Helicate

HELICATE · A-LEVEL BIOLOGY · TOPIC BANK

3.7.4 Populations in ecosystems

Topic question bank

Version 2 · 17 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
9	64	No time limit	/ 64

Contents

Subtopic	Questions	Marks
Communities, niches and carrying capacity Specification 3.7.4	01–03	17
Estimating population size: quadrats and transects Specification 3.7.4	04–05	17
Mark-release-recapture Specification 3.7.4	06	9
Succession Specification 3.7.4	07	10
Conservation and managing succession Specification 3.7.4	08–09	11
Total		**64**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA A-level Biology (7402), specification section 3.7.4. Not affiliated with or endorsed by AQA.

Do not write outside the box

Communities, niches and carrying capacity 3.7.4

Two species of bat, **P** and **Q**, live in the same area of woodland beside a lake. Both species feed at night on flying insects.

- Species **P** hunts in open air above the tops of the trees. It catches large moths and beetles.
- Species **Q** hunts a few centimetres above the surface of the lake. It catches small midges and other insects from just above the water.

0 1 . 1 Which statement about the ecosystem of this woodland and lake is correct?
Tick (✓) one box.

[1 mark]

It includes only the bats, insects, trees and other living organisms in the area. ☐

It is made up of the community and the non-living components of its environment. ☐

It is the place where the population of species **P** lives. ☐

It is too small to be an ecosystem, because ecosystems cover large areas. ☐

0 1 . 2 Use the information to explain how both species of bat are able to survive in the same habitat.

[2 marks]

.....

.....

.....

.....

.....

.....

3

Turn over for the next question

Do not write outside the box

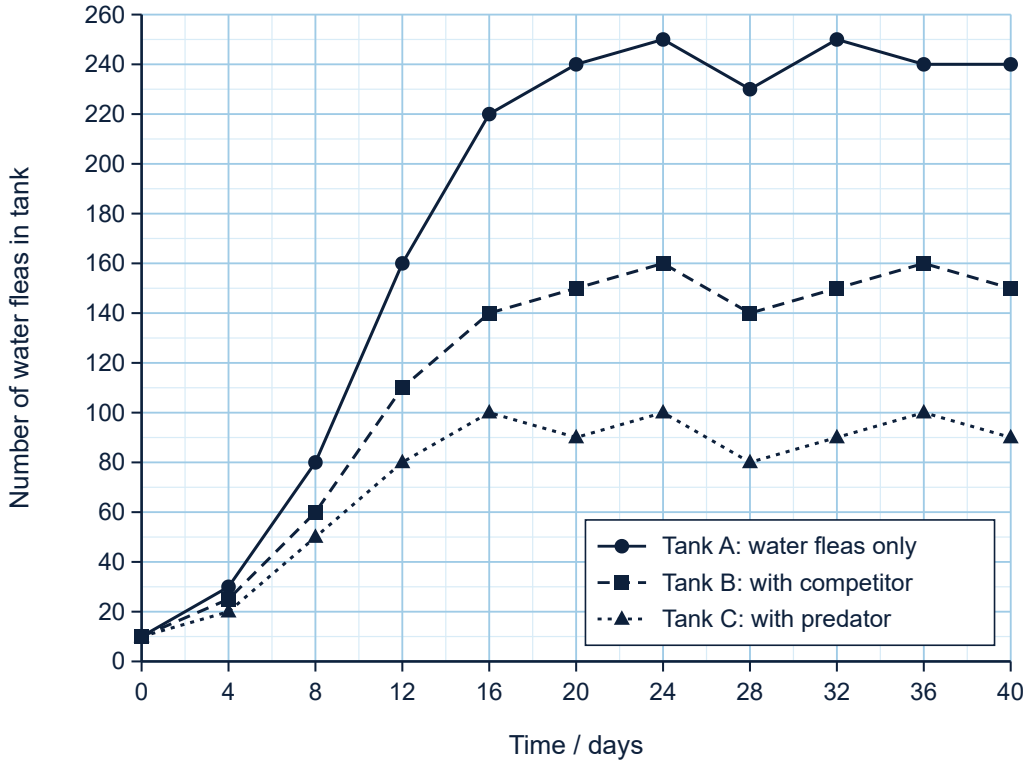
Water fleas are small crustaceans that feed by filtering single-celled algae from water.

A scientist set up three identical tanks of pond water. She added the same volume of algae to each tank every day. On day 0 she put 10 water fleas into each tank.

- Tank A contained only water fleas.
- Tank B also contained a second species of small crustacean, which feeds on the same algae.
- Tank C also contained insect larvae that catch and eat water fleas.

Every 4 days she estimated the number of water fleas in each tank. Figure 1 shows her results.

Figure 1



0 2 . 1 After about day 20, the number of water fleas in tank A stayed roughly constant. This is the size of population that the tank could support.
Give the term for the size of population of a species that an ecosystem can support.

[1 mark]

.....

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Explain why the number of water fleas in tank A stopped increasing after day 20.

[3 marks]

0 2 . 3 Calculate the percentage by which the number of water fleas in tank B was lower than the number in tank A on day 40.

[2 marks]

Answer ..... **%**

0 2 . 4 Use Figure 1 and the information given to explain the differences between the number of water fleas in tank A and the numbers in tanks B and C after day 20.

[3 marks]

9

Turn over for the next question

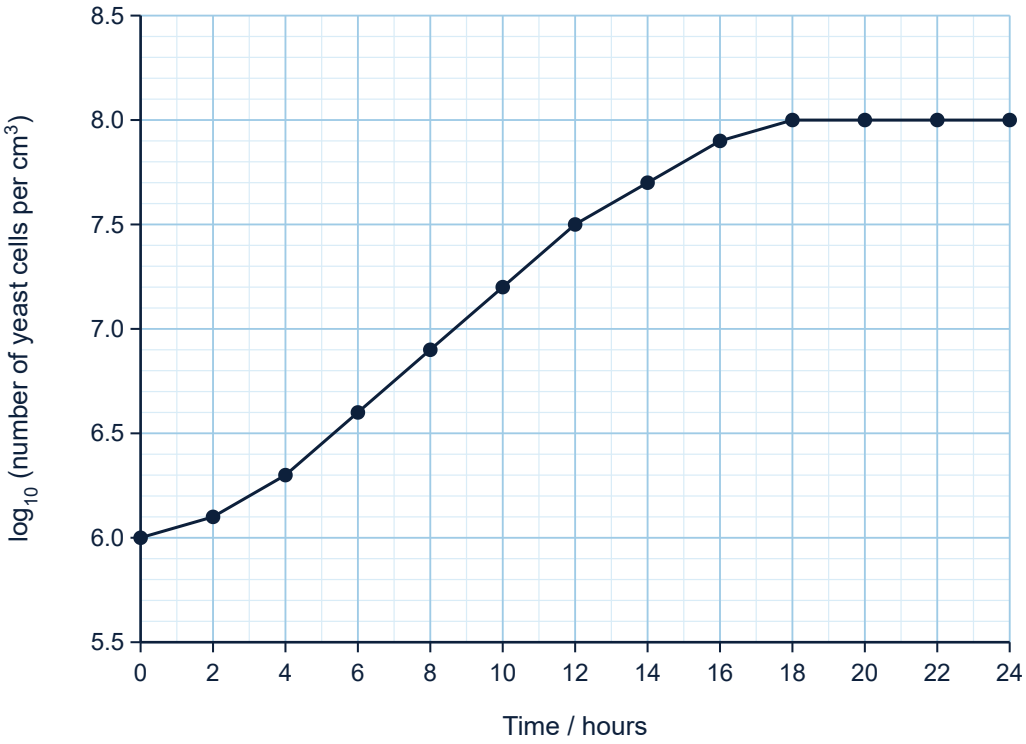
Do not write outside the box

A student investigated the growth of a population of yeast. She:

- added yeast cells to a flask of sterile nutrient broth containing glucose, to give about 1×10^6 cells per cm^3, and closed the flask with a cotton wool bung
- kept the flask at 30 °C
- every 2 hours, removed a small sample with a sterile pipette, diluted it with sterile broth where needed, and measured how cloudy (turbid) it was with a colorimeter
- used a calibration curve, allowing for any dilution, to convert each reading into the number of yeast cells per cm^3 of broth.

Figure 2 shows her results. The vertical axis shows $\log_{10}$ of the number of yeast cells per cm^3, so a value of 7.0 means 1.0×10^7 cells per cm^3.

Figure 2



Question 3 continues on the next page

Do not write outside the box

0 3 . 1 Suggest why the student plotted $\log_{10}$ of the number of cells instead of the number of cells.

[1 mark]

0 3 . 2 During rapid growth, each doubling of the population increases $\log_{10}$ of the number of cells by 0.30.
Use Figure 2 to calculate the mean time taken for the yeast population to double between 4 hours and 10 hours.

[2 marks]

Answer _____ **hours**

0 3 . 3 The student closed the flask with a cotton wool bung and used a sterile pipette to remove each sample.
Explain why these precautions were needed for her results to be valid.

[2 marks]

5

Turn over for the next question

Not affiliated with or endorsed by AQA.

Do not write outside the box

Estimating population size: quadrats and transects 3.7.4

Students estimated the number of daisy plants in a school playing field. The field is a rectangle measuring 80 m by 45 m. They used square quadrats with sides of 50 cm.

0 4 . 1 Describe how the students should decide where to place each quadrat so that their samples are random.

[2 marks]

Question 4 continues on the next page

 Not affiliated with or endorsed by AQA.

Do not write outside the box

Table 1 shows the number of daisy plants in each of 15 quadrats.

Table 1

Quadrat	Number of daisy plants	Quadrat	Number of daisy plants	Quadrat	Number of daisy plants
1	4	6	1	11	3
2	0	7	0	12	0
3	2	8	5	13	4
4	7	9	2	14	5
5	3	10	6	15	3

0 4 . 2 Use Table 1 to estimate the number of daisy plants in the field.
Show your working.

[3 marks]

Answer _____ **daisy plants**

0 4 . 3 Use Table 1 to explain why the students' estimate might not be reliable, and how they could make it more reliable.

[2 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 Frequency is the percentage of quadrats in a sample that contain a species.
What was the frequency of daisy plants in the students' sample?
Tick (✓) one box.

[1 mark]

3% ☐

20% ☐

80% ☐

100% ☐

8

Red fescue is a species of grass. A student investigated the distribution of red fescue from an open grassland into a neighbouring woodland. Light intensity at ground level decreases from the grassland into the woodland.

0 5 . 1 Describe a method the student could use to find out whether light intensity affects how red fescue is distributed from the grassland into the woodland.

[6 marks]

Question 5 continues on the next page

Do not write outside the box

The student used one transect, with one quadrat at each distance. Table 2 shows the student's results. The woodland edge was at 8 m.

Table 2

Distance along transect / m	Light intensity / % of full sunlight	Soil water content / %	Percentage cover of red fescue
0	100	18	62
4	97	19	58
8	70	24	41
12	36	31	17
16	22	34	6
20	15	36	2
24	12	37	0

0 5 . 2 The student concluded that low light intensity reduces the percentage cover of red fescue.
Evaluate this conclusion.

[3 marks]

9

Turn over for the next question

Do not write outside the box

Mark-release-recapture 3.7.4

Ecologists estimated the size of a population of field voles, a species of small mammal, in a large area of rough grassland. They used live traps: small boxes baited with grain, which close when a vole enters but do not harm it. Owls and kestrels hunt field voles from the air.

- On day 1 they caught 84 voles in the traps.
- They marked each vole by clipping a small patch of fur on the underside of its body.
- They released all the marked voles where they had been caught.
- Two days later, they set the traps again and caught 75 voles. Of these, 12 were marked.

0 6 . 1 Calculate the size of the vole population estimated by this method.

[2 marks]

Answer ..... **voles**

0 6 . 2 Explain why the ecologists:

[2 marks]

marked the underside of each vole .....

waited two days before setting the traps again .....

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Give **two** assumptions that the ecologists made when they used this method to estimate the size of the population.

[2 marks]

1 .....

.....

2 .....

.....

0 6 . 4 Some voles avoid traps for several days after they have been caught once. Suggest how this would affect the ecologists' estimate of the population size. Explain your answer.

[2 marks]

.....

.....

.....

.....

.....

0 6 . 5 In a second area of grassland, the ecologists marked and released 60 voles. Their second sample contained 45 voles. Their estimate of the population size in this area was 900 voles.
How many of the voles in the second sample were marked?
Tick (✓) one box.

[1 mark]

2 ☐

3 ☐

15 ☐

20 ☐

9

Turn over for the next question

Do not write outside the box

Succession 3.7.4

When a glacier retreats, it leaves behind bare rock and gravel with no soil. Scientists studied five sites in front of a retreating glacier. Each site had been free of ice for a different length of time.

Table 3 shows some of their results. Nitrogen was measured in the top layer of the ground, whether rock, gravel or soil. Some of the shrubs present at sites 2 and 3 have bacteria in their roots that fix nitrogen.

Table 3

Site	Time since ice retreated / years	Mean soil depth / mm	Nitrogen in ground / g m^{-2}	Number of plant species	Main plants present
1	5	0	1.5	4	Lichens, mosses
2	25	8	6.0	15	Mosses, grasses, low shrubs
3	60	35	24	27	Shrubs, young willow
4	110	95	41	33	Willow, young spruce
5	250	180	46	19	Spruce forest

0 7 . 1 Which statement describes the lichens and mosses at site 1?
Tick (✓) one box.

[1 mark]

They are pioneer species, which can survive in the hostile conditions of bare rock. ☐

They form a climax community, which will not change. ☐

They cannot change the abiotic conditions of the site. ☐

They can grow only where a deep layer of soil is already present. ☐

Question 7 continues on the next page

Do not write outside the box

0 7 . 2 Use Table 3 and your knowledge of succession to explain the changes in the community from site 1 to site 4.

[5 marks]

0 7 . 3 Calculate the mean rate of increase in soil depth between site 2 and site 4.
Give your answer in mm per year to **two** significant figures.

[2 marks]

Answer _____ **mm per year**

0 7 . 4 The number of plant species at site 5 is lower than at site 4.
Suggest an explanation for this.

[2 marks]

10

Turn over for the next question

Do not write outside the box

Conservation and managing succession 3.7.4

Lowland heathland is a habitat dominated by heather, a low-growing shrub. Several rare species, such as the sand lizard, live only on heathland. If heathland is not managed, birch trees grow from seeds blown in from nearby, and the heathland slowly becomes woodland.

0 8 . 1 Explain why conservation of heathland involves the management of succession.

[2 marks]

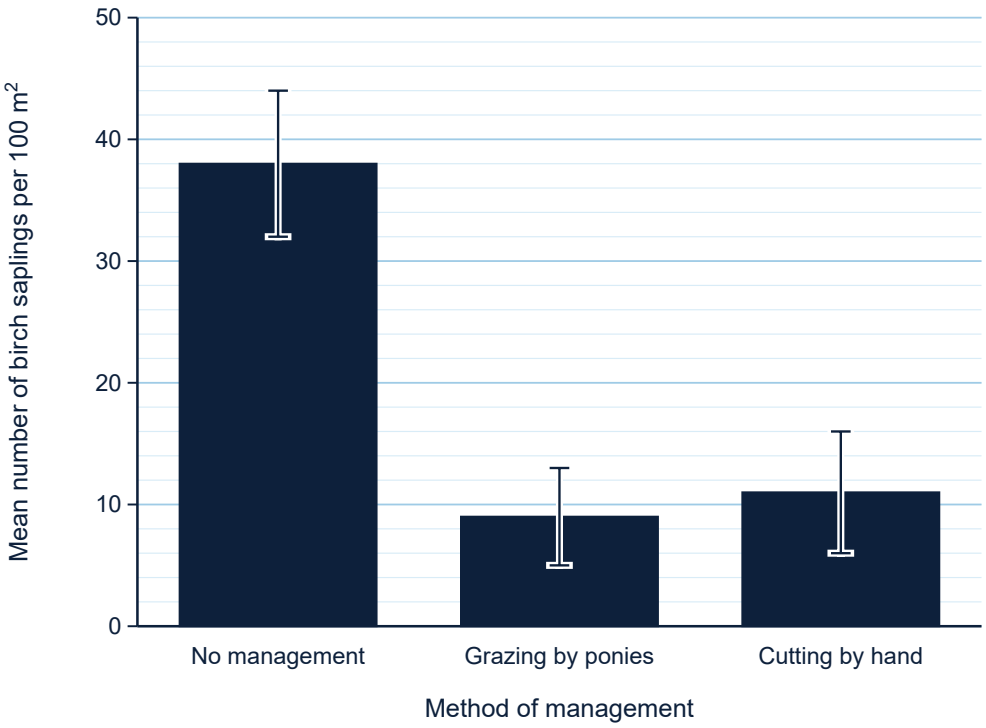
Question 8 continues on the next page

Do not write outside the box

Conservation managers compared three methods of controlling birch. Each method was used on 6 plots of heathland for 5 years. The managers then counted the birch saplings (young trees) in each plot.

Figure 3 shows their results. The error bars show ± 1 standard deviation.

Figure 3



0 8 . 2 The managers concluded that grazing by ponies is the best method for conserving this heathland.
Evaluate this conclusion.

[4 marks]

6

Turn over for the next question

Do not write outside the box

Reed beds are wetlands dominated by common reed, a tall grass. Local people cut reeds in winter and sell them for thatching roofs. The bittern is a rare bird that nests only among tall, dense reeds standing in water. If a reed bed is never cut, dead reed stems build up, the ground becomes drier and willow trees colonise.

Scientists studied plots in one large reed bed that had been managed in three different ways for 12 years. Table 4 shows their results.

Table 4

Management of plots	Reed harvested / bundles per hectare per year	Mean number of bittern nests per 10 hectares	Percentage cover of willow
Cut every winter	900	0.4	0
Cut in rotation (each part cut once every 4 years)	260	3.1	2
Never cut	0	1.2	35

0 9 . 1 Use Table 4 to suggest and explain how this reed bed should be managed to meet the needs of both the local people and the bitterns.

[3 marks]

Question 9 continues on the next page

Do not write outside the box

0 9 . 2 A second study, in a different reed bed, found more bittern nests in plots that were never cut than in plots that were cut in rotation.
Suggest **two** reasons why the results of the two studies were different.

[2 marks]

1 .....

.....

.....

2 .....

.....

.....

5

END OF QUESTIONS

Copyright © 2026 Helicate. All rights reserved.