

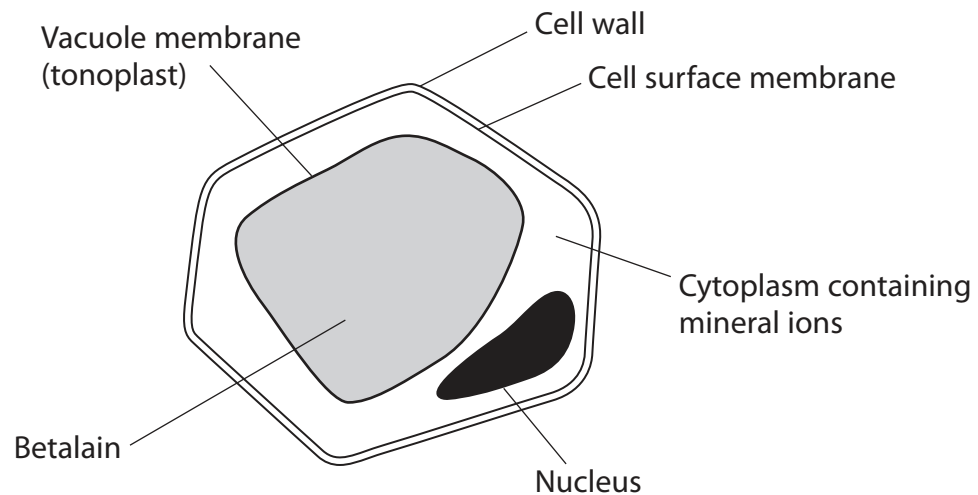
Answer ALL questions.

1 Fenitrothion is an insecticide used to control insects that feed on crop plants.

Before an insecticide is approved for use, its effects on insects and other animals is tested. The testing of fenitrothion showed that it affects the permeability of animal cell membranes.

Some scientists investigated the effect of fenitrothion on the permeability of the plant cell membranes of beetroot.

The diagram below shows a beetroot cell with a vacuole containing a red pigment called betalain.



Small discs, 1 mm thick and 5 mm in diameter, were cut from a beetroot. Any betalain on the outside of the discs was removed by washing the discs in water.

Twenty discs were placed into a beaker containing 20 cm³ of 1% fenitrothion solution in water.

Betalain began to leak from the discs, changing the colour of the solution. The colour of the solution in the beaker was recorded every hour.

(a) (i) Name the **independent** variable in this experiment.

(1)



(ii) Suggest how the **dependent** variable could have been measured.

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(iii) The temperature was kept constant throughout this investigation. Suggest a suitable value for this temperature. Give a reason for your answer.

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(iv) Suggest a suitable control for this investigation.

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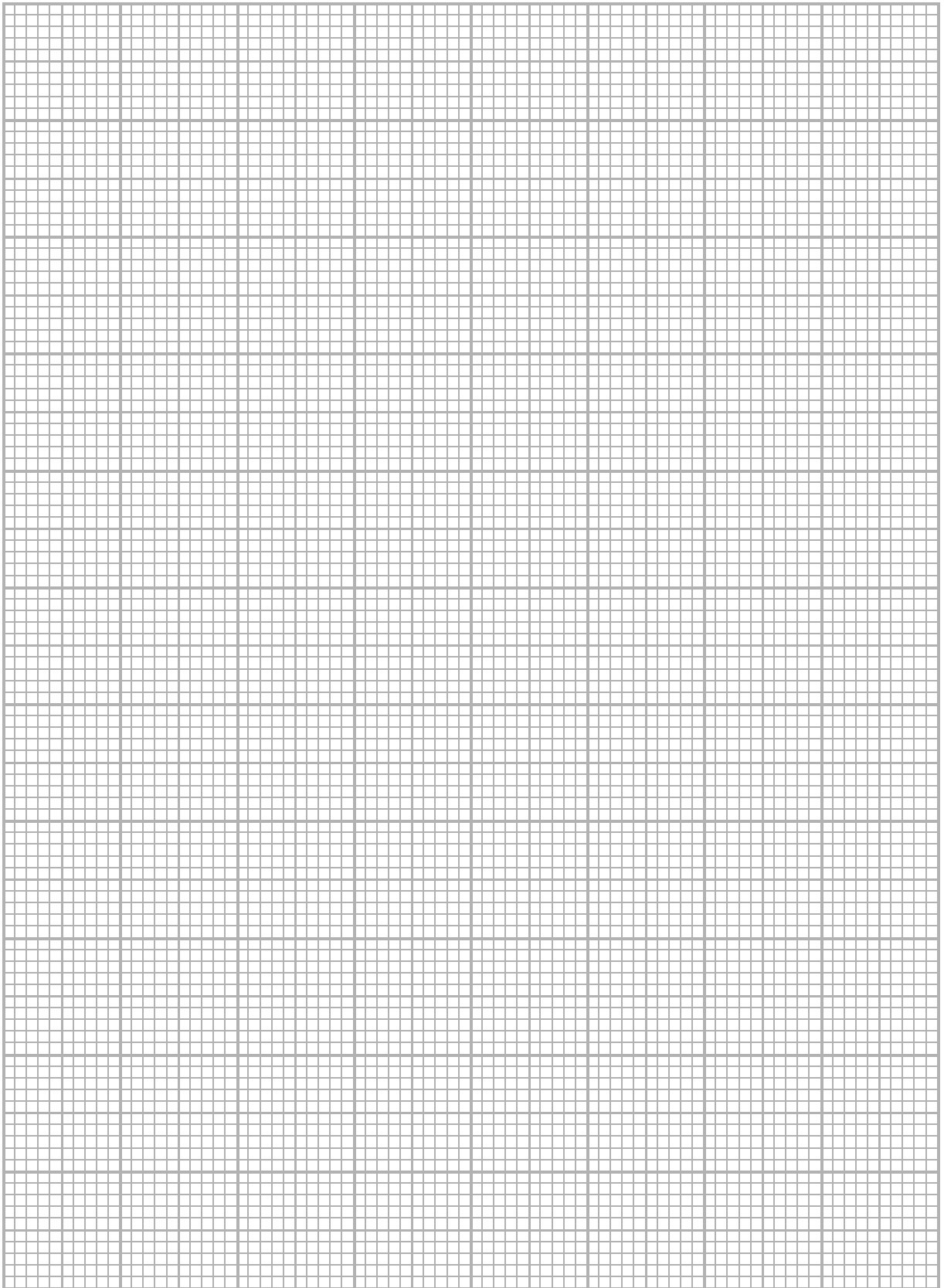
(b) The table below shows the colour of the solution every hour.

Time / hours	Colour of the solution / arbitrary units
0.0	0.00
1.0	0.00
2.0	0.00
3.0	0.03
4.0	0.05
5.0	0.10
6.0	0.12



(i) Plot a suitable graph to show these results.

(4)



P 4 2 9 1 4 R A 0 5 1 6

(ii) Suggest how this investigation could be modified so that the reliability of the results could be shown on the graph.

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(c) The scientists also investigated the loss of mineral ions from the discs treated with fenitrothion. The table below shows the concentration of mineral ions in the solution and the colour of the solution.

Time / hours	Concentration of mineral ions in the solution / arbitrary units	Colour of the solution / arbitrary units
0.0	0.01	0.00
1.0	0.02	0.00
2.0	0.03	0.00
3.0	0.05	0.03
4.0	0.08	0.05
5.0	0.09	0.10
6.0	0.11	0.12



Describe **one** similarity and **one** difference between the trends in the results for the colour of the solution and for the mineral ion concentration of the solution.

(2)

Similarity.....

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Difference.....

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(d) Using the information given, suggest explanations for the effect of fenitrothion on the loss of betalain and mineral ions from beetroot cells.

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(Total for Question 1 = 20 marks)



2 Read the following extract from a student's **unfinished** visit or issue report on the topic of using bees to deter elephants from damaging crops.

1. A major problem today is the rapid extinction of many species around the world. The Earth is going through mass extinction; with a loss of species at the rate of 0.01%–0.1% per year. As well as an 80% decline in biological diversity, which is caused by habitat destruction.
2. Human pressure on the environment is increasing, as is the demand for access to land for agriculture. Loss of habitats has led to conflicts between human needs and the needs of animals and plants.
3. Over the last 60 years, the number of Asian elephants in the wild has halved, partly due to human expansion into the elephants' habitats. The elephants leave their remaining natural habitat and enter agricultural land damaging crops. Furthermore, not only do elephants raid crops, they can often go on rampages. Angry farmers have begun to kill the elephants as a quick fix solution, however this has no effect on reducing the conflict between humans and elephants.
4. This report will explore this phenomenon and ways to reduce these conflicts.

Potential solutions are:

- Traditional methods – making noise, crop guarding, making fires, airborne missiles and decoy foods.
- Disturbance methods – intense bright flashes of light and flares, firing weapons and using tripwire alarms.
- Physical barriers – trenches, moats, stone walls, standard fences and electrified fences.

All these methods have limited success.

5. Scientists have found that the sound of buzzing bees causes elephants to move away. The elephants make low frequency cautionary rumbles to warn neighbouring elephants. Elephant skin can grow up to more than 3 cm thick, so it is impenetrable to bee stings. But skin behind the ears, eyes and the inner trunk is thinner and vulnerable to bee stings. So if elephants are stung here, this may make them fear bees in future.
6. In 2009, Lucy E. King and a team of researchers from Save The Elephants investigated the concept of deterring elephants with bees further and put it to the test. They used recordings of angry bees, from disguised loudspeakers in trees, on herds of elephants beneath the trees. The elephants soon became uneasy and vigilant. Within 10 seconds, almost half of the herd had fled with their tails in the air, occasionally throwing backwards glances at the loudspeakers. By 80 seconds, all but one was gone. The researchers played bee sounds to 17 families of elephants in this study and the control to 15. The control was the noise of a forest waterfall.



7. In another trial, one farm was protected with a bee fence (shown in the photograph below) and another was not. The number of incidents of crop damage by elephants, and the number of animals involved, were monitored over 6 weeks.



8. The results are shown in the table below:

Observation	Farm with bee fence	Farm without bee fence
Number of incidents of crop damage	7	13
Number of elephants involved in crop damage	38	95

The conclusion that can be drawn from this is that(note, I need to write a conclusion here).

9. The bee fence is robust enough to survive elephant raids and cheap enough for farmers to construct themselves.
10. Why not just use loudspeakers as King did? There is a chance that an elephant may encounter a fence but perceive that there are no bees. The elephant becomes aware that it is just speakers, so the chances of trespassing increase. Also, the loudspeaker system would be expensive and require electricity to run it.
11. There are some problems. The African honeybee is known to be very violent and to attack in large swarms. This could lead to an increase in the amount of deaths of young elephants, or at least cause them severe suffering. The introduction of beehives may also pose a threat to the residents around the local farm. African honeybees are well known for their defensive behaviour. Bee stings inject venom into the skin of the victim, and 3% of people that are stung have an allergic reaction, meanwhile 0.8% of bee sting victims may experience a life-threatening reaction called anaphylactic shock.



12. Offsetting this though, bee fences can provide extra income to the farmer from selling the honey. In addition, it could increase the amount of pollination in crops. This would be an ideal plan for poor farmers. You could call this a win-win circumstance. As there is no use of any guns, traps or poison; just a gentle nudge from nature.

13. There are some other innovative new methods. Farmers in Tanzania smear chilli mixed with engine oil on fences. When elephants approach the fence they 'snuffle and sneeze' and leave the scene. It is also an inexpensive and sustainable process adhering to the fence in all conditions. However, the advantages of the beehives overshadow this method.

(a) A visit or issue report requires a problem to be identified. Suggest the problem that this extract identifies.

(1)

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(b) Make a sketch to show how the data in the table in paragraph 8 could be compared.

(2)



(c) Another feature of a visit or issue report is some discussion of the implications for humans and other organisms.

(i) Identify two economic implications discussed in this extract.

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(ii) Explain the benefits to other organisms of the use of bee fences.

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(iii) Explain the risks to humans of the use of bee fences.

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(d) In paragraph 8, the student has written "The conclusion that can be drawn from this is that (note, I need to write a conclusion here)'. Using this data, write an appropriate conclusion.

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(e) Paragraphs 6 to 8 are about two studies of the effect of bees on elephant behaviour. How reliable and valid are the data from these two studies? Give reasons for your answers.

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- (f) The report is required to use information or arguments obtained from three or more sources when researching the issue. The student decided to find some data to support various points made in the report to cover this requirement.

The student found the following:

Costs for the bee fence based on using traditional beehives were approximately US\$315 per 100 m. In Kenya, 1 kg of honey can sell for US\$2 and each traditional beehive has the potential to generate two to three annual harvests of 7-10 kg per harvest. Upgrading traditional beehives to the more productive Kenyan Top Bar (KTB) beehives would generate more income, particularly if a queen excluder were fitted to separate the valuable honey from the brood.

Suggest two paragraphs in the report where some of this information might be quoted. Give reasons for your answers.

(4)

Paragraph number

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Paragraph number

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(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS





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