※ 考生請注意：本試題不可使用計算機

問答題(第 1~9 題) Essay questions (56%)

1. A new restriction endnuclease is discovered that recognized and cleaves the palindromic sequence GGATATCC. How often does this sequence appear in a random-sequence DNA in which all four nucleotides are present in equal amounts? In a random-sequence DNA in which the G+C content is 80%, will the frequency with which this site appears increase or decrease? (10%)

2. In proteomics work, two-dimensional gel electrophoresis is often used to separate the thousands of proteins in a cell on a single gel. Protein are separated by their charge (PI) in one dimension, and then by size in the second dimension. Why do researchers use two different electrophoretic procedures, instead of simply separating proteins by size in both dimensions? (5%)

3. MicroRNAs know as small temporal RNAs (stRNAs) have been discovered in higher eukaryotes. Describe their characteristics and general function. (5%)

4. Please describe the **DNA replication in *E. coli*.** (5%)

5. Please describe the **nucleotide excision repair system.** (5%)

6. Please describe in detail the **transcription initiation in prokaryotic cells.** (5%)

7. Please describe in detail the **spliceosome-mediated RNA splicing**. (5%)

8. Define the term **epigenetic**, and describe two examples. (12%)

9. In a cross of two yeast strains of genotypes a^+b^+ x ab the progeny were
   40 a^+b^+
   36 ab
   11 a^+b
   13 ab^+
   What frequency of recombination will appear? (4%)

(背面仍有題目，請繼續作答)

10. 解釋名詞（每題 4 分）（請說明該生物名詞的意涵，不只是翻譯）(20%)

(1) Metagenomics

(2) GMO

(3) Linkage disequilibrium

(4) Balancing selection

(5) Inbreeding

11. 單選題（每題 2 分）(24%)

(1) In a plant species, if the *B* allele (blue flowers) and the *b* allele (white flowers) are incompletely dominant (*Bb* is light blue), what offspring ratio is expected in a cross between a blue-flowered plant and a white-flowered plant?

a) 1/4 blue:1/2 light blue:1/4 white

b) 1/2 blue:1/2 white

c) All light blue

d) 3/4 blue:1/4 white

e) 1/3 blue:1/3 light blue:1/3 white

(2) If a mouse has a dominant phenotype (*P*-), how would you determine if it is homozygous (*PP*) or heterozygous (*Pp*)?

a) Cross it to a homozygous dominant mouse.

b) Cross it to a mouse with the dominant trait but a similarly unknown genotype.

c) Cross it to a mouse with the recessive trait.

d) Cross it to a heterozygous dominant mouse.

e) It cannot be determined.

(3) In a cross between two individuals *BbGG* X *Bbgg,* what ratio of phenotypes would be expected in the offspring if the two genes show *independent assortment*?

a) 3:1

b) 9:3:3:1

c) 1:2:1

d) 1:1

e) 2:1

(4) In mitosis, sister chromatids are separated during _____, while sisters are separated in _____ of meiosis.

a) prophase; prophase I

b) anaphase; anaphase I

c) metaphase; metaphase I

d) anaphase; anaphase II

e) metaphase; metaphase II

(5) Which of the following characteristics is common to species that reproduce sexually?

a) Morphologically distinguishable male and female gametes
b) Diploid adult stage
c) Different sets of sex chromosomes in males and females
d) Y chromosome in males
e) Meiosis

(6) Which of the following *best* describes the Lyon hypothesis?

a) Barr bodies are inactivated X chromosomes.
b) The paternal X chromosome of a female is inactivated in an early embryonic stage.
c) The maternal X chromosome of a female is inactivated in an early embryonic stage.
d) One of the two female X chromosomes is randomly inactivated in an early embryonic stage.
e) Each cell of a female randomly inactivates one X chromosome shortly after mitosis.

(7) All forms of extranuclear inheritance involve _____.

a) DNA carried by organelles other than the nucleus
b) endosymbiotic cells carried in the cytoplasm
c) gene products carried by the ooplasm
d) transmission from the maternal parent to all offspring
e) transmission of information via the cytoplasm

(8) Any molecule that serves as the genetic material must have the following characteristics *except*

a) the ability to be replicated
b) the ability to store information
c) the ability to directly influence the development of traits
d) the ability to express information
e) the potential to be changed via mutation

(9) Which of the following categories of mutations is not possible to pass to offspring?

a) Silent
b) Somatic
c) Frameshift
d) Induced
e) X-linked

(10) If a mother has type A blood and her son has type O blood, what are the possible blood types of her son's father?

a) Type O only
b) Types A or O
c) Types B or O
d) Types A, B, or O
e) Any blood type

(11) Although the most frequent forms of Down syndrome are caused by a random error, nondisjunction of chromosome 21, Down syndrome occasionally runs in families. The cause of this form of familial Down syndrome is _____.

a) an inversion involving chromosome 21
b) a translocation between chromosome 21 and a member of the D chromosome group
c) too many X chromosomes
d) a chromosomal aberration involving chromosome 1
e) a maternal age effect

(12) The maize genes *c* and *d* are linked, 40 map units apart. If a plant c^+d/cd^+ is selfed, what proportion of the progeny will be *cd*/*cd*?

a) 0.04
b) 0.10
c) 0.50
d) 0.20
e) 0.40