

1(a). In many areas, the number of elephants living in Africa is decreasing. They are often killed by hunters.

The table shows how the number of elephants in Africa has changed.

Year	1979	1989	2015
Population size	1.3 million	600 000	400 000

Calculate the percentage decrease in the population size between 1979 and 2015.

Give your answer to **2** significant figures.

Percentage decrease = % **[3]**

(b). What is the best description for how the population of elephants changed between 1979 and 2015?

Tick (✓) **one** box.

- Dropping at a decreasing rate☐
- Dropping at a steady rate☐
- Dropping at an increasing rate☐

[1]

(c). In some areas of southern Africa, elephants are very important for ecotourism.

i. Explain what is meant by the term **ecotourism**.

..... **[2]**

- ii. In ecotourism areas, elephant numbers are increasing.

This is causing problems as the elephants are eating crops.

Scientists therefore want to control the population size.

They have used three main ways to do this:

- **Culling** – a certain number of elephants from each population are killed.
- **Relocation** – elephants are moved to a country where their numbers have dropped.
- **Contraception** – female elephants are treated to reduce their fertility.

Suggest **one** disadvantage for each of these methods.

Culling

Relocation

Contraception

-----[3]

- iii. Scientists are using a new method of contraception to try and restrict the numbers of elephants.

This involves injecting antibodies which block the sperm receptor sites on eggs.

Describe **one** way that this method is different to the contraceptive pill used by female humans.

-----[1]

(d). In East Africa, elephants are hunted for their tusks.

Scientists have found that:

- occasionally female elephants are born without tusks,
- the absence of tusks is caused by a mutated dominant allele,
- the allele for an absence of tusks is lethal if inherited by a male embryo.

Explain why the number of tuskless elephants is rapidly increasing in East Africa.

Explain also why the spread of this allele may have negative effects on the elephant population.

-----[6]

2. What is the advantage of sampling using a transect line rather than using random sampling?

- A** A transect allows changes in the size of populations over time to be seen.
- B** A transect allows patterns in the distribution of organisms to be seen.
- C** A transect avoids areas which may contain few organisms.
- D** A transect gives a more accurate estimate of the population.

Your answer

☐

[1]

3(a). Explain how there can be a large community of butterflies but a low biodiversity of butterflies in an area.

-----[2]

(b).

Buddleia, a butterfly's friend?



Buddleia flowers attract butterflies that feed on nectar.

Buddleia bushes produce large numbers of very small seeds. This means that buddleia bushes quickly colonise new habitats.

This has resulted in the populations of other plants decreasing. Scientists have noticed there are large communities of butterflies in these areas but the biodiversity of butterflies is low.

Scientists have suggested two possible methods of reducing the damage caused to habitats by too many buddleia bushes.

Explain how each of these methods would reduce the damage to habitats.

- i. genetically engineering buddleia bushes that produce larger seeds

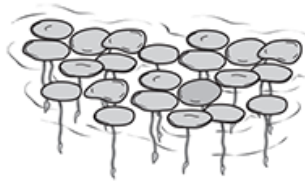
[2]

- ii. producing hybrid buddleia bushes that have uneven numbers of chromosomes, which prevent meiosis occurring

[2]

4(a). Some students investigate the effect of run-off water from a farm on the growth of plants. The run-off water is washed off the fields in the farm when it rains.

They use a pond plant called duckweed, shown in the diagram. A duckweed plant has a single leaf that floats on the surface of the water. They chose duckweed because it is easy to count the plants.



This is the method they follow:

- Put different volumes of clean pond water and run-off water into 4 beakers.
- Add 3 duckweed plants into each beaker.
- Leave the beakers for ten days at the same temperature.

The table shows the results.

Beaker number	Contents	Number of duckweed plants after ten days
1	250 cm ³ of pond water	6
2	230 cm ³ of pond water + 20 cm ³ of run-off	12
3	210 cm ³ of pond water + 40 cm ³ of run-off	24
4	190 cm ³ of pond water + 60 cm ³ of run-off	48

- i. Explain why the students put different volumes of clean pond water into each beaker.

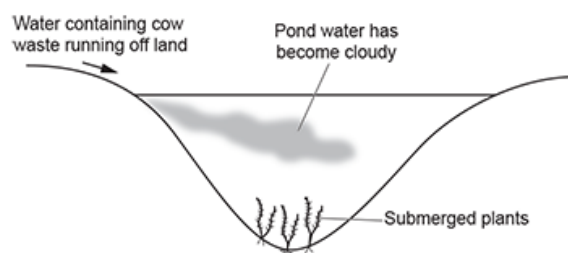
[2]

- ii. To improve their experiment, the students should make sure that the carbon dioxide levels are the same in each beaker.

Describe how they could achieve this.

[1]

(b). An article said that the run-off water contains waste from cows and this makes the pond water cloudy. The run-off water is reducing the growth of submerged plants that grow in the pond. The diagram shows this process.



Explain the results of the students' experiment and why using duckweed produces results that do **not** agree with the effect of run-off water described in the article.

[3]

(c). The students change their method to use a submerged plant rather than using duckweed.

Describe how the students could change their method to measure the growth of the submerged plant.

[1]

5. Describe a sampling technique that could be used to estimate the number of one species of butterfly in a habitat.

[3]

6. A rare species of animal is found in a less economically developed country.

The government of the country want to set up a conservation area.

Which of these is **unlikely** to be a problem for the government?

- A Making agreements with all the people that own the land.
- B Persuading conservation organisations that preserving the ecosystem is important.
- C The cost of the conservation scheme.
- D The need to allow ecotourism without causing damage.

Your answer

☐

[1]

7. Lichens grow on trees and can indicate air pollution levels.

A student wants to find out the level of pollution in an area by measuring the abundance of a particular species of lichen.

Which two tools should the student use to find out the abundance of the lichen in the area?

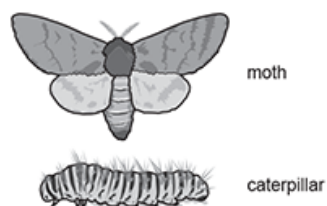
- A Key and net
- B Key and quadrat
- C Line transect and key
- D Pooter and quadrat

Your answer

☐

[1]

8(a). Pine processionary moths lay eggs that develop into larvae and then into caterpillars, as shown in the diagram.



The caterpillars are a major pest, eating and killing pine trees.

The caterpillars are fed on by birds such as cuckoos. The caterpillars are also parasitised by fungi.

Scientists are controlling the pine processionary moth to conserve pine trees.

They spray the caterpillar's eggs or larvae with fungal spores.

This has been successful when spraying different concentrations of spores:

- 1×10^6 spores / ml on the eggs
- 1×10^8 spores / ml on the larvae.

i. Name this type of control method.

..... **[1]**

ii. The concentration of spores used on the larvae is higher than the concentration used on the eggs.

By how many orders of magnitude is it higher?

..... **[1]**

(b). Scientists have tried to use natural plant defence methods on the larvae to conserve the pine trees.

The table shows the effects of two plant-based oils on the larvae in laboratory conditions and on the pine trees.

Type of oil	Deaths per 1000 larvae	
	In the laboratory	On the pine tree
Ginger	712	874
Rosemary	300	761
Control treatment	13	22

i. Calculate the percentage increase in the death of larvae on the pine trees compared to in the laboratory for the control treatment.

Percentage change = % **[2]**

ii. More larvae die in the natural environment of the pine trees than in the laboratory for all treatments.

Suggest **one** reason why.

..... **[1]**

iii. Evaluate the use of the two plant oils in the control of the larvae.

Use data from the table.

[3]

9(a). The diagram shows a tulip plant. Many gardeners like to grow tulip plants.



In 1637, tulip growers found that a small number of their tulip plants produced flowers with different coloured stripes.

Until recently, there were two possible theories that explained the colours of these tulips.

- Theory 1 - The stripes are caused by a mutation in the gene that produced the chemical that coloured the flower.
- Theory 2 - The stripes are caused by a pathogen that infects the plant and changes the production of the coloured chemical.

Put ticks (✓) or crosses (X) in the table to show whether each theory would produce changes in the phenotype and in the genotype of the tulip plants.

	Theory 1	Theory 2
Changes the phenotype of the tulip plant		
Changes the genotype of the tulip plant		

[2]

(b). Scientists now know that the colour changes are caused by a virus which infects the tulip tissue.

- The virus is injected into the phloem of the tulip by feeding insects.
- Although the infected bulbs produce attractive flowers, the infected bulbs become weaker every year until they die.

i. 2.0×10^9 tulips are grown in the Netherlands every year. This uses 14 200 hectares of land.

1.5% of all the tulips grown are infected.

Calculate how many infected tulips there are in one hectare of land.

Number of infected tulips = **[2]**

ii. * Growers need to identify infected tulips as soon as possible.

This allows them to only spray a small area with insecticide.

Scientists have developed a machine that moves rapidly through the fields scanning for infected tulips.

The text box shows the results of a trial of the machine in a field containing 1000 tulips.

The results of a trial of the machine are:

Actual results:

- 15 tulips infected
- 985 tulips not infected

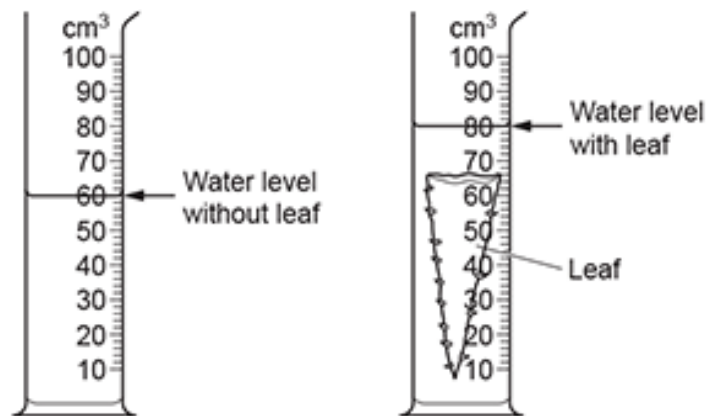
Machine results:

- All 15 infected tulips identified
- 14 not infected tulips identified as infected
- 971 not infected tulips identified as not infected

Discuss the advantage of early detection of infected tulips and how useful the machine may be in making this possible.

Use data from the text box in your answer.

They take the two measurements shown in the diagram.



What is the volume of the leaf, including the correct level of uncertainty?

- A** $20 \pm 0.1 \text{ cm}^3$
B $20 \pm 0.2 \text{ cm}^3$
C $20 \pm 1 \text{ cm}^3$
D $20 \pm 2 \text{ cm}^3$

[1]

11. Animal populations can be estimated using a method called capture-recapture. The number of animals in the population is estimated using the formula:

$$\text{population estimate} = \frac{\text{number in first sample} \times \text{number in second sample}}{\text{number of marked animals in second sample}}$$

Sometimes marking the animals makes them less well-camouflaged.

What effect would this have on the population estimate?

- A** The estimate is always too high.
- B** The estimate is always too low.
- C** The estimate is either too high or too low.
- D** There is no effect on the estimate.

Your answer ☐

[1]

12. The table shows the number of insects caught using a net in a week.

Day	M	Tu	W	Th	F	S	Su
Number of insects	6	8	5	4	8	9	2

Which of these types of average have the same value for this data?

- A** Mean and median
- B** Mean and mode
- C** Median and mode
- D** Median, mode and mean

Your answer ☐

[1]

END OF QUESTION PAPER