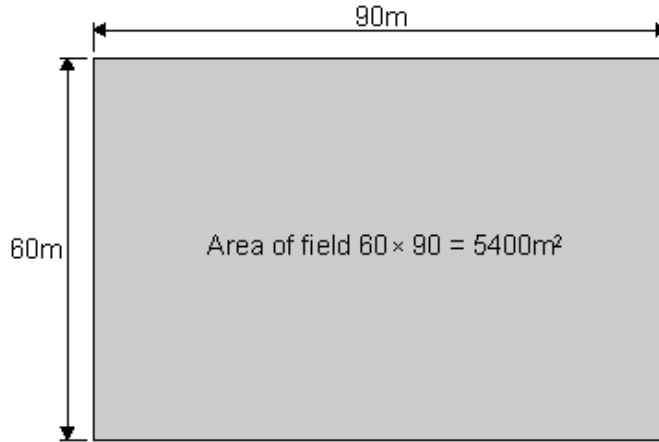**Q1.** A class of students was set the task of estimating the number of dandelions on the school field.

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.

(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)

Q2. Plants produce food by photosynthesis.

(a) Complete the equation for photosynthesis.

carbon dioxide + ... (+ light energy) → glucose + ...

(2)

Some students investigated the effect of temperature on the rate of photosynthesis in pond weed. They set up the apparatus and altered the temperature using ice and hot water. They counted the number of bubbles given off in a minute at different temperatures.
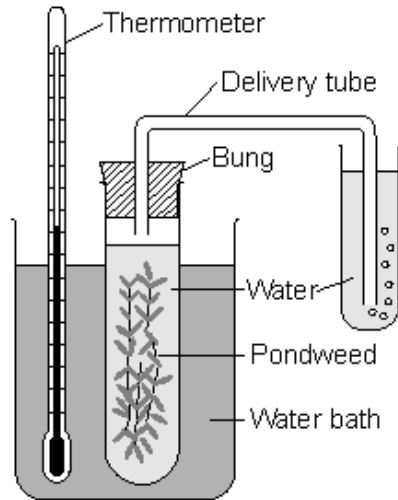
(b) Why did the students use a water bath?

....

....

(1)

The graph shows the students' results.
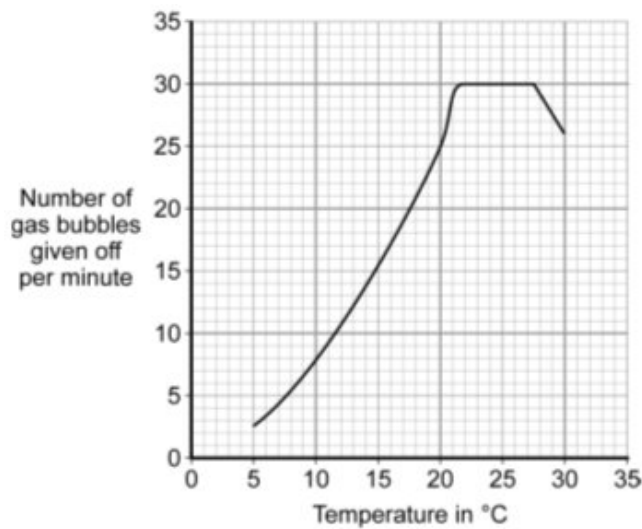
(c)   Explain the shape of the graph between 22 °C and 27 °C.

....

....

....

....

(2)

(d)   A farmer wants to grow lettuces as quickly and cheaply as possible in winter.

(i)   At what temperature should he keep his greenhouse to grow the lettuces as quickly and cheaply as possible?

.... °C

(1)

(ii)   Explain the reason for your answer.

....

....

....

....

....

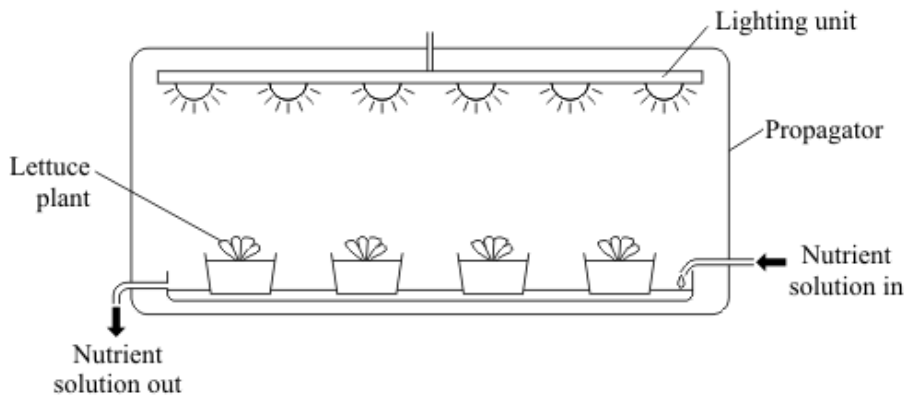...
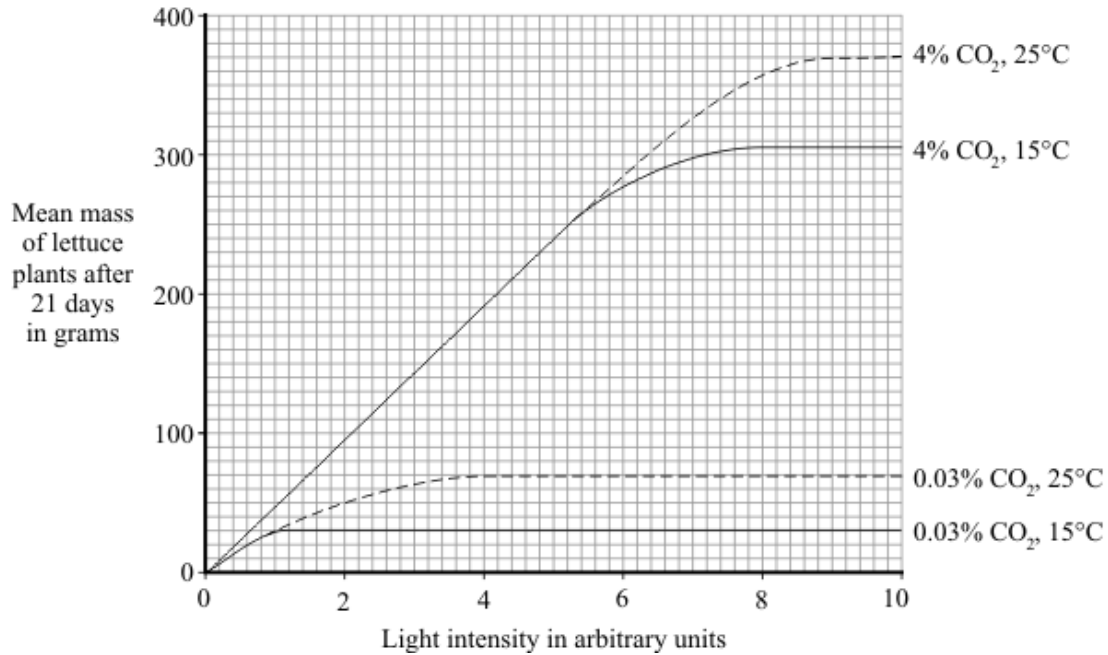
(2)
(Total 8 marks)

Q3.   Changing the conditions in which plants grow affects how fast they grow.

The diagram shows a propagator in which scientists can control temperature, light intensity and carbon dioxide concentration.

The graph shows the effects of changing the temperature, light intensity and carbon dioxide concentration on the growth of lettuce plants.

(a) Describe and explain the effect of increasing light intensity on the mean mass of lettuce plants at 4% carbon dioxide and 15 °C.

....

....

....

....

....

....

....

(3)

(b) Growers wish to make maximum profits from their lettuces.

What do they need to consider before making decisions about the growing conditions for their lettuces?

....

....

....

....

(2)

(c) The nutrient solution contains nitrate ions and magnesium ions.

Complete the table to show the functions of these ions in plants and their deficiency symptoms.

Ion	Function in plants	Deficiency symptoms
Nitrate	....	....
Magnesium	....	....

(4)
(Total 9 marks)

Q4.   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.
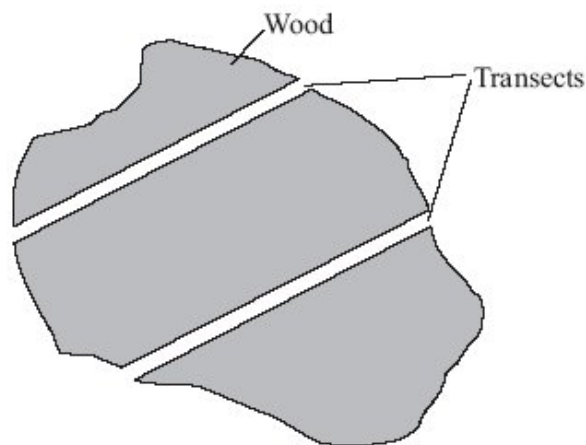
(a)   (i)   How many transects all together did the scientists survey in each **type** of woodland?

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.
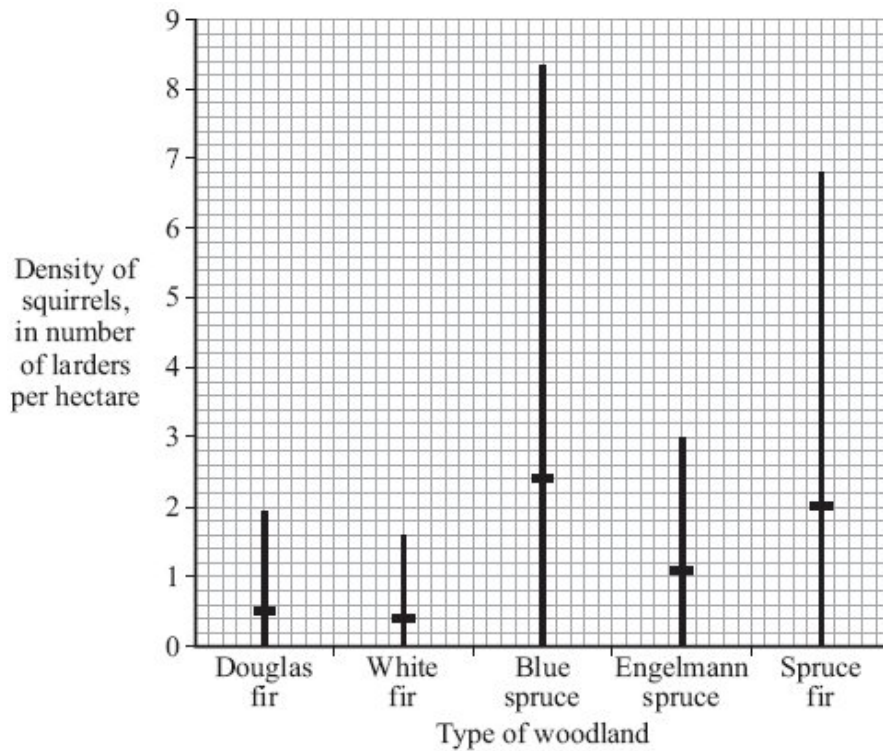
Explain how.

....

....

....

....

(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.

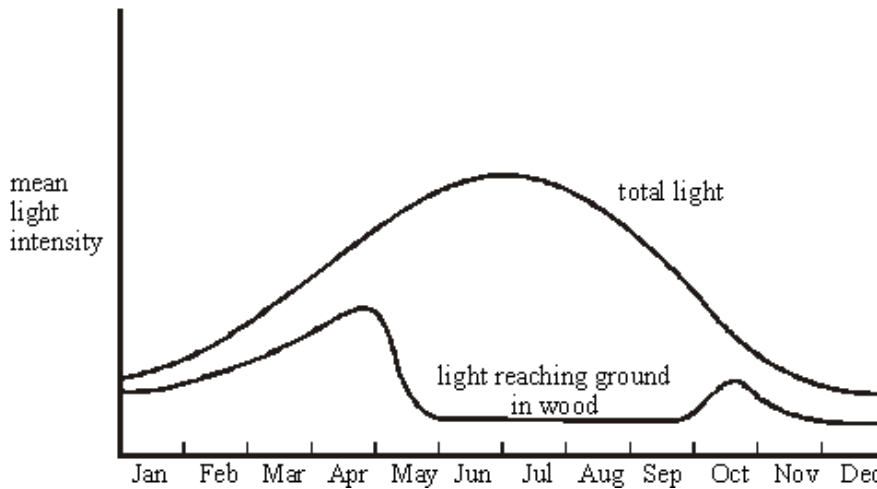(i) What was the range of the number of larders per hectare in the Spruce fir woodland?

....

(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)

Q5.   The graph shows the mean light intensity at different times of the year in an oak wood.

(a)   (i)   In which month would you expect the rate of photosynthesis in the oak trees to be greatest?

....

(1)

(ii)   There are plants living on the ground in the wood. In which month would you expect their rate of growth to be fastest?

....

Explain your answer.

....

....

....

....

(3)

(b)   Name **two** factors, other than light intensity, that would affect the rate of photosynthesis in the oak trees.

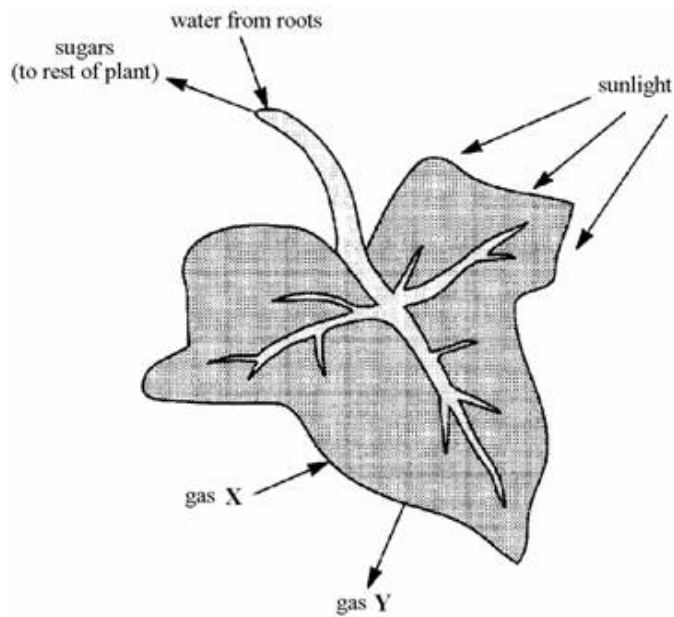1 ....

2 ....

(2)
(Total 6 marks)

Q6.   The diagram shows a plant leaf during photosynthesis.

(a)   Name:

(i)   gas **X**;   ....

(ii)   gas **Y**.   ....

(2)

(b)   Why is sunlight necessary for photosynthesis?

....

....

(1)
(Total 3 marks)

M1. (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]

M2. (a) water

1

oxygen

1

in this order

(b) keep temperature constant

1

(c) a factor other than temperature is limiting

*do **not** accept water*

1

eg carbon dioxide

1

(d) (i) 21/22

1

(ii) rate of photosynthesis is at maximum

1

for the least heating cost

1

[8]

M3. (a) any **three** from:

- ((mean) mass) increases up to 7 / 8 units (of light) then levels off

- light limiting factor up to 7 / 8 units

- for photosynthesis
  must be in correct context

- other factor / temperature limiting above 7 / 8 units

3

(b) any **two** from:

- cost of providing conditions / heat / light / CO_2

- effect of treatment on profit
  allow too much of factor is wasteful

- relevant use of data from graph eg limiting factors

- named other factors eg fertiliser / pest control / weeds / density of planting
  allow taste / appearance

2

(c) **nitrate function**

produce amino acids / proteins / enzymes
  ignore DNA
  *do **not** allow chlorophyll*

1

nitrate deficiency

stunted growth
  allow description
  ignore plant dies

1

magnesium function

produce chlorophyll
  ignore chloroplasts

1

magnesium deficiency

yellow leaves / plant
  ignore plant dies

1

[9]

M4. (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]

M5.　　(a)　(i)　June

　　　　　for 1 mark

1

　　　(ii)　April
　　　　max. light
　　　　photosynthesis makes sugars/substances needed for growth
　　　　　　for 1 mark each

3

(b)　2 of:
temperature
carbon dioxide availability
water
chlorophyll
　　　any 2 for 1 mark each

2

[6]

M6.　　(a)　(i)　carbon dioxide / CO_2　　(*reject* CO)

　　　(ii)　oxygen / O_2 / O　　　(*reject* water vapour)

　　　　　for 1 mark each

2

(b)　(provides) energy

　　　　for 1 mark

1

[3]