AP® Environmental Science

Sample Student Responses and Scoring Commentary Set 1

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Free-Response Question 3

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

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A	**Identify** an anthropogenic source of particulate matter, other than from motor vehicles.	**Point 01**

Examples of acceptable responses may include the following:

- Coal/fossil fuel combustion
- Industrial exhaust
- Construction/demolition
- Waste incineration
- Mining
- Burning of biomass
- Anthropogenically caused wildfires
- Unpaved roads
- Agricultural fields

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.	**Point 02**

Acceptable description point:

- It prevents fumes/vapors from escaping into the atmosphere when gassing/fueling (a motor vehicle).

C	**Explain** how a decrease in the number of people commuting to work in their personal vehicles could lead to a reduction in acid rain.	**Point 03**

Examples of acceptable responses may include the following:

- (A decrease in commuting) would result in lower nitrogen oxide/sulfur oxide emissions from cars/vehicles.
- (A decrease in commuting) would lead to less nitric acid/sulfuric acid in the atmosphere.

D	**Calculate** the percent change in gas mileage between the gasoline-powered SUV and the hybrid SUV based on the data provided. **Show** your work.	**Point 04**

One point for the correct setup to calculate the percent change in gas mileage.

Examples of acceptable responses may include the following:

- (36 mpg – 22 mpg) / 22 mpg x 100
- (36 – 22) / 22 x 100

	One point for the correct calculation of the percent change in gas mileage.	**Point 05**

Examples of acceptable responses may include the following:

- 63.6% increase
- 63.6%
- 63.6
- 64%
- 64

E	**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.	**Point 06**

One point for the correct setup to calculate how many more miles the hybrid SUV can drive than the gasoline-powered SUV.

Examples of acceptable responses may include the following:

- (14 gallon x 36 mpg) – (14 gallon x 22 mpg)
- (14 x 36) – (14 x 22)
- 14*(36-22)

	One point for the correct calculation of how many more miles the hybrid SUV can drive than the gasoline-powered SUV.	**Point 07**

Examples of acceptable responses may include the following:

- 196
- 200

F	**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.	**Point 08**

Examples of acceptable responses may include the following:

- Implement green building design features
- Open windows to reduce use of air conditioning
- Use energy-efficient heating and cooling equipment
- Adjust the thermostat to reduce use of heat and air conditioning
- Install conservation landscaping

G   **Calculate** the energy use in the school building in kilowatts per year using LED light bulbs. **Point 09**
Show your work.

One point for the correct setup to calculate the energy use in the school building in kWh/year using LED light bulbs.

Examples of acceptable responses may include the following:

- (2.8 x 10^4 bulbs) x 0.0085 kilowatt x 2,340 hours
- (2.8 x 10^4) x 0.0085 x 2,340

One point for the correct calculation of the energy use in the school building in kWh/year **Point 10**
using LED light bulbs.

Examples of acceptable responses may include the following (if units are included in the response, kWh/year or kW/year are accepted):

- 556,920
- 5.6 x 10^5
- 5.6E5

----Response A----

A) An anthropogenic source of particulate matter is construction of buildings.

----Response B----

B) A vapor recovery nozzle is able to absorb some of the harmful gasses emitted by the burning of fossil fuels such as lead or NOx that would be realeased into the atmosphere and cause harmful processes such as photocemical smog.

----Response C----

C) The reduction of people commuting to work in personal vehicles would reduce acid rain because their personal vehicles emit harmful gasses such as NO_2 and SO_2. These gasses combine with the atmospheric H_2O and create the atmospheric acids of H_2SO_4 and HNO_3 that come together to form the issue of acid rain. Therefore if there are less personal vehicles from people commuting to work then there will be less of the ingredients for the formation of acid rain.

----Response D----

D) (36-22)/22 x 100= 63.636%

----Response E----

E)

Gasoline=14x22=308 miles/tank

Hybrid=14x36=504 miles/tank

504-308=196 miles more in the Hybrid than Gasoline powered SUV

----Response F----

F) A school could impliment the change of using natural means in order to maintain the temperature such as strategically placed windows and trees that would block or let in the sun's rays depending on the time of year in order for the sun to naturally heat the school when it is colder outside and block the sun's rays when it's hot outside. Therefore allowing for the sun to help with heating and cooling so there is less of a reliance on using energy for heating and cooling.

----Response G----

G) 2.8×10^4 x 0.0085 x 2340= 556,920 kw/year

----Response A----

A) An anthropogenic source of particulate matter would be burning fossil fuels in factories.

----Response B----

B) A vapor recovery nozzle takes the gasoline that is toxic to the environment that motor vehicles export, and then store the gas so it doesn't get exposed into the atmosphere, overall helping and reducing the atmospheric pollution.

----Response C----

C) With less people commuting to work, it reduces the amount of people using their motor vehicles, which then reduces the pollutants let into the atmosphere from their motor vehicles, resulting in a less likely chance of the formation of acid rain.

----Response D----

D) (36 mpg - 22 mpg) / 22 mpg = 0.636 mpg

0.636 mpg x 100% = **63.6% mpg**

----Response E----

E) 14 gal x 22 mpg = 308 miles

14 gal x 36 mpg = 504 miles

504 miles - 308 miles = **196 more miles**

----Response F----

F) Schools could implement solar panels on their roof, which would greatly decrease the amount of energy that is used for heating and cooling, as it's source would then be from the sun.

----Response G----

G) ((0.0085 kw) / 1 hr) x ((2340 hr) / 1 yr)

=19.89 kw/year

----Response A----

ocean acidifcation

----Response B----

Using a vapor recovery nozzle stops the vapor from going into the atmosphere which reduces pollution.

----Response C----

With less motor vehicles in use there is less pollutant being relased into the atmosphere. With less pollutant there is less reaction to cause acid rain.

----Response D----

The pecentage in change is 1.6% 22/36

----Response E----

The hybrid SUV could drive 196 more miles

36x14=504 22x14=308 504-308=196

----Response F----

To decrease energy use for heating and cooling schools could install solar panels to collect energy and reuse it. Not only would that that decrease energy use but it would incease cost as well.

----Response G----

the energy use in the school would be 19.89   0.0085x2340

Question 3

Note: Student samples are quoted verbatim and may contain spelling and grammatical errors.

Overview

NEW for 2025: The question overviews can be found in the *Chief Reader Report on Student Responses* on AP Central.

Sample: 3A
Score: 9

One point was earned for part A for identifying "construction" as an anthropogenic source of particulate matter. No point was earned for part B. One point was earned for part C for explaining "The reduction of people commuting to work in personal vehicles would reduce acid rain because their personal vehicles emit harmful gasses such as NO_2 and SO_2. These gasses combine with the atmospheric H_2O and create the atmospheric acids of H_2SO_4 and HNO_3 that come together to form the issue of acid rain." Two points were earned for part D: One point was earned for the correct setup, and one point was earned for the correct answer. Two points were earned for part E: One point was earned for the correct setup, and one point was earned for the correct answer. One point was earned for part F for proposing "using natural means in order to maintain the temperature such as strategically placed windows and trees that would block or let in the sun's rays depending on the time of year in order for the sun to naturally heat the school when it is colder outside and block the sun's rays when it's hot outside," which are green building design features, as a realistic solution that schools could implement to decrease energy use. Two points were earned for part G: One point was earned for the correct setup, and one point was earned for the correct answer.

Sample: 3B
Score: 5

One point earned for part A for identifying "burning fossil fuels" as an anthropogenic source of particulate matter. No point earned for part B. No point earned for part C. Two points were earned for part D: One point was earned for the correct setup, and one point was earned for the correct answer. Two points were earned for part E: One point was earned for the correct setup, and one point was earned for the correct answer. No point earned for part F. No points were earned for part G.

Sample: 3C
Score: 2

No point was earned for part A. No point was earned for part B. No point was earned for part C. No points were earned for part D. Two points were earned for part E: One point was earned for the correct setup, and one point was earned for the correct answer. No point was earned for part F. No points were earned for part G.