Sampling with quadrats and transects

Answers, marking points and revision notes | AQA Combined Science 8464 and AQA GCSE Biology 8461

GCSE science required practicals

This practical online

Answers

1 Chloe and Arjun compared the open lawn with the area under trees. Name the independent variable and the dependent variable. (2 marks)

The independent variable is the area sampled (open lawn or under trees). The dependent variable is the number of daisies in each quadrat.

Marking points

- Independent: area or habitat sampled (open lawn or under trees)
- Dependent: number of daisies per quadrat

2 Explain why the quadrats must be placed at random positions. (2 marks)

So that the sample is not biased. If people choose where to put the quadrat they may pick spots with lots of daisies, which would give a mean that is too high.

Marking points

- To avoid bias / so the sample is representative
- Choosing positions might favour areas with more (or fewer) daisies

3 Describe how to use two tape measures and a random number generator to place a quadrat randomly. (2 marks)

Lay the two tape measures at right angles along the edges of the area to make axes. Use the random number generator to get two numbers and use them as coordinates, then place the quadrat at that point.

Marking points

- Tape measures laid at right angles to make a grid (axes)
- Random numbers used as coordinates to place the quadrat

4 Give one hazard when working on a school field and say how to reduce the risk. (2 marks)

Animal waste or stinging nettles in the grass could cause infection or stings. Wear gloves and wash hands thoroughly after the fieldwork.

Marking points

- A hazard, such as animal waste, stinging plants, insect stings or tripping
- A matching precaution, such as gloves and hand washing, or checking allergies

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5 Calculate the mean number of daisies per quadrat on the open lawn. (2 marks)

Total = 70. Mean = 70 / 10 = 7.0 daisies per quadrat

6 + 9 + 4 + 7 + 8 + 5 + 10 + 7 + 6 + 8 = 70

Mean = 70 / 10

Mean = 7.0 daisies per quadrat

Marking points

- Adds all ten counts (70) and divides by 10
- 7.0 daisies per quadrat

6 Find the median number of daisies per quadrat on the open lawn. (1 mark)

In order: 4, 5, 6, 6, 7, 7, 8, 8, 9, 10. The middle two are 7 and 7, so the median is 7.

Order: 4, 5, 6, 6, 7, 7, 8, 8, 9, 10

Middle two values: 7 and 7

Median = 7

Marking points

- 7 daisies

7 The open lawn has an area of 600 m^2. Each quadrat has an area of 0.25 m^2.
Estimate the population of daisies on the open lawn. Show your working. (3 marks)

Number of quadrats that fit = 600 / 0.25 = 2400

Estimated population = 7.0 x 2400 = 16 800 daisies

Estimated population = mean per quadrat x total area / quadrat area

Total area / quadrat area = 600 / 0.25 = 2400

Estimated population = 7.0 x 2400

= 16 800 daisies

Marking points

- Uses mean of 7.0 per quadrat
- 600 / 0.25 = 2400
- 16 800 daisies

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8 **Higher tier**

The shady area under the trees is a rectangle 8 m by 10 m. The quadrat has sides of 50 cm.

Use the results table to estimate the number of daisies under the trees. Show your working. (4 marks)

Mean under trees = 11 / 10 = 1.1 per quadrat

Area under trees = 8 x 10 = 80 m^2; quadrat area = 0.5 x 0.5 = 0.25 m^2

Estimated population = 1.1 x 80 / 0.25 = 352 daisies

Total under trees = 2 + 0 + 1 + 3 + 1 + 0 + 2 + 1 + 1 + 0 = 11

Mean = 11 / 10 = 1.1 daisies per quadrat

Area under trees = 8 x 10 = 80 m^2

50 cm = 0.5 m, so quadrat area = 0.5 x 0.5 = 0.25 m^2

Estimated population = 1.1 x 80 / 0.25

= 352 daisies

Marking points

- Mean under trees = 1.1
- Area under trees = 80 m^2
- Converts 50 cm to 0.5 m so quadrat area = 0.25 m^2
- 352 daisies

9 Compare the number of daisies on the open lawn and under the trees. Suggest a reason for the difference. (2 marks)

There are far more daisies on the open lawn (mean 7.0) than under the trees (mean 1.1). The trees shade the ground, so there is less light for the daisies to photosynthesise.

Marking points

- More daisies on the open lawn than under the trees, using data
- Less light under the trees, so less photosynthesis (or competition with tree roots for water and minerals)

10 **Higher tier**

Arjun ran a transect from a tree trunk out into the open lawn. He recorded these results:

0 m: light 800 lux, moss cover 70%
2 m: light 2100 lux, moss cover 45%
4 m: light 4600 lux, moss cover 20%
6 m: light 7900 lux, moss cover 5%
8 m: light 8200 lux, moss cover 0%

Arjun concluded that bright light stops moss growing. Evaluate his conclusion. (3 marks)

The data show a negative correlation: as light intensity increases, moss cover decreases, from 70% at 800 lux to 0% at 8200 lux. However, this does not prove light is the cause. Other factors also change along the transect, such as soil moisture or competition from grass, and these could explain the pattern. He only did one transect, so he should repeat it in other places before making a firm conclusion.

Marking points

- Describes the negative correlation between light and moss cover, using data
- Correlation does not prove cause: other factors such as moisture or competition from grass also change
- Only one transect, so more data needed (repeat transects)

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11 Chloe says they should have used 30 quadrats in each area instead of 10. Explain why this would improve the estimate.

(2 marks)

A larger sample is more representative of the whole area, so random high or low quadrats have less effect on the mean. The estimated population would be closer to the true value.

Marking points

- More quadrats give a more representative sample (reduces the effect of unusual quadrats)
- So the mean and the estimate are more accurate (closer to the true value)

12 Some daisies were partly inside and partly outside the quadrat. Chloe counted them but Arjun did not. Explain the problem and how to solve it.

(2 marks)

Their counts would not be comparable, so the results are not reproducible between them. They should agree a rule before starting, such as only counting plants that are more than half inside the quadrat.

Marking points

- Counts would differ between people (results not reproducible or consistent)
- Agree a rule for edge plants before starting, for example count if more than half is inside

13 On the transect Arjun estimated the percentage cover of moss instead of counting moss plants. Explain why.

(2 marks)

Moss grows as a carpet, so it is impossible to tell where one plant ends and the next begins. Estimating the percentage of the quadrat it covers is quicker and gives a more consistent measure than trying to count individual plants.

Marking points

- Individual moss plants cannot be told apart (it grows in a mat), so they cannot be counted
- Percentage cover gives a quicker, more consistent measure of how much is there

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14 Plan an investigation to find out how the distribution of dandelions changes with distance from a footpath across a park.

(6 marks)

Lay a tape measure in a straight line at right angles to the footpath, starting at its edge and running 20 m into the grass. Place a 0.25 m^2 quadrat beside the tape every 2 m, starting at 0 m. In each quadrat count the number of dandelions, using a picture guide to be sure of the identification and counting a plant only if more than half of it is inside. At each point also measure an abiotic factor that might matter, such as light intensity with a light meter or soil moisture with a probe, and note how trampled the grass is. Repeat the transect in two more places along the same path, a few metres apart, so the results are more representative, and calculate the mean number of dandelions at each distance. Do all the transects on the same day. Plot a graph of mean number of dandelions against distance from the path and describe the pattern, remembering that a correlation with a factor does not prove that factor is the cause.

Marking points (any 6, with the method in a logical order)

- Tape measure laid at right angles from the path to make a transect
- Quadrats placed at regular intervals along the tape
- Same size of quadrat each time
- Counts dandelions in each quadrat (or estimates percentage cover)
- Clear rule for plants on the edge, or careful identification
- Measures an abiotic factor such as light, moisture or trampling at each point
- Repeats the transect in other places and calculates means
- Plots or compares numbers against distance from the path

How it is marked

- 5-6 marks: a clear, ordered plan using a transect from the path with quadrats at regular intervals, a sensible counting method, repeat transects and means, and an abiotic factor measured to help explain the pattern.
- 3-4 marks: describes a transect with quadrats and counting, but some details are missing, such as regular intervals, repeats or what else to measure.
- 1-2 marks: a few relevant ideas, such as using quadrats near and far from the path, with no clear method.

Revision notes: the method

Aim: To estimate the population of a plant species in a habitat using random quadrats, and to see how its distribution changes along a transect.

Equipment

- Square quadrat, 0.5 m x 0.5 m (area 0.25 m^2)
- Two 30 m tape measures
- Random number generator (calculator or app)
- Clipboard, pencil and results table
- Identification key or picture guide for the plant
- Light meter (for the transect)
- Gloves

Method

1. Lay two tape measures at right angles along two edges of the area to make a grid.
2. Use a random number generator to pick two coordinates, for example 12 m along and 7 m up.

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3. Walk to those coordinates and place the quadrat with its bottom left corner on the point.
4. Count the number of the chosen plant (for example daisies) inside the quadrat, deciding in advance how to count plants on the edge.
5. Repeat for at least 10 random positions and record each count.
6. Calculate the mean number per quadrat and use it with the total area to estimate the population.
7. For a transect, stretch a tape measure in a straight line across a change in the habitat, such as from a tree into open grass.
8. Place the quadrat at regular intervals along the tape, for example every 2 m, and count the plants or estimate the percentage cover.
9. At each point also measure an abiotic factor, such as light intensity with a light meter.

Variables

- **Independent:** The area sampled (open lawn or under trees), or the distance along the transect.
- **Dependent:** The number of plants per quadrat (or percentage cover), counted inside the quadrat.
- **Control:** Same size of quadrat every time; Same rule for counting plants on the edge of the quadrat; Same number of quadrats in each area; Samples taken on the same day so conditions are similar; Same person identifying the plants

Hazards

Hazard	What could happen	How to reduce the risk
Stinging or thorny plants, and animal waste	Stings, cuts or infection	Wear gloves, avoid touching the face and wash hands after fieldwork
Allergies to pollen or insect stings	Allergic reaction	Check allergies before going out and make sure anyone at risk carries their medication
Tripping over tape measures or uneven ground	Sprains or bruises	Walk, do not run, and keep tapes flat and visible

Key points

- Place quadrats at random coordinates to avoid bias; do not throw them or pick nice-looking spots.
- Estimated population = mean number per quadrat x (total area / area of one quadrat).
- Use a transect, with quadrats at regular intervals, when looking at how a species changes across a habitat.
- More quadrats give a more representative mean, so the estimate is more reliable.
- Decide a rule for plants on the edge of the quadrat before you start and stick to it.
- A link between a factor and the number of plants is a correlation; other factors may also be involved.

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