

Question 3: Analyze an Environmental Problem and Propose a Solution (Doing Calculations)

10 points

A Identify a type of surface mining the company could use to access the coal. **Point 01**

Examples of acceptable responses may include the following:

- Strip mining
- Open pit
- Mountain top removal

B Describe an environmental problem associated with surface mining. **Point 02**

Examples of acceptable responses may include the following:

- Removal of vegetation/soil/rock causes loss/destruction of habitat.
- (Surface mining) causes loss of habitat, which results in loss of biodiversity.
- Removal of vegetation can increase rates of erosion.
- (Surface mining) can lead to contamination of groundwater/surface water/waterways from runoff of sediments/pollutants.
- Removal of vegetation/soil/bedrock/parent material can release dust particles/methane.
- High energy/fossil fuel consumption is needed to operate equipment and leads to air pollution.

C Describe an environmental problem the town could experience as a result of the electricity generation at the coal-burning power plant. **Point 03**

Examples of acceptable responses may include the following:

- Release of air pollutants/toxic metals/particulates/ NO_x / SO_x could lower air quality/result in respiratory problems.
- Release of air pollutants/sulfur dioxides/nitrogen oxides could cause acid rain.
- Greenhouse gas emissions/carbon dioxide/methane/water vapor could lead to altered precipitation/climate/weather/temperature patterns.

D Propose a realistic solution the local government could enact that would reduce the negative environmental consequences of using coal to generate electricity. **Point 04**

Examples of acceptable responses may include the following:

- Require/incentivize the plant to install scrubbers/electrostatic precipitators.
- Incentivize the use of alternative energy sources/energy efficient appliances.
- Incentivize green building design/conservation landscaping/planting trees as carbon sinks.

E 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. **Point 05**

One point for the correct setup to calculate how many pounds of coal would be needed.

Examples of acceptable responses may include the following:

- $(11,000 \text{ houses} \times 10,640 \text{ kWh per house}) / 0.88 \text{ kWh per lb of coal}$
- $(11,000 \times 10,640) / 0.88$

One point for the correct calculation of how many pounds of coal would be needed. **Point 06**

Examples of acceptable responses may include the following:

- 133,000,000
- 1.33×10^8

F Calculate the percent change in bird species per hectare since the power plant was installed. **Show** your work. **Point 07**

One point for the correct setup to calculate the percent change in bird species per hectare.

Examples of acceptable responses may include the following:

- $(6.0 \text{ species / ha} - 7.5 \text{ species / ha}) / 7.5 \text{ species / ha} \times 100$
- $(6.0 - 7.5) / 7.5 \times 100$

One point for the correct calculation of the percent change in bird species per hectare. **Point 08**

Examples of acceptable responses may include the following:

- -20%
- 20% decrease
- -20

G Assuming that the growth rate remains constant, **calculate** the year in which the population will reach 52,500. **Show** your work. **Point 09**

One point for the correct setup to calculate the year the population will reach 52,500.

Acceptable setup point:

- $(70 / 5.38) + 2022$

One point for the correct calculation of the year the population will reach 52,500. **Point 10**

Acceptable calculation point:

- 2035

Question 3: Analyze an Environmental Problem and Propose a Solution Doing Calculations 10 points

- (a) **Identify** one negative human health effect linked to the exposure to pollutants resulting from the combustion of coal. 1 point

Accept one of the following:

- Lung disease/respiratory diseases (asthma, COPD, bronchitis, lung cancer)
- Neurological damage
- Birth defects
- Heart disease
- Eye irritation/respiratory irritation/headaches

Total for part (a) 1 point

- (b) (i) **Describe** an environmental problem associated with coal ash waste disposal. 1 point

Accept one of the following:

- Leaching from landfills/clay-lined pits
- Overflowing of coal ash into bodies of water
- Leaking and contamination of groundwater, soil, or nearby bodies of water
- Coal ash washing into bodies of water as a result of severe weather events
- Dry ash carrying into nearby bodies of water, increasing turbidity/decreasing photosynthesis

- (ii) A proposed solution is to dispose North Carolina's coal ash in clay-lined pits. **Justify** this solution by providing one advantage of using clay soil. 1 point

- Clay is less permeable than unlined pits and can prevent the leaching of coal ash into soil/groundwater.

Total for part (b) 2 points

- (c) (i) **Calculate** the percent change in Charlotte's population from 2013 to 2019. **Show** your work. 1 point

One point for the correct setup to calculate the percent change:

- $\frac{857,425 \text{ people} - 757,278 \text{ people}}{757,278 \text{ people}} \times 100$
- $\left(\frac{857,425 \text{ people}}{757,278 \text{ people}} - 1 \right) \times 100$

One point for the correct calculation of the percent change: 1 point

Accept one of the following:

- 13%
- 13.22%
- 13.224602%

- (ii) Based on Charlotte's 2019 growth rate of 1.88%, **calculate** the year when the population of Charlotte will double, assuming the growth rate stays the same. **Show** your work. 1 point

One point for the correct setup to calculate the year the population of Charlotte will double:

- Doubling time = $\frac{70}{1.88} = 37 \text{ years} + 2019$

One point for the correct calculation year the population of Charlotte will double: 1 point

- 2056

- (iii) The average Charlotte resident uses 90 gallons of water per day. **Calculate** the gallons of water used by the population of Charlotte in the year 2018. **Show** your work. 1 point

One point for the correct setup to calculate the gallons of water used in 2018:

- $\frac{90 \text{ gallons of water}}{\text{person per day}} \times 841,611 \text{ people} \times 365 \text{ days}$

One point for the correct calculation of the gallons of water used in 2018: 1 point

Accept one of the following:

- 27,646,921,350 gallons
- 2.76×10^{10} gallons
- 2.8×10^{10} gallons
- 3×10^{10} gallons

Total for part (c) 6 points

- (d) Drought periods are becoming more frequent in North Carolina, causing water resources to become more scarce. **Describe** one realistic action that citizens could take to reduce domestic outdoor water use. 1 point

Accept one of the following:

- Plant drought resistant plant species/use artificial landscaping/use xeriscaping to reduce the need for irrigation.
- Eliminate/reduce nonessential usage of water, such as washing of cars, power washing.
- Reduce the use of sprinklers/irrigation by monitoring soil conditions, weather conditions or reducing frequency.
- Collect rainwater or gray water for irrigation.
- Water plants/lawn before sunrise/after sunset to limit evaporation.
- Switch to drip irrigation to limit evaporation.

Total for part (d) 1 point

Total for question 3 10 points