

Past-paper walk-through

Integrated Pest Management ■ 5.14

eXercise

Questions in this set

- 2025 Set 2 Q2
- 2022 Set 2 Q2
- 2021 Set 1 Q2

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 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

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both directions, apart) is shown at the boundary between the Arabian Plate and the Indian Plate. A compass rose (N/E/S/W) is in the bottom right. Legend: wavy line = Plate boundaries; solid line = East African Rift; bold arrow = Direction of plate movement.]

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Figure 2. Annual Migration of Wildebeest in Serengeti National Park

[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

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

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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.

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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.

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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.

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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.

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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.

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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.

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

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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.

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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 2

2022 Set 2 ■ Q2

Biologists collected data on the abundance of lizards on several Pacific islands with and without mongoose populations. The surveys were conducted at different locations on the islands by counting the number of lizards observed per hour and included habitats with both undisturbed areas and anthropogenically disturbed areas.

[Scatter/line graph titled "LIZARD NUMBERS ON PACIFIC ISLANDS". Y-axis: "Lizards Counted per Hour", logarithmic scale from 10^0 to 10^3 . X-axis: "Habitat Types", with categories in order from "Undisturbed" to "Highly disturbed": Primary Forest, Secondary Forest, Clearings, Gardens, Sugarcane Fields, Hotels, Parks, and Walking Trails. Two data series with individual data points and a smoothed trend curve for each: "Mongoose-free islands" (filled circles, solid curve) and "Mongoose-present islands" (open squares, dashed curve). Both curves rise from Primary Forest, peak around Clearings, Gardens (mongoose-free peak ≈ 50

Question 2

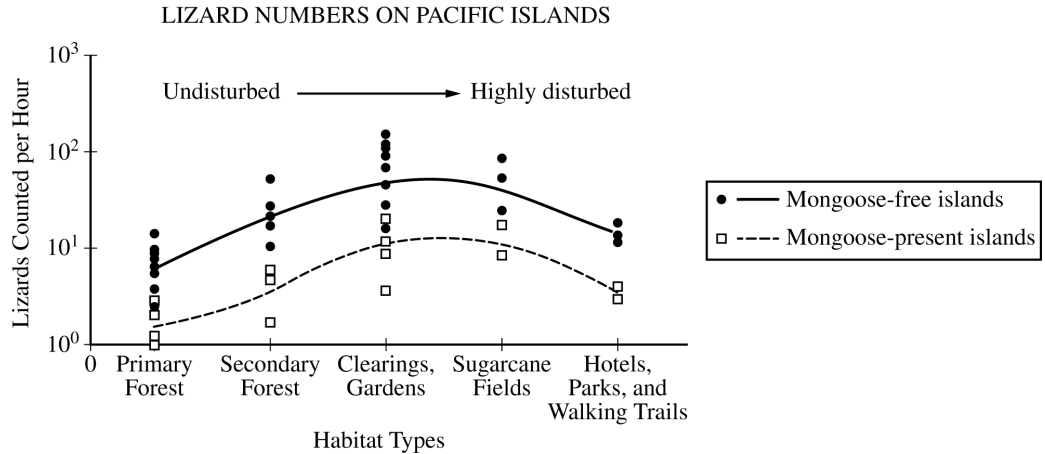
lizards/hour; mongoose-present peak ≈ 10 lizards/hour), then decline toward Hotels, Parks, and Walking Trails (mongoose-free ≈ 15 lizards/hour; mongoose-present ≈ 3 lizards/hour). At every habitat type, the mongoose-free (solid) curve lies above the mongoose-present (dashed) curve.]

(a)(i) The graph shows data collected by biologists on lizard numbers on several Pacific islands.

Based on the data in the graph, **identify** the habitat type with the greatest number of lizards.

(a)(ii) Based on the data in the graph, **describe** the relationship between the lizard numbers observed on islands with and without mongoose populations.

Question 2



Question 2

2022 Set 2 ■ Q2

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Question 2

Hotels, Parks, and Walking Trails (mongoose-free ≈ 15 lizards/hour; mongoose-present ≈ 3 lizards/hour). At every habitat type, the mongoose-free (solid) curve lies above the mongoose-present (dashed) curve.]

(b) Globally, islands vary in size, location, and habitat.

Based on the theory of island biogeography, **describe** the characteristics of an island with the greatest species diversity.

Question 2

2022 Set 2 ■ Q2

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(c)(i) Island ecosystems are often threatened by invasive species, such as the mongoose populations studied in the survey.

Describe one environmental problem caused by invasive animal species.

(c)(ii) Invasive species are often pests. **Make a claim** that proposes one way to control pest species.

(c)(iii) **Justify** the solution proposed in (c)(ii) by providing an additional benefit of the solution.

Question 2

2022 Set 2 ■ Q2

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(d)(i) Islands provide humans with many ecosystem services. However, humans may alter ecosystems when they obtain these services. Large-scale commercial sugarcane farming on the Pacific islands has led to significant ecological damage.

Identify a provisioning ecosystem service provided by primary forests.

(d)(ii) Based on the data in the graph, **explain** how replacing primary forests with sugarcane fields may have affected the number of lizards counted on the mongoose-free Pacific islands.

(d)(iii) The long-term use of monocultures in commercial sugarcane farming is one cause of the ecological damage. **Describe** one problem associated with monocultures.

Question 2

2022 Set 2 ■ Q2

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(e) One solution to the ecological damage of monocultures is to use a form of crop rotation using legumes.

Describe an advantage of crop rotation using legumes on soil fertility.

Solution 2

(a)(i)

Mark scheme

- Clearings/Gardens — this habitat type has the greatest number of lizards in the graph.

(a)(ii)

Mark scheme

- Any one description: lizard populations are smaller on islands where mongooses are present than on mongoose-free islands; lizard populations are larger on mongoose-free islands than on islands with mongooses; the relationship between lizard numbers and mongoose population is an inverse (negative) relationship.

Solution 2

(b)

Mark scheme

- A large island located near the mainland will have the greatest species diversity — per island biogeography theory, larger area supports a larger population/lower extinction rate, and proximity to the mainland increases the immigration (colonization) rate.

Solution 2

(c)(i)

Mark scheme

- Any one environmental problem: invasive species outcompete native species for resources, causing food web disruptions/trophic cascades/habitat loss; invasive species outcompete or prey on native organisms, decreasing biodiversity/reducing native population sizes.

Solution 2

(c)(ii)

Mark scheme

- Any one claim proposing pest control: introduce biological controls (natural predators of the species) to reduce pest numbers; use chemical controls such as pesticides to kill off pests; use manual/mechanical methods to remove plant species; trap/hunt animal species and remove/kill them from the area.

Solution 2

(c)(iii)

Mark scheme

- Justification must match the solution proposed in (c)(ii): biological control, manual/mechanical removal, or trapping/hunting is justified as least likely to harm other species because the pest species can be specifically targeted, and harmful synthetic chemicals are not introduced into the environment (manual/trapping methods can also cite financial gain from selling killed pest organisms); chemical control (pesticides) is justified as a quick/efficient method to reduce/eliminate the pest species.

Solution 2

(d)(i)

Mark scheme

- Any one provisioning ecosystem service from primary forests:
timber/lumber/wood; medicine; food.

Solution 2

(d)(ii)

Mark scheme

- Any one explanation: the cleared land is preferred habitat for the lizards, leading to increased lizard numbers in the sugarcane fields compared to forests; the cleared land has fewer predators, leading to increased lizard numbers in the sugarcane fields compared to forests; the cleared land has more food for the lizards, leading to increased lizard numbers in the sugarcane fields compared to forests.

Solution 2

(d)(iii)

Mark scheme

- Any one problem associated with monocultures: decreased genetic diversity of the monoculture species; decreased species diversity; increased susceptibility of the monoculture to disease/pests; depletion of nutrients from the soil; increased use of irrigation water/fertilizer/pesticide.

Solution 2

(e)

Mark scheme

- Any one advantage of crop rotation using legumes: improved nitrogen fixation in the soil; less nitrogen-based fertilizer required.

Question 2

2021 Set 1 ■ Q2

Pesticides have been utilized for many years to increase food production and control pest populations. Pesticide use can be both beneficial and harmful to humans and other organisms.

(a) Pesticide use has advantages, disadvantages, and unintended consequences on human health. **Describe** one benefit to human health that can result from the use of pesticides.

Question 2

2021 Set 1 ■ Q2

Pesticides have been utilized for many years to increase food production and control pest populations. Pesticide use can be both beneficial and harmful to humans and other organisms.

(b) Identify one way chemical pesticides can enter the human body.

Question 2

2021 Set 1 ■ Q2

Pesticides have been utilized for many years to increase food production and control pest populations. Pesticide use can be both beneficial and harmful to humans and other organisms.

(c)(i) Cotton farmers in the southern United States used a chemical pesticide to control an insect cotton-crop pest over a 40-year period. To study the effectiveness of the pesticide as an insect pest-control strategy, traps were placed in treated cotton fields and the number of pests captured were compared to application rates for the pesticide. The results of the study are shown in the table below.

Year	Grams of Pesticide Applied per Hectare	Number of Crop Insect Pests Captured
1960	0	700
1975	500	2
1980	500	3
1985	500	8
1990	550	14
1995	600	83
2000	700	150
2005	800	405
2010	900	727
2015	1,000	1,100

Question 2

Use the data in the table to answer the following questions.

Identify the year when the pesticide was most effective at reducing the size of the pest population.

(c)(ii) Describe the change in the number of crop insect pests in the cotton fields over time.

(c)(iii) Explain how the change in the cotton-crop pesticide effectiveness between the initial application in 1975 and the latest application in 2015 illustrates genetic resistance in pests, based on the data in the table.

Question 2

2021 Set 1 ■ Q2

Pesticides have been utilized for many years to increase food production and control pest populations. Pesticide use can be both beneficial and harmful to humans and other organisms.

(d) Describe TWO effects of pesticide use, other than death, on nontarget wildlife.

Question 2

2021 Set 1 ■ Q2

Pesticides have been utilized for many years to increase food production and control pest populations. Pesticide use can be both beneficial and harmful to humans and other organisms.

(e)(i) There are many problems associated with the repeated application of chemical pesticides to reduce pest populations.

Crop rotation is often used to reduce pesticide use. **Describe** the process of crop rotation.

(e)(ii) Propose one reasonable method, other than crop rotation, of reducing the use of pesticides in agricultural practices while still maintaining a high crop yield.

(e)(iii) Justify how the method proposed in (e)(ii) would provide a benefit to humans.

Solution 2

(a)

Mark scheme

- One benefit to human health from pesticide use (accept one): pesticides control disease vectors such as mosquitoes, ticks, rats, and mice that spread disease to/between humans; they reduce exposure to stinging insects that carry disease; or they increase food production, which decreases famine / increases food availability and thereby improves human health.

Solution 2

(b)

Mark scheme

- One way chemical pesticides can enter the human body (accept one):
inhalation/breathing in aerosols and powders (e.g. during application on farms, yards, golf courses); drinking water contaminated by pesticide runoff; consumption of food carrying pesticide residue; or dermal absorption through the skin during application of the pesticide.

Solution 2

(c)(i)

Mark scheme

- Identify the year the pesticide was most effective at reducing the pest population size: 1975 (the year of the initial application, when the number of crop insect pests captured was lowest).

Solution 2

(c)(ii)

Mark scheme

- Describe the change in the number of crop insect pests in the cotton fields over time: the pest population was high before the pesticide was first used, then dropped dramatically right after the initial 1975 application, and then increased again over subsequent years even as more pesticide (grams per hectare) was applied — overall, captures rose from about 2 pests in 1975 to about 1,100 pests by 2015 (roughly 700 to 1,100 across the full 1960–2015 span).

Solution 2

(c)(iii)

Mark scheme

- Explain how the change between the 1975 and 2015 applications illustrates genetic resistance: over time the same (or an increasing) amount of pesticide kills a smaller fraction of the pest population, because pests with a genetic resistance to the pesticide survive each application and reproduce, passing that resistance to their offspring. This is the "pesticide treadmill" — each year more pesticide must be applied, yet the number of pests captured (surviving) steadily increases, showing that an increasing share of the population carries genetic resistance to the pesticide.

Solution 2

(d) Mark scheme

- Describe TWO effects of pesticide use (other than death) on nontarget wildlife (accept any two): the pesticide may contaminate soil/water, negatively affecting organisms; it may bioaccumulate in an organism's body; it may biomagnify up the food web/chain; nontarget organism populations may increase where competitors/predators are removed and new habitat opens up; predator species may decrease, letting prey species grow rapidly; endocrine disruption may cause reproductive or developmental abnormalities; pesticides can disrupt signaling/communication in bees; they can cause eggshell thinning or other developmental abnormalities; or they can eliminate a food supply and disrupt the food chain for other species.

Solution 2

(e)(i)

Mark scheme

- Describe the process of crop rotation: growing different crops in succession (in different seasons or years) on the same piece of land, rather than growing the same crop repeatedly — i.e. harvesting one crop and then planting a different crop in that same area.

Solution 2

(e)(ii)

Mark scheme

- Propose one method, other than crop rotation, to reduce pesticide use while still maintaining a high crop yield (accept one): integrated pest management combining biological, physical, and chemical controls; reducing stubble/crop residue in fallow fields that harbor pests; applying pesticide only when the pest is most susceptible; intercropping instead of monoculture to reduce pest habitat; or using pest-resistant genetically modified crops.

Solution 2

(e)(iii)

Mark scheme

- Justify how the method proposed in (e)(ii) benefits humans (accept one): it reduces pesticide residue in food and pesticide ingested by humans; it provides economic benefits such as less money spent on pesticides, increased farmer profit from crops, and less equipment/labor needed to spray fields; or it reduces the number of agricultural workers exposed to pesticides, improving their health.