

國 立 清 華 大 學 命 題 紙

95 學年度 _____ 生命科學院 _____ 系 (所) _____ 甲 _____ 組碩士班入學考試

科目 _____ 遺傳學 _____ 科目代碼 _____ 0807 _____ 共 _____ 7 _____ 頁 第 _____ 1 _____ 頁 *請在【答案卷卡】內作答

I. Multiple Choice: choose one best answer (2.5 points each, 80 points)

1. The effects of transposons can include

- A. disruption of gene expression.
- B. prevention of gene expression.
- C. occurrence of inversions.
- D. occurrence of deletions.
- E. all of the above.

2. C-bands consist primarily of

- A. constitutive heterochromatin.
- B. intercalary heterochromatin.
- C. intercalary euchromatin.
- D. euchromatin.
- E. none of the above.

3. Telomerase is not active in

- A. yeast.
- B. protozoa.
- C. single-celled organisms.
- D. cancer cell.
- E. human cervical cells.

4. Which histone is not a necessary component in the formation of nucleosomes?

- A. H1
- B. H2A
- C. H2B
- D. H3
- E. H4

5. Chromosome puffs occur in

- A. all eukaryotic chromosomes.
- B. polytene chromosomes.
- C. satellite DNA.
- D. lampbrush chromosomes.
- E. scaffolding.

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6. A homeotic mutation is one in which
- A. some proteins are made from mRNA transcribed by the mother.
 - B. one cell type follows the developmental path of another.
 - C. the X-ray repair system is inactivated.
 - D. programmed cell death occurs.
 - E. gene activity depends upon whether the gene is of maternal or paternal origin.
7. Genomic imprinting refers to the fact that
- A. some proteins are made from mRNA transcribed by the mother.
 - B. one cell type follows the developmental path of another.
 - C. the X-ray repair system is inactivated.
 - D. programmed cell death occurs.
 - E. gene activity depends upon whether the gene is of maternal or paternal origin.
8. A _____ is a substance that diffuses through the egg and by its concentration determines the developmental fate of that part of the embryo.
- A. maternal-effect gene
 - B. developmental gene
 - C. homothallic
 - D. segmentation gene
 - E. morphogen
9. In human DNA, 80% of _____ in _____ sequences are methylated.
- A. adenines, ApT
 - B. thymines, ApT
 - C. cytosines, CpG
 - D. guanines, CpG
 - E. adenines, ApG
10. Moth pigmentation can be maternally influenced. If a^+ is the allele for pigmentation, a mother with genotype a^+/a and a father with genotype aa will produce
- A. all pigmented larvae.
 - B. all unpigmented larvae.
 - C. a 3 pigmented: 1 unpigmented ratio in the larvae.
 - D. a 1 pigmented: 1 unpigmented ratio in the larvae.
 - E. a variable ratio of pigmented: unpigmented larvae.
11. As adults, what percentage of the larvae in the above question 10 will be pigmented?
- A. 100%
 - B. 75%
 - C. 50%
 - D. 25%
 - E. 0%

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12. Which statement concerning the mitochondrial genome in humans is untrue?

- A. There are few noncoding regions.
- B. There are no introns.
- C. The DNA is linear.
- D. tRNA genes are located in this genome.
- E. The genome has been sequenced and is 16,569 bp long.

13. A strain of *Drosophila* normally growing at 21°C is exposed to 36°C for 22 hours. Dwarf progeny are produced. When these individuals are mated, a small fraction of each ensuing generation are dwarf. Smaller-than-normal flies persist into the fifth generation. This is an example of

- A. a maternal effect.
- B. a paternal effect.
- C. cytoplasmic inheritance.
- D. a dauer-modification.
- E. a heterokaryon.

14. Crossing over occurs

- A. in late interphase.
- B. in early to mid prophase.
- C. in mid to late prophase.
- D. when chiasmata appear.
- E. in all but A.

15. A recombination suppressor refers to

- A. a mutation in one of the genes whose product catalyzes recombination.
- B. a mutation that suppresses the occurrence of recombination.
- C. the products of recombination suppress the occurrence of chromosome aberration.
- D. a chromosome aberration which prevents the occurrence of recombination.
- E. a chromosome aberration which does not prevent the occurrence of recombination but affects the viability of recombinants.

16. A temperature sensitive mutant refers to

- A. a mutation of one of the anti-freeze genes.
- B. a mutation of one of the heat-shock genes.
- C. a specific type of gene mutation resulting in instability of gene product on non-permissive temperature.
- D. a mutation of a gene resulting in an unstable genome at non-permissive temperature.
- E. all of the above.

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17. Two *Drosophila* recessive mutations of bristles are nuked and singed. When the two mutants are mated, each offspring has bristles with mutant characteristics, not wild-type. We can say that these two mutations
- A. complement and are therefore allelic.
 - B. do not complement and are therefore allelic.
 - C. complement and are therefore not allelic.
 - D. do not complement and are therefore not allelic.
 - E. do not complement and are therefore on different pieces of DNA.
18. The failure of chromosomes to separate properly in meiosis or mitosis, leading to aneuploidy is called
- A. chromosome lagging.
 - B. centromeric fusion.
 - C. Robertsonian fusion.
 - D. nondisjunction.
 - E. unequal crossing over.
19. "Hot spots" in the rII region of phage T4 indicate that
- A. increased temperature causes more mutations.
 - B. not all base pairs (bp) are CG and AT.
 - C. mutation is totally random along the genome.
 - D. surrounding bases affect the mutation rate of a bp.
 - E. mutations never occur in some regions of a gene.
20. The restoration of function by a second mutation at a different site in the same gene is called
- A. back mutation.
 - B. conditional lethality.
 - C. intragenic suppression.
 - D. intergenic suppression.
 - E. tautomeric shift.
21. 5-bromouracil (a base analog) induces mutations by
- A. removing bases from DNA.
 - B. inducing tautomeric shifts.
 - C. inducing anti _ syn transitions.
 - D. intercalating into the DNA.
 - E. inactivating repair enzymes.
22. All of the following are different parts of a eukaryotic chromosome, except:
- A. chromatid.
 - B. centrosome.
 - C. kinetochore.
 - D. telomere.
 - E. centromere.

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23. Which of the following mutations are likely to have a global effect on the mutation rate in *Escherichia coli*? (r) mutations affecting the substrate recognition of DNA polymerases, (s) mutations affecting 5' to 3' exonuclease activity of DNA polymerases, (t) mutations affecting 3' to 5' exonuclease activity of DNA polymerases, (u) mutations defective in photoreactivation repair, (v) mutants affecting mismatch repair, (w) mutants affecting DNA adenosine methylation
- A. r, s, t, u, v.
 - B. r, t, v, w.
 - C. s, v, w.
 - D. r, s, v.
 - E. t, v.
24. Siblings share what percentage of their alleles?
- A. 1/2
 - B. 1/4
 - C. 1/8
 - D. 1/10
 - E. 1/16
25. A cross between two heterozygotes for one trait yields a phenotypic ratio of 2:1. What is the best explanation?
- 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.
26. Humans with the disorder PKU develop light colored hair. What kind of genetic effect is this?
- A. epistatic.
 - B. pleiotropic.
 - C. phenotypic.
 - D. variable expressivity.
 - E. incomplete penetrance.
27. In a human, what is the best explanation for being XX and phenotypically male?
- A. One of the X's is incomplete resembling a chromosome.
 - B. A small piece of the Y-chromosome is inserted on the X-chromosome.
 - C. Both the X's have a mutation deleting the "female" forming genes.
 - D. There is a fragment of the Y-chromosome inserted on an autosomal chromosome.
 - E. The SRY gene has mutated.

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28. Dosage compensation of *X*-linked genes in mammals is achieved by
- A. forming genetic mosaics in females with cells with one functional *X*-chromosome.
 - B. a gene that is turned off in males that allows expression of the *X*-chromosome.
 - C. the addition of methyl groups to the *Y*-chromosome.
 - D. a site on a chromosome which controls *X*-expression called the *X*-hyperactivation center.
 - E. both *X*-chromosomes in the female being inactivated.
29. 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.
30. Which of the following is not a feature of an ideal population under the Hardy-Weinberg Principle?
- A. few individuals.
 - B. isolated from migration.
 - C. no mutation.
 - D. no selection.
 - E. random mating.
31. 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.
32. A woman with type A blood would like to know what the possible blood types of her children would be if she mated with a type AB male. What are they?
- A. A
 - B. A, AB, or B
 - C. A or AB
 - D. O
 - E. B or AB

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II. Short Answer/Essay (20 points)

1. What are the consequences of mutations changing a nonsense codon to a codon for an amino acid? (5 points)
2. A gene called “*forked*” (*f*) produces shortened, bend or split bristles and hairs in *Drosophila*. Another gene called “*outstretched*” (*os*) results in wings being carried at right angles to the body. A third gene called “*garnet*” (*g*) produces pinkish eye in young flies. Wild-type female heterozygous at all three loci were crossed to wild-type male. The F₁ data appear below.

Females		All wild-type
Males	57	<i>garnet</i> , <i>outstretched</i>
	419	<i>garnet</i> , <i>forked</i>
	60	<i>forked</i>
	1	<i>outstretched</i> , <i>forked</i>
	2	<i>garnet</i>
	439	<i>outstretched</i>
	13	wild type
	9	<i>outstretched</i> , <i>garnet</i> , <i>forked</i>
	1000	

- (a). On what chromosome do these three genes reside? (2 point)
- (b). Which gene is in the middle? (2 points)
- (c). What was the linkage relationship between alleles at the *forked* and *outstretched* loci in the maternal parent? (3 points)
- (d). What was the linkage relationship between alleles at the *forked* and *garnet* loci in the maternal parent? (3 points)
- (e). Calculate the map distance? (3 points)
- (f). How much interference is operative? (2 point)