Past-paper walk-through

Impacts of Mining ▪ 5.9

eXercise

Questions in this set

- 2025 Set 2 Q3
- 2023 Set 1 Q3
- 2023 Set 2 Q1
- 2016 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 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(a) Identify a type of surface mining the company could use to access the coal.

Question 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(b) Describe an environmental problem associated with surface mining.

Question 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(c) The town is located downwind of the new coal-burning power plant.

Describe an environmental problem the town could experience as a result of the electricity generation at the coal-burning power plant.

Question 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(d) The local government is concerned about the environmental consequences of using coal to generate electricity for the town.

Propose a realistic solution the local government could enact that would reduce the negative environmental consequences of using coal to generate electricity.

Question 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(e) Burning one pound of coal produces an average of 0.88 kilowatt-hours (kWh) of electricity. An average household in the United States uses 1.064×10^4 kWh of electricity each year.

Calculate how many pounds of coal would need to be burned to generate enough electricity to power a town with 11,000 houses for a year. **Show** your work.

Question 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(f) Researchers are concerned about the impact of noise pollution on songbirds in a forest near the power plant. Since the power plant was installed, bird species richness has declined from 7.5 species per hectare to 6.0 species per hectare.

Calculate the percent change in bird species per hectare since the power plant was installed. **Show** your work.

Question 3

2025 Set 2 ▪ Q3

The local government of a newly built town has contracted with an electrical company to provide energy to the town. The company generates electricity primarily through the burning of coal and has built a new power plant for the town. A nearby deposit of coal was discovered close to the surface. To access the coal, the company decides to remove the overburden and vegetation over the deposit.

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

(g) The town has been growing since it was built and had a growth rate of 5.38% in 2022, with a population of 26,250.

Assuming that the growth rate remains constant, **calculate** the year in which the population will reach 52,500. **Show** your work.

Solution 3

(a)

Mark scheme

- A type of surface mining the company could use to access the coal: strip mining, open pit mining, or mountaintop removal. 1 point for naming any one valid surface-mining type.

Solution 3

(b)

Mark scheme

- An environmental problem associated with surface mining: removal of vegetation/soil/rock causes loss/destruction of habitat (and resulting loss of biodiversity); removal of vegetation can increase erosion rates; surface mining can contaminate groundwater/surface water/waterways via runoff of sediments/pollutants; removal of vegetation/soil/bedrock/parent material can release dust particles/methane; or high energy/fossil fuel consumption to operate equipment leads to air pollution. 1 point for any one valid problem.

Solution 3

(c)

Mark scheme

- An environmental problem the downwind town could experience from the power plant's electricity generation: release of air pollutants/toxic metals/particulates/NOx/SOx could lower air quality and cause respiratory problems; release of sulfur dioxides/nitrogen oxides could cause acid rain; or greenhouse gas emissions (carbon dioxide/methane/water vapor) could alter precipitation/climate/weather/temperature patterns. 1 point for any one valid problem.

Solution 3

(d)

Mark scheme

- A realistic solution the local government could enact: require/incentivize the plant to install scrubbers/electrostatic precipitators; incentivize the use of alternative energy sources/energy-efficient appliances; or incentivize green building design/conservation landscaping/planting trees as carbon sinks. 1 point for any one valid, realistic solution.

Solution 3

(e) Mark scheme

- Setup (1 point): pounds of coal needed = (11,000 houses x 10,640 kWh per house) / 0.88 kWh per lb of coal, i.e. $\frac{11{,}000 \times 10{,}640}{0.88}$, using the given household usage of 1.064×10^4 kWh/year and the given 0.88 kWh generated per pound of coal burned. Calculation (1 point): approximately 133,000,000 lb of coal (i.e. 1.33×10^8 lb). Award 1 point for the correct setup (total kWh needed for the town divided by kWh generated per lb of coal) and 1 point for the correct final numeric value (accept equivalent or reasonably rounded answers).

Solution 3

(f)

Mark scheme

- Setup (1 point): percent change = (6.0 species/ha - 7.5 species/ha) / 7.5 species/ha x 100, i.e. $\frac{6.0 - 7.5}{7.5} \times 100$. Calculation (1 point): -20

Solution 3

(g)

Mark scheme

- Setup (1 point): since the target population of 52,500 is double the 2022 population of 26,250, use the Rule of 70 to estimate doubling time and add it to the starting year: $\left(\frac{70}{5.38}\right) + 2022$. Calculation (1 point): 2035 (doubling time of about 13 years added to 2022). Award 1 point for the correct setup (70 divided by the percent growth rate, plus the starting year) and 1 point for the correct final year (accept 2035 or a value from a reasonably equivalent growth calculation).

Question 3

2023 Set 1 ▪ Q3

3. Crude oil is extracted, transported, and refined for various uses by humans.

(a) **Describe** one environmental impact on marine ecosystems associated with extraction or transportation of crude oil.

(b) **Identify** an atmospheric pollutant released during the combustion of refined oil products.

(c) **Propose** a solution an individual can use to reduce their reliance on refined oil products for transportation.

(d) **Justify** the solution proposed in part (c) by providing a benefit to human health.

Other natural resources, such as gold and silver, are also extracted. These resources can be used to make components for the electronics humans use. One metric ton of gold ore contains 5.0 grams of gold.

(e) A deposit is estimated to contain 260 million metric tons of gold ore. **Calculate** the number of grams of gold that could be extracted from the deposit. **Show** your work.

Question 3

(f) Assuming the price of gold is $62.56 per gram, **calculate** the value of the gold that could be recovered from 1,000 metric tons of gold ore in the deposit. **Show** your work.

(g) A typical cell phone contains 0.034 grams of gold. **Calculate** how many metric tons of gold ore would need to be mined to extract enough gold to manufacture 100,000 cell phones. **Show** your work.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

STOP

END OF EXAM

Solution 3

(a)

Mark scheme

- Any one environmental impact: marine life is harmed/killed by being coated/suffocated by oil from spills; animals are harmed/killed by ingesting spilled oil; oil slicks from spills can block sunlight from entering water and inhibit photosynthesis; oil that washes up on beaches/in marshes/in estuaries damages habitat; noise pollution disrupts marine animals' ability to communicate/mate/eat/evade prey; or CO2 from combustion of fuels in boats/equipment is absorbed by the ocean and contributes to ocean acidification.

Solution 3

(b)

Mark scheme

- Any one atmospheric pollutant: carbon dioxide (CO2); nitrogen oxides (NOx, NO, NO2, N2O); sulfur oxides (SOx, SO2, SO3); particulate matter (PM); carbon monoxide (CO); or volatile organic compounds (VOCs).

Solution 3

(c)

Mark scheme

- Any one solution: ride a bike/scooter/skateboard or walk instead of driving; replace a gasoline/diesel powered car with a hybrid or electric vehicle; replace a gasoline/diesel powered car with one that utilizes alternative fuel (biodiesel, ethanol, hydrogen); buy/drive a more fuel-efficient vehicle; work from home/telecommute to reduce miles driven; choose housing close to employment to reduce miles driven; take public transportation instead of driving; carpool instead of driving alone; or combine trips to reduce miles driven.

Solution 3

(d)

Mark scheme

- Fewer air pollutants (particulates, NOx, VOCs, smog) from the proposed solution lead to lower rates of respiratory illness/problems (such as asthma, COPD, lung cancer), lower rates of cardiovascular illness (such as heart attacks), and less eye irritation. If the solution proposed in (c) was active transport (biking/walking/scootering), an additional acceptable justification is improved health/decreased risk of disease/cardiovascular illness from more physical activity/exercise.

Solution 3

(e)

Mark scheme

- Setup (1 point): 260×10^6 metric tons $\times \dfrac{5 \text{ grams}}{1 \text{ metric ton}}$ (equivalently $5 \times 260{,}000{,}000$). Calculation (1 point): $260{,}000{,}000 \times 5 = 1{,}300{,}000{,}000$ grams of gold (i.e. 1.3×10^9 g). Award 1 point for the correct dimensional setup and 1 point for the correct final numeric answer (1,300,000,000 g or 1.3 x $10^9 g$).

Solution 3

(f)

Mark scheme

- Setup (1 point): $\dfrac{\$62.56}{1 \text{ gram}} \times 1{,}000 \text{ metric tons} \times \dfrac{5 \text{ grams}}{1 \text{ metric ton}}$ (equivalently $1{,}000 \times 5 \times \$62.56$). Calculation (1 point): $1{,}000 \times 5 \times 62.56 = 312{,}800$, so the gold recovered from 1,000 metric tons of ore is worth \$312,800. Award 1 point for the correct setup and 1 point for the correct final numeric answer (\$312,800).

Solution 3

(g) Mark scheme

- Setup (1 point): $\frac{0.034 \text{ grams}}{1 \text{ cell phone}} \times \frac{1 \text{ metric ton}}{5 \text{ grams}} \times 100{,}000$ cell phones (equivalently $\frac{0.034 \times 100{,}000}{5}$). Calculation (1 point): $\frac{0.034 \times 100{,}000}{5} = \frac{3{,}400}{5} = 680$ metric tons of gold ore. Award 1 point for the correct setup and 1 point for the correct final numeric answer (680 metric tons).

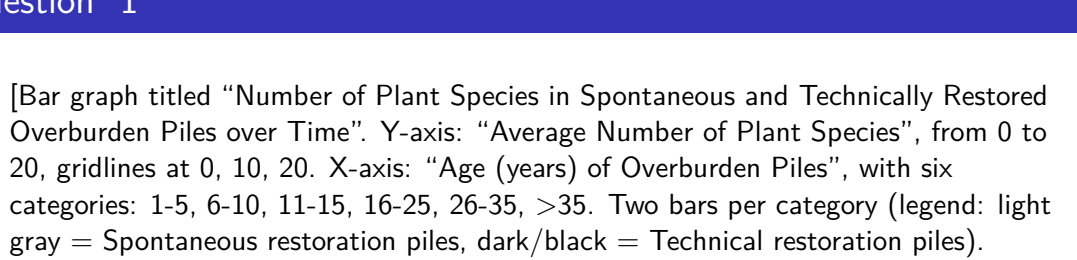
Question 1

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

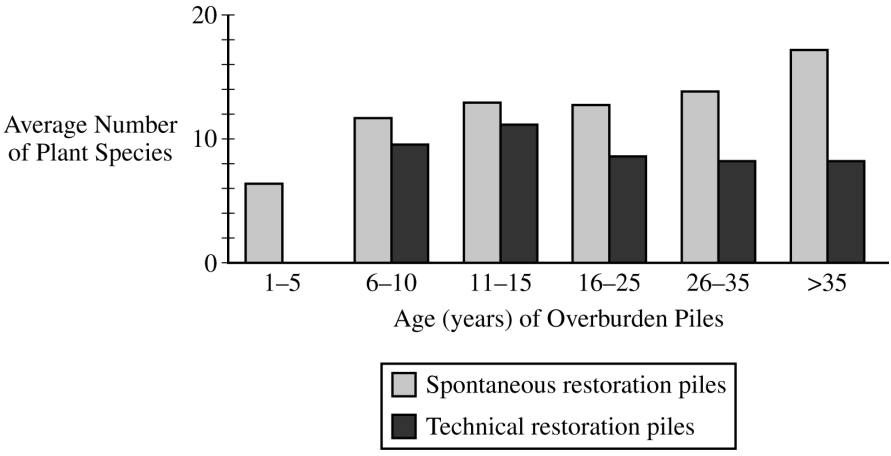
Limiting runoff on disturbed land improves soil and water quality. To model water runoff, students set up three large plastic trays and filled each tray with loam soil to 1 centimeter below the edge. Loam soil is a balance of sand, silt, and clay soil. One tray was seeded with wheatgrass and grown for 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
26–35
>35
Age (years) of Overburden Piles
Spontaneous restoration piles
Technical restoration piles

Question 1

2023 Set 2 ▪ Q1

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

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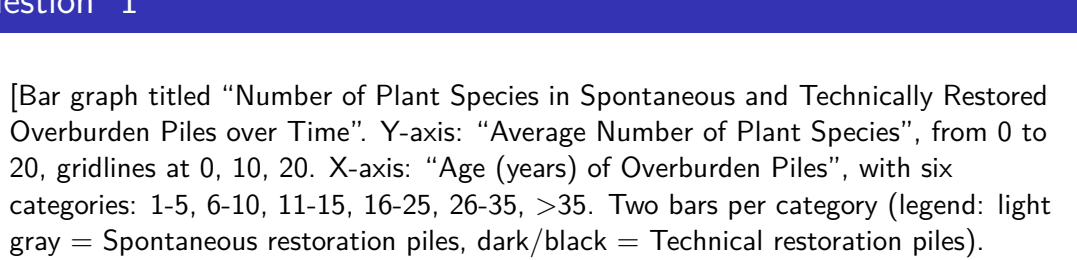

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