

Question 2: Analyze an Environmental Problem and Propose a Solution

10 points

A	Identify the sea surface condition for the eastern equatorial area of the Pacific Ocean illustrated in Figure 1. Acceptable identification point: (Ocean water) cooler than average	Point 01
B	Based on the information in Figure 1, identify the climate phenomenon associated with the sea surface conditions shown in the equatorial area of the Pacific Ocean. Acceptable identification point: La Niña	Point 02
C	Based on the information in Figure 2, describe a difference in climate patterns between the regions A and B. Examples of acceptable responses may include the following: - Region A has an increased chance of precipitation, while Region B has a decreased chance of precipitation. - Region A will be wetter, while Region B will be drier.	Point 03
D	Describe one reason why there is an increased risk of flooding in urban areas during extended periods of precipitation. Examples of acceptable responses may include the following: - Impervious/paved surfaces increase runoff/reduce infiltration/reduce absorption. - Parking lots/roads/buildings/sidewalks increase runoff/reduce infiltration/reduce absorption. - There is less vegetation and, therefore, less infiltration/absorption.	Point 04
E	Propose a realistic solution a city could implement to decrease the risk of flooding in urban areas. Examples of acceptable responses may include the following: - Use permeable pavement - Plant vegetation/establish parks/create rain gardens/build green roofs - Install retention ponds/stormwater basins	Point 05

- F** **Justify** the solution proposed in part E by providing an additional advantage other than a reduction in the risk of flooding. **Point 06**

Examples of acceptable responses may include the following:

Solution from part E	Justification of solution with additional advantages
Use permeable pavement	- Increased recharge of nearby aquifers/groundwater - Decreased pollution in runoff
Plant vegetation/establish parks/create rain gardens/build green roofs	- Vegetation absorbs pollutants - Vegetation stores carbon dioxide/produces oxygen - Decreased erosion - Increased/restored habitat for wildlife - Increased biodiversity - Helps reduce urban heat island effect - Aesthetic enjoyment/improved quality of life - Creates jobs (in landscaping/park maintenance)
Install retention ponds/stormwater basins	- Decreased pollution in runoff - Increased habitat/biodiversity

- G** **Describe** one difference between the climate of a temperate seasonal forest and that of a savanna. **Point 07**

Examples of acceptable responses may include the following:

- Temperate seasonal forests have a cooler climate than a savanna.
- Temperate seasonal forests have a stronger/colder winter than a savanna.
- Temperate seasonal forests have four distinct seasons while savannas do not.
- Temperate seasonal forests receive more annual precipitation than savannas.
- Temperate forests receive precipitation throughout the year while savannas have a rainy season/dry season.

- H** **Identify** the ecological process that occurs following a forest fire that leaves the soil intact. **Point 08**
- Acceptable identification point:
- Secondary succession

I	Describe one way burning forests contribute to atmospheric pollution. Acceptable description point: Burning of trees releases CO₂/CO/NO_x/particulate matter/VOCs.	Point 09
J	Describe one sustainable forestry practice that could be used to reduce the occurrence or severity of forest fires. Examples of acceptable responses may include the following: - Prescribed burns can remove excess fuel/dead leaves/underbrush. - Brush removal can remove excess fuel/dead leaves/underbrush. - Selective cutting can create a fire break. - In agroforestry, ground crops that might otherwise be fuel can be harvested/removed.	Point 10

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

10 points

A	Identify an anthropogenic source of particulate matter, other than from motor vehicles. 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	Point 01
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. Acceptable description point: It prevents fumes/vapors from escaping into the atmosphere when gassing/fueling (a motor vehicle).	Point 02
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. 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.	Point 03

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. One point for the correct setup to calculate the percent change in gas mileage. Examples of acceptable responses may include the following: $(36 \text{ mpg} - 22 \text{ mpg}) / 22 \text{ mpg} \times 100$ $(36 - 22) / 22 \times 100$	Point 04
	One point for the correct calculation of the percent change in gas mileage. Examples of acceptable responses may include the following: 63.6% increase 63.6% 63.6 64% 64	Point 05
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. 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: $(14 \text{ gallon} \times 36 \text{ mpg}) - (14 \text{ gallon} \times 22 \text{ mpg})$ $(14 \times 36) - (14 \times 22)$ $14 \times (36 - 22)$	Point 06
	One point for the correct calculation of how many more miles the hybrid SUV can drive than the gasoline-powered SUV. Examples of acceptable responses may include the following: 196 200	Point 07
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. 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	Point 08

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:

- $(2.8 \times 10^4 \text{ bulbs}) \times 0.0085 \text{ kilowatt} \times 2,340 \text{ hours}$
- $(2.8 \times 10^4) \times 0.0085 \times 2,340$

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

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

- 556,920
- 5.6×10^5
- 5.6E5

Question 2: Analyze an Environmental Problem and Propose a Solution 10 points

(a) Based on the information in the diagram, **identify** the temperature range of the water through which the majority of the adult manatee's daily movement occurs. **1 point**

- 13–19°C

(b) Large groups of manatees are often observed in shallow waters near the waste water released by the electrical power plant during the winter. Based on the information in the diagram, **identify** a characteristic of the power plant waste water that would attract the manatees. **1 point**

Accept one of the following:

- The waste water/It is warm.
- The waste water/It is between 24–26°C.

(c) Based on the information in the diagram, **describe** a potential negative impact of the waste water released by the power plant on other aquatic species. **1 point**

Accept one of the following:

- Warming of the water near where the waste water/it is released reduces the amount of dissolved oxygen available for aquatic organisms to use/breathe.
- Warming of the water near where the waste water/it is released could impact the survival/health of species with a range of tolerance for the original/lower water temperatures.
- Warming of the water near where the waste water/it is released could alter/affect the timing of reproductive cycles for aquatic species.

(d) (i) **Describe** a characteristic of the manatees that increases their vulnerability to the recent decline of seagrasses. **1 point**

Accept one of the following:

- They eat seagrass/are herbivores, so they would have less food/starve.
- They require a lot of energy to survive, so they would have less food/starve.
- They inhabit warm water, so they would need to travel to colder waters/further to find food/seagrass.
- They have a low reproductive/maturation rate, so they would take longer to recover from loss of food source.

(d) (ii) **Describe** the change in energy flow through the trophic levels that occurs when there is a significant loss of seagrasses. **1 point**

Accept one of the following:

- Less energy will flow/is available to organisms in higher trophic levels.
- Less energy from the Sun is stored by producers.

Total for part (d) 2 points

- (e) (i) **Propose** a solution to reduce nutrient or sediment pollution in an estuary that is surrounded by urban development. **1 point**

Accept one of the following:

- Replace existing pavement with permeable pavement.
- Add vegetation where it will intercept runoff.
- Reduce fertilizer use in the area.
- Install barriers/Construct fences where they will intercept runoff.
- Improve wastewater treatment plants in the area.

- (e) (ii) **Justify** the solution proposed in part (e)(i) by providing an additional advantage of reduced nutrients in an estuary, other than one related to manatees. **1 point**

Accept one of the following:

- Reduces eutrophication.
- Increases biodiversity/species richness.
- Improves water clarity.
- Increases ecotourism.
- Reduces cost of water treatment.
- Increases profits for commercial fisherman.

Total for part (e) 2 points

- (f) **Describe** how summertime weather conditions can increase the frequency of photochemical smog. **1 point**

Accept one of the following:

- Sunlight is more intense/there is more sunlight in summer, and more primary pollutants/nitrogen oxides/ NO_x react in sunlight.
- Summertime temperatures are warmer than other seasons, and chemical reactions occur more quickly in warmer temperatures.
- Trees release more VOCs in summer leading to more reactions that form photochemical smog.

- (g) **Identify** one ecological problem that results from exposure to photochemical smog. **1 point**

Accept one of the following:

- Causes respiratory problems/eye irritation in animals.
- Reduces photosynthesis.
- Slows/Inhibits/Stunts plant growth.
- Increases the susceptibility of plants to pests and disease.

- (h) **Describe** a potential disadvantage of using hydrogen fuel cells to power automobiles. **1 point**

Accept one of the following:

- High cost to manufacture automobiles that use hydrogen fuel cells.
- Obtaining hydrogen requires a lot of energy/may consume more energy than the hydrogen fuel can produce.
- Hydrogen is explosive/flammable (may catch fire).
- Lack of infrastructure (such as fueling stations) for hydrogen fuel.
- Obtaining hydrogen often uses fossil fuels.
- Hydrogen must be obtained by separating it from natural gas or water.

Total for question 2 10 points