

1. 簡述 DNA 的分子結構。DNA 分子的那些特性決定了 DNA 可以作為遺傳資訊的載體？(10%)
2. 簡述原核生物基因與真核生物基因之組成及結構的差異。(10%)
3. 簡述兩種可以用來檢測基因表現的方法，並簡要描述每種方法的優缺點。(10%)
4. 什麼叫 RNA 干擾 (RNA interference)？RNA 干擾有何應用價值？(10%)
5. 在研究人類一種生長因子 (growth factor) 基因的功能時，研究人員發現這個基因可以產生兩種蛋白質。其中較大的蛋白質具有穿膜結構域 (membrane-spanning domain)，其功能是識別細胞表面的生長因子並促進特異的下游訊息傳導途徑。然而，另一個相對較小的蛋白質被釋放到細胞外面，其功能是與游離於血液中的生長因子結合並抑制下游訊息傳導途徑。根據你現有的知識，推測細胞是如何產生這兩種蛋白質的。(10%)
6. How many different kinds of F_1 gametes, F_2 genotypes, and F_2 phenotypes would be expected from the following crosses: (9%)
 - (a) $AA \times aa$;
 - (b) $AA BB \times aa bb$;
 - (c) $AA BB CC \times aa bb cc$
7. If one cell contains two pairs of chromosomes and undergoes meiosis. Please name the phase of meiosis about the following questions: (7%)
 - (a) The number of chromosomes reduced in half by the end of this stage.
 - (b) Two pairs of chromosomes become clearly visible.
 - (c) Each cell has two chromosomes and spindle apparatus reforms.
 - (d) Two chromosomes line up along equator.
 - (e) Each centromere splits and sister chromatids separate.
 - (f) Synapsis occurs.
 - (g) Following this phase, each individual cell is haploid.

8. One chromosome in a plant has the sequence A B C D E F, and another has the sequence M N O P Q R. A reciprocal translocation between these chromosomes produced the following arrangement: A B C P Q R on one chromosome and M N O D E F on the other. Illustrate how these translocated chromosomes would pair with their normal counterparts in a heterozygous individual during meiosis. (4%)
9. What is paracentric inversion? (2%) Pericentric inversion? (2%) Why can inversions act as crossover suppressors? (6%)
10. *Drosophila* females heterozygous for three recessive mutations, a, b, and c, were crossed to males homozygous for all three mutations. The cross yielded the following results:

| Phenotype | Number |
|-----------|--------|
| +++ | 75 |
| ++c | 348 |
| +bc | 96 |
| a++ | 110 |
| ab+ | 306 |
| abc | 65 |

Construct a linkage map showing the correct order of these genes and estimate the distances between them. (10%)

11. When chromosomes are broken by exposure to high-energy radiation such as X-rays, the resulting broken ends exhibit a pronounced tendency to stick to each other and fuse. Why might this occur? (10%)