

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一、單選題：(20 分，每題 2 分)

1. Prokaryotic DNA polymerase III is thought to add nucleotides _____.
 - A) to the 5' end of the primer
 - B) on single-stranded templates without need for an RNA primer
 - C) to the 3' end of the primer
 - D) in the place of the primer RNA after it is removed
 - E) in a 5' to 5' direction
2. In human chromosomes, satellite DNA sequences of about 170 base pairs in length are present in tandem arrays of up to 1 million base pairs. Found mainly in centromere regions, these DNA sequences are called _____.
 - A) euchromatic regions
 - B) telomere-associated sequences
 - C) primers
 - D) telomeres
 - E) alphoid families
3. An intron is a section of _____.
 - A) protein that is clipped out posttranslationally
 - B) RNA that is removed during RNA processing
 - C) DNA that is removed during DNA processing
 - D) transfer RNA that binds to the anticodon
 - E) carbohydrate that serves as a signal for RNA transport
4. Which of the following are among the major components of prokaryotic ribosomes?
 - A) 23S rRNA, 16S rRNA, 5S rRNA
 - B) 28S rRNA, 18S rRNA, 5.8S rRNA
 - C) 23S rRNA, 16S rRNA, 5.8S rRNA
 - D) 28S rRNA, 18S rRNA, 5S rRNA
 - E) 23S rRNA, 5.8S rRNA, proteins
5. Which in the following are the pathways used in Eukaryotes for repairing the double strand break?
 - A) double strand break repair, homologous recombination repair, non-homologous end joining
 - B) SOS repair, double strand break repair, homologous recombination repair
 - C) excision repair, homologous recombination repair, non-homologous end joining
 - D) SOS repair, excision repair, homologous end joining
 - E) excision repair, double strand break repair, homologous recombination repair,
6. Which of the following is not the features of *E. coli* DNA polymerase I?
 - A) It requires a small stretch of DNA to add new nucleotides
 - B) It adds in nucleotides in the 3' to 5' direction
 - C) It has a 3' -5' exonuclease activity
 - D) It is the most abundant DNA polymerase in the cell
 - E) It has a 5' -3' exonuclease activity

7. Which of the following is not one of the approaches that cells use in chromatin remodeling?
- A) DNA methylation
 - B) DNA acetylation
 - C) histone methylation
 - D) histone acetylation
 - E) ubiquitination
8. Which enzyme in the following is required for protein synthesis during translation?
- A) DNA polymerase I
 - B) RNA polymerase II
 - C) reverse transcriptase
 - D) aminoacyl tRNA synthetase
 - E) polynucleotide phosphorylase
9. Which of the following description about the triplet genetic codes is false?
- A) The code is degenerate
 - B) The code is ordered
 - C) The code is universal
 - D) The code is nonoverlapping
 - E) The code is ambiguous
10. Holley's two-dimensional cloverleaf model for transfer RNA predicts:
- A) 5' acceptor arm and 3' anticodon arm
 - B) 5' anticodon arm and 3' amino acid binding site
 - C) 5' acceptor arm and 3' amino acid binding site
 - D) 5' amino acid binding site and 3' acceptor arm
 - E) 5' amino acid binding site and 3' anticodon arm

二、解釋名詞：(10 分，每題 2 分)

1. transcription factor
2. chaperon
3. open reading frame
4. nucleosome
5. topoisomerase

三、問答題：(20 分，每題 5 分)

1. What are the mutations that are classified based on phenotypic effects?
2. What is the order of forming a functional ribosome to initiate translation?
3. What is the general molecular and sequence organization of a eukaryotic genome?
4. What are the differences between prokaryotic and eukaryotic DNA replications?

四、單選題：(30 分，每題 2 分)

1. Which of these criteria have been used in selecting species whose genomes have been sequenced?
 - A) The species should be relevant for human health or well-being
 - B) The species should have a relatively small genome
 - C) The species should have an important ecological role
 - D) The species may yield key evolutionary insights
 - E) all of the above
2. Many pseudogenes (which no longer produce functional proteins) in vertebrate genomes lack introns. What process may account for such pseudogenes?
 - A) gene duplication followed by DNA splicing to remove introns
 - B) recombination between duplicated copies of genes
 - C) reverse transcription of a processed mRNA and insertion of the cDNA copy to a new chromosomal location
 - D) duplication events that involve just the exons
 - E) unequal crossing over between duplicated copies of genes
3. Which of the following is the best approximation for the size of the *H. sapiens* genome in terms of both millions of base pairs (Mb) and number of genes?
 - A) 4.6 Mb; 4,400 genes
 - B) 4.6 Mb; 20,000 genes
 - C) 3,000 Mb; 4,400 genes
 - D) 3,000 Mb; 20,000 genes
 - E) 5,000 Mb; 45,000 genes
4. What allows sister chromatids to separate in which phase of meiosis?
 - A) release of cohesin along sister chromatid arms in anaphase I
 - B) crossing over of chromatids in prophase I
 - C) release of cohesin at centromeres in anaphase I
 - D) release of cohesin at centromeres in anaphase II
 - E) crossing over of homologs in prophase
5. Albinism in humans occurs when both alleles at a locus produce defective enzymes in the biochemical pathway leading to melanin. Given that heterozygotes are normally pigmented, which of the following statements is correct?
 - A) One normal allele produces as much melanin as two normal allele
 - B) Each defective allele produces a little bit of melanin
 - C) Two normal alleles are needed for normal melanin production
 - D) The two alleles are codominant
 - E) The amount of sunlight will not affect skin color of heterozygotes
6. How and at what stage do chromosomes undergo independent assortment?
 - A) meiosis I pairing of homologs
 - B) anaphase I separation of homologs
 - C) meiosis II separation of homologs
 - D) meiosis I metaphase alignment
 - E) meiosis I telophase separation

7. How many different types of gametes can an individual with the genotype $AaBBccDdEeFf$ form?
- A) 4
 - B) 12
 - C) 16
 - D) 64
 - E) 256
8. Assume that a cross is made between $AaBb$ and $aabb$ plants and the offspring occur in the following numbers: 106 $AaBb$, 48 $Aabb$, 52 $aaBb$, 94 $aabb$. These results are consistent with the following circumstance:
- A) sex-linked inheritance with 30% crossing over
 - B) linkage with 50% crossing over
 - C) linkage with approximately 33 map units between the two gene loci
 - D) independent assortment.
 - E) 100% recombination
9. When an organism gains or loses one or more chromosomes but not a complete haploid set, the condition is known as _____.
- A) polyploidy
 - B) euploidy
 - C) aneuploidy
 - D) triploidy
 - E) trisomy
10. A female is heterozygous for the recessive X-linked gene for Lesch-Nyhan syndrome. What proportion of her daughters will be carriers for the trait if their father is not affected?
- A) 0%
 - B) 25%
 - C) 50%
 - D) 75%
 - E) 100%
11. Given the parents $AABBCc \times AabbCc$, assume simple dominance and independent assortment. What proportion of the progeny will be expected to phenotypically resemble the first parent?
- A) $1/4$
 - B) $1/8$
 - C) $3/4$
 - D) $3/8$
 - E) 1

12. A geneticist introduces a transgene into yeast cells and isolates five independent cell lines in which the transgene has integrated into the yeast genome. In four of the lines, the transgene is expressed strongly, but in the fifth there is no expression at all. Which is a likely explanation for the lack of transgene expression in the fifth cell line?
- A) A transgene integrated into a heterochromatic region of the genome
 - B) A transgene integrated into a euchromatic region of the genome
 - C) The transgene was mutated during the process of integration into the host cell genome
 - D) The host cell lacks the enzymes necessary to express the transgene
 - E) A transgene integrated into a region of the genome characterized by high histone acetylation
13. If an X-linked disease results from a rare recessive allele,
- A) there will be more females exhibiting the trait than males
 - B) there will be more males exhibiting the trait than females
 - C) the frequency of affected males and females will be equal
 - D) among females there will be more affected than carriers
 - E) all sons of affected males will be affected
14. Some XY individuals are phenotypically females. What chromosomal abnormality could account for this?
- A) mosaicism
 - B) dosage compensation
 - C) mitotic segregation
 - D) fragile X syndrome
 - E) A deletion of the portion of the Y chromosome containing the testis-determining factor
15. Which of the following is the term for a human cell that contains 22 pairs of autosomes and two X chromosomes?
- A) a male somatic cell
 - B) an unfertilized egg cell
 - C) a female somatic cell
 - D) a sperm cell
 - E) both A and D

五、解釋名詞：(12 分，每題 3 分)

1. synaptonemal complex
2. Barr body
3. DNA fingerprinting
4. paralogs

六、簡答題：(8 分，每題 4 分)

1. Why is it more practical to prepare karyotypes by viewing somatic diploid cells rather than haploid gametes?
2. Mitochondrial genes are critical to the energy metabolism of cells, but mitochondrial disorders caused by mutations in these genes are generally not lethal. Why not?