

國 立 清 華 大 學 命 題 紙

98 學年度 X 生命科學院、生命科學院醫學生物科技學程 系(所) 甲 組碩士班入學考試

科目 分子生物學 科目代碼 0204、0504 共 5 頁第 1 頁 *請在【答案卷】內作答

I. 單選題 (每題兩分, 題號 1~20; 總共佔 40 分)

Single-choice questions, 2% per each, total score = 40%

- Which of the following repair mechanisms is a damage bypass mechanism, not an actual repair mechanism?
(A) DNA photolyase (B) base excision repair (C) recombination repair
(D) mismatch repair (E) nonhomologous end joining
- The DNA polymerase involved in error-free by-pass that inserts dAMPs across from pyrimidine dimers is
(A) DNA Pol β . (B) DNA Pol γ (C) DNA Pol δ
(D) DNA Pol η (E) DNA Pol ξ .
- The *Ds* transposable element of maize cannot transpose on its own because it lacks
(A) Tn10. (B) inverted repeats. (C) origin of replication.
(D) antibiotic resistance. (E) transposase.
- In order for P element transfer to happen in *Drosophila* which of the following situations must occur?
(A) a P male crossed with an M female (B) a P male crossed with a P female
(C) an M male crosses with a P female (D) an M male crossed with an M female
(E) any male crossed with a P female
- Histone H1 lies on the _____ of the nucleosome.; _____ nucleosomes condense into the 30-nm fiber to form a zig-zag structure.
(A) outside - - - - two (B) outside - - - -four
(C) outside - - - - two (D) inside - - - - four
- _____ is relatively extended and potentially active, whereas _____ is condensed and genetically inactive.
(A) Nucleosome - - - - - histone (B) Histone - - - - - nucleosome
(C) Euchromatin - - - - - heterochromatin (D) Heterochromatin - - - - - euchromatin
- _____ require(s) for RNA capping.
(A) RNA triphosphatase (B) guanylyl transferase
(C) methyl transferase (D) all of the above
- Methylation occurs on the N7 of the capping _____ and the _____ group of the penultimate (Next-to-end) nucleotide during mRNA post transcription modification.
(A) guanosine - - - -2'-O-methyl (B) adenine - - - - 2'-O-methyl
(C) guanosine - - - -3'-O-methyl (D) adenine - - - - 3'-O-methyl

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科目 分子生物學 科目代碼 0204、0504 共 5 頁第 2 頁 *請在【答案卷】內作答

I. 單選題 (每題兩分, 題號 1~20; 總共佔 40 分)

Single-choice questions, 2% per each, total score =40%

9. Which of the following statement is false regarding the sigma-factor?
(A) Interaction with the core enzyme unmask the DNA-binding region.
(B) Subregions 2.4 and 4.4 are involved in promoter recognition.
(C) It can also bind to the nontemplate strand.
(D) It does not have a DNA-binding domain.
(E) It can bind to the -10 box.
10. A series of *E. coli* mutants was created by replacing two of the aspartic residues in the β' -subunit of RNA polymerase. Which of the following is the most like outcome in these mutants?
(A) The binding capacity of the subunit for magnesium will be increased.
(B) The cells die because such mutations are usually lethal.
(C) The subunit will bind more tightly to other subunits in the enzyme complex.
(D) The catalytic activity of the enzyme will be increased.
(E) None of the above choices is correct.
11. Which of the following is incorrect regarding rho-dependent terminators?
(A) They do not contain a string of T's in the non-template strand.
(B) They consist of inverted repeats.
(C) They form hairpin loops.
(D) Rho binds to the growing transcripts.
(E) Rho does not have helicase activity.
12. Select the correct statement about enhancers:
(A) They bind protein factors and stimulate transcription.
(B) They are proteins that promote transcription of RNA.
(C) They stimulate the binding of repressor to DNA.
(D) They are non-promoter protein elements.
(E) None of the above choices is correct.
13. Which of the following techniques can be use to study the interaction between repressors and operators?
(A) Southern blotting
(B) EMSA
(C) Immunoblotting
(D) S1 mapping
(E) DNAase I footprinting

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科目 分子生物學 科目代碼 0204、0504 共 5 頁第 3 頁 *請在【答案卷】內作答

I. 單選題 (每題兩分, 題號 1~20; 總共佔 40 分)

Single-choice questions, 2% per each, total score =40%

14. Which of the following is a possible effect of creating a mutant cell line with reduced levels of the eukaryotic general transcription factor TFIIS?
- (A) Proofreading of transcripts will be impaired
 - (B) Transcription initiation complex would be slow to form
 - (C) RNA polymerase II will show weak binding to the promoter
 - (D) The TFIIDAB complex will dissociate
 - (E) The interactions between a TATA-binding protein (TBP) and a TATA box will not take place
15. Protein translation is a complex process. In its elongation phase:
- (A) The fMET-tRNA binds to the aminoacyl site of a ribosome
 - (B) Chloramphenicol is an antibiotic that can block the peptidyl transferase step in most eukaryotic ribosomes
 - (C) EF-G, with GTP, can bind to an aminoacyl-tRNA to the ribosomal aminoacyl site
 - (D) EF-Tu, with GTP, translocates the growing peptidyl-tRNA with its mRNA codon to the peptidyl site of ribosome
 - (E) Streptomycin is an antibiotic that interferes with proofreading of translation elongation
16. Please predict the possible consequence of blocking the action of TFIIF.
- (A) The TFIIDAB complex will not form
 - (B) TFIIA will not bind to TFIID
 - (C) Polymerase may not bind to the TFIIDAB complex
 - (D) The DAB complex will not form and TFIIA will not bind to TFIID are correct
 - (E) The CTD of RNA polymerase II can not be phosphorylated
17. Which of the statements about eukaryotic ribosomal genes is not true?
- (A) They have a different base composition compared to other nuclear genes.
 - (B) They are transcribed by RNA polymerases I and III.
 - (C) These genes are no repetitive sequences.
 - (D) They are found in the nucleolus.
 - (E) They contain a higher GC content compared to other nuclear genes.
18. Termination of protein translation and posttranslation involve several different factors in prokaryotes and eukaryotes. Which of the following is not true?
- (A) Prokaryotic release factor RF3 is a GTP-binding protein facilitating binding of RF1 and RF2 to the ribosome
 - (B) Prokaryotic RF1 can recognize UAA and UAG
 - (C) Eukaryotic eRF1 can recognizes all three termination codons
 - (D) In the posttranslation processes, all the prokaryotic and eukaryotic cells use a trigger factor to help most newly-made polypeptides to fold properly
 - (E) RRF collaborates with EF-G to release ribosomes from mRNA after translation termination

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19. Which of the following statement related to the nuclear receptor is not true?
- (A) Typhoid hormone receptor belongs to type I receptors, which stay in the cytoplasm in the absence of its ligand
 - (B) Type III receptors are “orphan” receptors whose ligands are not yet identified
 - (C) In the presence of ligand, the glucocorticoid receptor can form a homodimer within the nucleus
 - (D) The nuclear receptors are belonging to zinc-containing module proteins
 - (E) Nuclear receptors interact with different endocrine-signaling molecules and activate gene expression via its binding to hormone response DNA elements
20. Which of the following statement is not true for the yeast RNA polymerases?
- (A) RNA polymerase I is insensitive to alpha-amanitin
 - (B) RNA polymerase II is highly sensitive to alpha-amanitin
 - (C) RNA polymerase III is isolated from the nucleolus fraction of the yeast cell extract
 - (D) Rpb10 and Rpb12 are common subunits in all three yeast RNA polymerases
 - (E) Rbp1 of the yeast RNA polymerase II can be phosphorylated

II. 填入正確文字 (每空格 1 分, 題號 1~2, 總共佔 9%).

Fill the right word(s) in each blank, Total score = 9%

1. A _____ is a complex of specialized _____ and _____ subunits that removes _____ from transcribed pre-mRNA (hnRNA) segment. This process is generally referred to as _____. (5 points).
2. _____ is the change in base sequence of an RNA after it is synthesized. This occurs naturally by adding or subtracting _____, or by deaminating _____ to IMPs, or CMPs to _____. (4 points)

You will refer to the following library to fill in each blank: (填字參考).

RNA editing, RNA splicing, UMPs, AMPs, GMPs, TMPs, DNA, RNA, protein, histone, transcription factors, introns, exons, RNA splicing, RNA editing, nucleosome, spliceosome

III. 計算題 (題號 1, 總共佔 8%); Calculation question, Total score = 8%

1. Phage P1 has a double-stranded DNA with 91500 bp. The spacing between base pairs is about $3.32 \times 10^{-4} \mu\text{m}$ along the helical axis. Based on your knowledge on DNAs and proteins, please answer the following questions. 8%
 - A. How many full double-helical turns does this DNA contain? (2 points)
 - B. How long is the DNA in micrometers (μm)? (2 points)
 - C. What is the molecular mass of this DNA? (2 points)
 - D. How many genes of average size (encoding proteins of about 40000 daltons (D) molecular weight) can this phage contain (the average molecular mass of an amino acid is about 110 daltons)? (2 points)

IV. 簡答題 (每題 4-6 分, 題號 1~9; 總共佔 43 %;)

Answer the following questions, Total score for questions #1~9 = 43%

1. Whether a given cell is lytically or lysogenically infected by phage λ depends on the outcome of a race between the products of the *cI* and *cro* genes. Explain how the race between *cI* and *cro* determines the fate of a λ infection of *E. coli*. (5 points)
2. Please describe the similarities and/or differences of the core subunits of bacteria RNA polymerase (alpha, beta and beta') and yeast RNA polymerase II (Rpb1, Rpb2 and Rpb3) (6 points)
3. DNA-binding and transcription-activating domains of activator proteins are independent modules. Yeast two-hybrid (Y2H) system is derived from this concept and can be used to study protein-protein interactions *in vivo*. Please explain how Y2H system works. (5 points)
4. Distinguish histone acetylation and methylation on following items (4 points)
 - (1) How is the gene transcription affected by (a) histone acetylation and by (b) histone methylation?
 - (2) Which amino acid(s) will be acetylate histone and which will methylate histone?
5. What parts of the tRNAs interact with (a) the 30S subunit of ribosome and with (b) the 50S subunit of ribosome? (4 points)
6. How do mammalian cells regulate iron homeostasis through posttranscriptional control of transferrin receptor and ferritin? (5 points)
7. Describe the role of human *let-7* miRNA in the control of translation initiation. (5 points)
8. How is the unusual amino acid selenocysteine incorporated into growing polypeptides? (5 points)
9. What are SNPs? How can some of them be useful, while most of them are unimportant? (4 points)