

題號： 67

國立臺灣大學 115 學年度碩士班招生考試試題

科目： 自然地理學

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※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

I. Multiple-Choice Questions (Select the single best answer)

1. (5%) What is the role of relief (topography) in soil development?

- a. It determines the mineral composition of the parent material.
- b. It directly controls chemical weathering of minerals.
- c. It affects soil thickness through erosion and affects soil moisture through sunlight exposure.
- d. It determines how long soil-forming processes can act.

2. (5%) What is the main difference between debris flows and grain flows of sand dunes?

- a. Debris flows leave poorly sorted deposits, while dunes are made of well-sorted sand.
- b. Only debris flows can stop on gentle slopes.
- c. Dunes mostly form U-shaped valleys, while debris flows form fans.
- d. Debris flows stop mainly because of slope, while dune grain flows stop mainly because of wind speed.

3. (5%) Which pedogenic processes best explain a soil profile characterized by a light grey, sandy surface horizon overlying a dense, reddish-brown subsurface horizon enriched in clay and iron oxides?

- a. Organic matter builds the top layer, and minerals change only in the lower layer.
- b. Materials build up in the top layer and are washed into the lower layer.
- c. Calcium builds up in the top layer, and salts build up in the lower layer.
- d. Fine materials are washed out of the top layer and build up in the lower layer.

4. (5%) Sea level can change by about 120 m during ice-age cycles. How can large river deltas still form and last?

- a. Mostly during long periods of stable, high sea level.
- b. When the river brings enough sediment to build land outward despite coastline changes.
- c. Because ice sheets push the coastline down and create space for sediment.
- d. Only during ice ages on the exposed seafloor, then they are abandoned when sea level rises.

5. (5%) What is a direct negative impact of climate change on farming?

- a. Higher CO₂ will make all crops increase in yield the same way.
- b. Higher temperatures increase the risk of heat stress and drought stress on crops.
- c. Warming makes growing seasons longer and more stable everywhere.
- d. Climate change removes year-to-year climate changes.

II. True/False Questions (Write the question number and answer True or False.)

- 1. (5%) Freeze-thaw weathering is the main weathering in warm tropical climates, while chemical weathering is strongest in cold regions.
- 2. (5%) Grasslands often have darker topsoil and can be more naturally fertile than soils under forests or in dry regions.
- 3. (5%) Healthy plants reflect a lot of near-infrared light and absorb a lot of red and blue light.
- 4. (5%) An alluvial fan often forms where a steep stream leaves a mountain area and flows onto flatter land, slowing down and dropping sediment in a fan shape.
- 5. (5%) Geomorphology studies landforms and how surface processes (water, wind, ice, gravity, and tectonics) shape them over time.

III. Short answer questions

1. Concept of Radiative Forcing in Surface Energy Balance

Radiative forcing is a key metric used to quantify the impact of natural and anthropogenic factors on the Earth's energy balance. It represents the change in the net vertical irradiance (expressed in $W m^{-2}$) at the tropopause or top of the atmosphere due to a change in an external driver of climate change, such as greenhouse gas concentrations or solar output. A positive radiative forcing tends to warm the surface, while a negative forcing tends to cool it.

Based on the above context, please briefly answer the following questions:

- (1) (5%) Do anthropogenic methane (CH₄) emissions contribute to a positive or negative radiative forcing? Please briefly explain why.
- (2) (5%) Does the increase in atmospheric aerosols (e.g., volcanic ash or industrial pollution) typically contribute to a positive or negative radiative forcing? Please briefly explain why.

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2. Feedback Mechanisms of Greenhouse Gases (GHGs)

In the study of climate change, feedback mechanisms play a crucial role in amplifying or dampening the initial temperature change caused by greenhouse gases. While CO₂ is often discussed in the context of positive feedback, other GHGs and associated processes also exhibit complex interactions. For example, water vapor, the most abundant greenhouse gas, is involved in several feedback loops that can significantly influence the Earth's climate sensitivity.

Based on the above context, please briefly answer the following questions:

- (1) (5%) Describe the Positive Feedback mechanism involving water vapor and surface temperature. (Hint: Consider the relationship between temperature, evaporation, and the greenhouse effect).
- (2) (5%) Water vapor can also contribute to a Negative Feedback mechanism through the formation of clouds. Briefly explain how cloud formation might act to cool the Earth's surface.

3. Impact of Land Use Change in Taiwan's Mountainous Areas

In Taiwan, many mountainous regions have experienced significant land use and land cover (LULC) changes, particularly the conversion of natural forests into agricultural land (e.g., betel nut plantations, high-altitude vegetable farms, or tea gardens). This transformation alters the physical properties of the land surface, leading to changes in the exchange of water and energy between the surface and the atmosphere. Such changes not only affect the local environment but also shift the mountain microclimate. Please explain the potential impacts of converting forest to mountain agriculture on the following aspects:

- (1) (7%) Hydrological Cycle: How does this transition affect rainfall infiltration, surface runoff, and the risk of soil erosion during extreme rainfall events (e.g., typhoons)?
- (2) (7%) Energy Balance: Forests typically have higher evapotranspiration rates and lower albedo compared to cleared agricultural land. How does this conversion change the ratio between Latent Heat Flux and Sensible Heat Flux?
- (3) (6%) Mountain Microclimate: How might these changes affect the local daily temperature range (DTR) and humidity levels in the surrounding mountain environment?

4. Biogeography and Climate Change: Mountain Ecosystems

As global temperatures rise, many species in mountain ecosystems are forced to migrate to different altitudes to remain within their optimal thermal niches. This phenomenon, often referred to as "upslope migration," is a critical topic in biogeography. However, the ability of species to migrate is often limited by topography, habitat fragmentation, and the availability of suitable soil conditions at higher elevations.

Based on the above context, please briefly answer the following questions:

- (1) (5%) Why are high-altitude specialist species (species living near mountain summits) considered more vulnerable to extinction due to climate change compared to lowland species?
- (2) (5%) Beyond temperature, please provide one other environmental or human factor that might prevent a forest species from successfully migrating to a higher altitude. Briefly explain your reason.