

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

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- (a) Based on the data in the graphs, **identify** the amount of land required to produce 1 kilogram of chicken protein. **1 point**
- 50 m²
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- (b) Based on the information provided, **identify** the type of survivorship curve exhibited by the darkling beetle. **1 point**
- Type III
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- (c) **Explain** why the reproductive strategy of the darkling beetle is an advantage for using mealworms as an alternative protein source for the rapidly growing human population. **1 point**
- Accept one of the following:
- Darkling beetles reproduce quickly, which allows for a large amount of protein to be produced in a short period of time.
 - Darkling beetles have many offspring, which allows for a large amount of protein to be produced in a short period of time.
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- (d) Based on the data in the graphs, **explain** whether producing 1 kilogram of chicken protein or 1 kilogram of pork protein would cause less environmental damage. **1 point**
- Accept one of the following:
- Chicken production has a lower global warming potential than pork production, so it would cause less environmental damage because chicken production releases less greenhouse gas.
 - Chicken production has a lower land use than pork production, so it would cause less environmental damage because there would be less deforestation/habitat destruction/soil erosion/fossil fuel use.
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- (e) Based on the data in the graphs, **explain** why the production of 1 kilogram of beef protein has a different impact on global warming than the production of 1 kilogram of protein from any of the other animals studied would have. **1 point**
- Accept one of the following:
- Beef has a larger impact because methane has a high global warming potential.
 - Beef has a larger impact because methane is a greenhouse gas.
 - Beef requires more land use, which results in loss of forests/habitat/grasslands leading to release of CO₂/reduction in carbon storage.
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(f)	Describe how water quality can be altered by cattle grazing that occurs near a stream or river. Accept one of the following: • Cattle cause erosion, which increases sedimentation/turbidity in water. • Cattle feces can add nutrients/nitrogen/phosphorus to waterways. • Cattle feces may contaminate waterways with bacteria.	1 point
(g)	Propose a solution to reduce the negative impacts on waterways that result from cattle grazing, while still allowing cattle to graze. Accept one of the following: • Practice rotational grazing/alternate grazing parcels. • Eat a diet with less meat/beef. • Fence/barricade the riparian zone. • Provide other water sources for the cattle.	1 point
(h)	Crop production can cause soil erosion. Describe a sustainable agricultural practice used to reduce soil erosion. Accept one of the following: • Switch crops to perennial plants. • Plant crops on terraces. • Implement contour plowing/farming. • Use no-till farming/cover crops.	1 point

- (i) **Justify** the use of the sustainable practice described in part (h) by describing an additional advantage, other than the reduction of soil erosion. **1 point**

Accept one of the following:

Solution proposed in (h)	Justification of solution with additional advantage other than the reduction of soil erosion
Switch to perennial plants	- Reduces the use of fossil fuels. - Reduces the cost of farming. - Increases/maintains carbon storage in soils. - Preserves habitats for organisms in soils.
Plant crops on terraces	- Allows areas to be farmed that are otherwise too steep. - Sediments and other contaminants settle out behind the terrace ridge reducing the amount of soil that runs off. - Increases groundwater absorption.
Implement contour plowing/farming	- Allows areas to be farmed that are otherwise too steep. - Increases groundwater absorption.
Use no-till farming/cover crops	- Reduces the use of fossil fuels. - Reduces the cost of farming. - Increases/maintains carbon storage in soils. - Preserves habitats for organisms in soils. - Cover crops can be used as green manure.

- (j) Crop production around the world is affected by climate change. **Describe** how crop production could be negatively affected by climate change. **1 point**

Accept one of the following:

- Crop production/yields could decrease because of:
 - Increased drought
 - Increased flooding
 - Increased insect infestation from warmer temperatures
 - Increased temperature
 - Changes in seasonal rain patterns (or temperatures)
 - Expansion of geographic range of invasive pests/species
 - Climate may be outside range of tolerance of crops

Total for question 2 10 points