

※ 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。

一、選擇題 (每題 2 分，共 8 分)

1. Which of the following about sexual reproduction is wrong?

- (A) Recombination breaks linkage disequilibrium
- (B) Recombination can bring together beneficial alleles of different genes in the same chromosome
- (C) Sexual reproduction creates more mutations than asexual reproduction
- (D) The costs of sexual reproduction include the time, effort, and risks to find proper mates

2. Which of the following description of inbreeding is correct?

- (A) Inbreeding decreases heterozygosity
- (B) An inbred population has more pure genetic background and is therefore more adaptive
- (C) Inbreeding decreases mutation rate
- (D) Inbreeding increases the effective population size

3. Which of the evolutionary processes reduces genetic variation?

- (A) Balancing selection
- (B) Mutation
- (C) Over-dominance
- (D) Directional selection

4. Which of the description about effective population size is correct?

- (A) The smaller the effective population size, the easier for a beneficial allele to reach fixation
- (B) The effective population size of modern human is about seven billion
- (C) Neutral substitution rate is independent of effective population size
- (D) The effect of natural selection is independent of effective population size

二、配合題 (自下方名詞中，選入適當的填入答案卷 (每題 2 分，共 12 分))

1. _____ An allele that has a beneficial effect on one trait may have a deleterious effect on another trait.

2. _____ Random changes in the frequencies of two or more alleles or genotypes within a population.

3. _____ The proportion of the variance in a trait among individuals that is attributable to differences in genotype.

4. _____ The difference between the mean relative fitness of individuals of a given genotype and that of a reference genotype

5. _____ Reduction or elimination of DNA sequence variation in the vicinity of a mutation that has been fixed by natural selection relatively recently

6. _____ The association of two alleles at two or more loci more frequently (or less frequently) than predicted by their individual frequencies.

A. Selective sweep

B. Selection coefficient

C. Linkage disequilibrium

D. Genetic drift

E. Antagonistic pleiotropy

F. Heritability

見背面

三、簡答題(共 30 分)

- (9 pt) Please explain: (A) What is synonymous mutation? (B) What is non-synonymous mutation? (C) In a functional gene, would you expect to see higher synonymous or non-synonymous substitution rates between species? Why?
- (6 pt) Gene A has two alleles, A and a . In a population with 400 individuals, 100 are AA homozygous males, 100 are AA females, 100 are aa males, and 100 are aa females. After one generation of random mating, 400 progenies are produced. What are the expected number of progenies with AA , Aa , and aa genotypes?
- (9 pt) In a bird population, scientists have estimated the phenotypic variance of body weight to be 100, and the genetic variance of body weight is 80. The mean body weight of this population is 100 g. After a severe drought, the mean body weight of the survivors is 60 g. Later, the survivors reproduce and generate the next generation of birds.
(A) What is the heritability of body weight in this population?
(B) What is the selection differential of this severe drought?
(C) What would be the mean body weight of the next generation?
- (6 pt) A scientist studied two populations of a plant species. She surveyed the patterns of genetic variation in five loci (A, B, C, D, and E), and their F_{ST} values are 0.06, 0.08, 0.1, 0.12, and 0.6.
(A) If we ignore locus E, the mean F_{ST} between the two populations is 0.09. Does most of the genetic variation exist between or within populations?
(B) What is the possible explanation for the high F_{ST} for locus E?

四、問答題(共 50 分)

- 比較人類與黑猩猩的基因體發現，雖然彼此之間只有 1% 的差異，這些差異中與腦發育相關的基因被檢測出很強的正向天擇。生物學家是因計算出這些基因有部分位點其 non-synonymous substitution rate (dn) 與 synonymous substitution rate (ds) 的比例顯著大於 1，而得出此結論。請解釋生物學家為何可如此推論? (10%)
- 研究發現生物結構複雜及多樣化的成因是 gene duplications 及 gene regulation，請提出你的觀點。(10%)
- 請推論你認為在(A)如大範圍穩定的生態系(5%)；(B)環境嚴苛及島嶼生態系(5%)，生物應採用自交或異交生殖策略，來維持族群繁衍?
- 花朵演化出多樣化的形態，可以分別吸引特定的傳粉者，促進種化。請解釋花演化出特定傳粉性狀 (pollination syndrome) 是合子前 (prezygotic barrier) 還是合子後屏障 (postzygotic barrier)? (5%) 而花兩側還是輻射對稱，比較能促進與傳粉者共演化呢? (5%)
- 在群聚譜系學 (community phylogeny) 分析中，如果在一個群落內，親緣相近的物種，傾向於佔據稍不同的棲位，且彼此間生長性狀較分化 (over-dispersed traits)，那麼如何解釋此群落形成的歷史成因? (5%) 反之，若親緣相近的物種，傾向佔據相似的棲位，又生長性狀較相似，又該如何解釋? (5%)

試題隨卷繳回