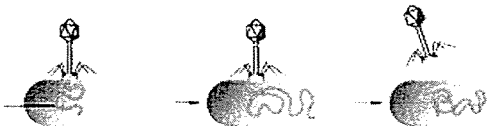
國立臺灣大學 105 學年度碩士班招生考試試題

※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

第一部分：含選擇、簡答、填充、配對等題型
(1-20 題，每題 2.5 分；21-25 題，每題 2 分)

1.



The concept proven by the experiment in this figure is that

a. protein is not the encoding material.
b. protein enters the host cell.
c. protein denatures due to radiation.
d. protein is composed of subunits with phosphate.
e. all of these are correct.

2. James Watson and Francis Crick

a. were both English researchers working at Cambridge University.
b. performed elegant experiments in DNA chemistry.
c. constructed an accurate model of the DNA molecule illustrating its structural simplicity.
d. performed experiments that convinced scientists that DNA is a double-stranded molecule.
e. did all of these

3. DNA polymerase assembles new strands

a. in a 5' to 3' direction only.
b. in a 5' to 3' direction building one strand and a 3' to 5' direction building the other stand.
c. in a 5' to 3' direction building the first half of a strand and a 3' to 5' direction building the second half of a strand.

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d. in a 3' to 5' direction building the first half of a strand and a 5' to 3' direction building the second half of a strand.
e. in a 3' to 5' direction on the "old" 3' to 5' strand.

4. Uracil will pair with
a. ribose.
b. adenine.
c. cytosine.
d. thymine.
e. guanine.

5. If the DNA triplets are ATG CGT, the mRNA codons are
a. AUG CGU.
b. ATG CGT.
c. UAC GCA.
d. UAG CGU.
e. all of these.

6. The first amino acid of a new polypeptide chain is
a. alanine.
b. cysteine.
c. variable.
d. phenylalanine.
e. methionine.

7. A gene mutation
a. is a change in the nucleotide sequence of DNA.
b. may be caused by environmental agents.
c. may arise spontaneously.
d. can occur in any organism.
e. is described by all of these.

8. Which of the following causes DNA to wrap tightly around histones essentially preventing transcription?

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a. methylation
b. acetyl CoA
c. nitrogenation
d. dehydration
e. carbonation

9. In knockout experiments,
a. genes are added to chromosomes.
b. normal genes are replaced physically by mutated genes.
c. genes are mutated or deleted to prevent their transcription or translation.
d. mRNAs are prevented from attaching to ribosomes.
e. the protein products of specific genes are inactivated.

10. Mutation of the A group gene in *Arabidopsis thaliana* affects development in its flower's
a. first whorl only.
b. second whorl only.
c. third whorl only.
d. first and second whorls.
e. second and third whorls.

11. Which of the following accounts for the negative control of operons?
a. promoters
b. repressors
c. structural genes
d. operators
e. all of these

12. A gene locus is
a. a recessive gene.
b. an unmatched allele.
c. a sex chromosome.
d. the location of an allele on a chromosome.
e. a dominant gene.

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13. According to Mendel, what kinds of genes "disappear" in F_1 pea plants?
a. sex-linked
b. dominant
c. recessive
d. codominant
e. lethal

14. An individual with a genetic makeup of *aa BB* is called
a. true-breeding.
b. recessive.
c. hybrid.
d. dihybrid.
e. heterozygous.

15. The ABO blood types are controlled by
a. pleiotropy.
b. multiple alleles.
c. incomplete dominance.
d. codominance.
e. multiple alleles and codominance.

16. A gene that produces multiple effects is called
a. a multiple allele.
b. an autosome.
c. an epistatic gene.
d. a pleiotropic gene.
e. an incompletely dominant gene.

SHORT ANSWER

17. In a certain plant, when individuals with blue flowers are crossed with individuals with blue flowers, only blue flowers are produced. Plants with red flowers crossed with plants with red flowers sometimes produce only red flowers, although other times they produce either red or blue flowers. When plants with red flowers are crossed with plants with blue flowers, sometimes only red flowers are produced; other times either red or blue flowers are produced. Which gene is dominant?

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18. Tall (*D*) is dominant to dwarf (*d*). Give the F_2 genotypic and phenotypic ratios of a cross between a pure-breeding tall plant and a pure-breeding dwarf plant.

19. In female mammals, most genes on one of the two X chromosomes are permanently inaccessible, and this phenomenon is called _____.

20. Gene expression requires the participation of the following three types of RNA: _____, _____and _____.

21. Gain-of-function mutations are associated with all of the following except
    a. dominant traits
    b. new properties in a gene
    c. phenotypes in heterozygous individuals
    d. a decrease in the normal activity of a gene

For questions 22, 23, 24, and 25, choose the kind of inheritance that best explains the data.

    a. recessive lethal allele
    b. dominant lethal allele
    c. incomplete dominance; two allelic pairs
    d. duplicate recessive epistasis; two allelic pairs
    e. dominant epistasis; two allelic pairs

22. When crossed, two pure-breeding varieties of white kernel corn yield progeny with purple kernels. When these purple progeny are selfed, a count of the kernels in the F_2 yields an average of 270 purple kernels : 210 white kernels per ear.

23. When pure-breeding wheat with red kernels is crossed to the pure-breeding white variety, the progeny have pink kernels. One hundred F_2 plants exhibit the following phenotypes: 6 red, 25 dark pink, 38 pink, 25 light pink, 6 white.

24. Yellow mice crossed to pure-breeding agouti mice produce a 50:50 ratio of yellow to agouti offspring. Crosses between yellow mice never produce 100 percent yellow progeny, but rather yield 36 yellow and 15 agouti offspring.

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25. At age 52, a man begins to show the symptoms of Huntington disease. Like his mother before him, he eventually dies from the disease. His wife is normal and there is no history of the disease in his wife's family or his father's family. Two of his four children also die from the disease, albeit not until late in their lives.

第二部分：簡答題(共 40 分)

1. In jimsonweed, purple flowers are dominant to white. Self-fertilization of a particular purple-flowered jimsonweed produces 28 purple-flowered and 10 white-flowered progeny. What proportion of the purple-flowered progeny will breed true? (**5 points**)
2. In guinea pigs, rough coat (*R*) is dominant over smooth coat (*r*). A rough-coated guinea pig is bred to a smooth one, giving eight rough and seven smooth progeny in the F_1 generation.
   a. What are the genotypes of the parents and their offspring? (**5 points**)
   b. If one of the rough F_1 animals is mated to its rough parent, what progeny would you expect? (**5 points**)
3. Four different albino strains of *Neurospora* were each crossed to the wild type. All crosses resulted in half wild-type and half albino progeny. Crosses were made between the first strain and the other three, with the following results:

   1 x 2: 975 albino, 25 wild type
   1 x 3: 1,000 albino
   1 x 4: 750 albino, 250 wild type

   Which mutations represent different genes, (**2 points**) and which genes are linked? (**2 points**) How did you arrive at your conclusions? (**6 points**)
4. Distinguish the effects you would expect from (a) a missense mutation and (b) a nonsense mutation in the *lacZ* (β-galactosidase) gene of the *lac* operon. (**5 points**)
5. A form of male sterility in corn is maternally inherited. Plants of a male-sterile line crossed with normal pollen give male-sterile plants. Some lines of corn carry a dominant, so-called restorer (*Rf*) gene that restores pollen fertility in male-sterile lines.

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a. If a male-sterile plant is crossed with pollen from a plant homozygous for gene *Rf*, what will be the genotype and phenotype of the F_1? (**5 points**)

b. If the F_1 plants of (a) are used as females in a testcross with pollen from a normal plant (*rf/rf*), what would be the result? Give genotypes and phenotypes and designate the type of cytoplasm. (**5 points**)

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