

Past-paper walk-through

Generalist and Specialist Species ■ 3.1

eXercise

Questions in this set

- 2026 Q1
- 2025 Set 2 Q2
- 2021 Set 1 Q3

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 1

2026 ■ Q1

The following information applies to parts A, B, C, D, and E.

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The results of this study are shown in the following diagram. Each unique shape in the diagram represents a different bird species, labeled A through E. Current distribution is shown on the left side of the figure, and predicted future distribution is shown on the right.

Bird Species Distribution

Question 1

[Diagram: a pyramid-shaped chart titled “Bird Species Distribution,” split into a “Current Distribution” half (left) and “Predicted Future Distribution” half (right), divided by a vertical center line. The pyramid is divided into four horizontal elevation bands, from top (narrowest) to bottom (widest): “High Elevations,” “Mid-High Elevations,” “Mid-Low Elevations,” and “Low Elevations,” separated by dashed lines. Each band shows bird-shape icons above the letters A, B, C, D, E (Current side) and A, B, C, D, E (Predicted Future side), indicating which species is present at that elevation. A legend defines a black bird silhouette = “Species present at elevation” and a gray bird silhouette = “Extinct species.”]

Current Distribution:

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- Mid-Low Elevations: Species B and Species D present.
- Low Elevations: Species B, Species C, Species D, and Species E present.

Predicted Future Distribution:

- High Elevations: Species A present; Species E shown extinct (gray icon).
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Question 1

The following information applies to parts F, G, and H.

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- Tank 1: 27°C and no sediment
- Tank 2: 32°C and no sediment

Question 1

- Tank 3: 37°C and no sediment

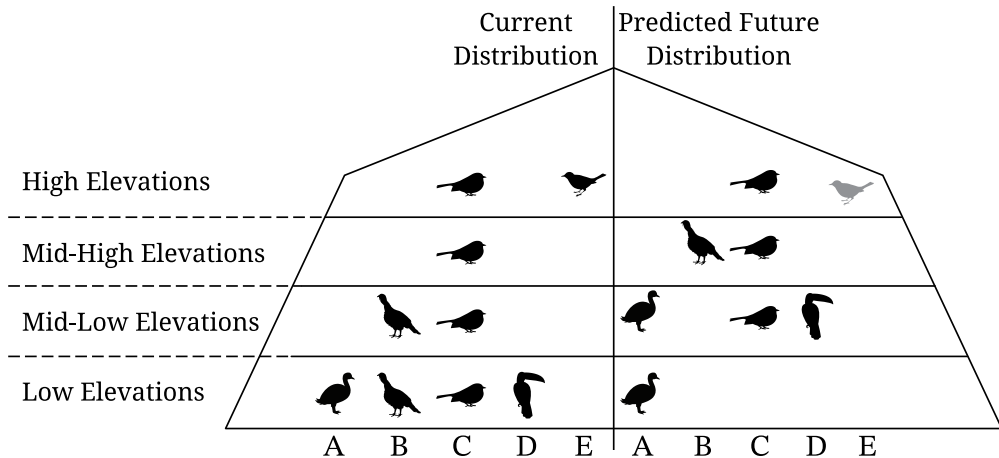
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- Tank 3: 27°C and high sediment

1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(a) Based on the information in the diagram, **identify** the elevation zone that has the highest species richness for the current distribution.

Question 1



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1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(b) Describe a climate condition at high elevations that is different than it is at low elevations.

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(c) A predator at low elevations currently feeds on Species C and D. Based on the information in the diagram, **describe** what could happen to the predator species in the future in response to the predicted changes in the prey community.

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(d) Species C is considered a generalist, while Species E is considered a specialist.

Explain why Species C and E are predicted to respond differently to climate change.

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(e) Based on the information in the diagram, **explain** why the bird community at low elevations in the future would be less likely to recover from natural disruptions than the current low-elevation bird community.

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(f) Identify the independent variable in Experiment 1.

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(g) Identify a likely scientific question for Experiment 1.

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(h) In Experiment 2 the temperature of the tanks was held constant, while the amount of sediment was varied. **Explain** how this modification could affect the results of this experiment.

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(i) Changes in climate also affect Arctic ecosystems. One impact of climate change is the loss of ice and snow in polar regions. **Describe** a positive feedback loop that results from the loss of ice and snow in polar regions.

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Question 1

to bottom (widest): “High Elevations,” “Mid-High Elevations,” “Mid-Low Elevations,” and “Low Elevations,” separated by dashed lines. Each band shows bird-shape icons above the letters A, B, C, D, E (Current side) and A, B, C, D, E (Predicted Future side), indicating which species is present at that elevation. A legend defines a black bird silhouette = “Species present at elevation” and a gray bird silhouette = “Extinct species.”

Current Distribution:

- High Elevations: Species A and Species C present.
- Mid-High Elevations: Species A present.
- Mid-Low Elevations: Species B and Species D present.
- Low Elevations: Species B, Species C, Species D, and Species E present.

Predicted Future Distribution:

- High Elevations: Species A present; Species E shown extinct (gray icon).

Question 1

- Mid-High Elevations: Species B and Species D present.
- Mid-Low Elevations: Species A, Species C, and Species D present.
- Low Elevations: Species A present.]

The following information applies to parts F, G, and H.

Some organisms such as birds can move in response to environmental changes, while other organisms such as corals cannot. Researchers studying the effect of climate change on marine organisms conducted two experiments involving photosynthetic algae that have a symbiotic relationship with corals.

In Experiment 1, the researchers placed photosynthetic algal colonies living in corals in three different saltwater tanks. The temperature of Tank 1 was set to 27°C, the average temperature at which most corals live. Water circulation in each tank mimicked natural ocean currents. After 30 days, the researchers counted the number of bleached corals. The tank setups are shown in the following list.

Question 1

- Tank 1: 27°C and no sediment
- Tank 2: 32°C and no sediment
- Tank 3: 37°C and no sediment

In Experiment 2, the researchers used the same photosynthetic algae living in corals but modified the conditions of the tanks as shown in the following list. Water circulation kept the sediment in the tanks suspended. After 30 days, the researchers counted the number of bleached corals.

- Tank 1: 27°C and no sediment
- Tank 2: 27°C and moderate sediment
- Tank 3: 27°C and high sediment

Question 1

1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(j) Describe one problem that Arctic species, such as polar bears or ringed seals, face because of warming in polar regions.

Question 2

2025 Set 2 ■ Q2

Serengeti National Park is located in Tanzania, Africa. The park is located in a valley along a tectonic plate boundary called the East African Rift. Figure 1 shows the East African Rift and other plate boundaries near the east coast of Africa.

Figure 1. Tectonic Plate Movement near East Coast of Africa

[Map figure showing tectonic plates near the east coast of Africa. Labels: “Arabian Plate” (north-central), “African Plate” (west), “Indian Plate” (east), “Lake Victoria” (small lake, west, with an arrow pointing away from it/west), “Western Rift Valley” and “Eastern Rift Valley” (two branching rift lines running north-south through the African Plate), “Serengeti National Park” (marked at the point where the Western and Eastern Rift Valleys meet), “Indian Ocean” (to the east). Bold arrows show direction of plate movement: one arrow points west/away from Lake Victoria area, one arrow points southeast from the rift valley junction, and a double-headed arrow (pointing

Question 2

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[Circular diagram showing the annual wildebeest migration route around Serengeti National Park, with a wildebeest icon and arrows connecting labelled month boxes in a loop: June → July → August → September → October (near "Ikorongo Game

Question 2

Reserve”) → November (near “Loliondo”) → December (near “Ngorongoro Conservation Area”) → January → February → March → April (near “Maswa Game Reserve”) → May → back to June. “Grumeti Game Reserve” is labelled near June/July. A dashed line labelled “Proposed location for new highway” crosses the northern part of the park near August/September. A solid line marks the “Serengeti National Park boundary.” A compass rose (N/E/S/W) is in the bottom right. Legend: arrow = Wildebeest migration route; wildebeest icon = Wildebeest; dashed line = Proposed location for new highway; solid line = Serengeti National Park boundary.] Respond to parts A, B, C, D, E, F, G, H, I, and J.

(a) Based on the information in Figure 1, **identify** the type of plate boundary that runs beneath Serengeti National Park.

Question 2

2025 Set 2 ■ Q2

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Question 2

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Question 2

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Legend: arrow = Wildebeest migration route; wildebeest icon = Wildebeest; dashed line = Proposed location for new highway; solid line = Serengeti National Park boundary.]

Respond to parts A, B, C, D, E, F, G, H, I, and J.

(b) Based on the information provided, **identify** the dominant biome within the Serengeti.

Question 2

2025 Set 2 ■ Q2

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Question 2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(c) Wildebeest give birth to their young when new grasses are growing. Based on the information in Figure 2, **identify** the location in the Serengeti where wildebeest are most likely to give birth.

Question 2

2025 Set 2 ■ Q2

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Question 2

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Question 2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(d) The Serengeti has two primary types of grasses: long and short. The two grass types provide similar levels of nutrition for animals. Wildebeest primarily consume long grasses, while other herbivores such as gazelle consume the short grasses. These two similar species coexist in Serengeti National Park.

Explain why resource partitioning allows for the coexistence of the wildebeest and the gazelle in the Serengeti.

Question 2

2025 Set 2 ■ Q2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(e) The Tanzanian government plans to build a highway across the northern portion of the Serengeti, as shown in Figure 2.

Describe one way the planned highway shown in Figure 2 could negatively affect the wildebeest population in the Serengeti.

Question 2

2025 Set 2 ■ Q2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(f) Propose a solution to the negative effect created by the planned highway described in part E.

Question 2

2025 Set 2 ■ Q2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(g) Many organisms live in grasslands. One weed species, the spotted knapweed, was introduced at one location in North America in the 1890s and is currently found throughout the rangelands of the western United States. The spotted knapweed poses several environmental problems in North America. Farmers often use crop rotation to control populations of pests like the spotted knapweed. A more traditional method of controlling pests involves spraying pesticides.

Describe a characteristic of an invasive species, such as the spotted knapweed, that allows them to outcompete native species.

Question 2

2025 Set 2 ■ Q2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(h) Justify the use of crop rotation as an environmental solution by providing an additional advantage, other than controlling pest populations.

Question 2

2025 Set 2 ■ Q2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(i) Describe an environmental problem associated with controlling pest populations with large amounts of pesticide.

Question 2

2025 Set 2 ■ Q2

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Respond to parts A, B, C, D, E, F, G, H, I, and J.

(j) Propose a solution to controlling pests, other than pesticides or crop rotation.

Solution 2

(a)

Mark scheme

- Divergent (boundary) - the plate boundary running beneath Serengeti National Park (part of the East African Rift) is a divergent boundary. 1 point for identifying it as divergent.

Solution 2

(b)

Mark scheme

- The dominant biome within the Serengeti is savanna (tropical grassland). 1 point for identifying savanna/tropical grassland.

Solution 2

(c)

Mark scheme

- Wildebeest are most likely to give birth in the Grumeti Game Reserve, i.e. the west/northwestern side/edge of Serengeti National Park, where new grasses are growing (per Figure 2). 1 point for identifying this location.

Solution 2

(d)

Mark scheme

- Resource partitioning allows wildebeest (which eat long grasses) and gazelle (which eat short grasses) to coexist because it reduces the negative impact of competition for limited resources - each species uses the shared, limited resource (grass) in a different way (different grass types), so they are not competing directly for the exact same food source. 1 point for explaining this reduced-competition mechanism.

Solution 2

(e)

Mark scheme

- One way the planned highway could negatively affect the wildebeest population: building the highway would fragment/destroy habitat, food, or resources; the highway could prevent, reduce, or disturb migration; wildebeest could be hit/killed by vehicles; or noise pollution from the highway could cause stress or change migratory routes. 1 point for any one valid negative effect.

Solution 2

(f) Mark scheme

- A realistic solution must correspond to the problem identified in part E. If habitat fragmentation/destruction was described: construct a habitat corridor over/under the highway, construct the highway over/above the habitat, relocate the highway north/outside the migratory path, or expand the national park/create additional protected habitat. If migration disturbance or vehicle strikes was described: relocate the highway north/outside the migratory path, or construct a habitat corridor over/under the highway. If noise pollution/stress was described: install a sound barrier to mitigate noise pollution, or relocate the highway north/outside the migratory path. 1 point for a solution that logically addresses the specific problem given in part E.

Solution 2

(g)

Mark scheme

- A characteristic of an invasive species (such as spotted knapweed) that allows it to outcompete native species: it has many offspring/reproduces quickly/matures early/invests minimal energy per offspring (tends to be r-selected); it can feed on/use many different types of resources; or it can survive in conditions outside its normal habitat/has a wide tolerance range (tends to be a generalist). 1 point for any one valid characteristic.

Solution 2

(h)

Mark scheme

- An additional advantage of crop rotation (besides pest control): improved soil fertility/soil structure/soil quality; increased nutrient cycling/reduced need for fertilizer; reduced soil erosion; increased food security/crop yield; or increased biological activity in the soil. 1 point for any one valid additional advantage.

Solution 2

(i)

Mark scheme

- An environmental problem from controlling pests with large amounts of pesticide: pesticides can harm/kill nontarget species, or pests can develop resistance to the pesticide (leading to a pesticide treadmill). 1 point for either problem.

Solution 2

(j)

Mark scheme

- A solution to controlling pests other than pesticides or crop rotation: use biocontrol/intercropping/natural predators; trap insects/use mechanical controls to eliminate pests; or use genetically modified crops that are pest resistant. 1 point for any one valid alternative solution.

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(a) Describe a characteristic of a specialist species that would make the specialist species more likely to be negatively affected by habitat fragmentation than a generalist species.

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(b) A rapidly growing suburban municipality purchases nearby forested land and proposes a newly planned housing development, which would involve clear-cutting much of the area for the construction of single-family homes. While evaluating the land, the development committee discovers that development will encroach upon the habitat of a wood thrush population. The wood thrush is a solitary, territorial bird whose preferred habitat consists of large, intact densely forested areas. Wood thrush populations are also threatened by cowbirds. A cowbird lays her egg in an existing nest of a wood thrush. After the cowbird egg hatches, the cowbird pushes the unhatched wood thrush eggs out. The wood thrush parents raise the cowbird hatchling as their own.

Identify the symbiotic relationship between the wood thrush and the cowbird.

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(c) Describe one ecological advantage of leaving areas of undeveloped forest in the development plan as compared to clear-cutting the property.

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(d) Propose a solution that will minimize the effect of development on the resident population of wood thrush while still meeting the municipality's need for a housing development.

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(e) A male wood thrush needs a minimum of 800 m^2 of territory for reproduction. The municipal development committee has set a biodiversity preservation target of 275 male wood thrush territories. ****Calculate**** the area that must be set aside to support the goal of 275 male thrush territories. ****Show**** your work.

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(f) A real estate developer wants to build houses on the property. The plan will support 1,000 lots with a lot size of $1,100 \text{ m}^2$. The developer has proposed setting aside land equal to 10

Question 3

2021 Set 1 ■ Q3

Habitat destruction and fragmentation can have many different effects on species.

(g) Calculate the percentage of each of the 1,000 lots that would need to be set aside in order to support the goal of 275 male wood thrush territories. **Show** your work.

Solution 3

(a) Mark scheme

- A characteristic of a specialist species that makes it more vulnerable to habitat fragmentation than a generalist species (accept one): specialists have a narrow ecological niche (compared to a generalist's broad niche), which is reduced even further by fragmentation; specialists have specialized adaptations and cannot adjust quickly to a changed/fragmented habitat, unlike generalists that adapt quickly; or specialists tend to have small populations with less genetic variation than generalist populations, which are larger and more genetically diverse, making specialists more vulnerable.

Solution 3

(b)

Mark scheme

- Identify the symbiotic relationship between the wood thrush and the cowbird: parasitism, specifically brood parasitism — the cowbird lays its eggs in the wood thrush's nest and uses the wood thrush as a surrogate parent to raise its hatchling, which benefits the cowbird and negatively affects the wood thrush.

Solution 3

(c) Mark scheme

- One ecological advantage of leaving areas of undeveloped forest instead of clear-cutting the property (accept one): since the habitat isn't clear-cut, it preserves some biodiversity by letting species survive in the remaining/fragmented forest areas; habitat fragmentation can benefit some generalist or edge species, whose populations may increase in edge habitat; buffer zones around conserved areas can reduce edge disturbance for specialist species; the remaining forest/trees reduce soil erosion; or the remaining forest helps with climate/cooling via transpiration and shade from trees.

Solution 3

(d) Mark scheme

- Propose a solution that minimizes the effect of development on the resident wood thrush population while still meeting the municipality's need for housing (accept one): leave wildlife corridors/crossings to prevent population isolation; include conservation easements in the plan that preserve species (and provide tax breaks for residents); create buffer zones near the development to separate it from wildlife habitat; create a mitigation plan that preserves land of similar quality elsewhere; cluster housing or build vertically to limit the development footprint; or incorporate common green spaces that promote wood thrush populations.

Solution 3

(e)

Mark scheme

- Calculate the area that must be set aside to support 275 male wood thrush territories at a minimum of 800 m^2 *per territory*. *Setup (1 point)*: 275 territories $\times \frac{800 \text{ m}^2}{1 \text{ territory}}$. Calculation (1 point): $= 220,000 \text{ m}^2$.

Solution 3

(f)

Mark scheme

- Calculate the maximum number of male wood thrush territories created under the developer's proposal (1,000 lots of 1,100 m² each, with 10

Solution 3

(g)

Mark scheme

- Calculate the percentage of each of the 1,000 (1,100 m²) lots that must be set aside to support the goal of 275 male wood thrush territories. Setup (1 point)

100 (equivalently $\frac{275 \text{ territories} \times 10\%}{137.5 \text{ territories}} \times 100$). Calculation (1 point): = 20% of each lot.