國立臺灣大學 114 學年度碩士班招生考試試題

※ 注意：請於試卷內之「選擇題作答區」依序作答。

一、 選擇題：(1~5: 每題 5 分；6~10: 每題 2 分；總共 35 分)

1. Which DNA sequence is most resistant to heat and remains double-stranded longer?
   a. AATTGGCC
   b. ATGCATTC
   c. AGGAGCTC
   d. TGGCTTAG
2. The compact packing of chromatin into chromosomes visible during nuclear division is facilitated by the interactions between which proteins?
   a. Cdk
   b. H1 histone
   c. H3 histone
   d. H4 histone
3. The genotypic ratio of the progeny of a monohybrid cross is typically
   a. 1:2:1
   b. 9:3:3:1
   c. 27:9:9:9:3:3:3:1
   d. 3:1
4. What is one function of the 3'UTR (untranslated region) of mRNA?
   a. Control the half-life of mRNA
   b. Bind RNA polymerase to initiate transcription
   c. Help activators bin to the enhancer region
   d. Bind ribosomes to initiate translation
5. Which of the following statements is true?
   a. Gene mutations occur independently of each other.
   b. Ionizing radiation causes chromosomal damage and free radical formation.
   c. Mutations are random; that is, it is impossible to predict exactly when a specific gene will mutate, but an expected frequency can be assigned.
   d. All of these are true.
6. What is the chance of obtaining a heterozygous individual from a testcross?
   a. 0%
   b. 50%
   c. at least 50%
   d. 100%
7. A typical phenotypic ratio of a dihybrid cross with dominant and recessive alleles is
   a. 9:1
   b. 1:2:1
   c. 3:1
   d. 9:3:3:1
8. In clover leaves, chevron pattern (a light-colored triangular leaf pattern) is controlled by seven different alleles at a single gene. From this information alone, what can be said
   a. Alleles at this gene show incomplete dominance.
   b. There is a multiple allelic series with seven alleles that controls chevron pattern.
   c. This gene shows epistasis.
   d. One allele at this gene must be completely dominant.
9. Sister chromatids are

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a. synonymous with homologous chromosomes
b. present only in meiosis and not in mitosis
c. identical products of chromosome duplication held together by a replicated but unseparated centromere
d. visible in interphase just after S phase

10. Six independently isolated mutations (*a–f*) all result in yellow tomatoes and are recessive to the normal red color. When different pairs of homozygous mutants are crossed, all produce plants bearing yellow tomatoes except for pairs involving mutation *c*. When *cc* plants are crossed to any of the other strains, progeny plants produce red tomatoes. Based on these observations, which one of the following statements is not true?
a. The six mutations affect six different genes.
b. Mutations *a*, *b*, *d*, *e*, and *f* are alleles at the same gene.
c. A complementation test was performed.
d. Mutation *c* affects a different gene than do mutations *a*, *b*, *d*, *e*, and *f*.

二、解釋名詞 (每題 5 分，總共 15 分)： ※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

1. Intron:
2. Locus:
3. Bimolecular fluorescence complementation (BiFC):

三、簡答題：(1: 10 分；2~6: 每題 8 分；總共 50 分)

1. Please explain how the CRISPR/Cas9 technique works.

2. In cattle, the polled (hornless) condition (*P*) is dominant over the horned (*p*) phenotype. A particular polled bull is bred to three cows. Cow A, which is horned, produces a horned calf; polled cow B produces a horned calf; and horned cow C produces a polled calf. What are the genotypes of the bull and the three cows, and what phenotypic ratios do you expect in the offspring of these three matings?

3. Grey seed color (*G*) in garden peas is dominant to white seed color (*g*). In the following crosses, the indicated parents with known phenotypes but unknown genotypes produced the progeny listed:

Parents	Progeny		Female Parent Genotype
Female x Male	Grey	White	
grey x white	81	82	?
grey x grey	118	39	?
grey x white	74	0	?
grey x grey	90	0	?

On the basis of the segregation data, give the possible genotypes of each female parent.

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4. In corn, a dihybrid for the recessives *a* and *b* is testcrossed. The distribution of the phenotypes is as follows:

A	*B*	122
A	*b*	118
a	*B*	81
a	*b*	79

Test the hypothesis that these genes assort independently using a chi-square test. Explain tentatively any deviation from expected values, and tell how you would test your explanation.

5. How does lactose trigger the coordinate induction of the synthesis of β-galactosidase, permease, and transacetylase? Why does the synthesis of these enzymes not occur when glucose is also in the medium?

6. Chromatin remodeling is essential for gene activation and can be achieved using different mechanisms.
   a. What different types of enzymes are used to modify histones, and how do these enzymatic modifications lead to chromatin remodeling?
   b. What phenotype(s) would you expect to see in a mutant where a protein involved in chromatin remodeling failed to function?

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