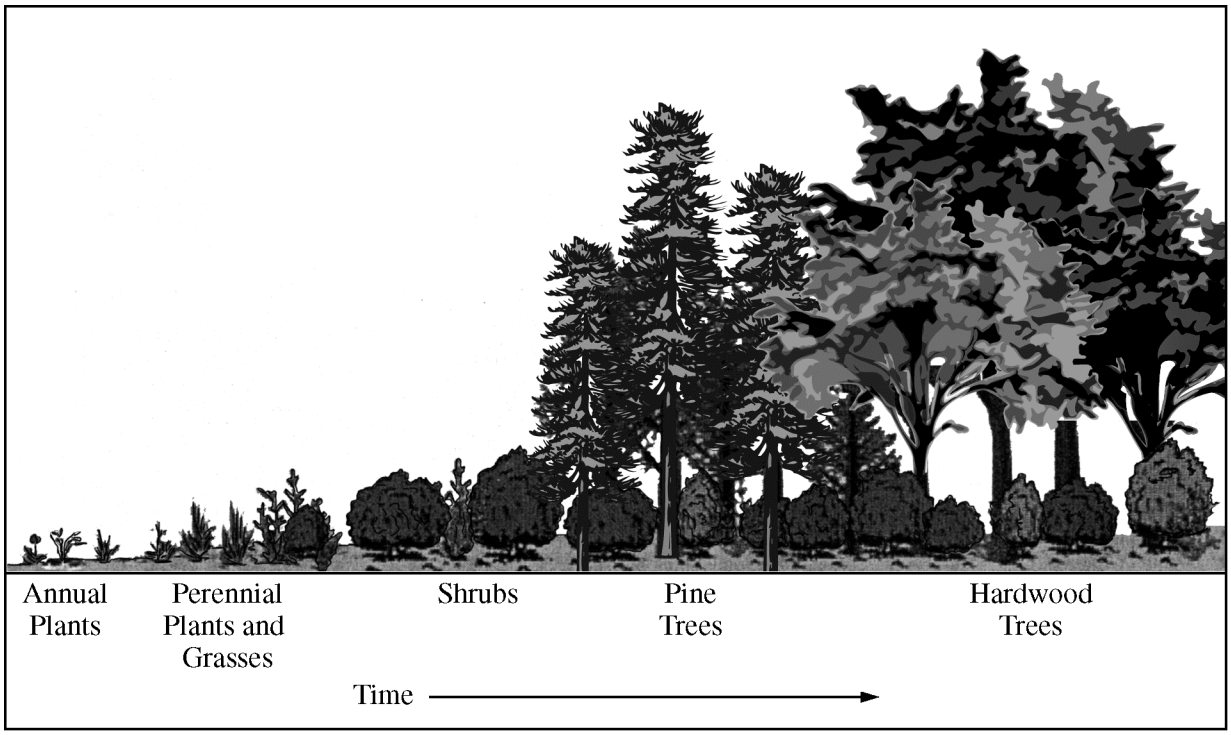

4. The diagram above shows the succession of communities from annual plants to hardwood trees in a specific area over a period of time.

   (a) **Discuss** the expected changes in biodiversity as the stages of succession progress as shown in the diagram above.

   (b) **Describe** and **explain** THREE changes in abiotic conditions over time that lead to the succession, as shown in the diagram above.

   (c) For each of the following disturbances, **discuss** the immediate and long-term effects on ecosystem succession.

      (i) A volcano erupts, covering a 10-square-kilometer portion of a mature forest with lava.

      (ii) A 10- square-kilometer portion of a mature forest is clear-cut.

END OF EXAM

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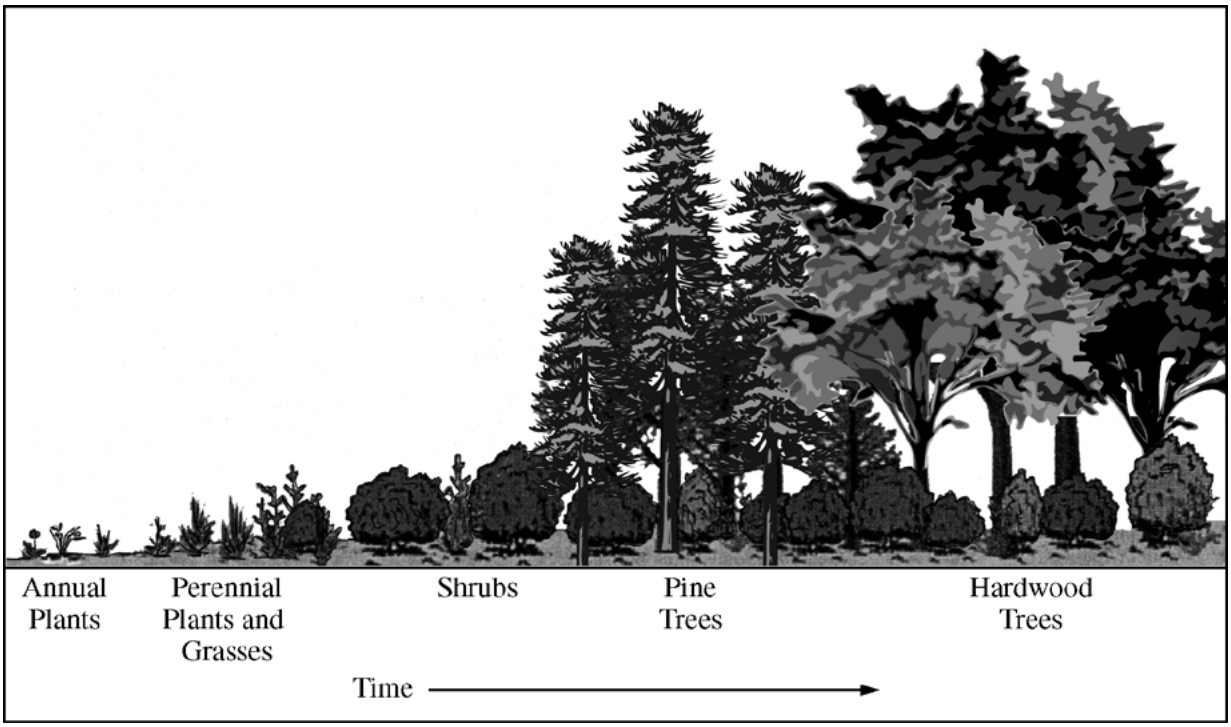
Question 4



The diagram above shows the succession of communities from annual plants to hardwood trees in a specific area over a period of time.

(a) **Discuss** the expected changes in biodiversity as the stages of succession progress as shown in the diagram above. **(2 points maximum; 1 point per bullet)**

Cannot simply list the organisms depicted (shrubs → gymnosperms → angiosperm hardwoods)

- Biodiversity increases (plants, animals, decomposers).

Explanation of why biodiversity increases/changes are observed:

- Some populations *facilitate* biodiversity/succession (by developing conditions more suitable for other species and/or developing conditions less suitable for their progeny).
- Some populations *inhibit* biodiversity/succession (by developing conditions less suitable for other species and/or developing conditions more suitable for their progeny).
- Increase in plant stratification (increased layering of plants; e.g., canopy, understory).
- More *niches/habitats* formed (plants, animals, decomposers).
- Pioneer plant species → dominants (more shade-tolerant plants emerge).
- Increase in producer diversity brings about increase in consumer diversity.

Other:

- Shift from more opportunistic (*r*) to more equilibrium (*k*) species.

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Question 4 (continued)

(b) **Describe** and **explain** THREE changes in abiotic conditions over time that lead to the succession, as shown in the diagram above. **(6 points maximum)**

It is not enough to say the condition (e.g., light, temperature, humidity) changes. The description/ explanation must be of a directional change (increase/decrease) in abiotic conditions and must be of a type that would lead to the changes shown in the diagram.

The following list is not exhaustive. **(2 points maximum per abiotic condition — i.e., any two cells from a single row below)**

Description of change in abiotic condition (1 point)	**Explanation (why abiotic condition changes) (1 point)**	**Explanation (why it enhances succession) (1 point)**
Increase in soil quantity	More detritus increases humus; decreased erosion because more plants hold soil in place.	Provides more anchoring for plants.
Improvement in soil quality	Soil gains organic matter (humus).	Provides more nutrients for plant growth.
More N available to ecosystem	Caused by decomposition and/or by nitrogen fixation.	Favors plants with higher nitrogen needs.
More P available	Caused by decomposition.	Favors plants with higher phosphorus needs.
Increase in water retained in soil	Increased organic matter retains water; increased shading reduces evaporation from the soil.	More water is available for plants.
Decrease in pH of soil	Acids released during decomposition lower pH.	Mobilizes cations facilitating mineral uptake (e.g., Fe^{++}, Ca^{++}); favors acid-tolerant plants.
Increase in pH of soil	Soil gets more basic with increase in ammonia (NH_3).	Favors plants with higher N requirement; favors alkaline-tolerant plants.
Decrease in light availability	Caused by shading.	Increased shading favors shade-tolerant species; inhibits shade-intolerant species.
Decrease in temperature	Caused by shading.	Favors species that are not heat tolerant; inhibits plants needing higher temperatures.
Higher humidity	Caused by more transpiration.	Facilitates transition from relatively xerophytic plants to more mesophytic plants.

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Question 4 (continued)

(c) For each of the following disturbances, **discuss** the immediate and long-term effects on ecosystem succession. **(4 points maximum)**

(i) A volcano erupts, covering a 10-square-kilometer portion of a mature forest with lava.

(ii) A 10- square-kilometer portion of a mature forest is clear-cut.

- **1 point** for time *comparison* that primary succession takes longer than secondary succession
- **1 point** per box

	Immediate	**Long-term**
i. Volcano erupts	• Primary succession/no soil.	• Lava must be degraded by weathering, microbes, lichens, fungi to form soils. • Lots of light is available (photophilic organisms will thrive when soil is present).
ii. Mature forest is clear-cut	• Secondary succession/ soil present. • All life is not destroyed. • Seed banks are present. • Different/other habitats/ niches open/close.	• Loss of trees may lead to erosion and soil loss. • Lots of light is available. • Many smaller plants actually benefit.

Note: A student must earn points from all three sections to earn the full 10 points on the question.