

PROBLEM 7: TERRAFORMING MARS

Section A – Multiple Choice Questions (*Circle the correct answer*)

- Which gas is primarily responsible for climate change?
 - Nitrogen gas
 - Carbon dioxide
 - Oxygen gas
 - Argon gas
- What is the name of the process by which plants absorb water through their roots and release water vapor through their leaves?
 - Transpiration
 - Photosynthesis
 - Respiration
 - Translocation
- What is the name of the process by which bacteria break down pollutants in the environment?
 - Phytoremediation
 - Ion exchange
 - Bioremediation
 - Bacterial remediation
- What is the name of the process by which the Earth's temperature increases due to the trapping of heat in the atmosphere?
 - Greenhouse effect
 - Global warming
 - Climate change
 - Thermal pollution
- Which of the following is a greenhouse gas that has a greater warming potential than carbon dioxide?
 - Nitrous oxide
 - Methane
 - Carbon monoxide
 - Ozone
- What is the name of the process by which carbon dioxide is removed from the atmosphere and stored underground or in other materials?
 - Carbon capture and storage
 - Carbon offsetting
 - Carbon sequestration
 - Carbon footprinting
- Which of the following pollutants is a product of incomplete combustion and can cause respiratory problems?
 - Nitrogen oxides
 - Sulfur dioxide
 - Carbon monoxide
 - Particulate matter

8. What is the name of the process by which bacteria convert nitrogen gas in the atmosphere into forms that plants can use?
 - a. Nitrogen fixation
 - b. Nitrogen assimilation
 - c. Nitrification
 - d. Denitrification

9. Which of the following pollutants can lead to the formation of smog and respiratory problems?
 - a. Carbon monoxide
 - b. Nitrogen oxides
 - c. Particulate matter
 - d. All of the above

10. If a certain plant is found to be highly effective at removing perchlorate salts from Martian soil, what would be the most likely next step in the process of using this plant for phytoremediation?
 - a. Cultivate large quantities of the plant and distribute it to all Martian colonies.
 - b. Conduct further research to determine the optimal growing conditions for the plant on Mars.
 - c. Genetically modify the plant to increase its effectiveness at removing perchlorate salts.
 - d. Begin using the plant immediately to remove perchlorate salts from Martian soil.

11. Which of the following is an example of ion exchange?
 - a. Using bacteria to break down oil spills in the ocean.
 - b. Growing plants to remove heavy metals from contaminated soil.
 - c. Using a water softener to remove calcium and magnesium ions from tap water.
 - d. Adding chemicals to soil to neutralize acid rain.

12. If a researcher wanted to test the effectiveness of a certain plant for phytoremediation, which of the following would be an appropriate experimental design?
 - a. Plant the test plant in a contaminated area and measure the pollutant levels before and after a certain period of time.
 - b. Compare the pollutant levels in a contaminated area to those in an uncontaminated area where the test plant is not present.
 - c. Measure the pollutant levels in the soil where the test plant is growing and compare them to the pollutant levels in the surrounding soil.
 - d. All of the above would be appropriate experimental designs

Section B – Structured Questions (*Write answer in space provided*)

1. What are Perchlorate salts, and why are they a concern for potential Martian colonies?

2. What is ion exchange, and how can it be used to address some of the global challenges?

3. What are some potential limitations of phytoremediation in combatting the effects of climate change?

4. How can bacterial remediation be used to combat the effects of climate change?

5. What are the potential limitations of bacterial remediation in combatting the effects of climate change?

6. What is the role of plants in sequestering carbon from the atmosphere?

7. How can ion exchange be used to remove excess salt from water sources affected by climate change?

8. What are some potential drawbacks of ion exchange as a method of water remediation?

9. How can bacteria be used to combat the release of methane into the atmosphere?

10. What is the role of ion exchange in addressing the effects of sea level rise?

11. What are some potential drawbacks of using bacterial remediation to combat the effects of climate change?

12. What are some potential benefits and drawbacks of using plants for carbon sequestration?

13. If a certain bacterial strain is effective at degrading petroleum hydrocarbons, what logical steps must be taken to ensure that this method of remediation is successful in a contaminated site?

14. If ion exchange is used to remove excess salt from soil affected by sea level rise, what logical implications can we draw about the types of soil that are most suited for this method?

15. If carbon sequestration is used to mitigate the effects of climate change, what logical steps must be taken to ensure that the sequestered carbon remains stored for a long period of time?

16. If plants are used for carbon sequestration, what logical implications can we draw about the types of plants that are most effective at sequestering carbon?

17. If bacterial remediation is used to clean up contaminated groundwater, what logical implications can we draw about the types of bacteria that are most effective at this task?

18. What is the main gas responsible for climate change?

19. What is the name of the process by which plants absorb water through their roots and release water vapor through their leaves?

20. Which type of soil pollution is caused by excessive amounts of fertilizers and pesticides?

21. Name two types of plants that are commonly used for phytoremediation.

22. What is the name of the process by which bacteria break down pollutants in the environment?

23. What is the name of the process by which the Earth's temperature increases due to the trapping of heat in the atmosphere?

24. Which gas is the primary component of the Earth's atmosphere?

25. Which part of the plant absorbs sunlight and converts it into energy through the process of photosynthesis?

26. What is the name of the process by which plants release oxygen into the atmosphere?

27. Which type of pollution is caused by excessive noise levels in the environment?
