Past-paper walk-through

Acid Rain ▪ 7.7

eXercise

Questions in this set

- 2025 Set 1 Q3
- 2016 Q4

Reading the mark scheme

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

Question 3

2025 Set 1 ▪ Q3

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

(a) One major environmental problem is air pollution. Air pollution can come from natural or anthropogenic sources. Motor vehicles can be a source of particulate matter (PM) and other pollutants.

Identify an anthropogenic source of particulate matter, other than from motor vehicles.

Question 3

2025 Set 1 ▪ Q3

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

(b) One way to reduce pollutants associated with motor vehicles is to use a vapor recovery nozzle. Describe one way a vapor recovery nozzle is used to reduce atmospheric pollution.

Question 3

2025 Set 1 ▪ Q3

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

(c) Acid rain is another air pollutant linked to motor vehicles. Over the past few years, there has been an increase in the number of people working from home, so fewer people are commuting to work in their personal vehicles.

Explain how a decrease in the number of people commuting to work in their personal vehicles could lead to a reduction in acid rain.

Question 3

2025 Set 1 ▪ Q3

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

(d) The average gas mileage for a small gasoline-powered sport utility vehicle (SUV) is 22 miles per gallon (mpg) in the city. The average gas mileage for a small hybrid SUV is 36 mpg in the city. One commuter sells their gasoline-powered SUV and replaces it with a hybrid SUV.

Calculate the percent change in gas mileage between the gasoline-powered SUV and the hybrid SUV based on the data provided. Show your work.

Question 3

2025 Set 1 ▪ Q3

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

(e) Both the gasoline-powered SUV and the hybrid SUV have 14-gallon gas tanks. As stated in part D, the average gas mileage for a small gasoline-powered sport utility vehicle (SUV) is 22 miles per gallon (mpg) in the city. The average gas mileage for a small hybrid SUV is 36 mpg in the city.

Calculate how many more miles the owner can drive in the hybrid SUV in the city than they could have driven in the gasoline-powered SUV. Show your work.

Question 3

2025 Set 1 ▪ Q3

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

(f) In addition to vehicles, buildings such as schools often have high energy consumption. The primary sources of energy use in many buildings are heating, cooling, and lighting.

Propose a realistic solution that schools could implement to decrease energy use for heating and cooling, other than a reduction in the amount of time the school building is occupied.

Question 3

2025 Set 1 ▪ Q3

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

(g) The school plans to upgrade its lighting to save money and reduce both its electricity use and its ecological footprint. The sustainability committee proposes that the school reduce its electricity use by switching to energy-efficient light-emitting diode (LED) bulbs. The school building uses 2.8×10^4 bulbs. The LED bulbs would each use 0.0085 kilowatts per hour. Each bulb would be used for an average of 2,340 hours per year.

Calculate the energy use in the school building in kilowatts per year using LED light bulbs. Show your work.

Solution 3

(a)

Mark scheme

- An anthropogenic source of particulate matter other than motor vehicles: coal/fossil fuel combustion; industrial exhaust; construction/demolition; waste incineration; mining; burning of biomass; anthropogenically caused wildfires; unpaved roads; or agricultural fields.

Solution 3

(b)

Mark scheme

- A vapor recovery nozzle reduces atmospheric pollution by preventing fumes/vapors from escaping into the atmosphere while gassing/fueling a motor vehicle.

Solution 3

(c)

Mark scheme

- A decrease in personal-vehicle commuting reduces acid rain because it results in lower nitrogen oxide/sulfur oxide emissions from cars, which leads to less nitric acid/sulfuric acid forming in the atmosphere.

Solution 3

(d)

Mark scheme

- Calculate percent change in gas mileage from 22 mpg (gasoline SUV) to 36 mpg (hybrid SUV). Setup (1 pt): % change = (36 mpg - 22 mpg) / 22 mpg x 100. Calculation (1 pt): (36-22)/22 x 100 = 14/22 x 100 63.6% increase (accept 63.6, 64%, or 64).

Solution 3

(e)

Mark scheme

- Calculate the extra miles drivable in the hybrid SUV vs. the gasoline SUV, both with 14-gallon tanks (36 mpg vs. 22 mpg). Setup (1 pt): (14 gal x 36 mpg) - (14 gal x 22 mpg), i.e., 14 x (36-22). Calculation (1 pt): 14x36 - 14x22 = 504 - 308 = 196 more miles (accept ~200).

Solution 3

(f)

Mark scheme

- A realistic school solution to decrease heating/cooling energy use (other than reducing occupied time): implement green building design features; open windows to reduce air-conditioning use; use energy-efficient heating and cooling equipment; adjust the thermostat to reduce heating/cooling use; or install conservation landscaping.

Solution 3

(g)

Mark scheme

- Calculate the school's annual LED lighting energy use: 2.8x10^4 bulbs, each using 0.0085 kW, used 2,340 hours/year. Setup (1 pt): (2.8x10^4 bulbs) x 0.0085 kW x 2,340 hours. Calculation (1 pt): 28,000 x 0.0085 x 2,340 = 556,920 kWh/year (accept ~5.6x10^5 or 5.6E5; kWh/year or kW/year units both accepted).

Question 4

2016 ▪ Q4

Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.
(a) Describe how TWO climate factors affect the rate of soil formation.

Question 4

2016 ▪ Q4

Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.

(b)(i) As soils form, distinct layers known as horizons develop over time. One of these is the A horizon.

Identify one specific biotic component of the A horizon.

(b)(ii) Identify one abiotic component of the A horizon.

Question 4

2016 ▪ Q4

Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.

(c)(i) Resources such as soil and water can be degraded by human activities. Nitrate levels exceeding the United States Environmental Protection Agency's primary drinking water standard have been found in the groundwater of areas with intensive agriculture.

Identify one agricultural practice that can lead to elevated nitrate levels in groundwater.

(c)(ii) Describe how the practice you identified in (c)(i) leads to elevated nitrate levels in groundwater.

Question 4

2016 ▪ Q4

Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.

(d)(i) Acid deposition has affected soil quality in many parts of the northeastern United States.

Explain one way acid deposition onto soil can affect plant health.

(d)(ii) Describe one method for remediating soil affected by acid deposition.

Question 4

2016 ▪ Q4

Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.

(e) Climate change is causing far-reaching ecosystem changes, including soil degradation in many of the world's biomes. **Describe** TWO ways that climate change can degrade soil.

Solution 4

(a) Mark scheme

- 2 points: 1 point for each of TWO correctly described climate factors affecting the rate of soil formation (merely naming a factor earns no point) — only the first two given earn credit. Acceptable: Temperature — high temperature increases biological/chemical activity (increases soil formation rate); low temperature decreases biological activity (decreases formation) but increases weathering via freeze-thaw/frost wedging (increases formation). Precipitation/humidity — high precipitation increases biological activity and weathering (increases formation) but also increases erosion/runoff (decreases formation); low precipitation decreases biological activity and weathering (decreases formation). Wind — can carry in particles (increases accumulation) or hasten erosion (decreases accumulation).

Solution 4

(b)(i)

Mark scheme

- 1 point for a correct identification of a specific biotic component of the A horizon: humus, microorganisms, bacteria, earthworms, macroinvertebrates, roots, fungi, beetles, decomposers, or insects.

(b)(ii)

Mark scheme

- 1 point for a correct identification of an abiotic component of the A horizon: sand, silt, clay, water, air, nutrients (N, P, K compounds), decomposing parent material, minerals, rocks, or pebbles.

Solution 4

(c)(i)

Mark scheme

- 1 point for a correct agricultural practice that can lead to elevated nitrate levels in groundwater: application of fertilizer; improper sealing of feedlots; or improper construction/maintenance of animal waste lagoons.

Solution 4

(c)(ii)

Mark scheme

- 1 point for a correct description linked to the practice identified in (c)(i): nitrates infiltrate/percolate/seep down into groundwater; or nitrates enter surface waters that recharge aquifers, connecting surface water to groundwater.

Solution 4

(d)(i) Mark scheme

- 1 point for a correct explanation of one way acid deposition onto soil can affect plant health: increased soil acidity may fall outside the plant's optimal tolerance range, causing poor growth or death; acid can leach cations/metal ions/nutrients from the soil, making them less available to plants and decreasing growth; aluminum is released and can be toxic to plants; acid can diminish the soil's buffering ability, leading to poor plant growth; increased soil acidity can damage plant root systems, stressing plants; or sulfur and nitrogen from acid deposition can build up to levels toxic to plants (or over-fertilize soils).

Solution 4

(d)(ii)

Mark scheme

- 1 point for a correct description of a remediation method for soil affected by acid deposition: add crushed limestone / lime / marble dust / bone meal / crushed egg shells or oyster shells to raise soil pH.

Solution 4

(e) Mark scheme

- 2 points: 1 point for each of TWO correctly described ways climate change can degrade soil — only the first two given earn credit. Acceptable: increased global temperatures and decreased precipitation cause desertification; increased temperatures increase evaporation of irrigation water, resulting in soil salinization; increased erosion and/or leaching from increased precipitation in certain areas; increased temperature leads to faster breakdown of organic matter (less organic matter in soil); increased temperatures and shifting climatic belts result in longer growing seasons, which can deplete soil nutrients; rising sea levels can flood coastal areas, leading to salinization and increased soil erosion; increased temperatures can lead to soil desiccation.