Past-paper walk-through

Population Ecology ▪ 8.3

eXercise

Questions in this set

- 2025 Q3
- 2021 Q5
- 2019 Q2
- 2016 Q2
- 2015 Q6
- 2014 Q1

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 3

2025 ▪ Q3

Buffelgrass, an invasive grass species in southwestern desert ecosystems, is threatening the saguaro cactus, a keystone species in these ecosystems. Buffelgrass is drought-tolerant and can survive wildfires. However, the dry buffelgrass also acts as fuel for wildfires, causing the fires to be more severe. Older saguaro cacti can survive wildfires; however, many of the young cacti cannot.

Scientists conducted an experiment to determine whether they could control the abundance of the buffelgrass population. The scientists identified several native grass species that, when grown with buffelgrass, might reduce the abundance of buffelgrass. They grew buffelgrass in the presence of several different native grass species in greenhouses, in either nondrought (watered every 3 days) or drought (watered every 9 days) conditions. After twelve weeks, they measured the height and dry weight of the buffelgrass in each treatment group.

Question 3

(a) Describe the effect that removing a keystone species will have on an ecosystem.
(b) Identify a control group the scientists should include in their experiment.
(c) State the null hypothesis of the experiment in which buffelgrass is grown in the presence of native grass species.
(d) Scientists have found that the population growth rates of native grasses are much slower than the population growth rate of buffelgrass following a wildfire. The scientists claim that wildfires will therefore increase the abundance of buffelgrass plants in the ecosystem. Based on the information given, justify the scientists' claim.

Solution 3

(a)

Mark scheme

- Removing a keystone species reduces biodiversity/diversity/resilience of the ecosystem, and can cause the ecosystem to collapse.

Solution 3

(b)

Mark scheme

- A control group with only buffelgrass planted (no native grass species) — i.e., buffelgrass grown alone under each water condition, to compare against buffelgrass grown together with native grasses.

Solution 3

(c)

Mark scheme

- Null hypothesis: there will be no difference in / effect on the abundance/dry weight/height/size of buffelgrass when grown alone compared with when grown together with native grass species (equivalently: no difference in these measures of buffelgrass grown under drought vs nondrought conditions).

Solution 3

(d)

Mark scheme

- With fewer native plant species surviving after a wildfire (since native grasses regrow much more slowly than buffelgrass), buffelgrass will face less/no competition for resources and so will have more resources available for growth, development, and reproduction — supporting the claim that wildfires increase buffelgrass abundance.

Question 5

2021 ▪ Q5

Annual plants complete their life cycle, including germination, seed production, and death, within one year. *Ambrosia trifida* (giant ragweed) is an annual plant that readily colonizes any land that has had a disturbance such as plowing. The plant is considered an invasive species in regions outside of its native range. In a particular region, the seeds of *A. trifida* germinate from early March through the end of the summer, while the seeds of other annual plants require warmer soil temperatures and thus germinate from late April through the end of the summer.

Researchers studied the influence of *A. trifida* on the biodiversity of other annual plant species that grow in the same field. In early spring, the researchers marked off identical plots of land in a field that had been plowed the previous fall and not replanted with new crops. All plants that grew on one half of the plots were left untouched (Figure 1A), while all germinating *A. trifida* seedlings were removed from the other half of the

Question 5

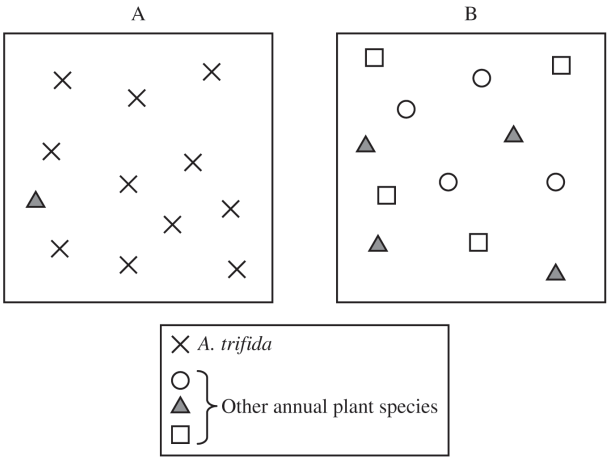
plots throughout the spring and summer (Figure 1B). In late summer, the researchers counted and identified all plants that grew in the plots. The distribution of plants is represented by the symbols in Figures 1A and 1B.

[Figure 1: Two square plots side by side, labeled A and B, each representing one experimental plot; each symbol represents 10 individual plants. Plot A (untouched) contains 10 "X" symbols (*A. trifida*) and 1 filled triangle (other annual plant species), scattered across the plot. Plot B (A. trifida removed) contains 3 open squares, 3 open circles, and 3 filled triangles (all "other annual plant species"), scattered across the plot, and no "X" symbols. Legend: X = *A. trifida*; open circle, filled triangle, and open square (bracketed together) = "Other annual plant species". Caption: "Figure 1. Representations of plant identity and distribution in experimental plots in late summer. Each box represents one typical experimental plot, and each symbol represents 10 individual plants."]

Question 5

(a) Describe a cause of logistic growth of the ragweed population.
(b) Based on the representation in Figure 1, **explain** why the scientists claim that plot B would be more resilient than plot A in response to a sudden environmental change.
(c) In a third group of plots, the researchers removed all seedlings of all plants that germinated before June 1. All plants that germinated after June 1 were left untouched. Using the template in the space provided for your response and the symbols shown in Figure 1, **represent** the expected plant species that would be found in this third group of plots three months later. Draw no more than 12 symbols. Assume all other environmental conditions are the same as for the initial study described.
(d) Explain how an invasive species such as ragweed affects ecosystem biodiversity, as illustrated in Figure 1.

Question 5



Solution 5

(a)

Mark scheme

- A cause of logistic growth of the ragweed population (accept either): a factor becomes limiting, causing the population size to stabilize; or a density-dependent factor such as space, sunlight, herbivory, phosphorus, or nitrogen becomes limiting, and the population stabilizes (approaching carrying capacity).

Solution 5

(b)

Mark scheme

- Plot B would be more resilient than plot A in response to a sudden environmental change because plot B has much greater species diversity than plot A does (a more diverse community is less likely to be devastated entirely by a change that affects only some species, and can recover/re-establish more readily).

Solution 5

(c) Mark scheme

- This is a draw/represent task graded on content, not a text answer: the student's diagram ($\leq$12 symbols) must include all four plant types shown in the Figure 1 key — the X symbol (A. trifida) and the three 'other annual plant species' symbols (circle, filled triangle, square). Rationale: because A. trifida germinates from early March through the end of summer and the other annual species germinate from late April through the end of summer, both A. trifida and the other species still have individuals that germinate after June 1 (the cutoff for seedling removal in this third treatment), so all four symbol types are still expected to be present three months later.

Solution 5

(d)

Mark scheme

- Explanation must describe a process/relationship and state that biodiversity decreases. Accept any of: there are no predators of the invasive species, so its population grows faster and reduces biodiversity; the invasive species germinates earlier, uses up resources, and reduces biodiversity; the invasive species outcompetes other species and reduces biodiversity (consistent with Figure 1, where plot A — with A. trifida left in — has only A. trifida present, while plot B — with A. trifida removed — retains multiple other species).

Question 2

2019 ▪ Q2

A student studying two different aquatic, plant-eating, unicellular protist species (species A and B) designed an experiment to investigate the ecological relationship between the two species (Table 1).

TABLE 1. EXPERIMENTAL TREATMENT GROUPS

Group	**Description**
Group I.	Species A and B are each grown in separate containers.
Group II.	Species A and B are grown together in the same container.

Question 2

In treatment group I, the student placed 10 individuals of species A into a container with liquid growth medium and 10 individuals of species B into a separate container with an equal amount of the same liquid growth medium. In treatment group II, the student placed 5 individuals of each species into a single container with the liquid growth medium. The student then maintained the containers under the same environmental conditions and recorded the number of individuals in each population at various time points. The results are shown in Table 2.

TABLE 2. NUMBER OF INDIVIDUALS IN EACH PROTIST POPULATION IN BOTH TREATMENT GROUPS

Time (h)	Group I. Grown Separately — Species A	Group I. Grown Separately — Species B	Group II. Grown Together — Species A	Group II. Grown Together — Species B
0	10	10	5	5
10	100	50	45	20
20	400	200	100	50
30	1100	500	250	25
40	1400	650	525	20
50	1500	700	900	10
60	1500	700	1250	0

Question 2

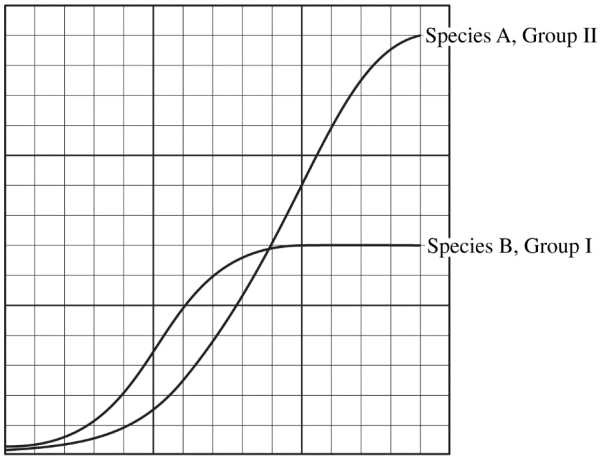
[Graph template: a blank grid (graph paper) with two curves already plotted (shaded columns of Table 2): “Species A, Group II” - an S-shaped curve rising steeply then leveling off at the top right; “Species B, Group I” - an S-shaped curve rising then leveling off at a lower plateau, labeled partway up the right side. Axes are unlabeled on the template, to be completed by the student with the unshaded columns (Species A, Group I and Species B, Group II).]

(a) The growth curves for species B in group I and for species A in group II (shaded columns) have been plotted on the template. Use the template to **complete** an appropriately labeled line graph to illustrate the growth of species A in treatment group I and species B in treatment group II (unshaded columns).

Question 2

	Group I. Grown Separately		Group II. Grown Together	
Time (h)	Species A	Species B	Species A	Species B
0	10	10	5	5
10	100	50	45	20
20	400	200	100	50
30	1100	500	250	25
40	1400	650	525	20
50	1500	700	900	10
60	1500	700	1250	0
70	1500	700	1400	0

Question 2



Question 2

Group I.	Species A and B are each grown in separate containers.
Group II.	Species A and B are grown together in the same container.