6. Norway Spruce (*Picea abies*) is an evergreen species of tree with needle-like leaves, found in regions with extremely cold winters.

The rate of photosynthesis of the species is at its maximum during spring then decreases from June to December.

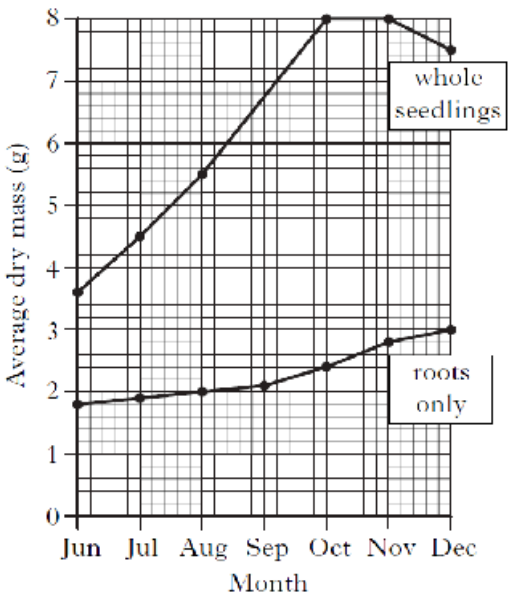
In an investigation, a sample of one-year-old seedlings was collected in each month from June to December.

For each sample of seedlings, the following measurements were made and averages calculated.

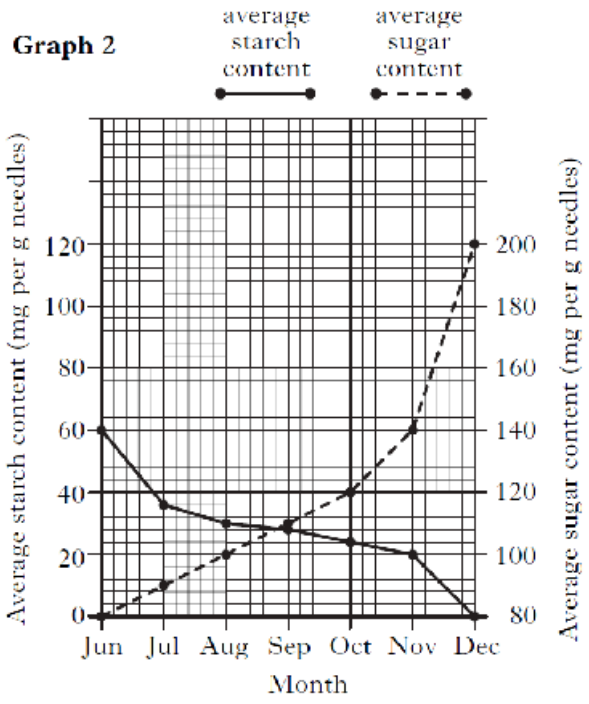
- Dry mass of whole seedlings
- Dry mass of roots only
- Starch content in needles
- Sugar content in needles

The results are shown in **Graphs 1** and **2**.

Graph 1



Graph 2



DO NOT WRITE IN THIS MARGIN

Marks

(*a*) (i) **Use values from Graph 1** to describe the changes in average dry mass of whole seedlings from June to December.

_____ **2**

(ii) Between which two months was there the greatest increase in average dry mass of the seedlings' roots only?

Tick (✓) **one** box.

Jun–Jul	Jul–Aug	Aug–Sept	Sept–Oct	Oct–Nov	Nov–Dec

1

(iii) **From Graph 2**, calculate the ratio of average starch content to average sugar content in the needles in November.

Space for calculation

_____ Starch: _____ Sugar **1**

6. (a) (continued) *Marks*

(iv) **From Graph 2**, calculate the percentage decrease in average starch content in the needles between June and October.

Space for calculation

_____ % decrease **1**

(b) Explain the decrease in average starch content in the needles between June and December.

_____ **1**

(c) Raffinose is a sugar that prevents frost damage to needles.

The table shows the raffinose content of needles from the seedling samples.

Month	*Raffinose content* (mg per g of needles)
June	0
July	1
August	2
September	3
October	9
November	30
December	50

(i) What evidence is there that raffinose is not the only sugar present in the needles of Norway Spruce?

_____

_____ **1**

(ii) Suggest how the changing raffinose content of needles from June to December is of survival value to Norway Spruce.

_____

_____ **1**

Marks *Marg*

6. An investigation was carried out to compare the rates of water loss from tree species during winter when soil water availability is low.

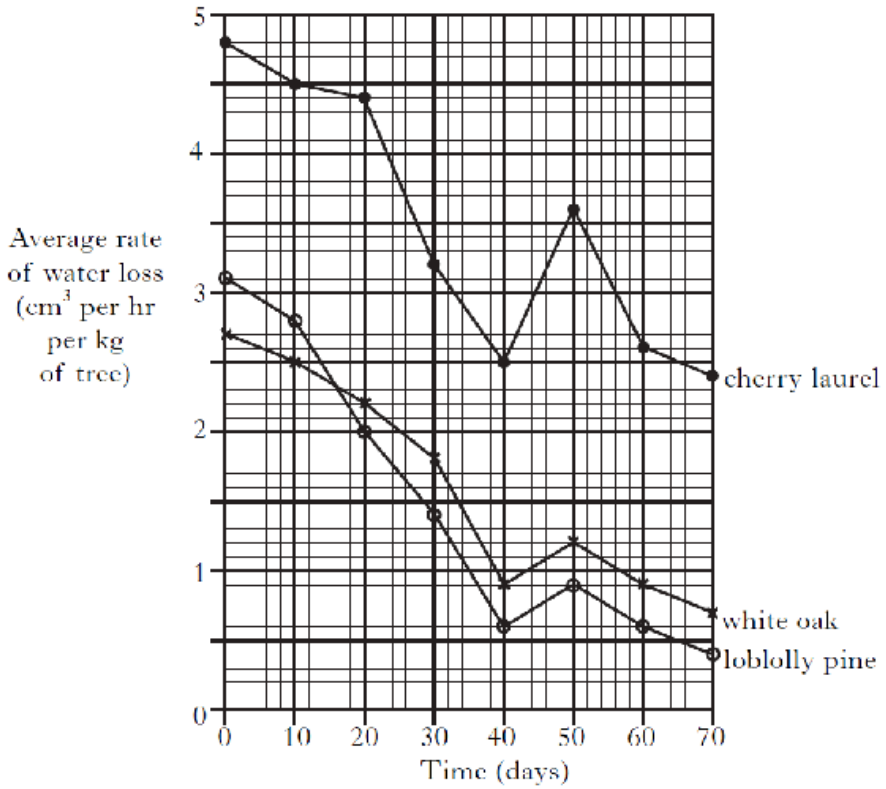
The table shows information about the tree species involved.

Tree species	*Leaf type*	*Leaves lost in winter*
cherry laurel	broad	no
white oak	broad	yes
loblolly pine	needle-like	no

One year old trees of each species were grown outside in identical environmental conditions during winter. The average rate of water loss from each species was measured every tenth day over a 70 day period.

The results are shown in **Graph 1**.

Graph 1



(*a*) (i) **Use values from Graph 1** to describe the changes in rate of water loss from loblolly pine over the 70 day period.

2

(ii) Calculate the percentage decrease in rate of water loss from cherry laurel between day 0 and day 50.

Space for calculation

% **1**

6. (*a*) **(continued)**

Marks

(iii) **From Graph 1** express, as the simplest whole number ratio, the rates of water loss from white oak and cherry laurel on day 20.

_____ white oak : _____ cherry laurel **1**

(iv) Using the information from the table **and** from Graph 1, suggest the advantage to the white oak of losing its leaves in winter.

Justify your answer.

Advantage _____

Justification _____

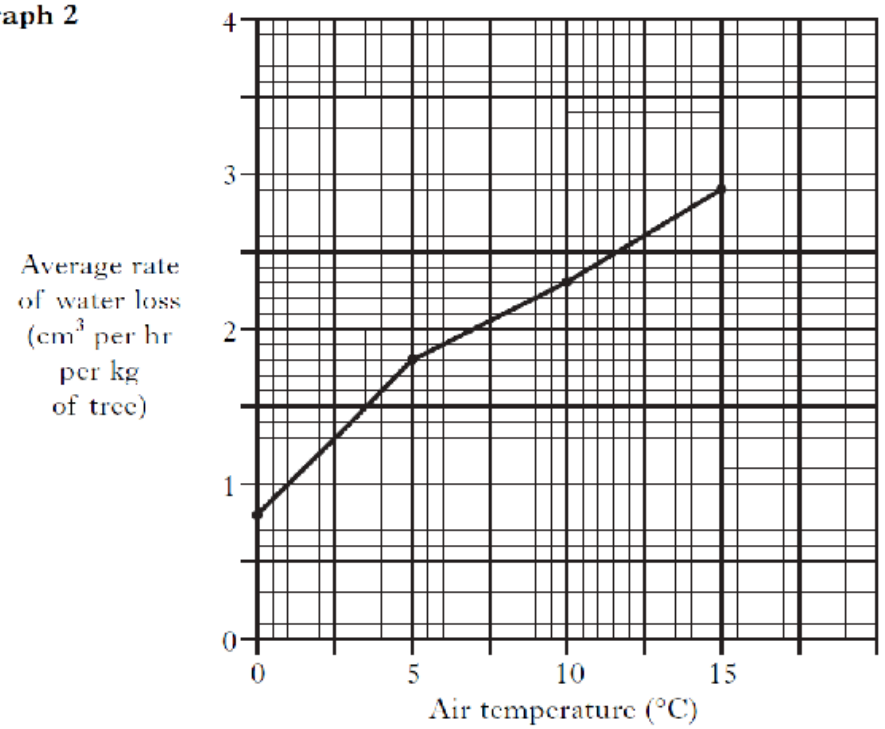
_____

_____ **2**

(*b*) In a further investigation, the effect of air temperature on the average rate of water loss from loblolly pine was measured.

The results are shown in **Graph 2**.

Graph 2



(i) Use the information from **Graphs 1 and 2** to suggest the air temperature on day 30 of the investigation.

°C **1**

(ii) Predict the rate of water loss from loblolly pine at an air temperature of 18 °C.

cm^3 per hour per kg of tree. **1**

(iii) Apart from air temperature and soil water availability, state **one** factor which can affect water loss from trees.

_____ **1**

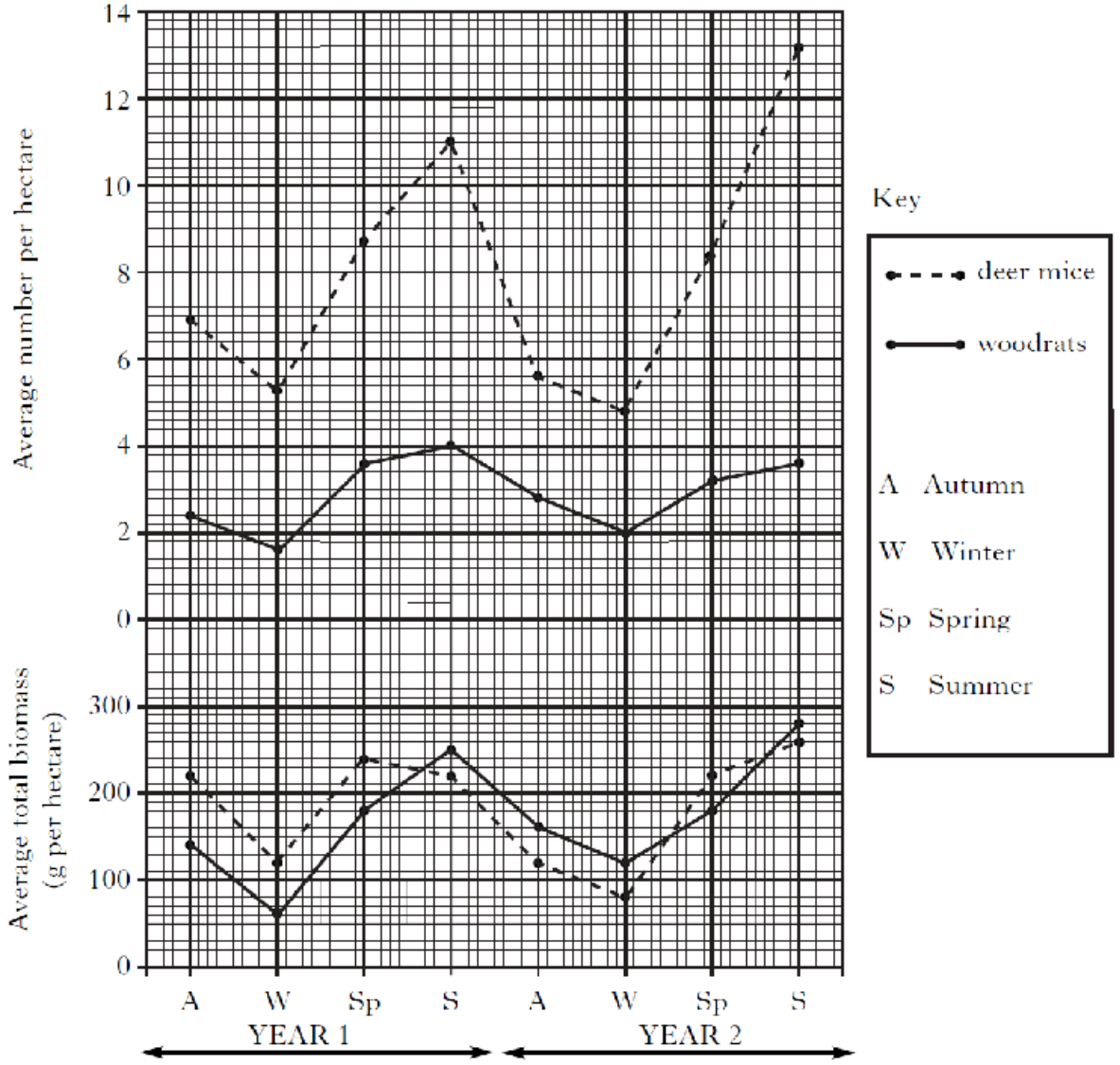
2009

5. Mexican spotted owls are territorial and prey on several species of small mammal. Three pairs of owls were studied over a two year period. *Marks*

The table below shows the number of each prey species eaten by each pair of owls.

Prey species	*Number of each prey species eaten by each pair of owls*		
	Owl pair A	*Owl pair B*	*Owl pair C*
deer mouse	484	528	515
woodrat	29	144	141
brush mouse	15	114	118
rock squirrel	22	24	23

The graph below shows the average number and average total biomass of deer mice and woodrats living in the study area in different seasons.



(*a*) (i) What percentage of the total number of prey eaten by owl pair A were deer mice?

Space for calculation

_____ % **1**

5. (a) (continued)

Marks

(ii) Express as the simplest whole number ratio the numbers of deer mice, brush mice and rock squirrels eaten by owl pair B.

Space for calculation

deer mice	:	brush mice	:	rock squirrels
_____	:	_____	:	_____

1

(*b*) Use evidence from the table to identify the owl pair that foraged in a different habitat to the other two pairs of owls.

Justify your answer.

Pair _____

Justification _____

_____

_____

1

(*c*) (i) **Use values from the graph** to describe the change in average number of woodrats per hectare from spring of Year 1 until spring of Year 2.

_____

_____

2

(ii) Calculate the percentage decrease in the average total biomass of woodrats between summer of Year 1 and winter of Year 2.

Space for calculation

_____ %

1

(*d*) Calculate the average biomass of one deer mouse in summer of Year 1.

Space for calculation

_____ g

1

(*e*) The size of the territory of a pair of Mexican spotted owls is different in winter and summer. Give an explanation of this observation which can be supported by evidence from the graph.

_____

_____

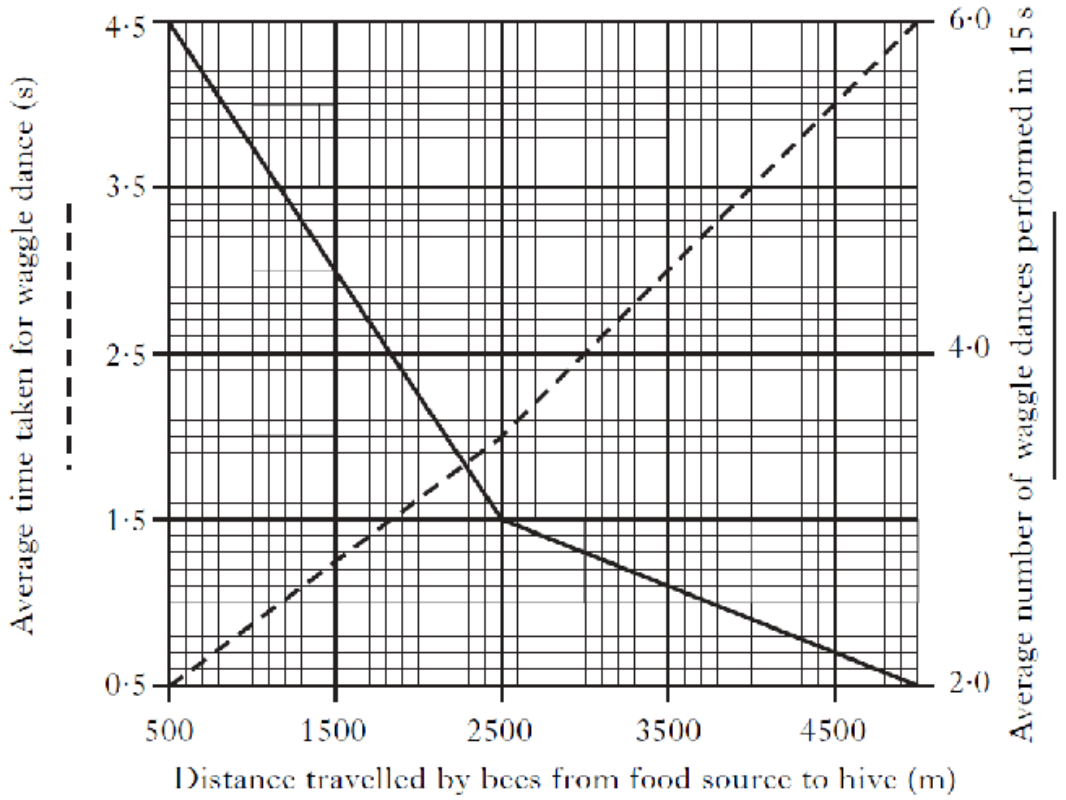
_____

1

6. Honey bees are social insects. They forage for food at various distances from their hive. When a bee finds a food source, it returns to the hive and communicates the location of the food to other bees using body movements called waggle dances. These are performed several times with short intervals between them.

In an investigation, bees were fitted with radio tracking devices which allowed the distances they travelled from the hive to be measured. The waggle dances performed by each returning bee were studied. The average time taken for its waggle dance was recorded and the number of times it was performed in 15 seconds was counted.

The results are shown in the graph below.



(*a*) (i) **Use values from the graph** to describe the relationship between the distance travelled by a bee from the food source and the number of waggle dances performed in 15 s.

_____

_____

_____ **2**

(ii) State the average time taken for a waggle dance when the distance travelled by a bee from the food source is 1500 m.

_____ s **1**

6. (*a*) (continued)

(iii) Calculate the percentage increase in the average time taken for a waggle dance when the distance from the food source to the hive increases from 500 to 3500 metres.

Space for calculation

_____% 1

(iv) Predict the total time a bee would spend in the waggle dances in a 15 s period when the food source is 2500 m away from the hive.

_____ s 1

(*b*) In another investigation, the waggle dances of six bees from another hive were observed.

The results are shown in the table below.

BEE	*Number of times waggle dance was performed in 15 s*
1	2·65
2	2·20
3	2·30
4	2·55
5	2·70
6	2·60
Average	

(i) Complete the table by calculating the average number of times the waggle dance was performed in 15 s.

Space for calculation

1

(ii) Using information from the table and the graph, predict the distance that was travelled by bee 6 to its food source.

_____ m 1

(*c*) (i) Apart from its distance from the hive, what other information about food sources would be useful to the bees?

_____ 1

(ii) In terms of the economics of foraging, explain the advantage of waggle dances to bees.

_____

_____ 1

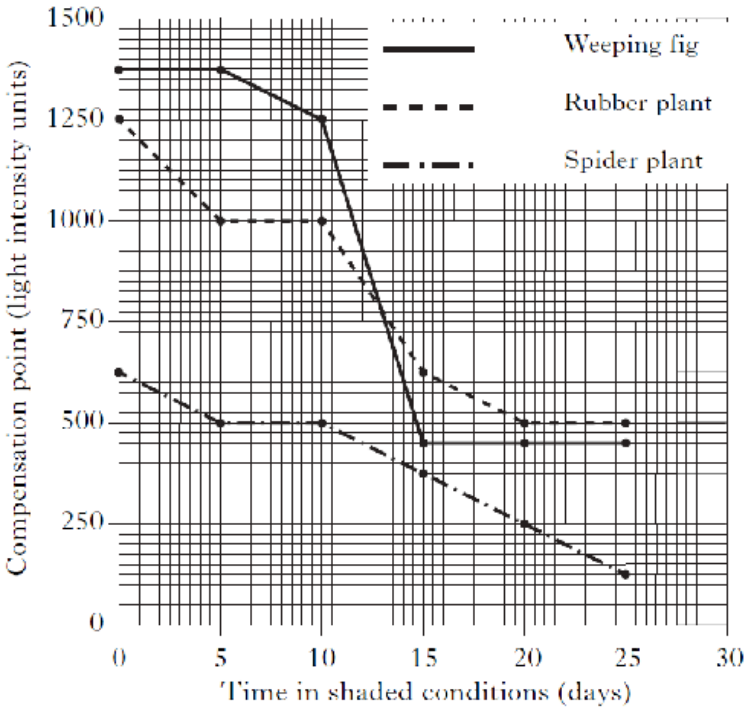
6. The compensation point is the light intensity at which a plant's carbon dioxide uptake by photosynthesis is equal to its carbon dioxide output from respiration.

Marks

In some plant species, compensation point can be reduced when the plant is moved from bright light to shaded conditions.

Graph 1 shows how the compensation points of three species of plant changed over a 25 day period after they were moved from bright light into shaded conditions.

Graph 1



(*a*) (i) Use values from **Graph 1** to describe the changes in compensation point of the weeping fig over the 25 day period.

2

(ii) Calculate the percentage decrease in compensation point of the rubber plant over the 25 day period.

Space for calculation

% **1**

(iii) Predict the compensation point of the spider plant at **28 days**.

_____ light intensity units **1**

(iv) Use evidence from the graph to explain why the rubber plant could not grow successfully in a constant light intensity of 400 light intensity units.

_____

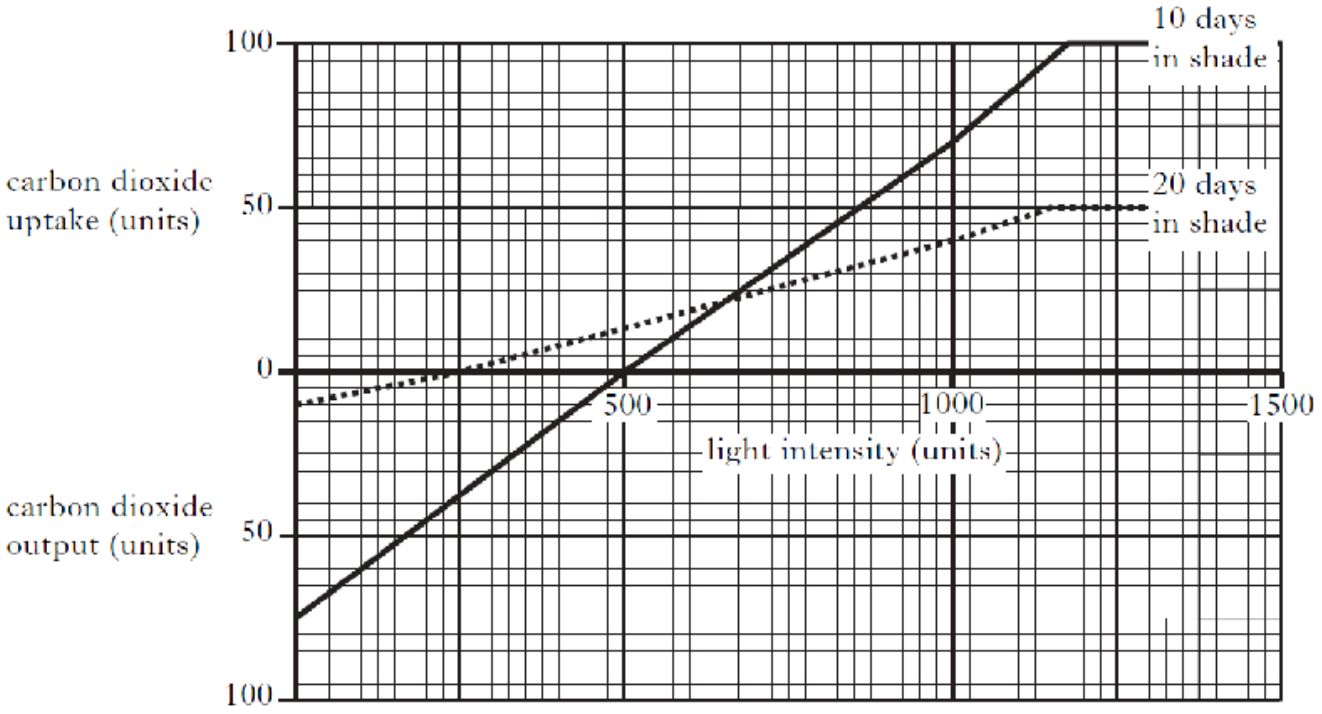
2

6. (continued)

(*b*) After 10 days in shaded conditions, a plant of one species was placed into different light intensities and its carbon dioxide output and uptake were measured. This was repeated with another plant of the **same** species which had been in the shade for 20 days.

The results are shown in **Graph 2**.

Graph 2



(i) Use all the data to identify the plant species referred to in **Graph 2**.

Tick (✓) the correct box and give a reason for your choice.

weeping fig ☐ rubber plant ☐ spider plant ☐

Reason

_____

1

(ii) From **Graph 2**, calculate how many times greater the carbon dioxide uptake of this plant was at 1000 units of light intensity after 10 days in shaded conditions compared with after 20 days in shaded conditions.

Space for calculation

_____ times **1**

10. French bean plants were grown over a period of four weeks in solutions containing different concentrations of lead ions.

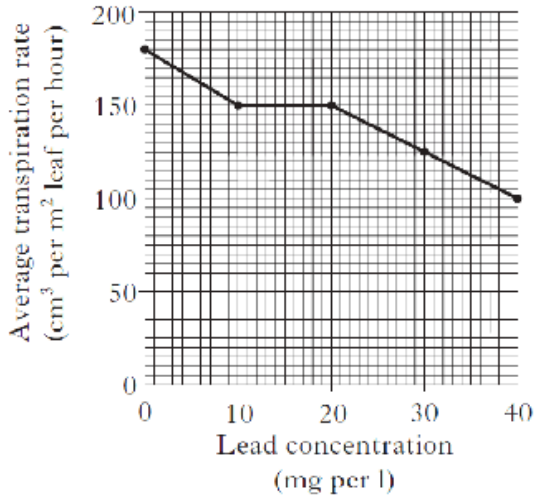
After this period, measurements of transpiration rate, dry mass and lead content were taken from plants grown in each solution.

The **Graph** shows the average transpiration rate.

The **Table** shows the average dry masses of the roots and shoots.

The **Bar Chart** shows the average lead content of the roots and shoots.

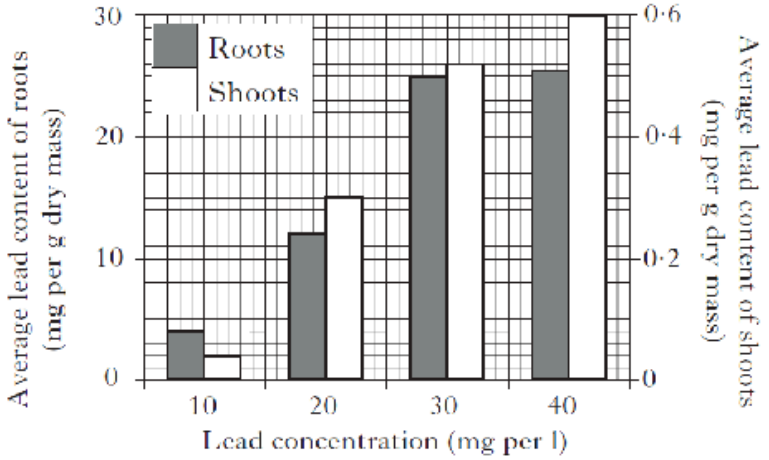
Graph



Table

Lead concentration (mg per l)	*Average dry mass of roots* (g)	*Average dry mass of shoots* (g)
0	3·1	0·4
10	3·2	0·3
20	2·2	0·2
30	2·0	0·1
40	1·3	0·1

Bar Chart



DO NOT WRITE IN THIS MARGIN

Marks

(*a*) (i) **Use values from the Graph** to describe the changes in average transpiration rate as the lead concentration increases from 0 to 40 mg per litre.

_____

_____

2

(ii) What evidence from the **Graph** suggests that lead concentration is **not** the only factor affecting transpiration rate in this investigation?

_____ 1

10. (continued) *Mark*

(*b*) Use information from the **Table**, to calculate the percentage decrease in **combined** average dry mass of shoots **and** roots when the lead concentration in the solution was increased from 0 to 40 mg per litre.

Space for calculation

_____ % decrease **1**

(*c*) Use information from the **Bar Chart** to:

(i) give the lead content of the shoots when the lead concentration of the solution was 10 mg per litre;

_____ mg per g dry mass **1**

(ii) calculate the simplest whole number ratio of lead content in roots to shoots for plants grown in a solution of 20 mg lead per litre.

Space for calculation

lead content in roots : lead content in shoots **1**

(*d*) The lead content is expressed in mg of lead per gram of dry mass of the plant. Explain the advantage of using dry mass rather than fresh mass.

_____

_____ **1**

(*e*) Using the **Table** and **Bar Chart**, calculate the average lead content of the roots of the plants grown in the solution containing 30 mg of lead per litre.

Space for calculation

_____ mg lead **1**

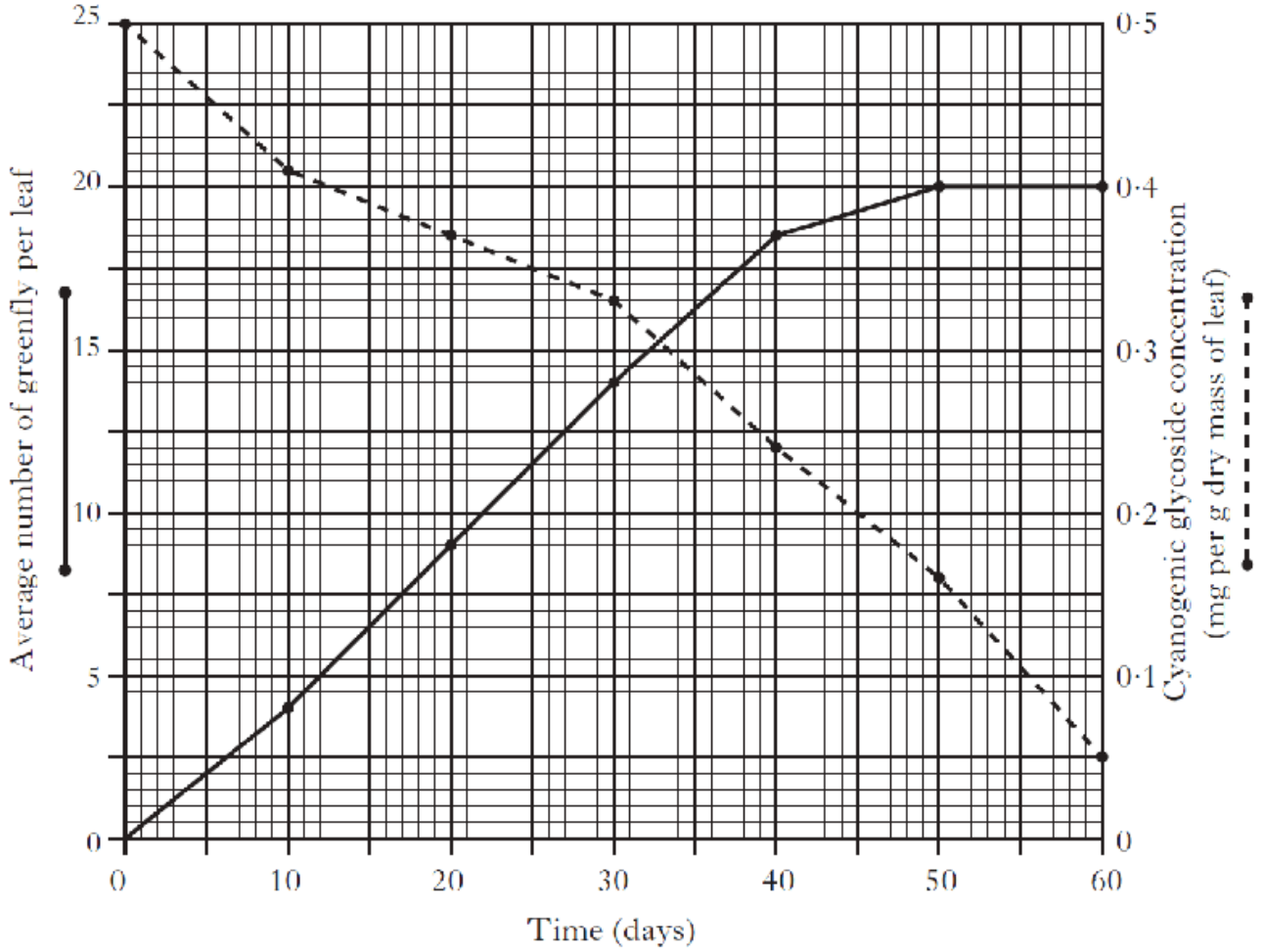
(*f*) Explain why the presence of lead ions in the cells of French bean plants resulted in a decrease in growth.

_____

2

2. (*a*) Cherry tree leaves are attacked by greenfly. The leaves contain cyanogenic glycosides which are broken down to release cyanide when greenfly damage them. The cyanide acts as a defence against **most** greenfly species.

The graph below shows the average number of individuals of a species of greenfly per leaf and the concentration of cyanogenic glycosides in the leaves of a cherry tree over a 60 day period.



(i) Explain how changes in the population of greenfly account for the fall in the cyanogenic glycoside concentration throughout the period.

_____

_____ **2**

(ii) What evidence is there that this greenfly species is resistant to the effects of cyanide?

_____ **1**

2. (*a*) (continued)

(iii) Calculate the average increase **per day** in the number of greenfly per leaf between day 10 and day 50.

Space for calculation

Average increase per day _____ **1**

(iv) State the cyanogenic glycoside concentration when the average number of greenfly per leaf was 14.

mg per gram dry mass of leaf **1**

2012 Rev

9. Human food production can be increased by the use of fertiliser which improves crop growth.

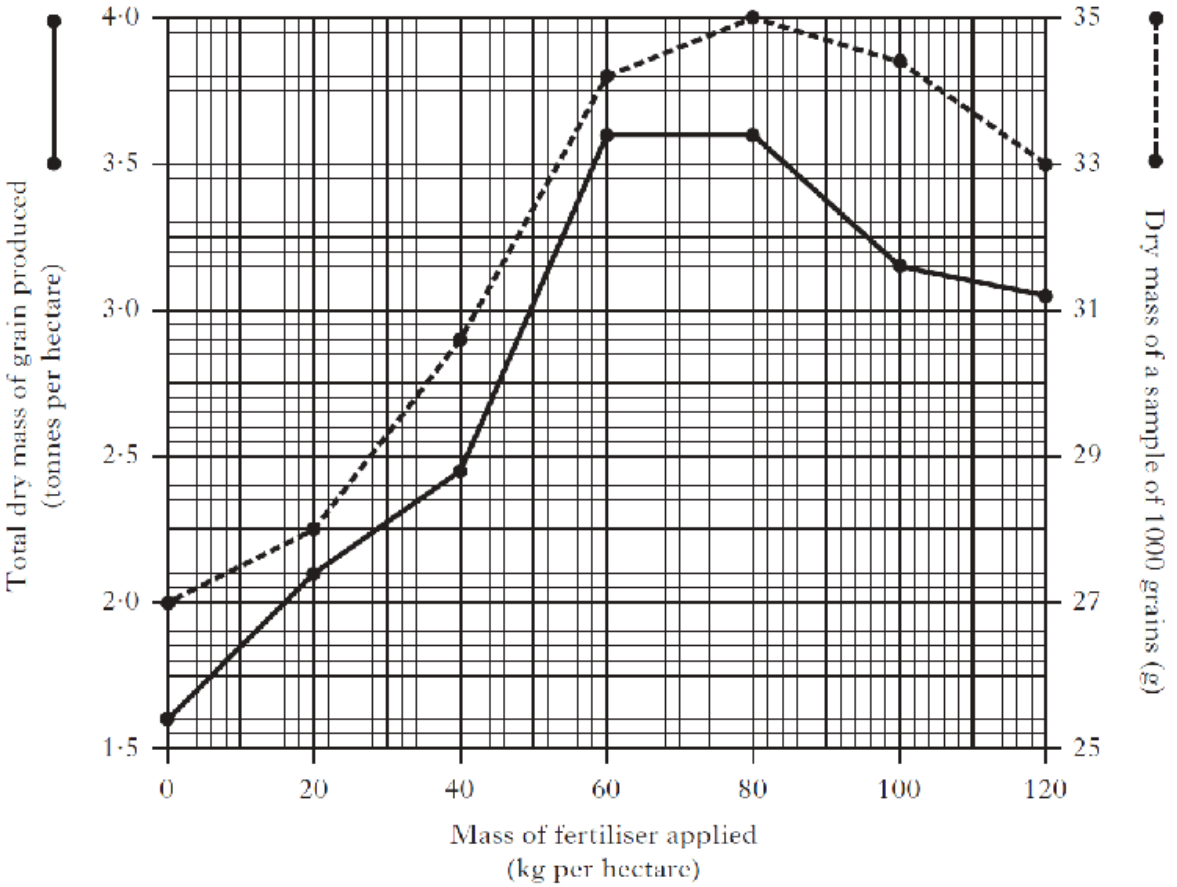
Marks

A field trial was carried out to show how the mass of fertiliser applied per hectare affected the growth of a wheat crop and to determine the level of fertiliser which should be recommended for use with this crop.

After the harvest of the wheat at each fertiliser level the following measurements of plant growth were made.

- Total dry mass of grain produced per hectare
- Dry mass of a sample of 1000 grains

The results are shown in the graph below.



(*a*) (i) **Use values from the graph** to describe the changes in the total dry mass of grain produced as the fertiliser application increased from 40 kg to 120 kg per hectare.

_____

_____

_____ **2**

(ii) Calculate the **average increase** in total dry mass of grain produced for every additional kg of fertiliser applied from 0 kg to 80 kg per hectare.

Space for calculation

_____ tonnes per hectare **1**

9. (continued)

(*b*) (i) Calculate the simplest whole number ratio of the dry mass of 1000 grains produced at 0 kg fertiliser per hectare to that at 120 kg fertiliser per hectare. *Mark*

Space for calculation

At 0 kg per hectare : At 120 kg per hectare 1

(ii) Calculate the **percentage increase** in the dry mass of 1000 grains when the fertiliser level was increased from 20 kg to 80 kg per hectare.

Space for calculation

_____ % 1

(*c*) At which fertiliser level is the average dry mass of an individual wheat grain the greatest.

Tick (✓) the correct box.

60 kg per hectare	80 kg per hectare	100 kg per hectare	120 kg per hectare
☐	☐	☐	☐

1

(*d*) The table below shows information about fertiliser level and yields of the wheat crop.

Complete the table by:

(i) inserting the missing term to complete the column heading; 1

(ii) inserting the missing fertiliser level using information from the graph; 1

(iii) calculating and inserting the missing harvest index. 1

Space for calculation

Fertiliser level (kg per hectare)	..... / ..... (*total plant biomass*) (tonnes per hectare)	*Economic yield* (*total dry mass of grain*) (tonnes per hectare)	*Harvest index*
	4·0	3·0	0·75
60	4·5	3·6	

(*e*) As a result of the field trial, the recommended level of fertiliser was 60 kg per hectare.

Suggest **two** reasons why this level was recommended.

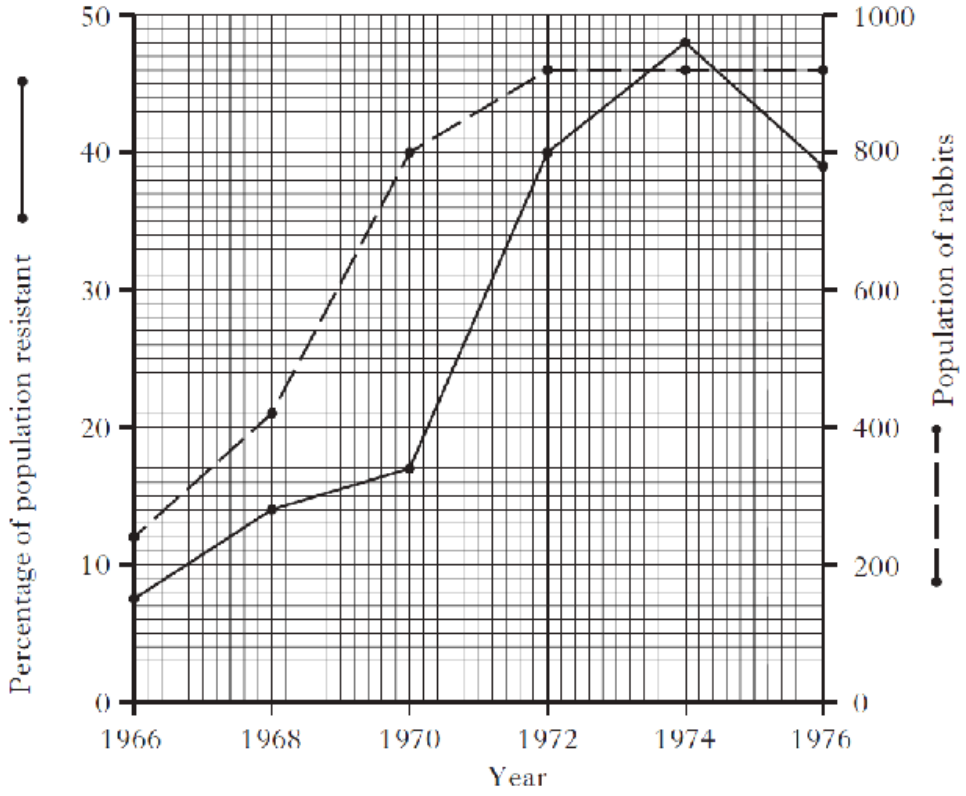
1 _____ 1

2 _____ 1

5. Myxomatosis is a viral disease to which some rabbits are resistant and survive while others die.

A rabbit population was monitored for 10 years. The percentage of the population which was resistant was recorded.

The results are shown in the graph below.



(*a*) (i) Calculate the number of rabbits which were resistant in 1972.

Space for calculation.

rabbits **1**

(ii) Calculate the average increase in the rabbit population per year between 1966 and 1970.

Space for calculation.

_____ rabbits per year **1**

(iii) Identify the two year period during which there was the greatest change in the percentage of the population resistant to myxomatosis.

Tick (✓) the correct box below.

☐ 1966–1968 ☐ 1968–1970 ☐ 1972–1974 ☐ 1974–1976 **1**

5. (continued)

(*b*) Explain the increase in resistance to myxomatosis in the rabbit population in terms of the frequency of genetic sequences.

_____

_____

_____ **1**

(*c*) Describe evidence from the graph that indicates that the myxomatosis virus underwent mutation during the 10 year period.

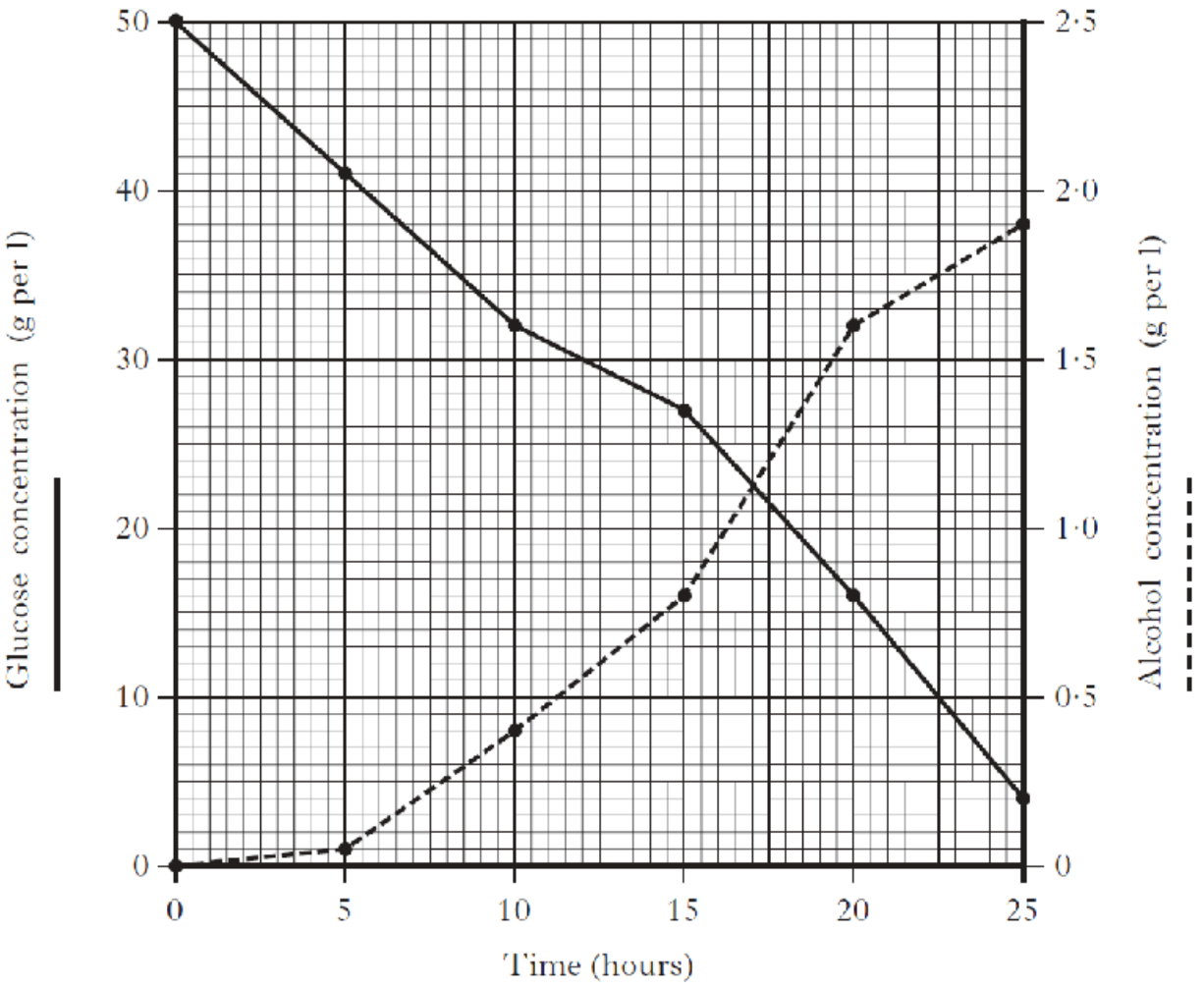
_____

_____ **1**

6. A culture of yeast was grown in 5 litres of glucose solution.

Glucose and alcohol concentrations in the culture were measured every 5 hours for 25 hours.

The results are shown in the graph below.



(*a*) State the alcohol concentration when the glucose concentration was 10 g per litre.

g per litre **1**

(*b*) Tick (✓) the box to identify the time period during which the rate of alcohol production was the greatest.

0 – 10 hours	5 – 15 hours	10 – 20 hours	15 – 25 hours
☐	☐	☐	☐

1

6. (continued)

(*c*) Identify the time at which the glucose concentration reached 50% of its starting concentration.

_____ hours **1**

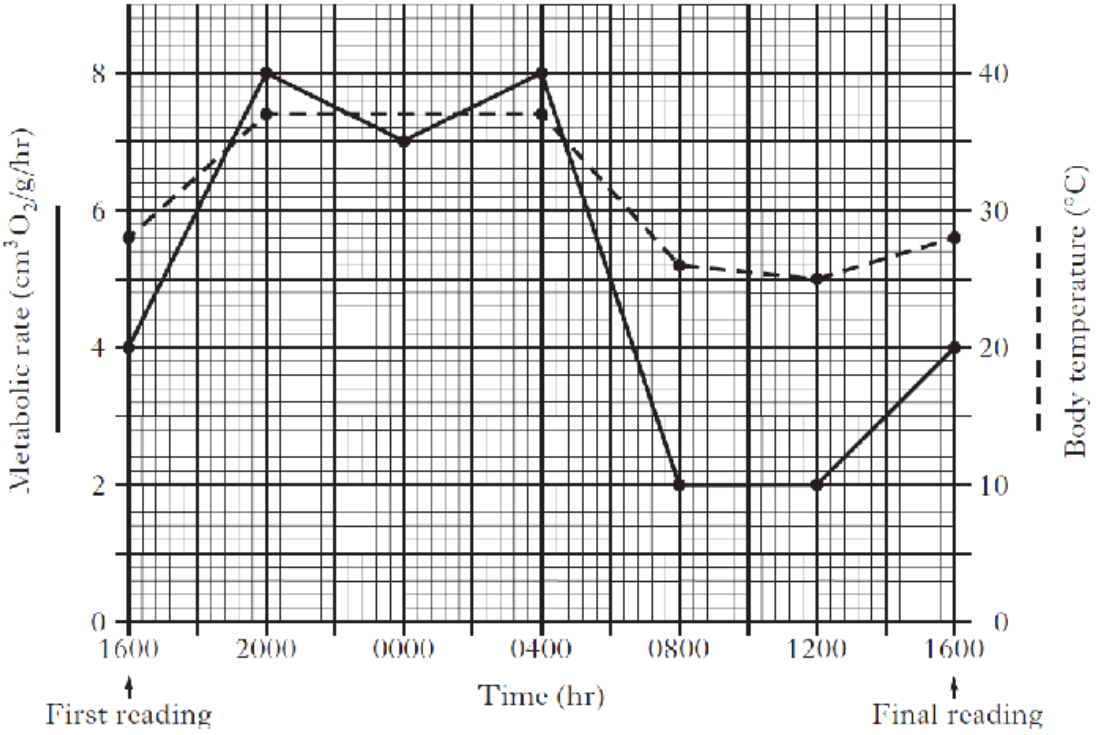
(*d*) Calculate how many grams of glucose remained in the solution at the end of the investigation.

Space for calculation

_____ g **1**

5. The northern blossom bat *Macroglossus minimus* is an Asian species which has a high metabolic rate and a daily rhythm of torpor.

The metabolic rates and body temperatures of a group of these bats were recorded every four hours over a 24 hour cycle and the results are shown on the graph below.



(*a*) Calculate the oxygen consumption of a 16 g bat at 0000 hours.

Space for calculation

_____ cm^3 O_2 per hr **1**

(*b*) Tick (✓) **one** box to identify the period when the bats were in full torpor and justify your answer.

1600 – 2000	2000 – 0000	0400 – 0800	0800 – 1200
☐	☐	☐	☐

Justification

2

(*c*) Give **one** benefit to the bats of their daily torpor.

_____ **1**

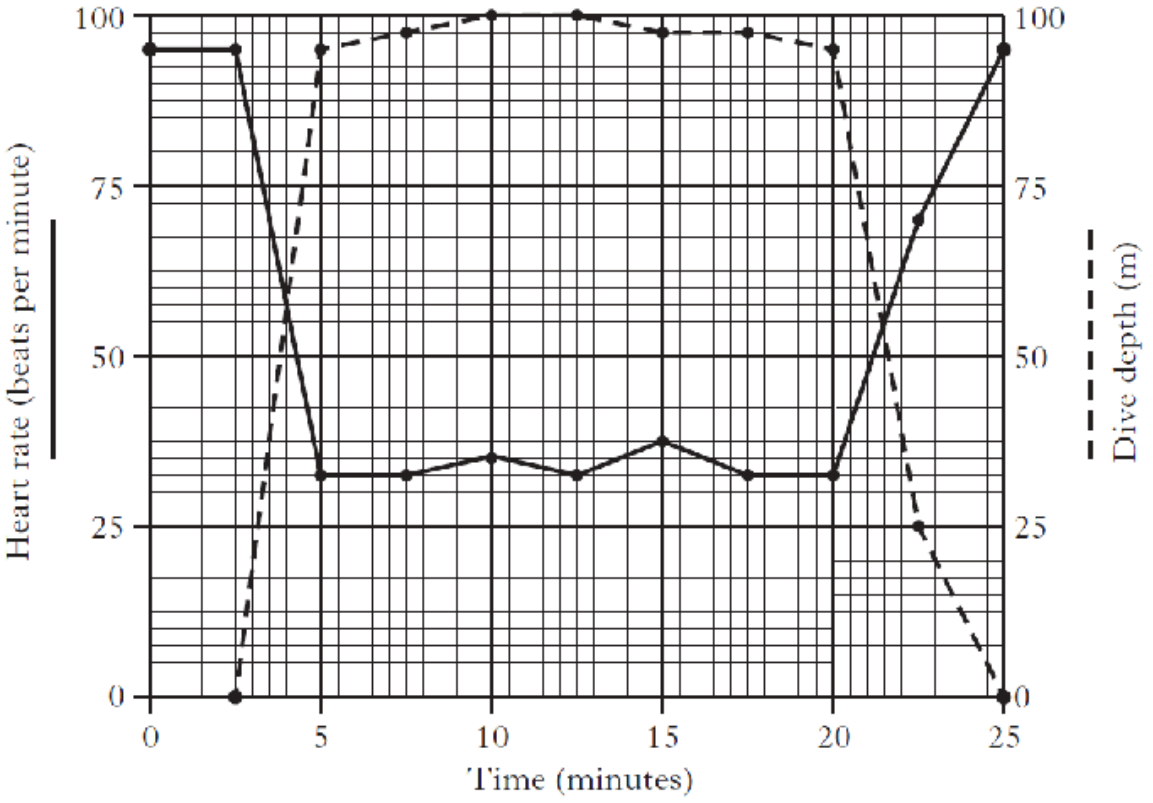
(*d*) Blossom bats are nocturnal.

Give **one other** behavioural adaptation of animals with high metabolic rates to allow survival in adverse conditions.

_____ **1**

7. The heart rate of a common seal was monitored over a 25 minute period before, during and after a dive.

The graph below shows how the heart rate changed with the depth of the seal's dive.



(*a*) (i) State the duration of the dive.

minutes **1**

(ii) Describe the relationship between the dive depth and the heart rate and suggest a reason for this.

1 Relationship _____

_____ **1**

2 Reason _____

_____ **1**

(*b*) Underline the correct option in each choice bracket to make the sentences correct.

Seals are mammals. Their hearts have {three / four} chambers and a {single / double} circulation.

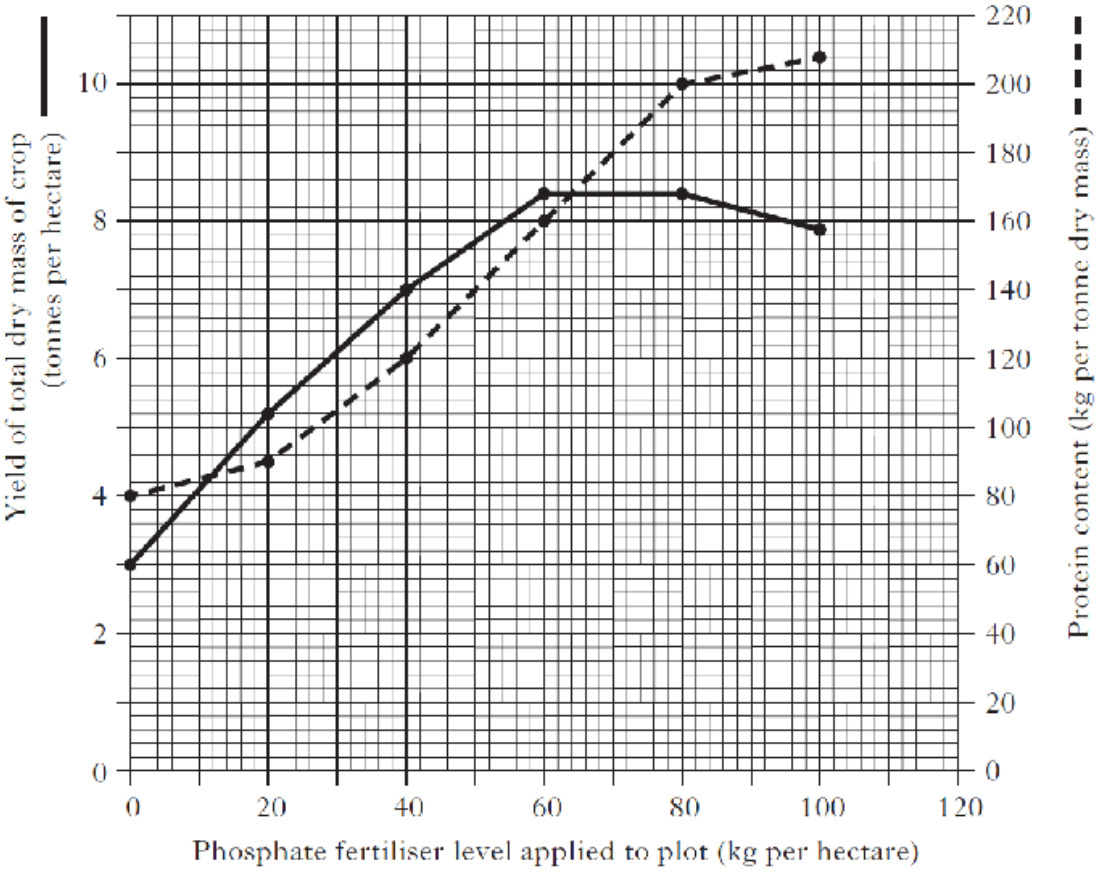
This arrangement allows seals to maintain {low / high} metabolic rates. **2**

10. Alfalfa is a crop plant often grown for cattle food.

Marks

In an investigation, alfalfa was grown in six plots each of which had been treated with a different level of phosphate fertiliser. The alfalfa was harvested after 24 weeks of growth and the total dry mass of the crop at each fertiliser level was calculated. The protein content of the alfalfa grown at each fertiliser level was also determined.

The results are shown in the graph below.



(*a*) (i) **Use values from the graph** to describe the changes in the yield of total dry mass of the crop as the phosphate fertiliser level was increased from 0 to 100 kg per hectare.

_____

_____

_____

_____ **2**

(ii) Predict the protein content of an alfalfa crop if 120 kg of phosphate fertiliser per hectare had been applied.

_____ kg per tonne dry mass **1**

(iii) Calculate the total mass of protein produced from one hectare when 40 kg of phosphate fertiliser per hectare was applied.

Space for calculation

_____ kg **1**

10. (continued)

(*b*) In a feeding trial, three groups of 10 cattle were fed with alfalfa of different protein contents over a 25 day period. The cattle were weighed at the beginning and end of this period and the average increase in their body mass calculated.

The results are shown in the table below.

Cattle group	*Protein content of alfalfa fed to cattle* (kg per tonne dry mass)	*Average increase in body mass of cattle over a 25 day period* (kg)
1	80	12
2	90	15
3	120	17

(i) State how the design of the feeding trial ensured the reliability of the results.

1

(ii) Using the information from the **table**, calculate the average increase in body mass per day of the cattle in Group 2.

Space for calculation

1

kg per day

(iii) Using information from the **graph and table**:

1 suggest the phosphate fertiliser level which was applied in the production of the alfalfa which the cattle from Group 2 were fed;

1

_____ kg per hectare

2 draw a conclusion about how phosphate fertiliser levels applied to the alfalfa affected the growth of cattle in the feeding trial.

1

(*c*) In terms of food security, explain why using agricultural land to grow cereal for human consumption rather than to grow cattle food would produce more food for humans per unit area.

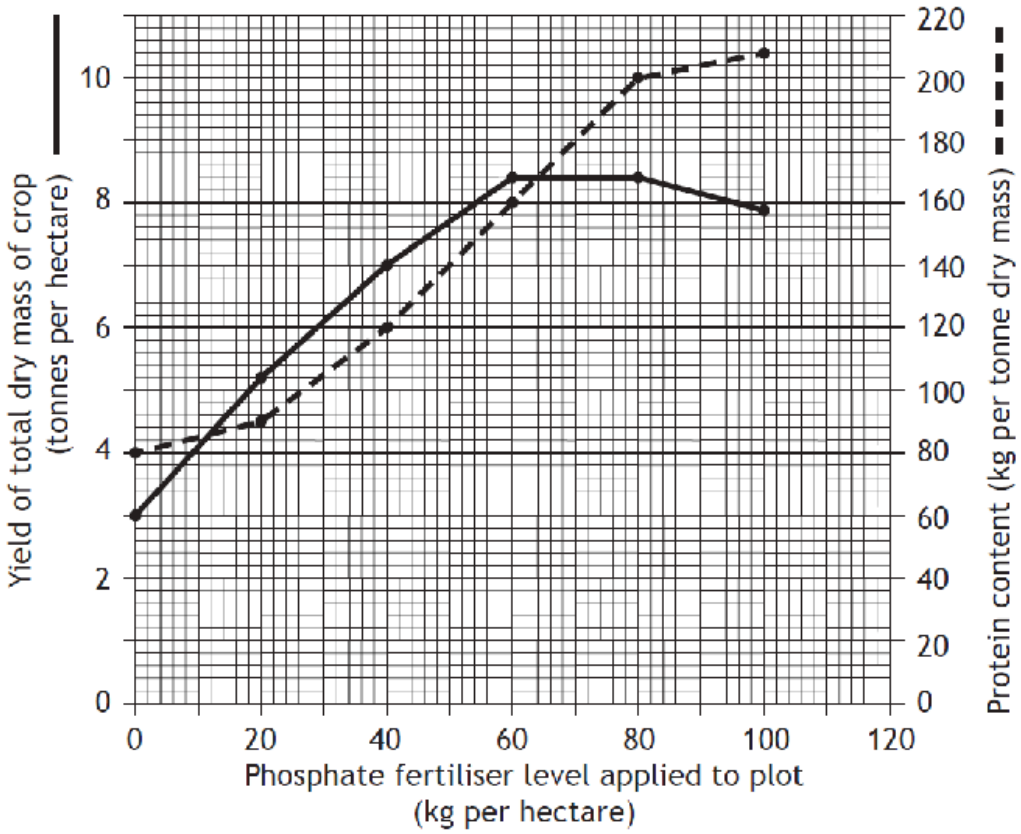
_____

_____ 1

9. Alfalfa is a crop plant often grown for cattle food.

In a field trial, alfalfa was grown in six plots each of which had been treated with a different level of phosphate fertiliser. The alfalfa was harvested after 24 weeks of growth and the total dry mass of the crop at each fertiliser level was calculated. The protein content of the alfalfa grown at each fertiliser level was determined.

The results are shown in the graph below.



(a) (i) **Use values from the graph** to describe the changes in the yield of total dry mass of the crop as the phosphate fertiliser level was increased from 0 to 100 kg per hectare. 2

(ii) Predict the protein content of an alfalfa crop if 120 kg of phosphate fertiliser per hectare had been applied. 1

_____ kg per tonne dry mass

9. (a) (continued) MARK

(iii) Calculate the total mass of protein produced from one hectare when 40 kg of phosphate fertiliser per hectare was applied. 1

Space for calculation

_____ kg

(b) In a feeding trial, three groups of 10 cattle were fed with alfalfa of different protein contents over a 25 day period. The cattle were weighed at the beginning and end of this period and the average increase in their body mass calculated.

The results are shown in the table below.

Cattle group	*Protein content of alfalfa fed to cattle* (kg per tonne dry mass)	*Average increase in body mass of cattle over a 25 day period* (kg)
1	80	12
2	90	15
3	120	17

(i) State how the design of the feeding trial ensured the reliability of the results. 1

_____

(ii) Using the information from the **table**, calculate the average increase in body mass per day of the cattle in Group 2. 1

Space for calculation

_____ kg per day

(iii) Using information from the **graph and table**;

1 suggest the phosphate fertiliser level which was applied in the production of the alfalfa which the cattle in Group 2 were fed; 1

_____ kg per hectare

2 draw a conclusion about how phosphate fertiliser levels applied to the alfalfa affected the growth of cattle in the feeding trial. 1

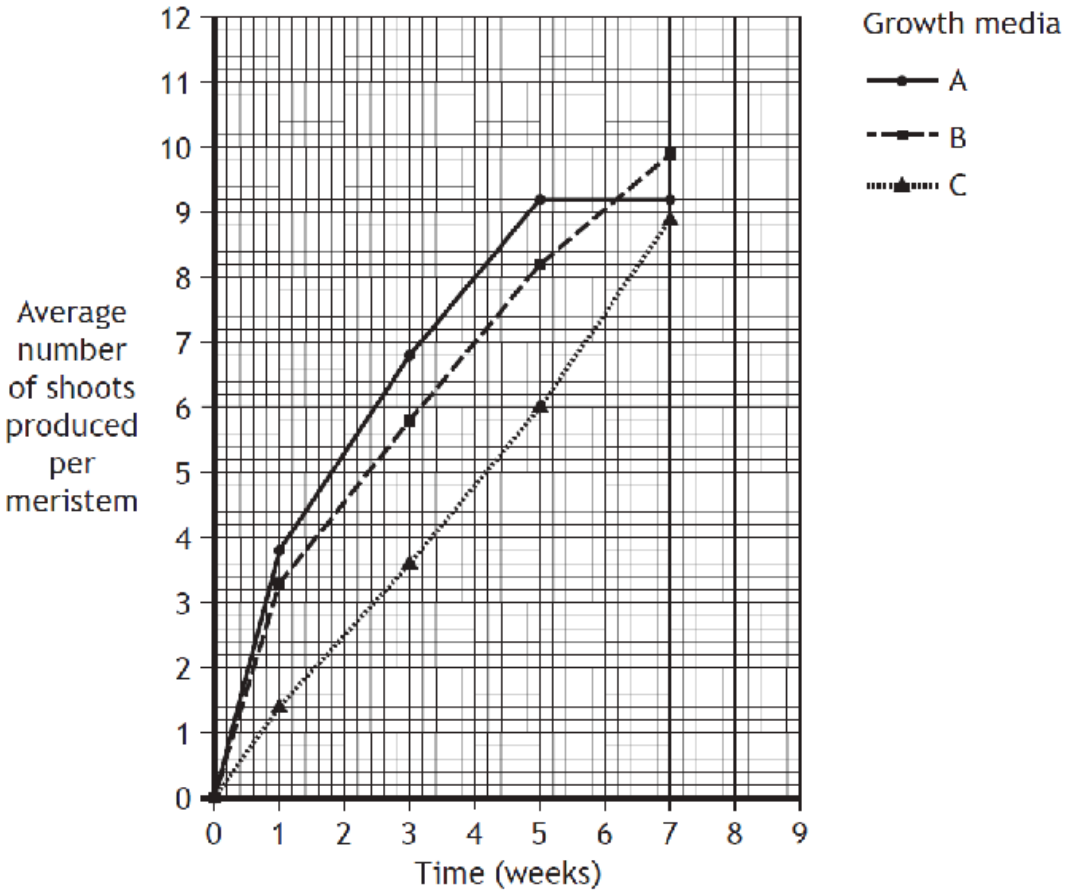
_____

4. Meristems can be cultured in growth medium to produce new plants.

An experiment was carried out to investigate the effects of three different growth media (A, B and C) on the production of shoots by meristems of African violet plants.

Five meristems were removed and cultured in each medium for a period of seven weeks. The average number of shoots produced per meristem was recorded at specific times during the investigation.

The results are shown in the graph below.



(a) (i) **Use values from the graph** to describe the average number of shoots produced per meristem over the seven week period in medium A. **2**

_____

_____

(ii) Calculate the percentage increase in the average number of shoots produced per meristem between week 1 and week 7 in medium B. **1**

Space for calculation

_____ %

4. (a) (continued) MARKS

(iii) Table 1 below shows the number of shoots produced per meristem at three weeks in one of the media.

Table 1

Meristem	*Number of shoots produced per meristem*
1	4
2	5
3	7
4	7
5	6

Using information from **Table 1 and the graph**, state the medium in which these meristems were cultured. **1**

Space for calculation

Medium _____

(b) Predict which medium would produce plants with the greatest number of shoots after nine weeks growth. Give a reason for your answer. **2**

Medium

Reason

(c) In a further experiment, the average number of roots and average root length at 7 weeks were recorded in each of the media.

The results are shown in Table 2 below.

Table 2

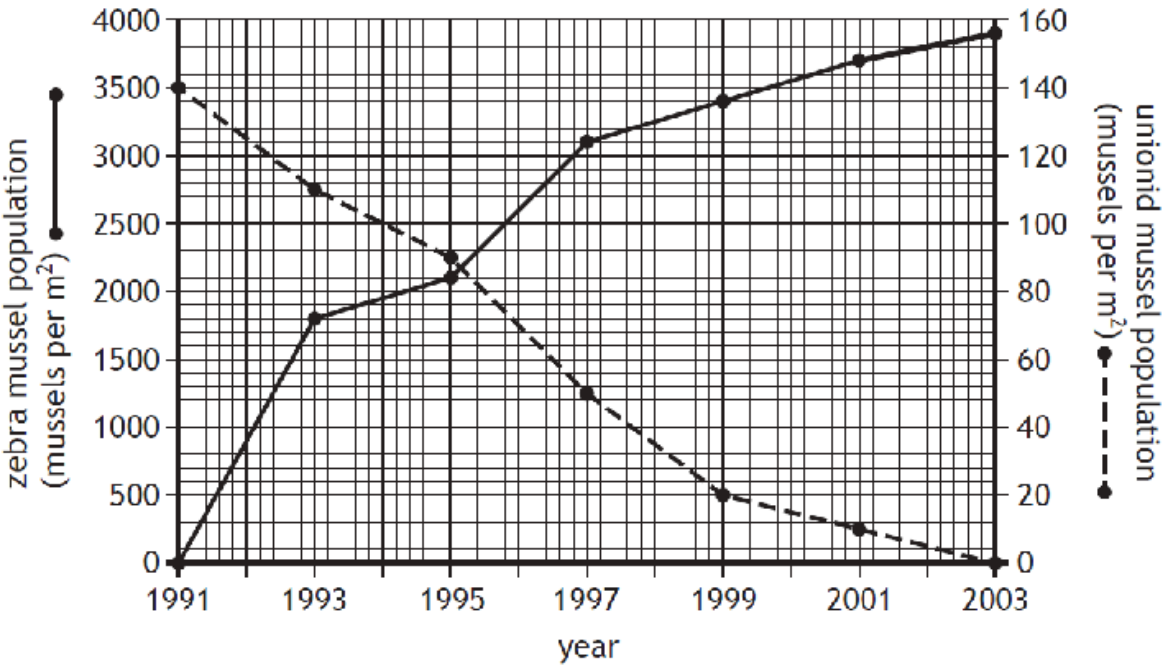
Medium	*Average number of roots produced per meristem*	*Average root length* (mm)
A	12	12
B	11	19
C	12	17

After analysing the results, medium B was used for the commercial production of plants.

Use the information in Table 2 to explain why plants cultured in medium B would grow best. **2**

13. Freshwater mussels are small animals which live on the beds of lakes and rivers. Zebra mussels are a species of freshwater mussel native to lakes in Russia. They were accidentally introduced by humans into a river in North America in 1991. The populations of zebra mussels and the native unionid mussels were measured over a 12 year period.

The results are shown in the graph below.



(a) (i) State the unionid mussel population in 1993. 1

_____ mussels per m^2

(ii) State the zebra mussel population when the unionid mussel population was 50 mussels per m^2. 1

_____ mussels per m^2

(iii) Calculate the average increase per year in the zebra mussel population between 1991 and 2003. 1

Space for calculation

_____ mussels per m^2 per year

(b) Explain how the graph confirms that zebra mussels are more successful competitors than unionid mussels. 1

_____

13. (continued)

(c) **Using evidence from the graph,** explain why zebra mussels are an invasive species. **1**

(d) Suggest a reason why the population of zebra mussels may have increased faster in the North American river than in its native habitat. **1**

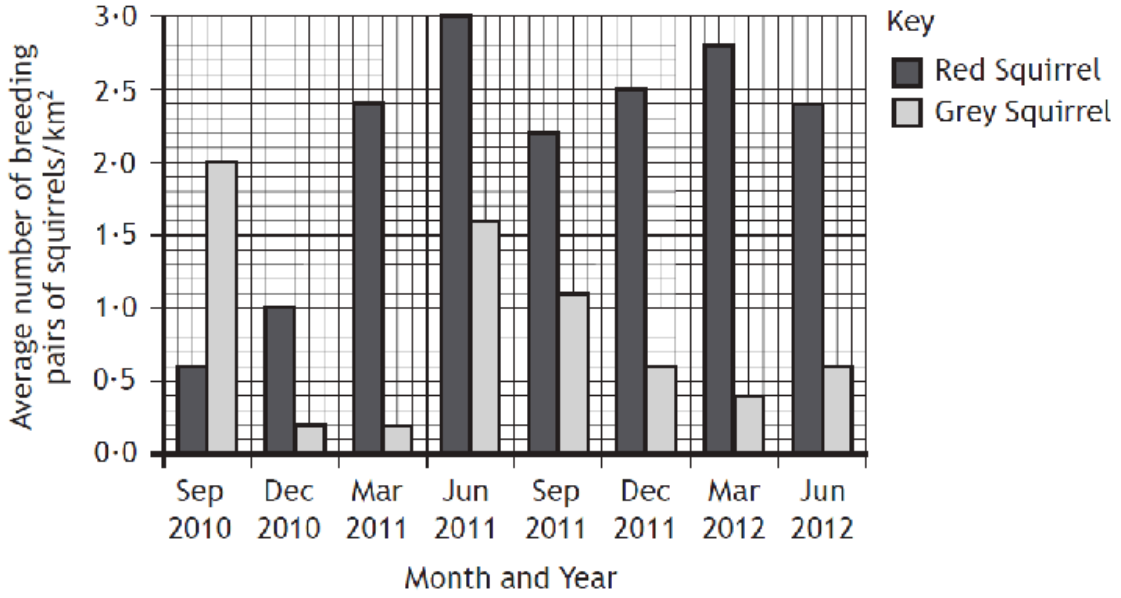
(e) Invasive species have a negative impact on genetic diversity of an ecosystem.

State what is meant by genetic diversity. **1**

6. An investigation was carried out to monitor the populations of red squirrels (*Sciurus vulgaris*) and grey squirrels (*Sciurus carolinensis*) in a 15 km^2 wooded area.

The average number of breeding pairs of each species was recorded between September 2010 and June 2012.

The results are shown in the graph.



(a) (i) Use **values from the graph** to describe the changes in the average number of breeding pairs of grey squirrels from March 2011 to March 2012. **2**

_____

_____

_____

(ii) Calculate the **total** number of breeding pairs of red squirrels in the wooded area in September 2011. **1**

Space for calculation

_____ breeding pairs

(iii) Express, as the simplest whole number ratio, the number of grey squirrels to red squirrels in June 2012. **1**

Space for calculation

_____ : _____

grey red

6. (continued)

(b) Pine martens (*Martes martes*) live in wooded areas and prey on squirrels.

Populations of pine martens, red squirrels and grey squirrels were estimated in two other wooded areas using automatic cameras. These cameras are triggered by the movement of passing animals.

The results are shown in the table.

Wooded area	*Estimated number of grey squirrels*	*Estimated number of red squirrels*	*Estimated number of pine martens*
1	88	645	45
2	465	112	12

(i) Suggest why the method used to estimate the numbers of pine martens and squirrels may lead to inaccurate results. **1**

(ii) Use evidence from the table which could be used to support the following statements.

1 Pine martens are more successful predators of grey squirrels than of red squirrels. **1**

2 Grey squirrels compete more successfully for food than red squirrels. **1**

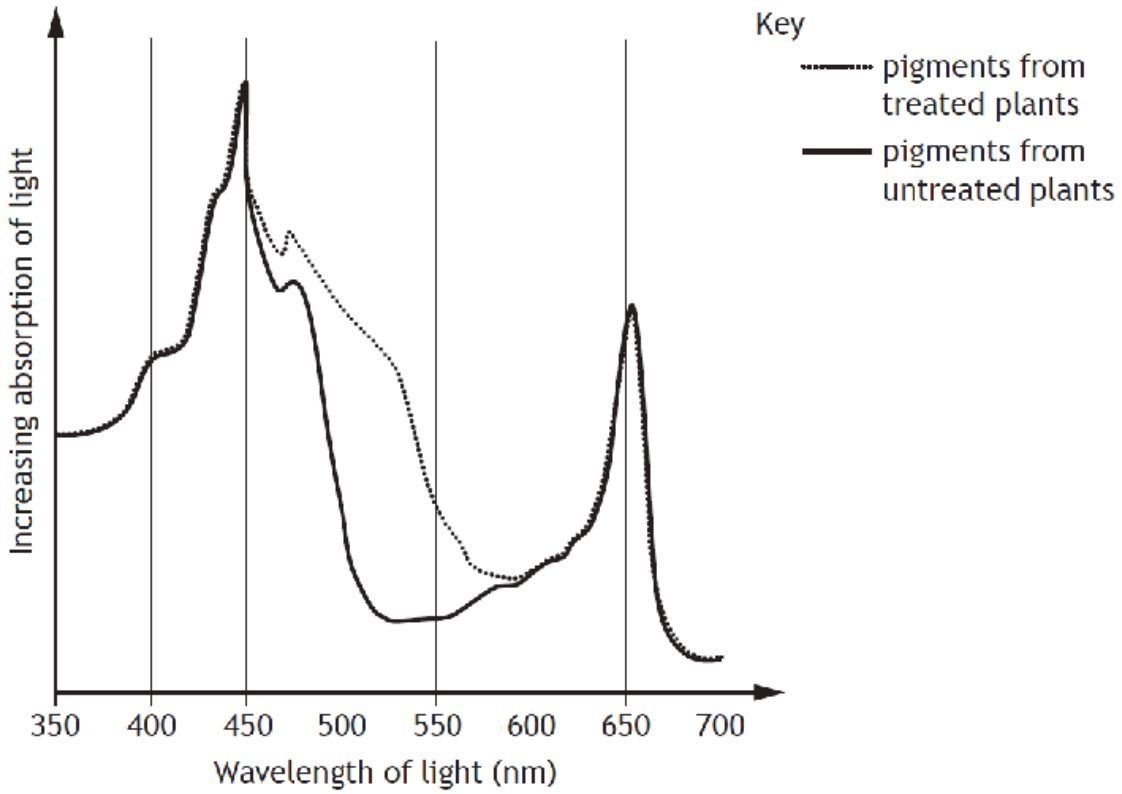
(c) Grey squirrels have spread rapidly and eliminated native red squirrels from much of the UK.

State the term used to describe grey squirrels in the UK as a result of this. **1**

7. Oil extracted from the seeds of the crop false flax (*Camelina sativa*) can be used as fuel. An investigation was carried out into the effect of a plant growth regulator paclobutrazol (PBZ) on the photosynthetic pigment content of the leaves and the oil yield from the seeds of false flax. The results are shown in the table.

Treatment	*Average photosynthetic pigment content* (mg/g of leaf)		*Average oil yield* (g/plant)
	Chlorophyll a and b	*Carotenoids*	
Untreated	3·28	3·02	1·7
Treated with PBZ	3·27	3·98	2·4

Absorption spectra for pigments from the treated and untreated plants were produced and are shown in the graph.



(a) (i) **Use values from the graph** to describe the difference in absorption spectra of the pigments from treated and untreated plants. 1

_____

_____

7. (a) (continued)

(ii) **Use evidence from the table** to explain the difference in the absorption spectra. **1**

(iii) State one use that plants make of the light energy absorbed by pigments during photosynthesis. **1**

(b) Suggest why seeds from the plants treated with PBZ yield more oil. **2**

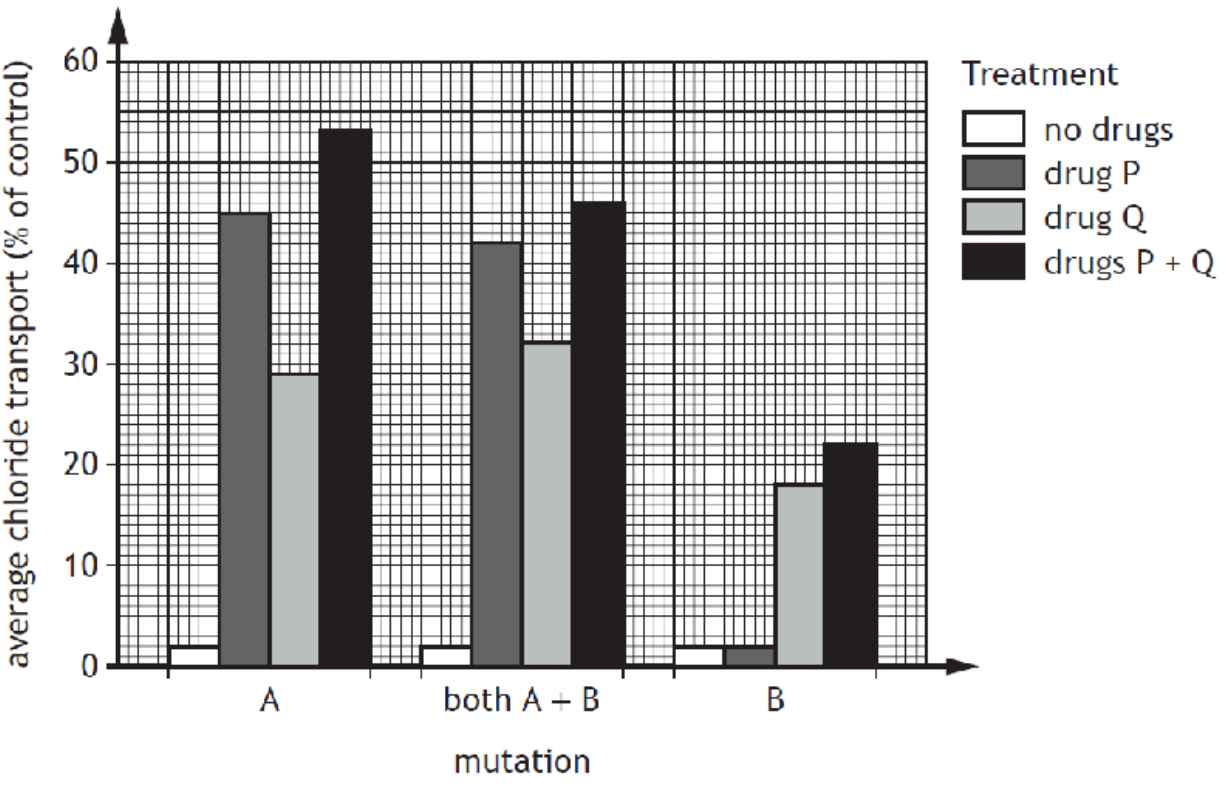
6. Cystic fibrosis in humans is caused by mutations in a gene that reduces chloride transport across the cell membrane.

An investigation was carried out to determine the effectiveness of two drugs, P and Q, on improving chloride transport in individuals with cystic fibrosis. Individuals with different mutations, A, B, and both A and B, were treated as follows.

- No drugs
- Drug P alone
- Drug Q alone
- Drug P and drug Q combined

Chloride transport across cell membranes was measured and compared to the chloride transport in a control group with no mutations in the gene.

The results are shown in the graph.



(a) State the purpose of including a control group in this investigation. 1

_____

_____

6. (continued)

(b) Identify the treatment and mutation for which the drug(s) had no effect. **2**

Treatment _____

Mutation _____

(c) State how the graph shows that each treatment was carried out on more than one individual with each mutation. **1**

_____

_____

(d) State the term used to describe the selection of drugs to treat individuals based on their genomic sequence. **1**

_____