國立成功大學

112學年度碩士班招生考試試題

編　號：259

系　所：生物化學暨分子生物學研究所

科　目：分子生物學

日　期：0207

節　次：第 2 節

備　註：不可使用計算機

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※ 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、選擇題：（15 分，每題 1 分）

1. The promoter site is
   a. the start site for transcription in DNA
   b. the binding site for regulatory proteins that stimulate transcription
   c. the general region of DNA downstream from the start site
   d. the site on DNA at which RNA polymerase binds to initiate transcription

2. Consensus sequences are
   a. sequences that are invariant throughout the DNA.
   b. sequences that have many bases in common
   c. sequences required for transcription to occur
   d. sequences that lie far upstream of the core promoter.

3. Control of transcription in prokaryotes **does not** involve
   a. leucine zipper proteins.
   b. silencers.
   c. enhancers.
   d. alternative σ factors.

4. Which enzyme transcribes genes encoding **tRNA** in eukaryotes?
   a. RNA polymerase I
   b. RNA polymerase II
   c. RNA polymerase III
   d. Different tRNAs are transcribed by different RNA polymerases.

5. Which of the following statements about eukaryotic and prokaryotic RNA polymerases, is **false**?
   a. There are 3 different RNA polymerases in eukaryotes, instead of just one.
   b. Only prokaryotic polymerases use sigma factor.
   c. Eukaryotic polymerases have the same number of subunits as prokaryotic ones.
   d. The enzymatic mechanism is the same for both types of organisms.

6. How do eukaryotic and prokaryotic RNA polymerases compare?
   a. Since eukaryotic RNA polymerases are more complex, little homology has been found between the actual protein sequences in the catalytic subunits.
   b. Despite their added complexity, eukaryotic and prokaryotic RNA polymerases are generally homologous.
   c. Since eukaryotic transcription is less complex than in prokaryotes, monomeric RNA polymerases are used.
   d. Eukaryotic and prokaryotic RNA polymerases are virtually identical.

7. Where is the TATA box located?
   a. At the transcription start site (+1).
   b. −10 region.
   c. −25 region.
   d. −40 region.

8. RNA polymerases from prokaryotes and eukaryotes
   a. have the same number and kind of subunits
   b. have identical σ factors
   c. differ because there is no analogue to the prokaryotic α subunit in eukaryotes
   d. have sequence homology in catalytic subunits

9. A transcription factor is
   a. a subunit of RNA polymerase II that does not have a prokaryotic analogue.
   b. the part of the promoter sequence closest to the start of transcription.
   c. a sequence that determines whether an upstream element will be an enhancer or silencer.
   d. a protein other than RNA polymerase that is involved in transcription.

10. Which of the following RNAs is noted for having a "cloverleaf" structure?
   a. mRNA
   b. rRNA
   c. tRNA
   d. All of these

11. The combination of events revolving around chromatin remodeling that controls transcription is known as:
    a. The histone code
    b. The second genetic code
    c. The genetic code
    d. Histone deacetylase code

12. Which of the following is true about micro RNAs?
    a. They are a type of non-coding RNA
    b. They are a type of small interfering RNA
    c. They have been found only in simple organisms like roundworms
    d. All of these are true

13. Ribozymes
    a. are more efficient catalysts than protein-based enzymes.
    b. are involved in protein synthesis.
    c. always use the same mechanism of catalysis.
    d. probably evolved later than protein-based enzymes.

14. Non-coding RNAs are known to:
    a. bind to mRNA targeting them for destruction
    b. bind to mRNA preventing their translation
    c. promote RNA silencing
    d. all of these

15. Which of the following is **not** true about RISC?
    a. It is only involved in cleaving dsRNA from viruses
    b. It is involved with processing of miRNA and siRNA
    c. It uses a protein from the argonaut family
    d. It unwinds dsRNA and eventually discards the passenger strand

二、簡答題：（45 分，如題示）

16. Please compare in detail the differences between microRNAs and small interfering RNAs (5 points).

17. Assume that you are studying a transcription factor (TF). You have constructed a plasmid vector for expression of GFP-tagged TF. You discover that TF is sometimes in the nucleus and sometimes in the cytoplasm.
    (a) Describe a possible mechanism for its cytoplasmic retention and subsequent signal-mediated import. (2 points)
    (b) Design an experiment to test your hypothesis and provide sample results. (3 points)

18. You suspect that a sequence upstream of a transcriptional start site is acting as an enhancer and not as a promoter.
    (a) Describe an experiment you would run to test your hypothesis. (2 points)
    (b) Predict the results based on your experimental design (3 points).

19. Several mechanisms are used by cells to guard the integrity of the mammalian genome.
    (a) What is double-strand break repair? Please describe the model and the mechanism. (5 points)
    (b) If you have a model cell line nicely cultured in the log-phase growth, please design an experiment to detect the sites of double-strand break (5 points).

20. Replication of DNA involves three parts: initiation, elongation, and termination. It requires multiple enzymes to extend the growing DNA strands.
    (a) Please describe the key enzymes and molecules involved in DNA elongation. (6 points)
    (b) Please describe the enzymatic mechanism of mammalian topoisomerase II. (4 points)

21. Replication of the E. coli circular duplex chromosome is initiated at the *OriC*.
    (a) Please describe the model of prokaryotic initiation (6 points).
    (b) Please design your experiments to verify whether dnaA can truly open the DNA unwinding element (DUE) in the OriC.(4 points)

三、問答題：（40 分，每題 10 分）

22. Please describe in detail the factors and their functions associated with the ribosome during various stages in prokaryotic translation.

23. Please first define and draw a mature mRNA produced from *in vitro* transcription IVT experiment and then describe in detail the functions of structural elements in this IVT's mRNA used for efficient protein translation.

24. Please first define and draw the organization of a bacterial operon and then describe the attenuation in *trp* operon based on coupling of transcription and translation.

25. Please describe in detail the molecular mechanism of X-chromosome inactivation in mammals.