Past-paper walk-through

Sustainable Forestry ▪ 5.17

eXercise

Questions in this set

- 2025 Set 1 Q2
- 2024 Set 2 Q3
- 2019 Q2
- 2017 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 2

2025 Set 1 ▪ Q2

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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.

Figure 1. Effects of Changes in Sea Surface Conditions in Equatorial Pacific Ocean

[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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2025 Set 1 ▪ Q2

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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.

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

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(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

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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.

(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

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.

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

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.

(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

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.

(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

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.

(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 2

2019 ▪ Q2

As conventional sources of crude oil are depleted, unconventional sources such as oil sands (also known as tar sands) are being utilized. Oils sands contain bitumen, which can be processed into a synthetic crude oil. A region of boreal forest in Alberta, Canada, that covers a deposit of oil sands will be cut and removed during the process of bitumen extraction. It is estimated that the deposit contains 73 billion barrels of recoverable bitumen. The rate of extraction from the deposit will be approximately 1 million barrels of bitumen per day.

(a) Identify one ecological benefit, other than providing habitat, that is provided by forests.

(b) Identify one economic benefit that is provided by forests.

Question 2

(c) Describe TWO environmental consequences, other than those related to the loss of boreal forest habitat, that result from the extraction of bitumen or the transportation of synthetic oil to customers.
(d) Assuming the above extraction rate, calculate how many days will be needed to extract the recoverable volume of bitumen from the oil sands.
(e) Calculate how many years will be needed to fully extract the recoverable volume of bitumen from the oil sands.
(f) Monthly production of synthetic crude oil is 30 million barrels. Producing one barrel of synthetic crude oil uses two barrels of heated freshwater. Calculate the number of barrels of freshwater needed each year to supply this demand.

Solution 2

(a)

Mark scheme

- One ecological benefit, other than providing habitat, provided by forests, e.g.: absorb carbon dioxide/produce oxygen (gas exchange); maintain ecological and/or species diversity; provide food for organisms; moderate/regulate (local) climate; purify/filter water or air; reduce soil erosion; absorb/store/regulate water; help maintain stream temperature/stream flow; aid in nutrient cycling; aid in soil formation. Full credit for any one valid benefit.

Solution 2

(b)

Mark scheme

- One economic benefit provided by forests, e.g.: source of forest products (timber, medicine, nuts, crops such as shade-grown coffee, etc.); tourism; jobs in recreation/tourism/forestry; reduction in air pollutants, which can reduce health care costs or improve crop yields. Full credit for any one valid benefit.

Solution 2

(c) Mark scheme

- Describe TWO environmental consequences, other than those related to loss of boreal forest habitat, that result from bitumen extraction or transport of synthetic oil, 1 point per correct distinct consequence (max 2), e.g.: release of greenhouse gases/air pollutants such as NO_x from fossil fuel combustion powering equipment/transportation/oil processing; release of air pollutants (NO_x, SO_x, or particulates) during mining operations or oil processing; storage and disposal of large amounts of solid/liquid mining waste, which can be toxic to organisms; pollution of surface water and/or groundwater from oil spills/leaks during transport; sediment pollution in surface water and/or groundwater from strip mining; disturbance from pipelines, such as habitat fragmentation or disruption of

Solution 2

migratory routes; noise pollution from use of machinery during processing or transport; diversion/use of water from surface water and/or groundwater for processing oil.

Solution 2

(d)

Mark scheme

- Setup: 7.3×10^{10} barrels of bitumen $\times \dfrac{1 \text{ day}}{1.0 \times 10^{6} \text{ barrels of bitumen}} = 7.3 \times 10^{4}$ days $= 73{,}000$ days. 1 point for the correct dimensional-analysis setup, 1 point for the correct numeric answer (73,000 days). Units are not required in the final answer.

Solution 2

(e)

Mark scheme

- Setup: 7.3×10^4 days $\times \dfrac{1 \text{ year}}{365 \text{ days}} = 2 \times 10^2$ years $= 200$ years. 1 point for correct setup, 1 point for the correct answer (200 years). An incorrect numeric answer carried over from part (d), if used correctly here, can still earn both points. Units are not required.

Solution 2

(f) Mark scheme

- Setup: $\frac{3 \times 10^7 \text{ barrels of synthetic oil}}{1 \text{ month}} \times \frac{2 \text{ barrels of fresh water}}{1 \text{ barrel of synthetic oil}} \times \frac{12 \text{ months}}{1 \text{ year}} = 7.2 \times 10^8$ barrels of fresh water $= 720{,}000{,}000$ barrels of fresh water per year. 1 point for correct setup, 1 point for the correct numeric answer. Units are not required.

Question 3

2017 ▪ Q3

Haiti shares a border with the Dominican Republic on the Caribbean island of Hispaniola.

(a)(i) The border between the two countries can be seen using satellite images because of the severe deforestation in Haiti.

Provide one reason why deforestation commonly occurs in a less developed country such as Haiti.

(a)(ii) Describe one realistic strategy to reduce deforestation in a less developed country.

Question 3

DEMOGRAPHIC DATA FOR HAITI

Measure	1995	2015
Fertility rate (number of children per woman)	5.2	2.7
Life expectancy (years)	55	64
Infant mortality (deaths per 1,000)	85	48

Question 3

2017 ▪ Q3

Haiti shares a border with the Dominican Republic on the Caribbean island of Hispaniola.

(b) Deforestation can affect water quality. Identify one change that can occur in the water quality of streams within a watershed that has been deforested. Explain how deforestation can lead to this change.

Question 3

2017 ▪ Q3

Haiti shares a border with the Dominican Republic on the Caribbean island of Hispaniola.

(c) Identify TWO environmental benefits, other than those related to water quality, of maintaining forest ecosystems.

The table below contains demographic data for Haiti in 1995 and 2015.

DEMOGRAPHIC DATA FOR HAITI

Measure	**1995**	**2015**
Fertility rate (number of children per woman)	5.2	2.7
Life expectancy (years)	55	64
Infant mortality (deaths per 1,000)	85	48

Question 3

2017 ▪ Q3

Haiti shares a border with the Dominican Republic on the Caribbean island of Hispaniola.

(d) Identify and discuss one factor in a less developed country that could contribute significantly to a change in life expectancy, similar to what occurred in Haiti from 1995 to 2015.

Question 3

2017 ▪ Q3

Haiti shares a border with the Dominican Republic on the Caribbean island of Hispaniola.

(e) Identify and discuss one economic or cultural factor in a less developed country that could contribute significantly to a change in the fertility rate, similar to what occurred in Haiti from 1995 to 2015.