

本試題共有七大題，答案請一律寫在答案紙上，否則不予計分，並請依序作答、標明題號。

1. Choose the most appropriate answer for the following questions, 2 points each. (28%)

- (1). A chromosome's gene sequence that was ABCDEFG before damage and ABCDLMNOP after is an example of
- inversion
 - deletion
 - duplication
 - translocation
 - aneuploidy
- (2). A polytene chromosome
- is found in the salivary glands of some insect larvae
 - is a chromosome that has repeatedly divided and stuck together to produce a giant chromosome
 - played a key role in the development of the chromosome theory of inheritance
 - shows alternating dark and light bands
 - all of the above
- (3). An organism with a $2n + 1$ chromosome composition is known as
- monosomy
 - trisomy
 - diploid
 - aneuploidy
 - both b and d, but not a and c
- (4). Male calico cats
- are not possible
 - are possible and occur often
 - are possible in the abnormal genotype XXY but are sterile
 - have different coat patterns than female calicos
 - none of the above
- (5). A Barr body is normally found in the nucleus of which kind of human cell?
- unfertilized egg cells only
 - sperm cells only
 - somatic cells of a female only
 - somatic cells of a male only
 - both male and female somatic cells
- (6). Glucose-6-phosphate dehydrogenase deficiency (G6PD) is inherited an X-linked recessive gene in humans. A woman whose father suffered from G6PD marries a normal man. What proportion of their sons is expected to be G6PD?
- 1
 - 1/2
 - 1/4
 - 1/8
 - 1/16

(背面仍有題目,請繼續作答)

- (7). A species of which of the following genera is used to produce Ti plasmid?
- Pseudomonas
 - Agrobacterium
 - Rhizobium
 - Saccharomyces
 - Proteus
- (8). A "gene probe" is which of the following?
- a virus that transfer DNA to a recipient cell
 - a piece of radioactively labeled DNA or RNA that is used to find a specific gene
 - an enzyme that locates a specific restriction site on DNA
 - a promoter site that associated with a specific set of genes
 - a transposon that recognizes a specific DNA sequences
- (9). Which of the following types of organism is (are) used as host(s) for transferring gene(s)?
- bacteria
 - yeast
 - mammalian cells
 - all of the above
 - none of the above
- (10). Karyotype analysis is
- is a means of detecting and reducing mutagenic agents
 - is a surgical technique that separates chromosomes that have failed to segregate properly during meiosis II
 - is used in prenatal diagnosis to detect chromosomal mutations and metabolic disorders in embryos
 - substitutes defective alleles with normal ones
 - all of the above
- (11). The difference between normal hemoglobin and sickle-cell hemoglobin is in the
- heme portion of the molecules
 - number of chains of amino acids
 - substitution of any amino acid for a specific amino acid in the hemoglobin molecule
 - substitution of a specific amino acid for another specific amino acid
 - loss of only one amino acid from the normal hemoglobin molecule
- (12). Mitochondrial DNA
- contains a few codons that specify amino acids other than what the codons of nuclear DNA specify
 - uses the same assortment of codons as does the DNA in the nucleus
 - can never replicate itself because DNA polymerases are not present in mitochondria
 - can never be transcribed or translated because RNA polymerases are not present in mitochondria
 - can never replicate itself because there are no promoter sequences to initiate transcription

- (13). Which of the following events may occur in all viruses, prokaryotes, and eukaryotes?
- duplication
 - aneuploidy
 - translocation
 - mutation
 - all of the above
- (14). The ___ determines the rate at which a certain mRNA chain is to be synthesized
- repressor gene
 - heterogeneous nuclear DNA
 - promoter sequence
 - operator sequence
 - none of the above

2. Generalized transducing phages obtained from $a^+ b^+ c^+$ donor bacteria were used to infect recipient cells of genotype $a^- b^- c^-$. Transductants for a^+ were selected and later tested for the cotransfer of the other genes. Of a total of 500 a^+ transductants examined, 265 were $b^+ c^+$, 165 were $b^- c^+$, 5 were $b^+ c^-$, and 65 were $b^- c^-$. (1) Calculate the cotransduction frequencies for the markers a^+ and b^+ and for a^+ and c^+ . (2) Determine the order of the three loci on the bacterial chromosome. (10%)

3. (12%)

(1) In the rat cross, give the following data:

Parent	Offspring	
	Yellow	Agouti
Yellow x Yellow	2397	1234
Yellow x Agouti	2379	2396

Based on this phenotypic ratio, explain the genetic basis of this trait.

(2) In a variety of onions, three bulb colors segregate: red, yellow, and white. A plant with a red bulb is crossed to a plant with a white bulb and all the offspring have red bulbs. when these are selfed, the following plants are obtained:

Red-bulbed	119
Yellow-bulbed	32
White-bulbed	9

What is the mode of inheritance of bulb color and how do you account for the ratio?

(背面仍有題目,請繼續作答)

4. (10%)

- (1) For what reasons, the nematode worm *Caenorhabditis elegans* has become another excellent model system for studying the genetic control of development.
- (2) What is the heterochrony? Using examples to explain.

5. (10%)

- (1) You have isolated a new histidine auxotroph, and despite all efforts, you cannot produce any revertants. What probably happened to produce the original mutant ?
- (2) The transposase protein of the P transposable element in *Drosophila* is encoded by 4 exons, numbered 0, 1, 2 and 3. The germ-line transcript is 2.1 kb long, contains these 4 exons, and encodes a protein with transposase activity. However, the somatic P element transcript, which is 2.5 kb long, contains all 4 exons and in addition does not remove the intron between exons 2 and 3. The longer somatic mRNA encodes a protein that is only 75 percent as large as the protein encoded by the shorter germ-line transcript. How can a longer transcript encoded a shorter protein?

6. (12%)

- (1) How would you develop a probe for a gene whose messenger RNA could not be isolated? How could an expression vector be used to isolated a cloned gene?
- (2) A 12 kb DNA molecule cut with *EcoR* I yield one 12 kb fragment. When the original molecule is cut with *BamH* I, three fragments of 2 kb, 4.5 kb, and 5.5 kb are produced. When the fragment from *EcoR* I is treated with *BamH* I, four fragments of 2 kb, 2.5 kb, 3.0 kb and 4.5 kb are produced. Draw a restriction map.

7. (18%)

- (1) What is chromosome walking? When is it used?
- (2) Explain the following terms:
 - a. Transposon tagging
 - b. Multigene family
 - c. Telomere
 - d. RNA editing