一、 **選擇題: (25題, 每題2分, 共50分)**

1. Which amino acid in a protein can form disulfide bond?
(A) Proline (B) Cysteine (C) Arginine (D) Tyrosine

2. Which of the following statements is incorrect?
(A) The majority of human intergenic sequences are composed of repetitive DNA
(B) Genes make up most of the eukaryotic chromosomal DNA
(C) Microsatellite DNA is composed of very short, tandemly repeated sequences.
(D) E. coli has higher gene density than human

3. Which of the followings does not belong to core histones?
(A) H1 histone (B) H2A histone (C) H3 histone (D) H4 histone

4. The retroviral reverse transcriptase enzymes are used by molecular biologists for the
(A) synthesis of RNA with DNA as a template
(B) synthesis of protein with RNA as messenger
(C) synthesis of protein from DNA
(D) synthesis of a complementary DNA strand to an RNA

5. Which of the following descriptions is correct?
(A) The rate of DNA synthesis by E. coli DNA polymerase III holoenzyme is ~ 1000 nt/sec
(B) DNA polymerases incorporate only ribonucleotides into DNA.
(C) DNA polymerase never makes mistakes.
(D) DNA ligases catalyze the separation of the two strands of duplex DNA during the DNA replication.

6. The strand on which DNA replication is continuous is called the:
(A) Leading strand (B) Lagging strand
(C) Major strand (D) Minor strand

7. During Eukaryotic DNA replication, prereplicative complex (pre-RC) is activated by:
(A) DnaA (B) Cdc6 (C) Cdk (D) DNA polymerase

8. Which of the following protein can resolve the Holliday junction structure?
(A) RecA (B) RuvA (C) RuvB (D) RuvC

9. Which description is false?
(A) an A to G mutation is called a transition mutation.
(B) DNA can be damaged from alkylation, oxidation, and radiation.
(C) Human cells are used in the Ames test to determine the carcinogenic effects of chemical.
(D) X-rays are hazardous because they cause double-strand breaks in the DNA, which are hard to repair.

10. Which of the following is a DNA helicase?
(A) DnaA (B) DnaB (C) DnaG (D) Gyrase

11. Which transposable element does not use an RNA intermediate to insert into new sites in the genome of the host cell?
(A) DNA transposons (B) Viral-like retrotransposons
(C) Retroviruses (D) Poly-A retrotransposons.

12. The technique of making knock-out mice is based on :
(A) Site-directed mutagenesis (B) Nucleotide excision repair
(C) Homologous recombination (D) Non-homologous end-joining

13. Which process requires participation of snRNAs?
(A) Pre-mRNA splicing (B) hnRNP assembly
(C) MicroRNA production (D) Ribosome biogenesis

14. Which process in *E. coli* requires a Shine-Dalgarno sequence for initiation?
(A) Recognition of the replication origin
(B) Recognition of a transcription promoter
(C) Recognition of a translation initiation codon
(D) Recognition of a protein phosphorylation site

15. Which enzymatic process is catalyzed by RNA?
(A) Semi-conservative DNA replication
(B) pre-mRNA splicing
(C) RNA interference
(D) Histone acetylation

16. Which microscope is best suitable for tracking protein movement in live cells?
(A) Atomic force microscope
(B) Multi-photon excitation microscope
(C) Scanning electron microscope
(D) Scanning tunneling microscope

17. Which RNA polymerase is responsible for expression of tRNA in eukaryotes?
(A) RNA polymerase I
(B) RNA polymerase II
(C) RNA polymerase III
(D) RNA polymerase IV

18. What is the most likely consequence to the expression level of the *lac* operon if the lactose permease is non-functional?
(A) Expression of the *lac* operon is fully activated under all conditions
(B) Expression of the *lac* operon remains at the basal level under all conditions
(C) Expression of the *lac* operon is activated when lactose is present
(D) Expression of the *lac* operon can not be suppressed by the *lac* suppressor

19. Which experimental technique can determine the length of a specific mRNA?
(A) Northern blotting
(B) Real time PCR
(C) Footprinting assay
(D) Primer extension

20. What is the percentage of the exon sequences in human genome?
(A) 40%　(B) 15%　(C) 1.5%　(D) 0.15%

21. The bacterial ribosome is about 70S. Which experimental method is used to define the Svedberg unit (S)?
(A) Ultracentrifugation
(B) Electrophoresis
(C) Mass spectrometry
(D) Chromatography

22. What is the main function of the N protein of the lambda phage?
(A) Initiation of rolling cycle replication
(B) Allowing expression of CII and CIII by anti-termination
(C) Integrating of lambda DNA into the host chromosome
(D) Maintaining expression of lambda suppressor

23. Which subunit of the bacterial RNA polymerase holoenzyme recognizes the promoter sequence?
(A) The α subunit
(B) The β subunit
(C) The σ subunit
(D) The ω subunit

24. How many polypeptide is produced by each ribosome unit if a frameshifting event occurs?
(A) One　(B) Two　(C) Three　(D) Four

25. Under which cellular condition is catabolite activating protein activated?
(A) Depletion of tryptophan
(B) Presence of lactose
(C) Depletion of ATP
(D) Depletion of glucose

二. **簡答題**：(共 **10** 分)

26. Please describe the functions of the following molecules: (2 points each)
    a. Spo11
    b. RecA
    c. γ subunit of DNA polymerase III
    d. Helicase
    e. Topoisomerase

三. **問答題**：(七題, 共 **40** 分)

27. What are the two most commonly seen secondary structures of polypeptides? (4 points)

28. Describe the complete process (including **initiation, elongation, and termination**) of DNA replication in *E. coli*. (8 points)

29. How do B cells generate more than millions of different antibodies from limited number of genes? (4 points)

30. Describe the steps and the enzymes required for microRNA biogenesis. (9 points)

31. What is the function of an internal ribosome entry site? (5 points)

32. If the initiation codon of the leader peptide of the *trp* operon is mutated to GUA, expression of the *trp* operon will be increased or decreased? Why? (5 points)

33. What are the steps in the translation process to ensure the codon is translated into correct amino acid residue? (5 points)