Past-paper walk-through

Terrestrial Biomes ▪ 1.2

eXercise

Questions in this set

- 2025 Set 1 Q2
- 2025 Set 2 Q2
- 2024 Set 2 Q3
- 2023 Set 2 Q1
- 2021 Set 2 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.

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Figure 1 shows temperature and precipitation patterns associated with one phase of this phenomenon in the equatorial Pacific Ocean. Figure 2 shows the associated temperature and precipitation patterns that occur over North America.

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[Map of the equatorial Pacific Ocean region spanning from Africa/the Indian Ocean on the left to Australia and the western coast of South America on the right, with dashed horizontal reference lines at “30° North” and “Equator 0°”. A large hatched region (diagonal lines, labeled in the legend as “Ocean water cooler than average”) covers the

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western/central Pacific Ocean around and south of Australia and Indonesia. A large solid-shaded region (labeled "Ocean water warmer than average") lies to the west of the hatched region, overlapping the Indian Ocean/Indonesia area. A solid black patch (labeled "Increased chance of precipitation") sits over Australia. A bold horizontal arrow points from right (near South America) to left (toward Indonesia/Australia) along the Equator, labeled "Stronger than normal trade winds". A compass rose (N/S/E/W) is shown in the lower right. Legend: ⊠ (diagonal hatch) = Ocean water cooler than average; ⊟ (grey fill) = Ocean water warmer than average; ■ (black fill) = Increased chance of precipitation; ← (bold arrow) = Stronger than normal trade winds.]

Figure 2. Polar Jet Stream and Climate Conditions in North America

[Map of North America showing a thick curved arrow labeled "Polar Jet Stream" that dips from the northwest, curves down over the western/central United States, and rises

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back up toward the northeast (Atlantic Canada), with an arrowhead at the northeast end. A region labeled "A" (dashed-outline circle, dotted fill pattern) is located over the northwestern/western Canada-US border area. A dotted-fill band (same pattern as region A, labeled in the legend as "Increased chance of precipitation") stretches along the path under the jet stream curve across the northern/central US. A region labeled "B" (dashed-outline box, solid grey fill) sits over the south-central/southeastern United States, within a larger grey-shaded band (labeled "Decreased chance of precipitation"). A diagonally hatched region (labeled "Warmer than average") covers the southeastern United States. A compass rose (N/S/E/W) is shown in the lower left. Legend: ☐ (dotted outline/fill) = Increased chance of precipitation; ⊟ (solid grey fill) = Decreased chance of precipitation; ☐ (dotted fill, different pattern) = Cooler than average; ⊠ (diagonal hatch) = Warmer than average.]

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(a) Identify the sea surface condition for the eastern equatorial area of the Pacific Ocean illustrated in Figure 1.

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(b) Based on the information in Figure 1, identify the climate phenomenon associated with the sea surface conditions shown in the equatorial area of the Pacific Ocean.

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(c) Based on the information in Figure 2, describe a difference in climate patterns between the regions A and B.

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(d) Increases in regional precipitation can lead to increased flooding in certain locations. Describe one reason why there is an increased risk of flooding in urban areas during extended periods of precipitation.

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(e) Propose a realistic solution a city could implement to decrease the risk of flooding in urban areas.

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(f) Justify the solution proposed in part E by providing an additional advantage other than a reduction in the risk of flooding.

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(g) Terrestrial biomes are primarily determined by temperature and precipitation patterns. Describe one difference between the climate of a temperate seasonal forest and that of a savanna.

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(h) Droughts are one environmental problem that can affect the frequency and severity of forest fires. Identify the ecological process that occurs following a forest fire that leaves the soil intact.

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(i) Describe one way burning forests contribute to atmospheric pollution.

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(j) Describe one sustainable forestry practice that could be used to reduce the occurrence or severity of forest fires.

Solution 2

(a)

Mark scheme

- The sea surface condition in the eastern equatorial Pacific shown in Figure 1: ocean water is cooler than average.

Solution 2

(b)

Mark scheme

- The climate phenomenon associated with these cooler-than-average equatorial Pacific sea surface conditions is La Niña.

Solution 2

(c)

Mark scheme

- Difference in climate patterns between regions A and B (Figure 2): Region A has an increased chance of precipitation while Region B has a decreased chance of precipitation — i.e., Region A will be wetter while Region B will be drier.

Solution 2

(d)

Mark scheme

- One reason for increased flood risk in urban areas during extended precipitation: impervious/paved surfaces (parking lots, roads, buildings, sidewalks) increase runoff and reduce infiltration/absorption; urban areas also have less vegetation, further reducing infiltration/absorption.

Solution 2

(e)

Mark scheme

- A realistic city solution to decrease urban flood risk: use permeable pavement; or plant vegetation/establish parks/create rain gardens/build green roofs; or install retention ponds/stormwater basins.

Solution 2

(f) Mark scheme

- Justify the part-E solution with an advantage beyond flood reduction, matched to the chosen solution. Permeable pavement: increased recharge of nearby aquifers/groundwater; decreased pollution in runoff. Vegetation/parks/rain gardens/green roofs: absorbs pollutants; stores carbon dioxide/produces oxygen; decreases erosion; increases/restores wildlife habitat and biodiversity; reduces the urban heat island effect; improves aesthetic enjoyment/quality of life; creates landscaping/park-maintenance jobs. Retention ponds/stormwater basins: decreased pollution in runoff; increased habitat/biodiversity.

Solution 2

(g)

Mark scheme

- One climate difference between a temperate seasonal forest and a savanna: temperate seasonal forests have a cooler climate with a stronger/colder winter and four distinct seasons, and receive more annual precipitation (spread throughout the year), whereas savannas are warmer with a distinct rainy season and dry season and do not have four distinct seasons.

Solution 2

(h)

Mark scheme

- The ecological process that occurs following a forest fire that leaves the soil intact is secondary succession.

Solution 2

(i)

Mark scheme

- One way burning forests contributes to atmospheric pollution: burning trees releases CO2, CO, NOx, particulate matter, and/or VOCs into the atmosphere.

Solution 2

(j)

Mark scheme

- One sustainable forestry practice to reduce the occurrence/severity of forest fires: prescribed burns (remove excess fuel/dead leaves/underbrush); brush removal (removes excess fuel); selective cutting (creates a fire break); agroforestry, where ground crops that might otherwise become fuel are harvested/removed.

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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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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

Question 2

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(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

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

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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.

Question 2

2025 Set 2 ▪ Q2

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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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2025 Set 2 ▪ Q2

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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

2024 Set 2 ▪ Q3

The Rocky Mountains, the headwaters for the Colorado River, have experienced a severe drought for many of the past twenty years. States and cities downstream that depend on the river water have had to find solutions to the reduced water flow.
One city located downstream from the Rocky Mountains is Las Vegas, Nevada. In Las Vegas, one solution to reduce the amount of water used for irrigation is to remove landscaping and lawns that use grasses not native to the local area and replace them with desert-tolerant landscaping.

(a) Identify a typical type of plant that would be used in desert-tolerant landscaping.

Question 3

2024 Set 2 ▪ Q3

The Rocky Mountains, the headwaters for the Colorado River, have experienced a severe drought for many of the past twenty years. States and cities downstream that depend on the river water have had to find solutions to the reduced water flow.

One city located downstream from the Rocky Mountains is Las Vegas, Nevada. In Las Vegas, one solution to reduce the amount of water used for irrigation is to remove landscaping and lawns that use grasses not native to the local area and replace them with desert-tolerant landscaping.

(b) Justify the removal of landscaping and lawns that use grasses not native to the local area by describing an additional advantage, other than reducing the amount of water needed for irrigation.

Question 3

2024 Set 2 ▪ Q3

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(c) Warmer seasonal temperatures in the Rocky Mountains have led to earlier mountain snowmelt and an increased risk of forest fires as soil and vegetation dry out. Describe how a prescribed burn would reduce the severity and spread of forest fires.

Question 3

2024 Set 2 ▪ Q3

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(d) Describe a disadvantage of a prescribed burn in a forested ecosystem.

Question 3

2024 Set 2 ▪ Q3

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(e) Lake Powell is a large reservoir on the Colorado River. Lake Powell is formed by a dam with a hydroelectric power plant. At full capacity or full pool, Lake Powell contains 25.16 million acre-feet (maf) of water. Currently, Lake Powell is at 36% full capacity.

Question 3

Calculate the number of million acre-feet (maf) of water currently in Lake Powell. Show your work.

Question 3

2024 Set 2 ▪ Q3

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(f) In 2021, after years of drought, Lake Powell held 7.9 million acre-feet (maf) of water. One million acre-feet is equivalent to 3.26×10^{11} gallons.

The watershed of the Upper Colorado River contributes an average of 9.60 maf of water to Lake Powell annually. The melted mountain snow found in the watershed contributes 50

Question 3

2024 Set 2 ▪ Q3

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One city located downstream from the Rocky Mountains is Las Vegas, Nevada. In Las Vegas, one solution to reduce the amount of water used for irrigation is to remove landscaping and lawns that use grasses not native to the local area and replace them with desert-tolerant landscaping.

(g) The average household in the United States consumes 5.0×10^4 gallons of water in a year. Calculate the number of households that could be supported for one year by the average flow of 9.60 maf of water into Lake Powell. Show your work.

Solution 3

(a)

Mark scheme

- A typical desert-tolerant landscaping plant: cactus/cacti, succulent plants, or other drought-tolerant plants. Full credit for naming one such plant type.

Solution 3

(b)

Mark scheme

- An additional advantage (besides reduced irrigation water) of removing non-native grass lawns: any one of (1) native desert plants support habitat/provide food for local wildlife; (2) less mowing means decreased yard-maintenance time/cost; (3) desert-tolerant plants need less fertilizer/pesticide; (4) it creates jobs for landscapers to remove/replace turf; (5) less use of gas-powered yard tools reduces air pollution/noise pollution/gasoline consumption. Full credit for any one such advantage.

Solution 3

(c)

Mark scheme

- A prescribed burn reduces the severity/spread of forest fires because it removes undergrowth, decreasing available fuel/flammable material, and/or it thins the forest, creating a fire break that reduces the spread of future fires. Full credit for either mechanism.

Solution 3

(d)

Mark scheme

- A disadvantage of a prescribed burn: any one of (1) it reduces habitat for wildlife/can harm or displace animals; (2) it releases carbon dioxide, contributing to climate change; (3) it releases particulates/air pollutants, worsening air quality; (4) runoff after the burn can degrade water quality; (5) it reduces competition, which can help invasive species spread/expand. Full credit for any one such disadvantage.

Solution 3

(e)

Mark scheme

- Setup (1 point): 25.16 maf $\times\, 36\% = 25.16 \times 0.36$. Calculation (1 point): ≈ 9.06 maf (accept 9.0576, 9.058, 9.06, or 9.1). Full credit (2 points) needs both a correct setup showing 25.16 maf multiplied by 36

Solution 3

(f)

Mark scheme

- Setup (1 point): 9.60 maf $\times\, 36\% \times 50\% = 9.60 \times 0.36 \times 0.5$. Calculation (1 point): ≈ 1.73 maf (accept 1.728, 1.73, or 1.7). Full credit (2 points) needs both the correct multiplicative setup (annual average flow times 2021's 36

Solution 3

(g)

Mark scheme

- Setup (1 point): 9.60 maf $\times \dfrac{3.26 \times 10^{11} \text{ gallons}}{1 \text{ maf}} \times \dfrac{1 \text{ household}}{5.0 \times 10^{4} \text{ gallons}}$.
  Calculation (1 point): $\approx 62{,}592{,}000$ households (i.e. 6.2592×10^{7}). Full credit (2 points) needs both the correct unit-conversion setup (maf to gallons to households) AND the correct resulting value.

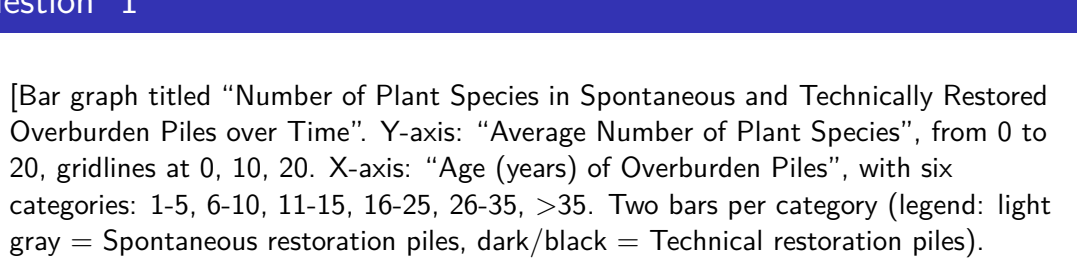
Question 1

2023 Set 2 ▪ Q1

Two restoration methods designed to reclaim the overburden piles removed from open pit coal mines in temperate forests of eastern Europe were studied over several years. The first method was spontaneous restoration, where the soil and rock were dumped in noncompacted, random piles and not replanted with vegetation. The second method was technical restoration, where the land was leveled by heavy machinery, organic material was added, and eight plant species were added. Technical restoration started 5 years after the piles were formed, so no bar is included in the 1-5 year range in the graph.

Number of Plant Species in Spontaneous and Technically Restored Overburden Piles over Time

Question 1



[Bar graph titled "Number of Plant Species in Spontaneous and Technically Restored Overburden Piles over Time". Y-axis: "Average Number of Plant Species", from 0 to 20, gridlines at 0, 10, 20. X-axis: "Age (years) of Overburden Piles", with six categories: 1-5, 6-10, 11-15, 16-25, 26-35, >35. Two bars per category (legend: light gray = Spontaneous restoration piles, dark/black = Technical restoration piles). Approximate bar heights: 1-5: Spontaneous ~6.5, Technical (none, no bar); 6-10: Spontaneous ~12, Technical ~9.5; 11-15: Spontaneous ~13, Technical ~11.5; 16-25: Spontaneous ~13, Technical ~8.5; 26-35: Spontaneous ~14, Technical ~8; >35: Spontaneous ~17.5, Technical ~8.]

Scientists hypothesized that after 35 years, the number of animal species in the spontaneously restored piles would be higher than the number of animal species in the technically restored piles.

Question 1

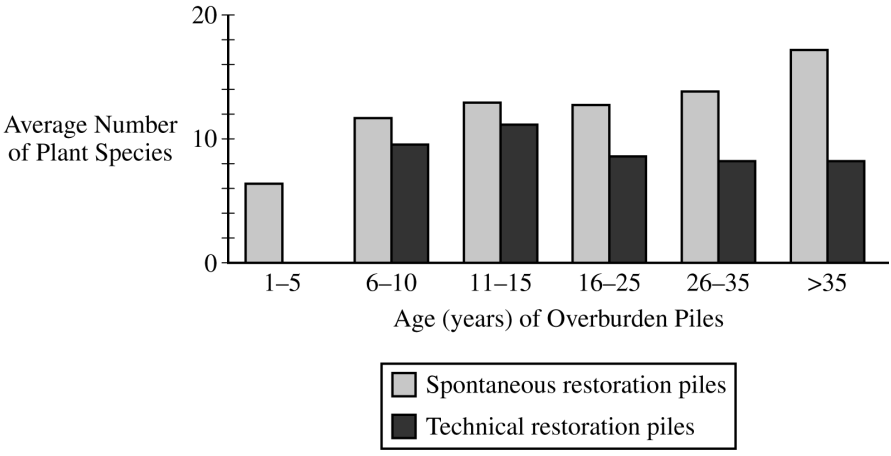
Limiting runoff on disturbed land improves soil and water quality. To model water runoff, students set up three large plastic trays and filled each tray with loam soil to 1 centimeter below the edge. Loam soil is a balance of sand, silt, and clay soil. One tray was seeded with wheatgrass and grown for 30 days, one tray was covered with small wood chips, and one tray was soil only. Five hundred milliliters of water was sprinkled evenly onto the soil surface of each tray. All three trays were placed on a slight slope, and water that ran off the surface was collected. The results are shown in the following table.

Tray	**Water Collected (mL)**	**Water Appearance**
Wheatgrass grown in soil; no small wood chips	190	Clear
Small wood chips covered soil; no wheatgrass	300	Transparent; light brown
Soil only; no wheatgrass or small wood chips	360	Cloudy; dark brown

Question 1

Runoff from mining waste can also affect water quality.
(a) Based on the data in the graph, **identify** the average number of species found in technically restored piles 16-25 years after restoration started.

Question 1


Average Number of Plant Species
20
10
0
1–5
6–10
11–15
16–25
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>35
Age (years) of Overburden Piles
Spontaneous restoration piles
Technical restoration piles

Question 1

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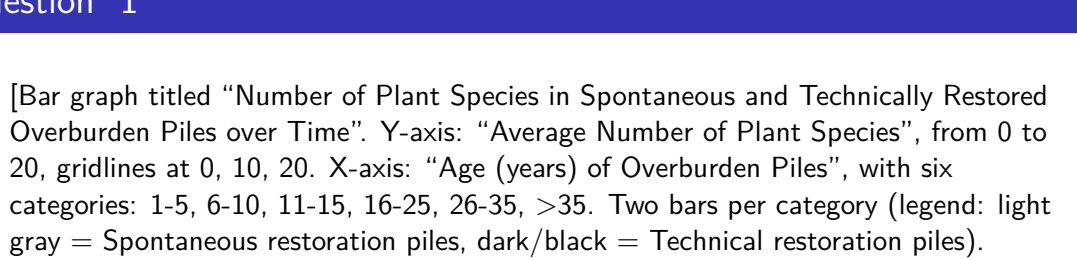

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