

九十三年度 國立中山大學生物醫學研究所碩士在職專班入學考試

遺傳學

Note: ~~read~~^{read} all questions carefully. **Write legibly.** Answer all questions on the sheets provided.

A total of 50 questions, two points each, perfect score = 100 points.

I. Transmission Genetics & Genomics (17 questions)

1. Parents who do not have Tay-Sachs disease produce a child who has Tay-Sachs disease (recessive). What are the chances the next child will have Tay-Sachs? (1) 0% (2) 25% (3) 50% (4) 100%.
2. Mutations can be transmitted to the next generation only if they are present in (1) brain cells (2) somatic cells (3) germ cells (4) muscle cells.
3. The genetic ratio 1:2:1 may indicate (1) complete dominance (2) gene interaction (3) partial dominance or co-dominance (4) either (1) or (2).
4. What was the first animal to be artificially cloned from an adult? (1) cattle (2) mouse (3) goat (4) sheep.
5. What similarities exist between two twins derived from the same egg? (1) they share the same genetic inheritance (2) they think in the same way (3) they always react in the same way (4) they usually get the same disease.
6. What aspect of chromosome behavior most clearly accounts for Mendel's law of Independent Assortment? (1) movement of sister chromatids to opposite poles at anaphase II of meiosis (2) movement of homologous chromosomes to opposite poles at anaphase I of meiosis (3) crossing over between homologous chromosomes during prophase I of meiosis (4) independent alignment of different homologous pairs on the metaphase I spindle.
7. What were Avery, McLeod and McCarty referring to they said "transforming principle"? (1) DNA (2) bacterial cell walls (3) phage capsid proteins (4) rough to smooth transitions.
8. How many billion nucleotide bases make up the human genome? (1) 2 (2) 3 (3) 4 (4) 23.
9. The difference between a simple tandem array and a compound tandem array is (1) the frequency of different sequences (2) the direction the sequences face (left or right) (3) the number of different sequences involved (4) the number of repetitions sequences.
10. In the fruit fly, the (A+T/G+C) ratio is 1.52. In yeast, (A+T/G+C)=0.86. Which of the following statements is true? (1) the fruit fly has lower GC content than yeast and will denature at a lower temperature (2) the fruit fly has higher GC content than yeast and will denature at a lower temperature (3) the fruit fly has lower GC content than yeast and will denature at a higher temperature (4) the fruit fly has higher GC content than yeast

國立中山大學九十三年度碩士班招生考試試題

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and will denature at a higher temperature.

11. Which gene is considered the guardian of the genome? (1) *TP53* (2) *WT* (3) *RB* (4) *BRCA1*.
12. Map-based cloning of gene is also known as (1) forward genetics (2) reverse genetics (3) molecular cloning (4) *in silico* cloning.
13. In general, most mutations are (1) small in size, large in effect (2) large in size, large in effect (3) small in size, small in effect (4) large in size, small in effect.
14. Which of the following statement is true about functional genomics? (1) microarray analysis make use of cDNA molecules (2) microarray analysis is useful because it tells you specifically what a gene codes for (3) RNA interference (RNAi) blocks expression by degradation of complementary cDNA (4) forward genetic techniques start with the DNA sequence and finding the phenotype.
15. Which of the following does **not** commonly found in the non-coding regions of human DNA? (1) single nucleotide polymorphisms (SNPs) (2) short repeated sequences (3) transposon insertions (4) frameshift mutations.
16. The entire complement of DNA in an organism is referred to as its (1) chromosome (2) genome (3) proteome (4) phenome.
17. The differences in DNA fragment sizes resulting from differences in restriction enzyme cutting sites are called (1) polymorphisms (2) VNTRs (3) RFLPs (4) STRs.

II. Cytogenetics (8 questions)

1. Which genetic change is best described by the following statement: a chromosomal rearrangement is formed after a section breaks off from one chromosome and becomes attached to a nonhomologous chromosome (1) translocation (2) deletion (3) addition (4) mutation.
2. During S phase of the cell cycle, mitosis or meiosis (1) DNA recombines (2) sister chromatids move to opposite poles (3) the cell cycle stalls (4) DNA content essentially doubles.
3. Assuming that the amount of DNA in the nucleus at G_1 of the cell cycle is $3 \times 10^{-12}g$, how much nuclear DNA would be present in anaphase of meiosis II (1) $3 \times 10^{-12}g$ (2) $6 \times 10^{-12}g$ (3) $1.5 \times 10^{-12}g$ (4) $12 \times 10^{-12}g$.
4. Which one statement is **not** true about polyploidy? (1) if all of the chromosomes are involved in non-disjunction, the result would be a change in the ploidy level or a triploid (2) higher ploidy levels can arise from a failure of cytokinesis following mitosis (3) polyploidy is abnormal in any organs (4) For most animals, triploidy and higher level ploidy states are not compatible with normal development.

5. Crossing over between homologous chromosomes occurs at which of the following stages? (1) prophase of meiosis I (2) prophase of meiosis II (3) metaphase of meiosis I (4) metaphase of meiosis II.
6. Barbara McClintock discovered that pieces of the genome are able to move to alternate locations (1) exons (2) introns (3) point mutations (4) transposons.
7. In a _____, the short arm of two acrocentric chromosome break, and the long arms join, forming an unusual, long chromosome (1) Robertsonian translocation (2) reciprocal translocation (3) inversion (4) duplication.
8. Small scale (one or a few base pairs) insertions or deletions are most likely to be caused by (1) base analogs (2) tautomeric shifts (3) intercalating agents (4) alkylating agents.

III. Molecular Genetics (17 questions)

1. The central dogma specifies that (1) DNA sequence encodes RNA sequence which encodes protein (2) RNA sequence encodes protein which encodes DNA (3) DNA at centromeres plays the major role in gene expression (4) reverse transcriptase converts RNA to DNA.
2. DNA molecules are packaged by coiling around (1) nucleic acids (2) carbohydrates (3) amino acids (4) proteins.
3. A portion of one strand of a DNA molecule has the base sequence GATTACA, what is the base sequence for the other strand? (1) AGCCGTG (2) CTAATGT (3) GUAAUGU (4) TCGGCAC.
4. Where does most translation take place within a cell? (1) in the nucleus (2) on the endoplasmic reticulum (3) in the cytoplasm (4) in the mitochondria.
5. What molecules transfer amino acids to a growing chain of protein? (1) mRNA (2) tRNA (3) rRNA (4) DNA.
6. An operon refers to (1) a protein that prevents RNA polymerase from reaching structural genes (2) the entire DNA unit for expressing a particular trait (3) a gene that stimulates expression of structural genes (4) a protein that binds to a repressor protein, preventing it from binding to the operator gene.
7. Electroporation is a technique used with (1) cell suspensions (2) pollen (3) protoplasts (4) organs.
8. In prokaryotes, translation is said to be coupled to transcription. This means that: (1) transcribed genes are both transcribed and translated by ribosomes (2) one mRNA can be bound by several ribosomes (3) both transcription and translation take place in the same part of the nucleus (4) genes are often translated as they are being transcribed.
9. The most abundant form of RNA in *E. coli* is (1) mRNA (2) rRNA (3) tRNA (4) snRNA.

10. Each mRNA molecule is usually translated into (1) one copy of a single polypeptide chain (2) hundreds of copies of a single polypeptide chain (3) hundred of copies of tRNA (4) three different polypeptides each corresponding to one reading frame.
11. Anti-sense RNAs are thought to repress gene expression by (1) binding to promoters and excluding positively-acting transcription factors (2) binding to complementary sites in mRNA and interfering with their translation into protein (3) encoding anti-proteins which inhibit the function of their cognate proteins (4) binding to complementary sequences in DNA and preventing their transcription.
12. Poly A tails on mRNA transcripts are formed by (1) transcription through a polyT region of 60-90 bp encoded on DNA, followed by transcriptional termination (2) cleavage of transcripts before the AATAAA sequence and addition of a poly A tail (3) cleavage of transcripts after the AATAAA sequence and addition of a poly A tail (4) transcriptional termination at AATAAA site, followed by addition of a poly A tail to the mRNA 3' end.
13. Which of the following clusters of terms accurately describes DNA as it is generally viewed to exist in prokaryotes and eukaryotes? (1) double-stranded, parallel, $(A+T)/(C+G)=\text{variable}$, $(A+G)/(C+T)=1.0$ (2) double-stranded, antiparallel, $(A+T)/(C+G)=\text{variable}$, $(A+G)/(C+T)=1.0$ (3) single-stranded, antiparallel, $(A+T)/(C+G)=1.0$, $(A+G)/(C+T)=1.0$ (4) double-stranded, parallel, $(A+T)/(C+G)=1.0$, $(A+G)/(C+T)=1.0$.
14. Which cluster of terms accurately reflects the nature of DNA replication in **prokaryotes**? (1) fixed point of initiation, bidirectional, conservative (2) random point of initiation, bidirectional, semiconservative (3) fixed point of initiation, bidirectional, semiconservative (4) random point of initiation, unidirectional, semiconservative.
15. DNA polymerase I is thought to add nucleotides (1) to the 5' end of primer (2) to the 3' end of the primer (3) in the place of the primer RNA after it is removed (4) on single-stranded templates without need for an RNA primer.
16. Which one is **not** likely the result of a missense mutation that exchanges a hydrophobic amino acid for a hydrophilic amino acid at the active site of the protein product (1) truncated transcript (2) translation occurs (3) shape of protein altered (4) function altered.
17. For each tRNA other than the initial one, choose the best description (1) enters A-site, has peptide chain transferred to it, moves to P-site, transfers chain, moves to E-site (2) enter P-sites, has peptide chain transferred to it, moves to A-site, transfers chain, moves to E-sites (3) enter A-site, transfers amino acid to P-site, moves to P-site, receives chain, moves to E-site (4) enter P-site, transfers amino acid to A-site, moves to A-site, receives chain, moves to E-site.

IV. Quantitative/Population Genetics & Bioinformatics (8 questions)

1. Polygenic traits are ones that are (1) controlled by more than just a single pair of alleles (2) responsible for a number of traits in the phenotype (3) found in either men or women but not both (4) traits are influenced by

polymorphic genes.

2. What is the probability that in an organism with a diploid number of 8 that a sperm will be formed that contains all 4 chromosomes whose centromeres were derived from maternal homologs? (1) 1/2 (2) 1/4 (3) 1/8 (4) 1/16.
3. A scientist wants to determine narrow sense heritability (h^2) of tail length in mice. She measures tail length in a mouse population and finds the mean = 9.7 cm. She selects 10 mice with the longest tails; mean tail length in these selected mice = 14.3 cm. She interbreeds the long-tailed mice and examines tail length in their progeny. The mean F_1 tail length is 13 cm. What is the heritability for tail length in these mice? (1) 0.72 (2) 0.62 (3) 0.52 (4) 0.42.
4. In a large randomly mating population with no mutation, migration or differential reproductive success, the frequencies of alleles in a population will not change. This is so called (1) Morgan Hunt's Law (2) Medelian Law (3) Hardy-Weinberg Principle (4) Waston's Theory.
5. Which of the following is **not** a cause of linkage disequilibrium of two gene loci? (1) physical linkage (2) locations on different chromosomes (3) selection or multilocus genotypes (4) genetic drift.
6. The primary structure of a polypeptide means (1) the exact sequence of amino acids in the chain (2) the immediate structure of the chain, *e.g.*, and alpha-helix or beta-sheet (3) the overall three-dimensional structure of the protein (4) the exact structure as determined by X-ray crystallography.
7. What is the central paradigm of bioinformatics (1) DNA, RNA, protein (2) sequence, structure, function (3) intron, exon, intergenic (4) mRNA, tRNA, rRNA.
8. The identification of drugs through genomic study (1) Genomics (2) Cheminformatics (3) Pharmacogenomics (4) Pharmacogenetics.

國立中山大學九十三年學年度碩士班招生考試試題

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問答題（每題 15 分，共 75 分）

1. 請說明蛋白質一、二、三、四級結構與其穩定力量。
2. 請由結構生物學觀點比較血紅素(Hemoglobin)及肌紅素(Myoglobin)與氧分子親合性不同的原因。
3. 請比較 DNA 及 RNA 結構的異同點及其所扮演之角色。
4. 請說明 TCA cycle 及 Urea cycle 在生理代謝機制扮演之角色。
5. 請比較 Alternative splicing 及 Exon shuffling 對基因產物的影響。

解釋名詞（每題 5 分，共 25 分）

1. Cell cycle
2. Gene therapy
3. Posttranslational modification
4. Allosteric regulation
5. Signal transduction