

北海道大学大学院環境科学院環境起学専攻

Division of Environmental Science Development

Graduate School of Environmental Science, Hokkaido University

**Course in Human and Ecological Systems, Course in Environmental Adaptation Science,
and Course in Global Environmental Management**

令和 8 年度大学院修士課程入学試験問題（春季入試）

Entrance Examination

専門科目 解答例

Specialized Subjects Example Answers

1. A point where the gradient changes abruptly in the longitudinal profile of a river. Representative landforms include waterfalls and gorges. It is often formed when the river's base level of erosion is lowered due to uplift, sea-level fall, volcanic activity, or fault movement.
2. A depression formed by the relative subsidence of a central block between parallel normal faults. It forms in regions where normal faults develop due to tensional forces pulling the crust apart. The East African Rift is a representative example.
3. A landform where rock debris (clasts) gravitationally fallen from upper steep slopes, such as cliffs accumulate in a semi-conical shape at the base. It is commonly found in mountainous regions where physical weathering is dominant and consists of poorly sorted angular gravels.
4. A land-tied sandbar formed when sand and gravel deposited by waves and shore currents extend to connect an offshore island to the mainland. The urbanized area of Hakodate is a representative example.
5. A phenomenon in cold periglacial regions where wet surface soil slowly moves downslope under the influence of gravity due to repeated freezing and thawing. This process results in the formation of gentle, rounded slopes that are characteristic in cold environments.
6. The practice of dividing protected areas, such as national parks, into multiple zones based on their ecological importance and intended use. For instance, areas are divided into "core areas" for strict protection and "buffer zones" where moderate use or residence is permitted, aiming to balance conservation and utilization.
7. Technology that enhances prediction and decision-making accuracy by analyzing vast amounts of known data and identifying patterns through algorithm-based learning, being applied to data analysis for meteorology and oceanography, and terrain analysis such as potential landslide distribution mapping.
8. Permafrost is defined as thermal state of soil or rock that remains at or below 0°C for two or more consecutive years. Seasonally frozen ground is the soils or rocks that freeze and thaw repeatedly with the seasons.
9. When we project the spherical (ellipsoid) Earth onto a plane, distortion is inevitable in either angle, area, or distance. There are three map projection methods that correctly represent the shape of any regions (angular-conformity projection), the relative area of any regions (equal-area projections), and the relative distance between any two points (equidistant projections).
10. Frost cracking is one of the mechanical weathering processes. As freezing, water infiltrated into the rock porosities expands their volume by 9% and causes tensile stress. When this volume expansion exceeds rock porosity, the rocks are fractured.
11. Sensible heat is the heat required for changing temperature of a substance, the heat used to increase the thermal vibrations of the atoms composing the substance. Latent heat is the heat

required for changing the state of a substance, or the heat required to alter the spatial arrangement of the molecules composing the substance.

12. Thermal conductivity is a measure of how much heat can transfer through materials per unit area and unit time, expressed in the unit W/mK. The soil bulk thermal conductivity varies significantly with the proportions of soil particles, water (ice), organic matters.
13. Autotrophs are organisms that synthesize organic matter from inorganic carbon sources using light energy or chemical energy, and live using chemical energy provided by the organic matter they produce. In contrast, heterotrophs are organisms that obtain chemical energy by consuming other organisms.
14. The portfolio effect is the concept that populations or ecosystems with greater diversity (e.g. of species, genotypes or phenotypes) can reduce overall variability and increase stability by balancing and averaging out the responses and fluctuations of each component.
15. The fundamental niche is the range of environmental conditions and resources under which a species is expected to survive and reproduce. In contrast, the realized niche is the range of environmental conditions and resources that a species actually uses as a result of biotic interactions (e.g., competition, predation, and parasitism).
16. This refers to an international initiative where companies aim to cover 100% of their operational electricity consumption with renewable energy. Such efforts are crucial for corporate management because shareholders favor companies prioritizing ESG investing, while employees also prefer companies operating with social responsibility.
17. This refers to the area in the central North Pacific Ocean where large amounts of floating marine debris accumulate. This accumulation is strongly influenced by physical environmental factors such as the North Pacific Gyre, forming in this specific location. Fishing nets are considered the primary components, but microplastics are also relatively abundant.
18. A strategy that leverages biodiversity and ecosystem services to assist communities in adapting to the effects of climate change. For instance, wetlands, along with their biodiversity and functions, can be effectively managed to mitigate flood risks while also supplying food and cultural resources to local populations.
19. Life history traits are characteristics that describe when and how organisms allocate resources over their lifetime to growth, survival, and reproduction, including lifespan, age at maturity, frequency of reproduction, and reproductive output.
20. A territory refers to an area actively and exclusively defended by an individual, whereas a home range refers to an area an individual routinely uses without active defense.
21. Conservation refers to the management of ecosystems and biodiversity to maintain them over the long term while allowing sustainable human use. In contrast, preservation emphasizes

- safeguarding them by restricting or excluding most human impacts.
22. Light pollution is a phenomenon in which artificial lighting at night alters the nocturnal light environment, disrupts natural light cycles and animal behavior, and ultimately exerts negative effects on ecosystems and human well-being.
 23. Herbivores are primary consumers in ecosystem food chains that specialize in feeding mainly on living plants or their parts, such as leaves, stems, or roots. For example, deer and rabbits are typical herbivores.
 24. A scientific name is a universally used name for an organism, established according to international codes. At the species level, it is expressed in binomial nomenclature, consisting of the genus name followed by the specific epithet.
 25. The radiative equilibrium temperature refers to the Earth's effective temperature under the assumption that incoming shortwave solar radiation is balanced by outgoing longwave radiation emitted to space. It corresponds to the theoretical surface temperature without the greenhouse effect (approximately 255K) and is lower than the observed annual mean surface temperature.
 26. The water vapor mixing ratio is defined as the mass of water vapor per unit mass of dry air (in the unit of kg/kg). It is conserved as long as no condensation or evaporation occurs and there is no mixing with the surrounding air. Therefore, it is widely used in analyses of atmospheric water vapor transport and distribution.
 27. SSPs are socioeconomic scenarios that provide the underlying assumptions for future projections of global warming. They describe five alternative pathways of future development in terms of population, economy, technology, and policy. The SSPs are often used in combination with radiative forcing scenarios when referring to future climate simulations.
 28. Bénard-type convection refers to a phenomenon in which a viscous fluid heated from bottom forms regular convection cells once the vertical temperature gradient exceeds a critical threshold value. In the atmosphere, such convection can be visualized by clouds, and the cloud streets observed over the Sea of Japan in winter are considered an example of similar cellular convection.
 29. The subtropical jet is a strong westerly wind belt formed in the upper troposphere as a result of the thermal wind relationship associated with the meridional temperature gradient. Its seasonal north-south migration serves as an indicator of seasonal evolution, and its meandering and variability sometimes lead to extreme weather events.
 30. Milankovitch cycles refer to variations in the latitudinal and seasonal distribution of incoming solar radiation caused by changes in Earth's orbital eccentricity, obliquity, and precession, occurring on timescales of tens to hundreds of thousands of years. Corresponding periodic signals are observed in paleoclimate proxies worldwide, and these cycles are considered a

major external factor controlling glacial-interglacial cycles.