

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

I. Choose the correct answer (only one answer) from each of the question. (20%, each 2 %)

1. A suppressor gene is one that:
 - A) masks the effects of the dominant allele
 - B) suppresses the wild-type to reveal a mutated gene
 - C) reverses the effect of mutation resulting in the wild-type phenotype
 - D) suppresses the recessive alleles to reveal the mutant
 - E) produces the recessive phenotype
2. When a wild-type fly is crossed to a fly homozygous for an autosomal recessive gene, all of the progeny express the recessive phenotype, what type of chromosomal change probably accounts for this result?
 - A) inversion
 - B) deletion
 - C) duplication
 - D) translocation
 - E) trisomy
3. Which structure holds two homologous chromosomes together?
 - A) synaptonemal complex
 - B) centromere
 - C) kinetochore
 - D) polar microtubules
 - E) spindle apparatus
4. Which of the following best describes a karyotype?
 - A) a pictorial representation of all the genes for a species
 - B) a display of each of the chromosomes of a single cell
 - C) the combination of all the maternal and paternal chromosomes of a species
 - D) the collection of all the chromosomes in an individual organism
 - E) a photograph of all the cells with missing or extra chromosomes
5. Cystic fibrosis affects the lungs, the pancreas, the digestive system, and other organs, resulting in symptoms ranging from breathing difficulties to recurrent infections. Which of the following terms best describes this?
 - A) incomplete dominance
 - B) multiple alleles

- C) pleiotropy
D) epistasis
E) codominance
6. There is good evidence for linkage when
- A) a gene is associated with a specific phenotype
B) two genes occur together in the same gamete
C) two genes work together to control a specific characteristic
D) two characteristics are caused by a single gene
E) genes do not segregate independently during meiosis
7. Mendel's law of independent assortment has its physical basis in the:
- A) separation of alleles into haploid cells
B) spindle attachment in anaphase I
C) random arrangement of chromosomes on the metaphase plate in meiosis I
D) sister chromatids separating in meiosis II
E) haploid cells forming
8. New combinations of linked genes are due to which of the following?
- A) nondisjunction
B) independent assortment
C) mixing of sperm and egg
D) gene interaction
E) crossing over
9. In a certain breed of dog, the alleles B and b determine black and brown coats respectively. However, the allele Q of a gene on a separate chromosome is epistatic to the B and b color alleles resulting in a gray coat (q has no effect on color). If animals of genotype B/b; Q/q are intercrossed, what phenotypic ratio is expected in the progeny?
- A) 12 gray, 3 black, 1 brown
B) 9 gray, 3 black, 4 brown
C) 9 gray, 4 black, 3 brown
D) 1 gray, 2 black, 1 brown
E) 9 gray, 6 black, 1 brown
10. If two independently derived recessive mutant alleles producing similar recessive phenotypes fail to complement, what can you conclude?
- A) The alleles are epistatic
B) The alleles must be on different genes

- C) They are both mutations of the same allele
- D) The alleles must be on the same gene
- E) The alleles are both homozygous

II. Answer the following questions. (20%)

1. What is RNAi and how does it work? What advantages of RNAi over other functional genomic techniques (7%)
2. About 25,000 genes in the human genome and that number was much lower than the actual number of proteins in a human cell (more than 100,000). Why is this so? (4%)
3. How many different combinations of maternal and paternal chromosomes can be packaged in gametes made by an organism with a diploid number of 8 ($2n = 8$)? (4%)
4. Why does scientific research make use of model organisms? (5%)

III. 解釋名詞 (30%，每題三分)：請說明下列名詞的定義及內涵

1. transcriptome
2. metagenomics
3. Hardy-Weinberg equilibrium
4. SNPs
5. linkage disequilibrium
6. epigenetics
7. genetic drift
8. selective sweep
9. balanced polymorphisms
10. trait

IV. 填充題 (30%，每格二分)，以中文或英文作答皆可

1. Nucleotides are the building blocks of all nucleic acid molecules. Their structure units consist of three essential components: a nitrogenous base, a _____, and a _____ group.
2. Watson and Crick published their analysis of DNA structure in 1953 by building models. Two features in their model are: 1) Two long polynucleotide chains are coiled around the central axis, forming a _____ double helix. 2) The two chains are _____, that is, their C-5'-to-C-3' orientations run in opposite directions.
3. Two polynucleotide chains of different lengths can be separated by _____ technique.

This technique uses features that polynucleotide chains are _____ charged and a porous medium such as a _____.

4. Polymerase _____ are the major forms of the enzyme involved in initiation and elongation during eukaryotic nuclear DNA synthesis.
5. Eukaryotic chromosomes end in distinctive sequences called _____ that help preserve the integrity and stability of the chromosome.
6. The genetic codons exhibit several features. One of them is the pattern of _____: most often sets of codons specifying the same amino acid are grouped, such that the first two letters are the same, with only the third differing.
7. The initial step in prokaryotic gene transcription is template binding. In bacteria, the site for initial binding is established when _____ subunit recognizes specific DNA sequences called _____ which contain similar sequences in different genes of the same organism.
8. In many eukaryotic genes, a common cis-acting core sequence in the initiation of transcription is _____, which locates about 30 base pairs upstream the start point of transcription.
9. Introns are major components of nuclear-derived pre-mRNA transcripts of eukaryotes. Their removal requires a complex mechanism, which is mediated by a huge molecular complex called a _____.
10. A common sequence upstream the AUG initiator codon called _____ is important for the initiation of translation of eukaryotes. The presence of this sequence in eukaryotes is considered to increase the efficiency of translation.