國立清華大學 106 學年度碩士班入學考試試題

系所班組別：生命科學院甲組、醫學生物科技學程

考試科目（代碼）：分子生物學（0504、0804）

　*請在【答案卡】作答

I. 單選題 (每題二分，共 40 分)

1. A DNA element that binds one or more activators and stimulates transcription of a gene or genes is called _____.
   A Promoter
   B Suppressor
   C Operator
   D Enhancer
   E Terminator

2. Which of the following descriptions is correct about an *ara* operon?
   A Arabinose can derepress the *ara* operon by causing AraC to loosen its attachment to $araO_1$ and to bind to $araI_2$ instead.
   B In the positive control, CAP-cAMP complex-binding site is located within the $araP_c$ promoter.
   C AraC binds to $araI_2$ and $araO_2$, but not $araI_1$ in the looped state.
   D The two dimers in an *ara* repressor tetramer interact with the major groove of the DNA.
   E Recent experimental evidence has shown that three *ara* operator sequences are needed for maximal expression.

3. You are designing an experiment to investigate the presence of promoter binding sites for holoenzymes bearing σ^B and σ^E in *B. subtilis*. A DNA template is available along with the two holoenzyme complexes and the *in vitro* transcription buffers. Which of the following is a suitable negative control for this experiment?
   A a reaction containing all the components minus UTP
   B a reaction containing DNA lacking the -10 region
   C a reaction containing DNA lacking the -35 region
   D a reaction containing DNA lacking the UP element
   E a reaction containing a DNA lacking the two promoter regions

4. Which of the following is mostly likely to occur when *E. coli* mounts the heat shock response?
   A sigma factor (σ^{32}, also called σ^{H})—switching.
   B complete shutdown of transcription.
   C transcription of genes which encode proteins related to sporulation.
   D activation of vegetative genes.
   E reduction of endospore formation.

5. *O, P, Q, S,* and *R* genes are part of the λ phage genome. A new clone of lambda was constructed that lacked the O and P region. Which of the following would be observed if this new clone were used to infect bacteria?
   A The clone would not enter the cell.
   B The clone would be destroyed by the bacterial host.
   C Replication of phage DNA would be impaired in the lytic phase.
   D A rapid burst of replication would occur.
   E The transcription of delayed early genes would be terminated.

6. Which of the following engineered nucleases is NOT used for genome editing?
   A zinc finger nucleases (ZFNs).
   B transcription activator-like effector-based nucleases (TALENs).
   C clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9.
   D meganuclease.
   E micrococcal nuclease (MNase)

7. Which of the following enzymes is NOT involved in RNA editing of trypanosomatid kinetoplast gene?
   A endonuclease
   B 3'- exonuclease
   C terminal uridylyl transferase (TUTase)
   D RNA ligase
   E RNase P

8. Which of the following snRNPs is NOT present in spliceosome cycle during mRNA processing?
   A U1
   B U2
   C U3
   D U4
   E U5

9. Which of the following is NOT a function of the mRNA cap?
   A protects the mRNA from degradation
   B enhances translatability of the mRNA
   C enhances transport of the mRNA to the cytoplasm
   D enhances splicing of the mRNA
   E helps regulate expression of the mRNA

10. Which of the following molecules contains a poly(A) tail?
   A rRNA
   B tRNA
   C gRNA
   D hnRNA
   E miRNA

11. Which of the following molecule is responsible for guiding RNA polymerase to initiate gene transcription in prokaryotes?
   A Sigma factor
   B Dna A
   C TBP
   D Rho
   E None of the above

12. Which of the following statement is incorrect for bacteria two-component regulatory system?
    A Controlled by transferring phosphates between different components.
    B A protein with a DNA binding domain that can change its own structure.
    C A sensor kinase is involved.
    D Autophosphorylation on the DNA binding protein may change its DNA-binding ability.
    E Two-component regulatory system is found in many bacteria, but also in lower eukaryotes.

13. DNA sequence that are rich in guanine and cytosine are called _____ and are usually targets of _____.
    A interins; acetylation
    B promoters; transcriptional regulation
    C enhancers; mediator binding
    D GC islands; methylation
    E GC islands; acetylation

14. Which of the following mechanism does not explain the diverse gene products generated from a single gene?
    A Protein splicing
    B RNA polyadenylation
    C Alternative promoter selection
    D RNA base modification
    E mRNA alternative splicing

15. Which of the following feature do you expect NOT to see in heterochromatin?
    A Massive DNA methylation
    B The presence of histone deacetylase
    C The histone acetylase
    D The methylcytosine binding proteins
    E None of the above

16. Which of the following is the primase that synthesizes primers during DNA replication in *E. coli*?
    A DnaG
    B DnaA
    C HU protein
    D DnaB
    E RNA polymerase

17. Which of the following subunits of the DNA polymerase III holoenzyme is referred to as the "sliding clamp"?
    A α
    B β
    C γ
    D χ
    E θ

18. Put the following steps of *E. coli* primosome assembly in the correct order.
    (1) DnaG binds.
    (2) DnaA binds to *oriC* at *dnaA* boxes.
    (3) DnaB binds to the open complex.
    (4) DnaA, ATP, and HU protein melt the DNA.
    A 4, 1, 2, 3
    B 3, 4, 1, 2
    C 4, 2, 1, 3
    D 2, 4, 3, 1
    E 2, 4, 1, 3

19. Primer extension is used to _____.
    A locate the binding of RNA polymerase
    B determine the interaction of RNA and proteins
    C determine the transcriptional start site
    D generate primers for PCR
    E none of the above

20. Which of the following is NOT true concerning immunoglobulin gene recombination signal sequences? 請在答案卡作答

A There are conserved heptamers.

B There are conserved nonamers.

C Recombination occurs between a 12 bp signal and a 23 bp signal.

D Recombination only occurs between two heptamers.

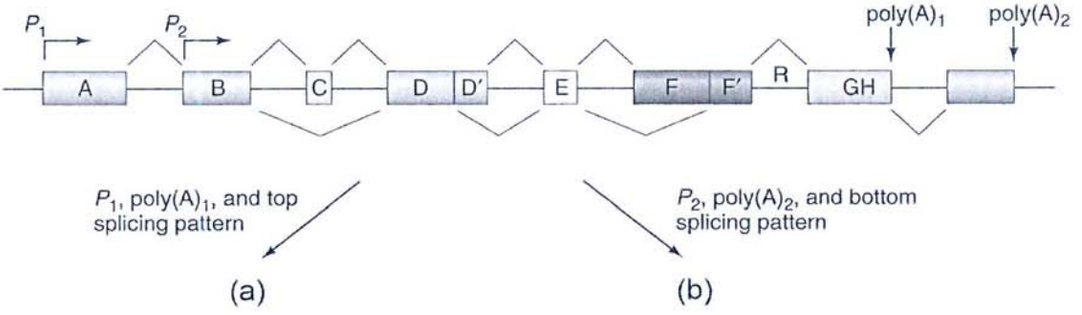
E The conserved sequences are separated by a nonconserved sequence of either a 12 bp or a 23 bp sequence.

II. 問答題 (共 60 分) 請在答案卷作答

1. (a) Draw a diagram and describe the principles of run-off transcription. (4 分)
(b) By applying the method of run-off transcription, please design an experiment to demonstrate the importance of promoter's -10 box in *E. coli* gene transcription. (4 分)

2. Draw diagrams and compare the intrinsic (or rho-independent) transcription termination with the rho-dependent termination. (7 分)

3. Please draw two RNA products (a) and (b) that are generated from alternative splicing coupled with alternative promoters and polyadenylation sites. (12 分)



4. Please list at least 3 different chemical modifications on the tails of core histones. (3 分)

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5. Please explain why do translations of mammalian proteins always start with the same amino acid? And which amino acid it is. (5 分)
6. Please explain how do enhancer sequences promote gene transcription. (10 分)
7. Please describe the following terms. (每題一分，共 5 分)
   (a) Nucleoside; **(b)** Nucleotide; **(c)** Nucleic acid; **(d)** Replicon; **(e)** Replisome
8. Please describe the steps (the required enzymes in detail) of eukaryotic base excision repair (including two major subpathways). (10 分)