

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. One point for the correct setup to calculate how many pounds of coal would be needed. Examples of acceptable responses may include the following: • $(11,000 \text{ houses} \times 10,640 \text{ kWh per house}) / 0.88 \text{ kWh per lb of coal}$ • $(11,000 \times 10,640) / 0.88$	Point 05
	One point for the correct calculation of how many pounds of coal would be needed. Examples of acceptable responses may include the following: • 133,000,000 • 1.33×10^8	Point 06
F	Calculate the percent change in bird species per hectare since the power plant was installed. Show your work. One point for the correct setup to calculate the percent change in bird species per hectare. Examples of acceptable responses may include the following: • $(6.0 \text{ species / ha} - 7.5 \text{ species / ha}) / 7.5 \text{ species / ha} \times 100$ • $(6.0 - 7.5) / 7.5 \times 100$	Point 07
	One point for the correct calculation of the percent change in bird species per hectare. Examples of acceptable responses may include the following: • -20% • 20% decrease • -20	Point 08
G	Assuming that the growth rate remains constant, calculate the year in which the population will reach 52,500. Show your work. One point for the correct setup to calculate the year the population will reach 52,500. Acceptable setup point: • $(70 / 5.38) + 2022$	Point 09
	One point for the correct calculation of the year the population will reach 52,500. Acceptable calculation point: • 2035	Point 10

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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