

一· 單選題 (請於試卷【選擇題作答區】依題號作答)

1. Which of the following enzymatic reactions requires ATP? (3 points)
  - (A) DNA ligases
  - (B) DNA polymerases
  - (C) Reverse transcriptases
  - (D) Ribonucleases
  - (E) None of the above
  
2. Which of the following statements about tRNA is NOT correct? (3 points)
  - (A) One tRNA may recognize more than one codon.
  - (B) One codon may be recognized by more than one tRNA.
  - (C) Aminoacyl-tRNA is formed by joining the carboxyl group of the amino acid to the tRNA.
  - (D) Both the amino acid residue and the anticodon determine the specificity of the aminoacyl-tRNA.
  - (E) All tRNAs are similar in shape.
  
3. Which of the following statements about transcription is correct? (3 points)
  - (A) A short RNA oligomer is required for initiation.
  - (B) Transcription usually starts with AUG.
  - (C) The DNA strand directing mRNA synthesis is the coding strand.
  - (D) The RNA polymerase binds to the pre-formed transcription bubble for initiation.
  - (E) The promoter surrounds the startpoint of transcription.
  
4. What is a Shine-Dalgarno sequence? (3 points)
  - (A) It is a pyrimidine-rich stretch.
  - (B) It is complementary to the 3'-end of the 16S ribosomal RNA.
  - (C) It is followed immediately by the AUG initiation codon.
  - (D) It is usually 10 – 15 bases in length.
  - (E) It directs the eukaryotic ribosome to the initiation codon.
  
5. Which of the following changes to mRNA will make it less stable in the cell? (3 points)
  - (A) Capping at the 5' end
  - (B) Polyadenylation at the 3' end
  - (C) Binding to ribonuclear proteins
  - (D) Presence of a nonsense mutation
  - (E) The stability is not changed by all the above factors.
  
6. An enhancer (3 points)
  - (A) is a protein that binds to RNA polymerase and stimulates transcription.
  - (B) acts as a binding site for RNA polymerase.
  - (C) interacts with repressor proteins to enhance transcriptional repression.
  - (D) is a DNA element that stimulates transcription of eukaryotic promoters.
  - (E) none of the above.

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7. Micro RNAs (miRNAs) are (3 points)

- (A) for expression of short proteins.
- (B) transcribed by RNA polymerase II.
- (C) processed by RNA-induced silencing complex (RISC).
- (D) involved in post-translational control.
- (E) originally identified in *E. coli*.

8. Which statement is correct? (3 points)

- (A) Histone proteins are mainly negatively charged.
- (B) The core histones include H1, H2A, H2B, H3, and H4.
- (C) The RNA polymerase can displace histone octamers during transcription.
- (D) Nucleosomes appear uniformly throughout genomic DNA.
- (E) None of the above.

9. RNA splicing (3 points)

- (A) requires ATP
- (B) removes exons
- (C) requires no protein factors
- (D) usually occurs in prokaryotes
- (E) usually occurs after 5' capping

10. Which of the following statements on ribosome is NOT correct? (3 points)

- (A) It is consisted of two subunits.
- (B) The RNA component contributes more to the mass than does the protein component.
- (C) The catalytic core is consisted of proteins.
- (D) The atomic resolution has been determined.
- (E) None of the above

二·問答題 (請於試卷【非選擇題作答區】依題號作答)

11. A particular virus with DNA as its genetic material. The DNA isolated from this virus contains 20% A, 30% T, 20% G, and 30% C. How would you explain these values? (6 points)

12. A graduate student used PCR to amplify a DNA fragment from the genomic DNA of mice. He successfully cloned this DNA fragment into a plasmid. Then, he re-cultured the bacteria containing the plasmid and kept the bacterium culture at -70 degree freezer. An undergraduate student would like to use this clone for her experiment. She streaked some frozen cells of this bacterium strain and picked up six colonies. She extracted plasmids from these six colonies and checked the plasmids by restriction digestion. She expected to see two fragments (2.9 kb and 3.5 kb) after digestion of the correct plasmid. However, among the six DNA preparations, three plasmid preparations showed the 2.9 + 3.5 pattern, the other three displayed a pattern of 2.9 + 5.0. She re-streaked one culture producing the 2.9 + 3.5 pattern, and again, picked up six independent colonies to culture and extracted plasmids. This time, she got two plasmid preparations with the 2.9 + 3.5 pattern, three plasmid preparations with the 2.9 + 5.0 pattern, and one displayed a 2.9 + 3.5 + 5.0 pattern. How would you explain this unusual phenomenon? (8 points)

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13. Please compare DNA microarray with Northern blot in analysis of gene expression. (6 points)
14. Haploid yeast cells that preferentially repair double-strand breaks by homologous recombination are especially sensitive to agents that cause double-strand breaks in DNA. If the breaks occur in the G1 phase of the cell cycle, most yeast cells die; however, if the breaks occur in the G2 phase, a much higher fraction of cells survive. How would you explain these results? (6 points)
15. When a nucleotide substitution occurs within the coding region of a protein-encoding gene, what are the possible outcomes might be resulted? (6 points)
16. Eukaryotic viruses usually have all the proteins encoded on only one viral mRNA strand. Assume X-Y are the first and second open reading frames on the viral mRNA, respectively.
- (A) Expression of protein Y usually has to follow an alternative way, different from protein X and other host proteins. Why? (4 points)
- (B) Frameshifting is a reaction that shifts the tri-nucleotide ribosomal decoding site on mRNA by one base toward the 5' or 3' end (e.g., shifted from ...UGC-CAU-GGA... to ...U-GCC-AUG-GA...). Many viruses use this mechanism to control the expression of protein Y. The fused protein X-Y is produced when frameshifting occurs, otherwise only protein X is produced. Describe how the control is achieved. (6 points)
- (C) In addition to frameshifting, describe briefly another way of which protein Y may be expressed. (4 points)
17. Define the following terms (3 points each)
- (A) gene
- (B) telomerase
- (C) cohesin complex
- (D) operon
- (E) chemiosmosis
- (F) checkpoint
- (G) real-time PCR
- (H) ribozyme

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