

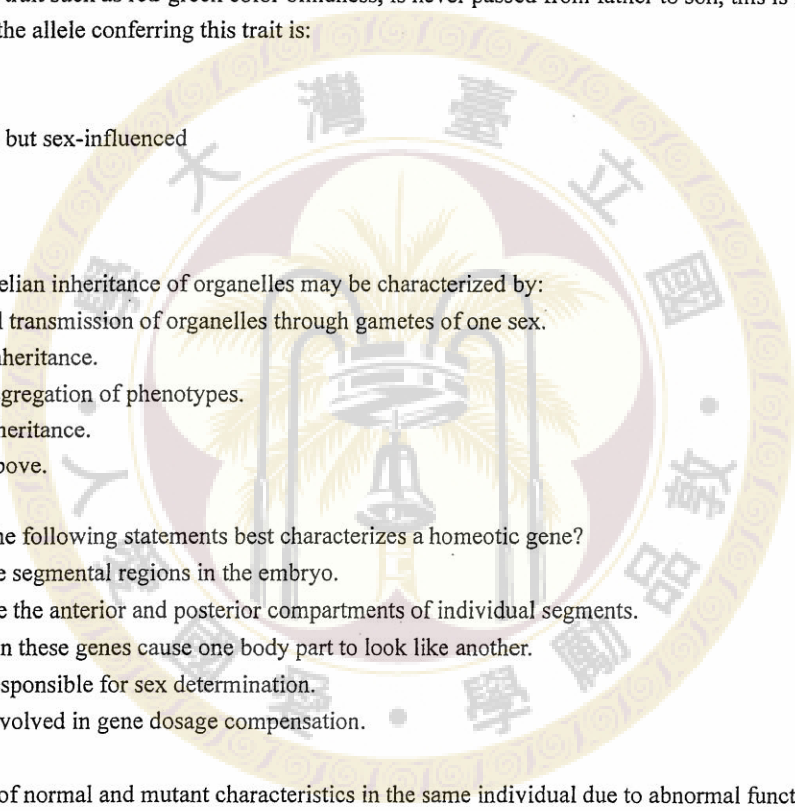
I. 解釋名詞 (15%) :

- (1) Insertion sequence (IS) element
- (2) Null allele
- (3) Homozygosity by descent
- (4) Incomplete penetrance
- (5) Reciprocal crosses

II. 單選題 (65%; 1-15 題各 3 分, 16-19 題各 5 分) : ※ 注意：請於試卷上「選擇題作答區」依序作答。

1. Siblings share what percentage of their alleles?
 - a) 1/2
 - b) 1/4
 - c) 1/8
 - d) 1/10
 - e) 1/16
2. Sickle-cell anemia in humans is an example of _____.
 - a) codominance
 - b) incomplete penetrance
 - c) heterozygous advantage
 - d) multiple allele systems
 - e) none of the answers are correct
3. If you cross a Gg (G =yellow, g =green) Ww (W =round, w =wrinkled) individual with a $ggWw$ individual what would be your expected phenotypic ratio?
 - a) 9:3:3:1
 - b) 6:6:2:2
 - c) 7:4:3:2
 - d) 5:5:5:1
 - e) 8:6:1:1
4. A man has inherited an allele that codes for dark hair, but his hair is brown. This is a possible example of:
 - a) variable expressivity.
 - b) incomplete penetrance.
 - c) an environmental interaction.
 - d) an epistatic interaction.
 - e) all of the above
5. A cross between two heterozygotes for one trait yields a phenotypic ratio of 2:1. What is the best explanation?

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- a) The dominant trait is lethal in its homozygous form.
- b) The trait forms sterile progeny.
- c) Either the dominant or the recessive allele in its homozygous form is lethal.
- d) The trait causes semisterility in one of the parents.
- e) The recessive allele for the trait is lethal in its homozygous form.
6. If a human trait such as red-green color blindness, is never passed from father to son, this is likely an indication that the allele conferring this trait is:
- a) X linked
- b) Y linked
- c) Autosomal but sex-influenced
- d) Recessive
- e) Dominant
7. Non-Mendelian inheritance of organelles may be characterized by:
- a) preferential transmission of organelles through gametes of one sex.
- b) maternal inheritance.
- c) irregular segregation of phenotypes.
- d) paternal inheritance.
- e) all of the above.
8. Which of the following statements best characterizes a homeotic gene?
- a) They define segmental regions in the embryo.
- b) They define the anterior and posterior compartments of individual segments.
- c) Mutations in these genes cause one body part to look like another.
- d) They are responsible for sex determination.
- e) They are involved in gene dosage compensation.
9. A mixture of normal and mutant characteristics in the same individual due to abnormal functioning of euchromatic genes that are artificially transposed to a heterochromatic environment, is called:
- a) position-effect variegation
- b) gene amplification
- c) gene-dosage compensation
- d) inactivation of whole chromosomes
- e) signal transduction
10. Which of the following would not be considered part of a gene in a complementation test to define a gene?
- a) introns
- b) 5' noncoding regions involved in regulation
- c) 3' noncoding regions involved in regulation

- d) only exons
e) none of the above
11. Which of the following is not unique to eukaryotic gene regulation (*i.e.*, also found in prokaryotes)?
a) alternate splicing.
b) heat shock proteins.
c) hormone responsive elements.
d) euchromatin.
e) gene-dosage compensation.
12. In a given population of *Drosophila*, curly wings (*c*) is recessive to the wild-type condition of straight wings (*c*⁺). You isolate a population of 35 curly winged flies, 70 flies that are heterozygous for straight wings and 45 that are homozygous for straight wings. What is the frequency of alleles in this population?
a) 35% *c*; 45% *c*⁺
b) 46.7% *c*; 53.3% *c*⁺
c) 50% *c*; 50% *c*⁺
d) 55% *c*; 45% *c*⁺
e) none of the answers are correct
13. Telomere length has not been correlated with:
a) aging.
b) sex determination.
c) progerias.
d) cancer.
e) all of the above
14. In RNAi, the following are true EXCEPT:
a) a double-strand RNA is injected into a cell.
b) a vector can be introduced to produce a double-stranded RNA hairpin
c) fragments of the RNA anneal with a promoter and silence gene transcription.
d) fragments of the RNA anneal with the target mRNA.
e) the RiSC system degrades the target mRNA and the annealed RNA fragment.
15. Which of the following is NOT a feature of continuous 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 the above

16. There are three phenotypes for fur color in monsters: wild-type fur is brown, one mutant color is purple, another mutant color is lavender. When we cross the two mutant monsters, we find that the F₁ has only brown fur. What is the best explanation?

- a) The combination of lavender and purple equals brown.
- b) There was a back mutation to brown in one of the genes.
- c) The mutations are in two different genes affecting color.
- d) The lavender and purple gene are codominant.
- e) The purple gene is completely dominant over the lavender gene.

17. Klinefelter males (XXY) have a single Barr body, indicating one X has been subject to X chromosome inactivation. What is the most likely explanation for the observation that these males are not completely normal?

- a) Gene dosage very early in embryogenesis, prior to X chromosome inactivation, is critical for proper development.
- b) The allele associated with Klinefelter is X-linked, and XXY males develop Klinefelter symptoms if the X that is inactivated carries the wild-type allele.
- c) Recessive disease alleles carried on one X are revealed when the other X is inactivated.
- d) The Barr body is not an indicator of X chromosome inactivation.
- e) The Y chromosome also carries an SRY mutation.

18. During conjugation, one gene (A) is found to transfer to the recipient bacteria 26 minutes following the start of conjugation, while a second gene (M) is found to transfer 37 minutes following the start of conjugation. A third gene (T) transfers 45 minutes following the start of conjugation. Based on this information, which of the following is true?

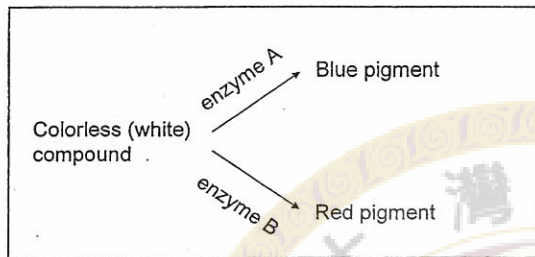
- a) Genes A and M have a genetic distance of 11 minutes.
- b) Genes A and T have a genetic distance of 19 minutes.
- c) Genes M and t have a genetic distance of 8 minutes.
- d) The order of the genes is A M T.
- e) All of the answers are correct.

19. True genetic distance may be much greater than the observed recombination frequency. Which is NOT an explanation of this phenomenon?

- a) The genes are far apart.
- b) Two crossover events may not produce recombinant chromosomes.
- c) Four crossover events may not produce recombinant chromosomes.
- d) Interference with 2 genes that are tightly linked affects the recombination frequency.
- e) A double crossover contributes to the average number of exchanges on a chromosome.

二、問答題 (20%)

1. In certain plant, the flower petals are normally purple. Two recessive mutations arise in separate plants and are found to be on different chromosomes. Mutation 1 (m_1) gives blue petals when homozygous (m_1/m_1). Mutation 2 (m_2) gives red petals when homozygous (m_2/m_2). Biochemists working on the synthesis of flower pigments in this species have already described the following pathway:



- Which mutant would you expect to be deficient in enzyme A activity? (2%)
- A plant has the genotype $M_1/m_1; M_2/m_2$. What would you expect its phenotype to be? (2%)
- If the plant in part *b* is selfed; what colors of progeny would you expect and in what proportions? (6%)

2. In *D. melanogaster*, the following 3 phenotypes are determined by 3 different X-linked genes:

- Yellow vs. gray BODY COLOR: determined by the alleles y and y^+
- Vermilion vs. wildtype EYES: determined by the alleles v and v^+
- Singed vs. straight BRISTLES: determined by the alleles sn and sn^+

When females heterozygous for each of these genes were testcrossed with yellow, vermilion, singed males, the following classes and numbers of progeny (N= 1000) were obtained:

yellow, vermilion, singed	53
yellow, vermilion	108
yellow, singed	331
yellow	5
vermilion, singed	3
vermilion	342
singed	95
wildtype	63
	1000

- What is the order of these 3 genes? Construct a linkage map with the genes in their correct order and indicate the map distances between the genes. (6%)
- How does the frequency of double crossovers observed in this experiment compare with the frequency expected if crossing-over occurs independently in the two chromosome regions? Determine the coefficient of coincidence and the interference. (4%)