

國 立 清 華 大 學 命 題 紙

九十二學年度 生 命 科 學 院 (所) 甲 組碩士班研究生招生考試

科目 遺 傳 學 科號 0807 共 5 頁第 1 頁 *請在試卷【答案卷】內作答

I. Short Answer/Essay (one or two sentences is enough)

1. Since we cannot do crossing studies with humans, how can we do QTL mapping? (6 Pt)
2. There are many different methods for genetically determining sex. Describe two. (7 pt)
3. A P_1 with blue-flowered, short-stalked plants and white-flowered, long-stalked plants is crossed as is the resulting F_1 . You find:
 - 400 blue, short.
 - 400 white, long.
 - 100 blue, long.
 - 100 white, short.
 What is the recombination frequency? (6 pt)
4. In maize, three recessive genes (z , xt , and cm) are autosomally linked on chromosome 3. A homozygous plant for the recessives is crossed with a wild-type plant. The F_1 is crossed to get an F_2 with the following results:
 - $z\ xt\ cm$: 44
 - $z\ +\ cm$: 460
 - $+ \ xt\ cm$: 390
 - $z\ xt\ +$: 164
 - $+ \ xt\ +$: 474
 - $z\ +\ +$: 355
 - $+ \ +\ cm$: 158
 - $+ \ +\ +$: 37
 What is the order of the three genes on chromosome 3? (6 pt)
5. What are the functions of RecA protein? (7 pt)
6. How does the *E. coli* mismatch repair system distinguish newly synthesized DNA from its template? (6 pt)
7. The differences between attenuation control of *E. coli histidine* operon and anti-termination control of λ gene expression (i.e. protein involved in termination of transcription) (6 pt)
8. You are trying to map the promoter and operator in a hypothetical prokaryotic gene. You divided the promoter-operator to 5 regions, Q-R-S-T-U and generated deletions in these regions. Here is the summary of your results:

Deletion strain	deleted region	Phenotype
Strain 1	Q	never make RNA
Strain 2	R	no effect
Strain 3	S	constitutive level
Strain 4	S-T	constitutive level
Strain 5	U	no effect

 Where are the promoter and operator sequences probably located? (6 pt)

九十二學年度 生 命 科 學 院 (所) 甲 組碩士班研究生招生考試
 科目 遺 傳 學 科號 0807 共 5 頁第 2 頁 請於電腦答案卡上作答

II. Multiple Choice (Please choose the most suitable answer, 2 points each)

- Who was the first scientist to associate a gene with its gene product, an enzymatic activity?
 - Gregor Mendel
 - Archibald Garrod
 - Willain Bateson
 - James Watson
 - William Harvey
 - What fraction of the progeny will show a recessive phenotype for just one gene in a cross between $AaBbCc \times AaBbCc$?
 - 7/16
 - 9/64
 - 1/4
 - 27/64
 - 26/64
 - If we perform a testcross between two heterozygous flies for eye color ($B = \text{red}$; $b = \text{brown}$) and get a result of 290 red eyed flies and 110 brown eyed flies, what is the chi-square value for this experiment?
 - 1.29
 - 0.33
 - 1.33
 - 1.00
 - 1.03
 - Which of the following can affect the expression of a phenotype?
 - environment
 - epistasis
 - incomplete penetrance
 - variable expressivity
 - all of the above
- A B
 Precursor -----> Intermediate -----> Product
- Consider the above biological pathway. Both A and B are dominant forms of two different genes. What is a functional genotype for this pathway?
- AB
 - $AAbb$
 - $Aabb$
 - $A-B-$
 - $aabb$
- Hemophilia is an example of an X -linked mutation. What is the probability of having a child with hemophilia if the grandmother of the mother is known to have the trait and the father is not a hemophiliac?
 - 1/2
 - 1/4
 - 1/8
 - 1/12
 - 1/16

九十二學年度 生 命 科 學 院 (所) 甲 組碩士班研究生招生考試
科目 遺 傳 學 科號 0807 共 5 頁第 3 頁 請於電腦答案卡上作答

7. Crossing over occurs:
 - a. in mid to late prophase.
 - b. in late interphase.
 - c. when chiasmata appear.
 - d. in early to mid prophase.
 - e. in both c and d.
8. Crossing yeast with two different mutations yields almost all asci with a parental ditype pattern. We can conclude that:
 - a. the genes are loosely linked.
 - b. the genes are on two different chromosomes.
 - c. the genes are closely linked.
 - d. neither of the two genotypes are like the parental genotype.
 - e. we need more data to determine the linkage.
9. Selection that favors an extreme phenotype is called:
 - a. balanced polymorphism.
 - b. directional selection.
 - c. disruptive selection.
 - d. frequency-dependent selection.
 - e. stabilizing selection.
10. Genetic drift:
 - a. can be due to the founder effect.
 - b. causes very small deviations in allele frequencies.
 - c. changes allele, but not genotype, frequencies.
 - d. occurs in very large populations.
 - e. all of the above.
11. Which of the following is a form of postzygotic reproductive isolation?
 - a. different courtship patterns
 - b. Gametes do not fuse.
 - c. Populations have different pollinators.
 - d. Hybrids are inviable.
 - e. Populations live in different habitats.
12. Proteins evolve at different rates because:
 - a. introns are not under selection.
 - b. some base substitutions do not cause an amino acid substitution.
 - c. some amino acid substitutions occur in non-functional parts of a protein.
 - d. some mutations are more likely than others.
 - e. some proteins are more functionally constrained than others.
13. The occurrence in the phenotype of a recessive trait, although only one copy of the recessive allele is present, is named
 - a. pleiotropy
 - b. pseudodominance
 - c. epistasis
 - d. acentricity
 - e. trisomy

國 立 清 華 大 學 命 題 紙

九十二學年度 生 命 科 學 院 (所) 甲 組碩士班研究生招生考試

科目 遺 傳 學 科號 0807 共 5 頁第 4 頁 請於電腦答案卡上作答

14. Given the following biochemical pathway: $a \rightarrow b \rightarrow c \rightarrow d \rightarrow e \rightarrow f$, what substance should accumulate in cells with a mutation that blocks the step between d and e?
- a
 - d
 - e
 - f
 - c
15. In an inversion heterozygote all of the following may be true EXCEPT
- crossovers are suppressed.
 - semisterility occurs.
 - recessive alleles are expressed more frequently than expected
 - dicentric and acentric chromosomes may be produced
 - chromosome pairing
16. The failure of chromosomes to separate properly in meiosis or mitosis, leading to aneuploidy is called
- chromosome lagging
 - centromeric fusion
 - Robertsonian fusion
 - nondisjunction
 - unequal crossing over
17. A Barr body refers to
- a sex-linked trait in cats.
 - a recessive mutant trait in fruit flies.
 - an inactivated Y chromosome.
 - an inactive X chromosome in mammals
 - the location of spore formation in Neurospora.
18. The sexual process by which a phage transfers bacterial DNA between bacteria is named
- transformation
 - transduction
 - sexduction
 - conjugation
 - viral recombination
19. Two *Drosophila* mutations of bristles are nuked and singed; they are recessive traits. When the two mutants are mated, each offspring has bristles with mutant characteristics, not wild-type. We can say that these two mutations
- complement and are therefore allelic.
 - do not complement and are therefore allelic.
 - complement and are therefore not allelic.
 - do not complement and are therefore not allelic.
 - do not complement and are therefore, on different pieces of DNA.

國 立 清 華 大 學 命 題 紙

九十二學年度 生 命 科 學 院 (所) 甲 組碩士班研究生招生考試

科目 遺 傳 學 科號 0807 共 5 頁第 5 頁 * 請於電腦答案卡上作答

20. "Hot spots" in the rII region of phage T4 indicate that
- increased temperature causes more mutations.
 - not all base pairs (bp) are CG and AT.
 - mutation is totally random along the genome.
 - surrounding bases affect the mutation rate of a bp.
 - mutations never occur in some regions of a gene.
21. The restoration of function by a second mutation at a different site in the same gene is called
- back mutation.
 - conditional lethality.
 - intragenic suppression.
 - intergenic suppression.
 - tautomeric shift.
22. 5-bromouracil (a base analog) induces mutations by
- removing bases from DNA.
 - inducing tautomeric shifts.
 - inducing anti _ syn transitions.
 - intercalating into the DNA.
 - inactivating repair enzymes.
23. The mutation that results in a decreased level of overall mutation in the cell is called
- an antimutator mutation.
 - a mutator mutation.
 - a frameshift mutation.
 - a nonsense mutation.
 - a missense mutation.
24. An O^c mutation in the lac operon is
- operator constitutive.
 - cis-dominant.
 - trans-acting.
 - operator constitutive and cis-dominant.
 - operator constitutive and trans-acting.
25. Which of the following statement concerning the *Ac-Ds* of maize is NOT TRUE
- Ds element cannot transpose by itself
 - Ac element cannot transpose by itself
 - these DNA elements can induce chromosome breakage
 - these DNA elements can induce the formation of dicentric chromosome
 - Ds element cannot induce chromosome breakage by itself