Exam Papers Practice

2.4 Biomes, Zonation & Succession

Mark Schemes

Course	SL IB Environmental Systems & Societies (ESS)
Section	2. Ecosystems & Ecology
Topic	2.4 Biomes, Zonation & Succession
Difficulty	Medium

To be used by all students preparing for
SL IB Environmental Systems & Societies (ESS)
Students of other boards may also find this useful

1a

Indicative Content	Commentary
i) The ecological term used to describe the distinct pattern of changes in vegetation is: • (Altitudinal) zonation; [1 mark] *ii) Global warming might affect the pattern of vegetation in the following ways:* Any **one** from the following: • The zones of vegetation will increase in altitude / move further up the mountain; [1 mark] • The upper zones of vegetation (e.g. grass/herbs/shrubs) may decrease / disappear (completely); [1 mark] • Any vegetation zone may experience an increase in growth/abundance or declines due to changing rainfall patterns / increasing temperatures (above optimal range); [1 mark]	You would still gain a mark for identifying one vegetation type from the figure and suggesting how it would be found at a higher location / greater altitude You would not gain a mark for referring to 'melting of snow', unless you directly relate this to a change in vegetation (e.g. 'snow melt may provide vegetation at higher altitudes with greater access to water, allowing greater plant growth at these higher altitudes')

1b

Indicative Content
Rising temperatures caused by global warming may affect the food production systems of Andean communities living at an altitude of around 2 500 m in the following ways: Any **three** from the following:

- Rising temperatures may increase the altitude at which these food crops can be grown/produced **OR** rising temperature may change/raise the lower/upper altitudinal limits at which these food crops can be grown/produced; [1 mark]
- (These communities) may be able to start growing/producing coffee and bananas; [1 mark]
- (These communities) may be able to grow/produce more apples/grapes; [1 mark]
- (These communities) may be able to grow/produce less wheat/barley/potatoes (if the lower altitude limits of these crops moves up/increases); [1 mark]
- It is hard to predict because rising temperature may cause changes in other climatic factors (e.g. rainfall patterns), which may affect crop production in other/unpredictable ways; [1 mark]
- Llama pasture may decrease in size/area so less meat (production); [1 mark]
- Maize production is unlikely to be affected (as it grows at a broad range of altitudes/temperatures); [1 mark]

2a

Indicative Content

Tundra and tropical rainforest biomes can be distinguished as follows:

Any **three** from the following:

- Temperature: tundra has (relatively) low(er) mean annual temperatures, whereas tropical rainforest is warm(er) / has (relatively) high mean annual temperatures **OR** tundra experiences 6–10 months of freezing temperatures, whereas tropical rainforest experiences constant warm(er) temperatures throughout the year; [1 mark]
- Insolation: tundra has (relatively) low(er) insolation, whereas tropical rainforest has the highest insolation of all biomes **OR** tundra experiences long/dark winters, whereas tropical rainforest experiences constant insolation throughout the year; [1 mark]
- Precipitation: tundra experiences precipitation as low as in deserts, whereas tropical rainforest experiences the largest annual

precipitation compared to any biome **OR** tundra precipitation occurs mostly in the form of snow / tundra has a characteristic layer of frozen ground below the surface/permafrost, whereas tropical rainforest has almost constant rainfall throughout the year / never experiences snow/frost/frozen ground; [1 mark]

- Biodiversity: tundra has (relatively) low(er) biodiversity, whereas tropical rainforest has the highest biodiversity of all biomes / supports a wide variety of plant/animal species; [1 mark]
- Geographic location: tundra is found at the poles (Arctic/Antarctic regions), whereas tropical rainforest is found near the equator (both north and south / between the Tropic of Cancer and Tropic of Capricorn); [1 mark]

2b

Indicative Content
The atmospheric system influences the distribution of biomes in the following ways: Any **four** from the following: • Atmospheric circulation / tri-cellular circulation / Hadley, Ferrel, and polar cells create climate patterns that determine dominant vegetation types in different regions; [1 mark] • Intense heating / high insolation at the equator creates low pressure / rising moist air, leading to high precipitation and the formation of rainforests; [1 mark] • Air moving towards poles (at high altitude) cools/sinks and this descending / dry air (at 20–30° latitude / tropics) creates high-pressure zones, resulting in arid/water-limiting conditions and the formation of deserts; [1 mark] • Air continues moving towards poles and this transfers heat from the (sub-)tropics to mid-latitudes, contributing to the formation of temperate biomes; [1 mark] • Descending/dry air at high latitudes / in polar regions creates water-limiting conditions in tundra; [1 mark]

- Water vapour from mid-latitudes / temperate regions moves to high(er) latitudes, leading to heavy precipitation / snowfall in boreal forests; [1 mark]
- Water vapour from ocean surfaces is transferred overland, contributing to the formation of freshwater aquatic systems; [1 mark]
- High to low pressure / prevailing wind / jet stream brings precipitation to specific regions, influencing the presence of biomes e.g. temperate rainforests in mountainous areas; [1 mark]
- High mountains create a rain shadow effect, causing dry winds on the leeward side, resulting in arid or semi-arid biomes (e.g., Tibetan Plateau / Mongolian Gobi desert / steppes); [1 mark]
- The atmosphere's changing patterns / global warming can lead to shifts in biomes over time; [1 mark]

3a

Indicative Content	Commentary
Species diversity increases towards the later stages of succession because: Any **three** from the following: • As the ecosystem becomes more complex, more niches become available; [1 mark] • This allows more species to coexist within the same habitats in the ecosystem / offers more diverse ecological opportunities for different species; [1 mark] • New species move or are transported into the area / arrival of new species through migration/dispersal; [1 mark] • (Towards later stages of succession) primary productivity increases, providing more energy/resources/support for a greater variety of species; [1 mark]	Usually, the greater the number of species present in an ecosystem, the higher the species diversity However, diversity also takes into account how evenly distributed these species are (i.e. an

• Nutrient cycling becomes more developed as succession proceeds, leading to better nutrient availability and supporting a greater variety of species; [1 mark] • There is an increase in the evenness and richness of species, meaning a more balanced distribution of individuals / a higher number of different species coexisting; [1 mark] • Facilitation among species / symbiotic relationships becomes more prevalent in later stages, providing favourable conditions for additional species to thrive; [1 mark] • As the ecosystem becomes more established, abiotic stress factors may decrease (e.g. shrubs and trees provide shade/shelter) allowing a broader range of species to survive / colonise the area; [1 mark] • In earlier stages, intense competition may limit the number of coexisting species, but as succession progresses, competitive exclusion may diminish, enabling more species to coexist; [1 mark]	ecosystem that contains ten species but is dominated by one or two species will have a lower diversity than an ecosystem with the same number of species, as long as these ten species are more even in numbers) Another example of this concept can be found here

3b

Indicative Content
The processes involved in the formation of fertile soils from bare rock include: Any **four** from the following: • Mechanical/chemical weathering/breaking down of parent rock into smaller particles; [1 mark] • Sediment/eroded material is deposited on bare rock, increasing the depth of the soil; [1 mark]

- These initial particles / particle material dissolves (in water / with rainfall), releasing soluble minerals; [1 mark]
- The parent rock / sediments / initial soil is colonised by lichens/mosses/plants/animals/decomposers/pioneer species; [1 mark]
- Biological/atmospheric nitrogen fixation adds nitrogen (in the form of nitrates/ammonium) to the soil; [1 mark]
- Bacteria/(mycorrhizal) fungi/decomposers cause decomposition of dead organisms / leaf litter releasing/creating/adding minerals/nutrients/organic material/humus (into the soil); [1 mark]
- Mosses/early plant growth forms mats/root systems that stabilise soils / prevent soil erosion; [1 mark]
- Earthworms / burrowing insects help spread soil particles / open up pores in soil / aerate soil; [1 mark]
- Precipitation adds water to the soil / increases soil moisture content; [1 mark]
- These processes / the process of soil formation can take centuries or millennia; [1 mark]

4a

The table should be completed as follows:

- Each correct row; [1 mark]

Feature	r-strategist species	K-strategist species
Reproductive rate	*High*	*Low*
Growth rate	*High*	*Low*
Investment in offspring (parental care)	*Low*	*High*

Survival rate	*Low*	*High*
Level of specialisation	*Low*	*High*

4b

Indicative Content	Commentary
Factors contributing to the low resilience of coniferous forest monocultures include: Any **three** from the following: • Monocultures exhibit low resilience as they lack biodiversity and are less adaptable to disturbances; [1 mark] • The limited genetic diversity within monocultures increases the risk of disease spread among the trees; [1 mark] • Having a single tree species in a monoculture increases the vulnerability to (species-specific) pest attacks; [1 mark] • The absence of younger growth / proximity of large/older trees in monocultures increases the risk of forest fires; [1 mark] • Monocultures tend to reduce soil fertility, leading to lower primary productivity / biodiversity, which affects their overall resilience; [1 mark] • The reduction in habitat within monocultures results in lower species complexity / lower/disrupted food web complexity / lower/disrupted energy flows, all contributing to reduced adaptability to disturbances; [1 mark]	Human activities can divert the progression of succession to an alternative stable state by modifying the ecosystem through various activities, such as burning, agriculture, grazing pressure and resource use (such as deforestation) These activities, which divert the progression of succession, may be temporary or permanent depending upon the resilience of the ecosystem Resilience refers to the ability of an

• The lower species diversity in monocultures makes the food web more susceptible to collapse when disturbed; [1 mark] • Coniferous species in monocultures are often water-intensive, making them less resilient in drought conditions [1 mark]	ecosystem to recover from a disturbance and return to its original state Unnatural systems, like monocultures, often have low resilience