

九十三學年度 資訊系統與應用 系(所) 丙 組碩士班入學考試
科目 遺傳學 科號 3303 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

I. True or false – mark (T) for True and (F) for false statements (2 point each)

1. Cytogenetics

- (1). Flies that are $XX/X0$ mosaics have only male structures and are referred to as gynandromorphs.
- (2). The different chromosomes of a karyotype can sometimes be definitively identified by their size.
- (3). Chromosomes are most easily visualized in cells that are not dividing.
- (4). Chromosome rearrangements may have caused structural differences in related species affecting their evolution.
- (5). Chromatin can be visualized during interphase.
- (6). An octaploid cell has eight of each of the haploid chromosomes.

2. Linkage and mapping

- (1). Ordered tetrads permit mapping of the loci responsible for chromosome movement.
- (2). In duplication mapping, the duplication uncovers a recessive mutation that must lack a wild-type copy of the mutant gene.
- (3). The most direct way to ascertain gene location in humans is the analysis of pedigrees.
- (4). Cell hybridization is helpful in determining whether a gene is sex-linked or autosomal.
- (5). Four hundred human genes have been identified using different human mapping strategies.
- (6). In duplication mapping, the duplication uncovers a recessive mutation that must lack a wild-type copy of the mutant gene.

3. Molecular genetics I

- (1). Griffith's experimentation with *Diplococcus pneumoniae* proved that DNA could "transform" a non-virulent strain into a virulent one.
- (2). In the Hershey and Chase T2 experiment, progeny phage particles released after the initial *E. coli* infection were shown to contain some of the ^{32}P but none of the ^{35}S .
- (3). Chargaff analyzed the composition of DNA and identified that the molar ratios of G to C and A to T were always equal, the concentration of pyrimidines is always equal to purines, and that the $[\text{A}+\text{T}/\text{G}+\text{C}]$ ratio was well conserved among organisms.
- (4). The structure of RNA:DNA duplexes are in the B-form conformation, the form believed to be maintained *in vivo*.
- (5). The unineme model of chromosome structure has come from studies of transcriptionally inactive lampbrush chromosomes.
- (6). Centromeres have been exchanged between chromosomes and have been shown to be fully functional at promoting chromosomal segregation of sister chromatids.

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4. Molecular genetics II

- (1). The addition of 5' methylguanosine caps to pre-mRNA's occurs in a 5'-5' linkage, when mRNA's are only about 30 nucleotides long.
- (2). RNA editing is carried out in one of two ways changing the structure of individual bases or inserting or deleting uridine monophosphate residues.
- (3). Introns contain no conserved regions with the exceptions of the GT and AG dinucleotides at the intron-exon junctions.
- (4). In the first step of pre-mRNA splicing, the 3rd A (reading left to right), of the TACTAAC box is 100% conserved and involved with the covalent linkage at the 5' end of the intron.
- (5). Transfer RNA's are cloverleaf-shaped molecules that function as adapters between amino acids and the codons of mRNA during translation.
- (6). In RNA synthesis, the RNA molecule is complementary to the DNA template strand and identical to the nontemplate strand, with the exception that U's replace A's in the RNA molecule.

5. Transposable element

- (1). Hybrid dysgenesis was found to be linked to *P* element movement by the identification of DNA insertions in the *white* gene mutants after mating a P-cytype male with a M-cytype female..
- (2). *Drosophila* transposons, although they play an active role in evolution, have not been shown to play vital roles in cellular processes.
- (3). *IS* element insertion into an appropriate site results in a target site duplication, causing a short, inversely repeated sequence to be generated on either side of the transposon.
- (4). In maize, *double DS* elements contain non-*Ac* DNA between their inverted terminal repeats and thus causes chromosomal breaks upon activation by *Ac*.
- (5). Cytype is a cellular condition that is transmitted maternally through the egg cytoplasm.
- (6). Ectopic intrachromosomal exchanges include crossing over events between homologous transposons located in different positions on the same chromosome.

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III. Open end questions (5 points each)

1. What are the differences among dominance, epistasis, and pleiotropy? How can you determine that pleiotropic effects such as those seen in sickle-cell anemia, are not due to different genes?
2. If albinism occurs in only 1 individual in each 10,000 in the population, how many matings at random in this population will be between heterozygotes carriers?
3. What is the goal of the human genome project?
4. Would you expect genes encoded by retrotransposons to contain introns? Why?
5. In a cross of $AaBbCcDd$ to $AabbCcDD$, what will be the proportion of progeny that show all four dominant traits?
6. Define and illustrate *specialized* and *generalized transduction*.
7. Two curly-winged flies, when mated, produce sixty-one curly and thirty-five straight-winged progeny. Use a chi-squared test to determine whether these numbers fit a 3:1 ratio?
8. A polyploid series of related plant species has chromosome numbers of 18, 27, 36, 45, 63, and 72. What can you say about the genetic relationship of these plants based solely on chromosome number?