(b) Identify and describe TWO major causes for the predicted 200 ppm increase in atmospheric CO_2 concentration between 1950 and 2050.

(c) Identify TWO gases other than CO_2 that contribute to the anthropogenic increase in mean global temperature. For each gas, describe a major human activity that leads to its release.

---

3. The city of Fremont has a large brownfield located along the Fremont River. The brownfield is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The city council is considering two options for reclaiming the brownfield. The first option is to excavate and remove the contaminated soil, and the second option is to decontaminate the soil on the site using vegetation.

(a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.

(b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.

(c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.

(d) Identify and describe

(i) one method currently used to reduce the production of hazardous waste and

(ii) one method of legally disposing of hazardous waste.

Question 3

(a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.

(*2 points possible*)

One point is earned for describing each problem associated with removal of the contaminated soil.

ACCEPTABLE PROBLEMS

- High cost of removing/cleaning/replacing large amounts of soil
- Need to find a place to dispose of contaminated soil—may only move the problem from one site to another
- Erosion at the site
- Ecological disturbance of the area
- Risks from transporting contaminated soil
- Exposure of workers or residents to contaminants (airborne)
- Groundwater contamination remains a problem

(b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.

(3 points possible)

One point is earned for explaining how vegetation can be used for soil decontamination, 1 point is earned for one advantage of using plants to decontaminate the soil, and 1 point is earned for one disadvantage of using plants to decontaminate the soil.

CORRECT VEGETATION USAGE

When vegetation is planted on a brownfield, the plants take up the contaminants (along with water and nutrients) from the soil.

Advantages of Using Plants	Disadvantages of Using Plants
• Low cost. • Reduces soil erosion. • Reduces the amount of material that has to be taken to a landfill. • Less habitat disruption (not removing the soil). • Aesthetically pleasing.	• Process may be slow. • Vegetation may become hazardous to insects or animals that feed on it. • When the vegetation is removed, it is still hazardous. • May not remove all of the contaminants /effective only to the depth that the roots reach. • May introduce exotic species. • Appropriate plant species may be difficult to grow on the site. • Volatilized compounds may be emitted through plant pores.

Question 3 (continued)

(c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.

(2 points possible)

One point is earned for one environmental benefit, and 1 point is earned for one societal benefit.

ACCEPTABLE ENVIRONMENTAL BENEFITS

- Creates green spaces—habitat for plants, insects, animals
- Reduces hazardous runoff into streams, lakes, rivers
- Reduces groundwater contamination
- Reduces urban sprawl by reclaiming urban land

ACCEPTABLE SOCIETAL BENEFITS

- Cleaned up area improves property values
- Can provide green space for parks, athletic fields, or aesthetic value
- Can provide area for housing, businesses, or crops
- Land made available for development can add to tax base and provide jobs
- Decreases health risks related to living near a brownfield
- Use as a positive model for successful reclamation which could increase environmental awareness/community service
- Reduces urban sprawl (if not credited above)

(d) Identify and describe

(i) one method currently used to reduce the production of hazardous waste and
(ii) one method of legally disposing of hazardous waste.

(4 points possible)

Two points can be earned for each section. In part (i), 1 point can be earned for correctly identifying one current method, and 1 point can be earned for describing that method. In part(ii), 1 point can be earned for correctly identifying one current method, and 1 point can be earned for describing that method.

Question 3 (continued)

(i) One method currently used to reduce the production of hazardous waste

Acceptable Method of Reduction	Acceptable Description of Reduction
Recycling, reuse of materials	• Reusing the waste for another application • Establishing trading centers where leftover paint, solvents, pesticides, or cleaning solutions are reused • Reusing batteries (rechargeable) • Gas stations accepting oil for recycling
Substitution of nonhazardous materials for hazardous materials	Using a less toxic material • Acetamide—Substitute: Stearic acid • Chromic acid cleaning solutions—Substitute: Detergents Formaldehyde—Substitute: Ethanol • Mercury thermometers—Substitute: Alcohol thermometers
Government regulation of the contaminant	• Prohibition of PCBs, CFCs, DDT • Specific limitations or acts/laws/regulations (EPA: RCRA) • Pollution prevention act • Monitoring for compliance • Pollution credits, tax credits, or trading credits • Requiring the use of catalytic converters
Substitution of alternate energy sources that do not produce hazardous wastes	Wind, solar, hydroelectric, or geothermal
Becoming more efficient in the manufacturing process	Specific examples of increased efficiency

Question 3 (continued)

(ii) One method of legally disposing of hazardous waste

Acceptable Legal Method of Disposal	Acceptable Description of Legal Disposal of Hazardous Wastes
Incineration	Burning waste plus one of the following: • reduces volume • detoxify the waste • may produce air pollution
Bioremediation	Using organisms to decompose the contaminants.
Chemical methods	Detoxification or stabilization before disposal, vitrification of nuclear wastes (glass rods)
Landfills	Description of the site to include at least one of the following: • lined • contained • sealed drums
Deep well injection	Injection of hazardous wastes into underground sites that are geologically stable
Exportation of wastes	Ship to a less regulated country
Utilize a local hazardous waste collection site (only 1 point)	Must include specific details about the collection or the site. Must specify that there is a local site.
Name of a specific disposal site (e.g., Yucca Mountain)	Description of the site must include at least one of the following: • monitored for leakage • geologically stable • isolated from population centers
Surface impoundments	Lined liquid disposal pits