

題號： 455  
科目： 遺傳學(C)  
節次： 7

國立臺灣大學 108 學年度碩士班招生考試試題

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I. Multiple choice: select one best answer from the list of choices (3 points each) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

1. A molecule that interacts easily with water is known as:

- A. Hydrophonic
- B. Hydrophilic
- C. Hydrophobic
- D. Lipid based
- E. Protein based

2. Eukaryotic cells that possess two copies of each chromosome are said to exist in a \_\_\_\_\_ state.

- A. Haploid
- B. Diploid
- C. Aneuploid
- D. Polyploid
- E. None of these

3. A man was born with six fingers on each and six toes on each foot. His wife and their son have a normal number of digits.

Having extra digits is a dominant trait. The couple's second child has extra digits. What is the probability that their next child will have extra digits?

- A. 10%
- B. 25%
- C. 50%
- D. 100%
- E. 0%

4. A woman who is blood type A has a child who is blood type O. Which of the following individuals could not be the father of this child?

- A. Type A
- B. Type B
- C. Type O
- D. Type AB
- E. All of these could be the father

5. A ( $w^+/w^+$ ) red-eyed *Drosophila* female is crossed with a white-eyed male. Assuming the trait for eye color is sex-linked, what are the possible phenotypes of the progeny?

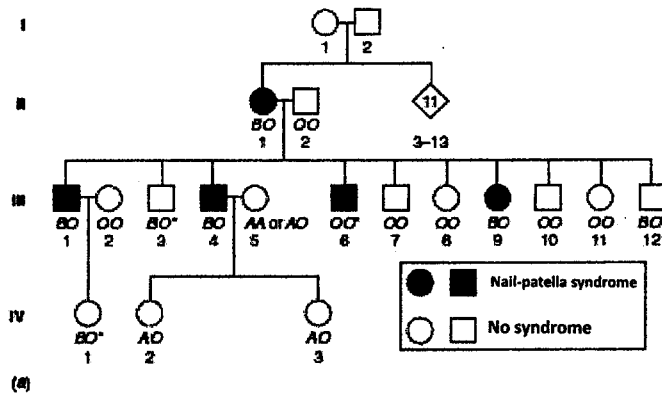
- A. All red-eyed individuals
- B. Red- and white-eyed females and males
- C. Only red-eyed females and white-eyed males
- D. Both red- and white-eyed males and only white-eyed females
- E. None of these

6. Fertile tetraploids seem to have arisen by chromosome duplication in a hybrid that was produced by a cross of:

- A. Two different, but related, diploid species
- B. Two identical diploid species
- C. Four different but related haploid species
- D. Four identical diploid species
- E. Four identical haploid species

見背面

7. For the pedigree shown here, nail-patella syndrome was found to be linked to which blood type?



- A. A  
 B. B  
 C. O  
 D. AB  
 E. none of the above
8. During *B. subtilis* transformation, which of the following statements is incorrect?  
 A. Large, double-stranded DNA fragments are bound to the cell surface  
 B. Bound DNA is attached to specific receptor sites  
 C. DNA moves across the membrane in an energy independent manner  
 D. One strand of the double-stranded DNA is hydrolyzed during uptake by a bound DNase  
 E. One strand of DNA is protected from degradation by a coating of single stranded binding proteins and the RecA protein
9. Which of the following characteristics or functions is not believed to be exhibited by highly repetitive DNA?  
 A. Structural or organizational roles for the chromosome.  
 B. Transposable elements  
 C. Heterochromatin  
 D. Influencing regions of chromosome pairing  
 E. Junk
10. Telomere length has not been correlated with:  
 A. Aging  
 B. Sex determination  
 C. Progeria  
 D. Cancer  
 E. All of these
11. Consider the DNA template 3'—AAATTTAGCCA—5'. When transcribed, which of the following is the correct resulting transcript?  
 a) 5'—TTTAAATCGGT—3'  
 b) 5'—UUUAAAUGCCA—3'  
 c) 5'—UUUAAAUCGGU—3'

- d) 3'—TTTAAATCGGT—5'
- e) 3'—AAATTTAGCCA—5'

12. Mutations that result in no gene product or totally nonfunctional gene products are called:

- A. Isomers
- B. Isoalleles
- C. Null alleles
- D. Lethal alleles
- E. Forward alleles

13. Which of the following is found in a YAC?

- A. Yeast origin of replication
- B. Two yeast telomeres at the end of the minichromosome
- C. Yeast centromere
- D. Polylinker site
- E. All of these

14. The study of genome evolution is also known as:

- A. Comparative genomics
- B. Functional genomics
- C. Structural genomics
- D. Phylogenetic genomics
- E. Comparative genomics and Phylogenic genomics

15. Recorded patterns of DNA polymorphisms that can provide strong evidence of an individual's identity are known as:

- A. DNA STRs
- B. DNA fingerprints
- C. RFLP fingerprints
- D. Genetic identification
- E. None of these

16. Which of the following is not a feature of quantitative traits?

- A. Environment influences phenotype
- B. Effect of environment can vary with genotype
- C. Mendel's laws do not apply to these traits
- D. Two or more genes are often involved
- E. All of these

17. In a sample of 500 men, 240 have X-linked hemophilia and all the others have normal blood clotting. If men are hemizygous for the allele, what is the frequency for the X-linked hemophilia allele?

- A. 0.1
- B. 0.12
- C. 0.24
- D. 0.48
- E. 0.88

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18. Which of the following statements about IS elements is not correct?
- A. IS elements are responsible for the formation of Hfr strains of *E. coli*.
  - B. IS elements are less than 2,500 nucleotide pairs in size and contain only genes involved with promoting or regulating transcription.
  - C. IS elements are demarcated by short, inverted terminal repeats which have no role in the transpositional process.
  - D. IS elements are capable of creating target site duplications.
  - E. All of these are correct.
19. Each bifurcation in a phylogenetic tree represents
- A. a different ancestor.
  - B. a common ancestor.
  - C. a common descendent.
  - D. a different descendent.
  - E. a mutation
20. Recombination between bacteria occurs between:
- A. The main chromosome of the donor and a fragment of the recipient.
  - B. The main chromosome of the recipient and a fragment of the donor.
  - C. The main chromosome of the donor and the main chromosome of the recipient.
  - D. The main chromosome of the recipient and the main chromosome of the donor.
  - E. None of the above

**II. Solve the problems**

1. Five human genomic DNA clones present in PAC vectors were tested by hybridization for the presence of six sequence-tagged sites designated STS1 through STS6. The results are given in the following table: a plus indicates the presence of the STS, and a minus indicates the absence of the STS. (5 points)

		STS					
		1	2	3	4	5	6
YAC clone	A	+	-	+	+	-	-
	B	+	-	-	-	+	-
	C	-	-	+	+	-	+
	D	-	+	-	-	+	-
	E	-	-	+	-	-	+

- a. Draw the contig map defined by these data.
  - b. What is the order of the STS sites on the chromosome?
2. The gene for  $\alpha$ -globin is present in all vertebrate species. Over millions of years, the DNA sequence of this gene has changed in the lineage of each species. Consequently, the amino acid sequence of  $\alpha$ -globin has also changed in these lineages. Among the 141 amino acid positions in this polypeptide, human  $\alpha$ -globin differs from shark  $\alpha$ -globin in 79 positions; it differs from carp  $\alpha$ -globin in 68 and from cow  $\alpha$ -globin in 17. Do these data suggest an evolutionary phylogeny for these vertebrate species? (5 points)
3. Inherited cancers like retinoblastoma show a dominant pattern of inheritance. However, the underlying genetic defect is a recessive loss-of-function mutation—often the result of a deletion. How can the dominant pattern of inheritance be reconciled with the recessive nature of the mutation? (5 points)

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4. Explain the Wobble hypothesis and discuss the predictions based upon this hypothesis that have proven true. (5 points)
5. CRISPR-Cas9 based genome editing is a powerful tool in life science. Describe this technique and how it might help people with hemophilia. (10 points)
6. Explain, in detail, how the hemoglobin mutants provide excellent examples of deleterious mutations and how they show that mutation is a process in which changes in gene structure, can cause changes in the amino acid sequences of the polypeptide gene products. (10 points)

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