)

- light intensity

- light colour / wavelength ⎱

*allow **1** mark for light if neither intensity or colour are awarded*

- pH

- size / amount of pondweed / plant

- same / species / type pondweed

- amount of water <u>in the tube</u>
  ignore amount of water alone

2

(ii)　number / amount of bubbles **or** amount of gas / oxygen
allow volume of bubbles (together)
ignore 'the bubbles' unqualified

1

(relevant reference to) time / named time interval
allow how long it bubbles for
*do **not** accept time bubbles start / stop*
ignore speed / rate of bubbling
ignore instruments
*do **not** accept other factors eg temperature*
*accept how many bubbles per minute for **2** marks*

1

(c)　(i)　temperature
allow heat / cold / °C

1

(ii)　carbon dioxide / CO_2
allow CO2
*do **not** accept CO^2*

1

[7]

M11.　(a)　area of strips / length of transects / number of transects

1

(b) (i) since squirrels are mobile and could be missed / counted twice

1

(ii) numbers of larders observed likely to be lower than actual
*do **not** accept squirrels share larders or squirrels have more than one larder*

1

since unlikely that all could be spotted if 5 m away **or**

old larders **or**

squirrels moved on / died

1

(c) (no)

the bars show the range of the number of squirrel larders in the different types of woodland

1

although spruce woodlands have the larger ranges, some spruce woodlands will have very low numbers of larders

1

[6]

M12. (a) xylem **and** phloem
either order
allow words ringed in box
allow mis-spelling if unambiguous

1

(b) (i) movement / spreading out of particles / molecules / ions / atoms
ignore names of substances / 'gases'

1

from high to low concentration
accept down concentration gradient
ignore 'along' / 'across' gradient
ignore 'with' gradient

1

(ii) oxygen / water (vapour)
allow O_2 / O2

ignore O^2 / O
allow H_2O / H2O

ignore H^2O

1

[4]