

答案請填寫於試卷內，附上題號，並依序作答。可用中文或英文作答。

一、是非題（每題 2 分，共 10 分）

1. Ocean acidification can cause harmful effects on marine organisms. In particular, all marine animals regardless of their sizes are equally vulnerable to acidification.
2. Eutrophication of estuaries tends to lead to low oxygen concentration.
3. Realized niche is a part of fundamental niche by a species.
4. The logistic growth model assumes that population growth will be suppressed at low population density.
5. Biomass decreases as trophic level increases.

二、選擇題（每題 3 分，共 30 分）

1. Marine snow contains a variety of inorganic and organic matter. Which of the following items is NOT commonly found in marine snow? A) larvacean houses, B) phytoplankton, C) fish, D) virus.
2. Enrichment of which of the following elements can contribute to the biological pump that facilitates fixation of carbon from atmosphere into oceans? A) nitrogen B) phosphorus, C) iron, D) all of above.
3. In ecology, chaos is NOT characterized by A) sensitivity to initial conditions, B) instability, C) non-repeating patterns, D) deterministic dynamics.
4. Given differences in generation time and trophic interactions, individual fish populations often display distinct population dynamics. Thus, maintaining variability in population assemblages within a region can help stabilize population production. Which of the following concept best describes this effect? A) portfolio effect, B) diversity balance effect, C) smoothing effect, D) variance dampening effect.
5. A K-strategy species A) are often found in unpredictable environments, B) have a small body, C) produce extremely high number of offspring, D) provide parental care.
6. Which of the following statements about symbiotic relationships is true? A) symbiotic organisms usually have similar body sizes, B) a commensalistic relationship can sometimes be mutualistic or parasitic, C) the most efficient type of parasite is one that kills its host, D) in a parasitic relationship, one organism benefits and the other is harmed.
7. Which of the following compound is NOT a greenhouse gas? A) methane, B) carbon monoxide, C) Nitrous oxide, D) ozone.

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8. Hypoxia A) naturally occurs, B) leads to an increase in biological diversity, C) is caused by volcano eruption, D) leads to ocean acidification.

9. Food chain length (FCL) is a measure of the number of energy transfers or trophic links between primary producers and the top predator in an ecosystem. FCL is most related to which of the following factors? A) ecosystem size, B) ecosystem patchiness, C) ecosystem productivity, D) ecosystem temperature.

10. Zonation of rocky shore intertidal organisms is NOT influenced by which of the following biological processes? A) camouflage, B) competition, C) predation, D) tolerance of desiccation.

三、簡答題 (每題 5 分, 共 30 分)

Describe the following concepts: a) Bergmann's rule, b) Redfield ratio, c) Liebig's Law of the Minimum, d) Mendel's principles of inheritance, e) intermediate disturbance hypothesis, f) keystone species

四、計算、畫圖、申論題(每題 6 分, 共 30 分, 答案須包含計算過程)

1. A general metapopulation model assumes a large number of homogeneous patches, each can be occupied by a single population. Let f = fraction of patches occupied. The change in f is described by Eq 1:

$$\text{Eq 1. } \frac{df}{dt} = p_c * (1 - f) - p_e * f$$

where p_c and p_e , respectively, are the probability of local colonization and extinction. Find the equilibrium value of f for this model and discuss the persistence of such a metapopulation (assuming both p_c and p_e are > 0).

2. Consider three gene loci in the cross below, each with two alleles.

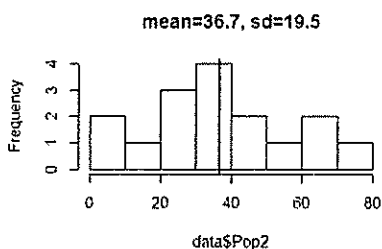
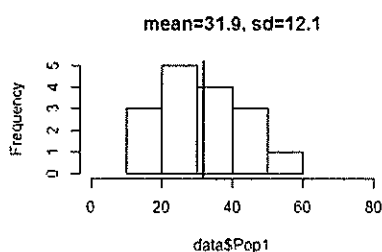
Female AaBBcC x AaBbcc Male

Assuming that each gene locus is assorting independently from each other gene locus. Determine the probabilities of the following events:

- The female parent produces a gamete carrying ABC
- The first offspring is aaBBcc

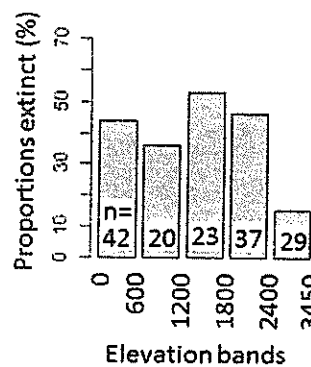
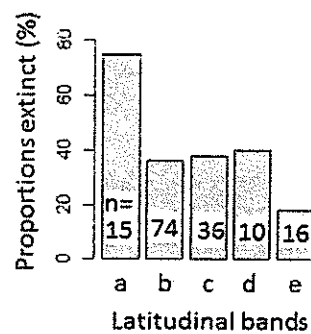
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3. Histogram of body lengths for two fish populations are shown below. Calculate the coefficient of variation for each population.



4. Sketch these general relationships based on the metabolic theory of ecology (Brown et al. 2004): a) temperature (x-axis) vs. mass-corrected metabolic rate (y-axis); b) body mass (x-axis) vs. temperature-corrected metabolic rate (y-axis).

5. Climate change can cause local extinction, leading to a shift in distribution of organisms. For example, Parmesan (1996) assessed local extinction for the Edith's checkerspot butterfly *Euphydryas editha* throughout the distribution of this species in the North America. She found that proportions of population extinction varied by latitudes and elevation (see figure on the right; modified from original paper). a) Estimate the mean proportion of extinct populations for the latitudinal groups (upper panel); b) Describe the patterns of local extinction by latitudes and elevation in your words. Note: Latitudinal bands a-e are from south to north of distribution; n = no. populations.



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