

國 立 清 華 大 學 命 題 紙

96 學年度__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__6__頁第__1__頁 *請在【答案卷卡】內作答

Part I. In the following 25 questions, please choose a CORRECT answer. (2 points/question)

- Which of the following subunits is responsible for the specificity of the *E. coli* RNA polymerase?
 - α
 - β
 - β'
 - σ
- Which of the following serves to assemble the *E. coli* RNA polymerase holoenzyme?
 - α
 - β
 - β'
 - σ
- Which of the following subunits binds nucleotides at the active site of the *E. coli* polymerase where phosphodiester bonds are formed?
 - α
 - β
 - β'
 - σ
- Which of the following RNA polymerase II subunits is homologous to β subunit of the *E. coli* polymerase?
 - RPB1
 - RPB2
 - RPB3
 - RPB4
- Which of the following genes has an internal promoter?
 - β -globin
 - 7s rRNA
 - U6 rRNA
 - 5S rRNA
- Which of the following transcription factors can bind RNA polymerase directly and help RNA polymerase bind to the promoter?
 - TFII D
 - TFII E
 - TFII F
 - TFII H

國立清華大學 命題紙

96 學年度__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__6__頁第__2__頁 *請在【答案卷卡】內作答

7. Which of the following transcription factors is involved in DNA repair?
- A. TFII D
 - B. TFII E
 - C. TFII F
 - D. TFII H
8. Poly (A) head can be added to the 5'-end of RNA by:
- A. PAB
 - B. PAP
 - C. gRNA
 - D. RNA polymerase
9. Which of the following is NOT required for RNA editing?
- A. UTP
 - B. 3'-exonuclease
 - C. ligase
 - D. kinase
10. Specific RNA can be degraded by specific short dsRNA in cells. This is called:
- A. siRNA
 - B. RNAi
 - C. gRNA
 - D. gene therapy
11. Which of the following recognizes the 5'-splice site?
- A. U1 snRNA
 - B. U2 snRNA
 - C. Slu7
 - D. IBP
12. Transcription activator GAL4 stimulates transcription by facilitating binding of which of the following factors to the pre-initiation complex?
- A. TFII A
 - B. TFII B
 - C. TFII E
 - D. TFII H
13. The factor that does not bind by itself to the promoter but is absolutely required for transcriptional activity of RNA polymerase I is:
- A. CBF
 - B. SL1
 - C. UBF
 - D. TBP

國 立 清 華 大 學 命 題 紙

96 學年度__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__6__頁第__3__頁 *請在【答案卷卡】內作答

14. Transcription of reconstituted chromatin shows core nucleosomes inhibits transcription by:
- A. 25%
 - B. 50%
 - C. 75%
 - D. 100%
15. Which of the following is involved in mRNA splicing, capping and polyadenylation?
- A. TFII D
 - B. CTD
 - C. GTP
 - D. PAP
16. In the spliceosome cycle, which of the following is released from the complex LAST?
- A. mRNA
 - B. U1 snRNA
 - C. U2 snRNA
 - D. Intron
17. The DNA binding domain of transcription activator SP1 has a structure known as:
- A. leucine zipper
 - B. zinc finger
 - C. homeodomain
 - D. helix-loop-helix
18. Which of the following receptors can activate and repress transcription of genes under different conditions?
- A. EGF receptor
 - B. PDGF receptor
 - C. Thyroid hormone receptor
 - D. TGF β receptor
19. Which of the following entities is usually paired with ribosome binding site?
- A. 5'-terminus of 5S RNA
 - B. 3'-terminus of 5S RNA
 - C. 5'-terminus of 16S RNA
 - D. 3'-terminus of 16S RNA
20. Which of the following events does not contribute to the control of initiation of translation?
- A. Secondary structure of the mRNA
 - B. L11 operon
 - C. Methylation of initiation factor
 - D. Phosphorylation of initiation factor-binding protein

國 立 清 華 大 學 命 題 紙

96 學年度__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__6__頁第__4__頁 *請在【答案卷卡】內作答

21. Which of the following molecules has similar molecular structure as the antibiotic puromycin?
- A. Alaninyl-tRNA
 - B. Lysyl-tRNA
 - C. Serinyl-tRNA
 - D. Tyrosyl-tRNA
22. Which of the following mechanisms can be used to deal with aberrant termination?
- I. trans-translations
 - II. exosome-mediated degradation
 - III. nonsense-mediated mRNA decay
 - IV. nonsense-associated altered splicing
- A. I, II, III, IV
 - B. II, III, IV
 - C. I, II, III
 - D. II, IV
23. Which of the following enzymes or enzyme activities are not needed for the synthesis of Okazaki fragment during replication of *E. coli* chromosome?
- (1) DNA polymerase I (2) DNA polymerase III (3) primase (4) helicase
- A. (1)
 - B. (3)
 - C. (1, 3)
 - D. (2, 3, 4)
 - E. (1, 3, 4)
24. Which of the following mechanisms are responsible to generate a large group of antibody recognizes different antigen (antibody diversity)?
- (1) Somatic hypermutation (2) Alternative splicing (3) V(D)J joining
(4) Alternative transcription termination
- A. (1, 2)
 - B. (1, 3)
 - C. (2, 3)
 - D. (2, 4)
 - E. (1, 2, 3)
25. Which of the following statements concerning the Ac-Ds of maize are true?
- (1) Ds element, the nonautonomous element, cannot transpose by itself
(2) Ac element, the autonomous element, cannot transpose by itself
(3) Ds element can induce chromosome breakage by itself
(4) Ac and Ds transpose via replicative transposition
- A. (1)
 - B. (1, 2)
 - C. (1, 3)
 - D. (2, 3)
 - E. (2, 3, 4)

國立清華大學 命題紙

96 學年度__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

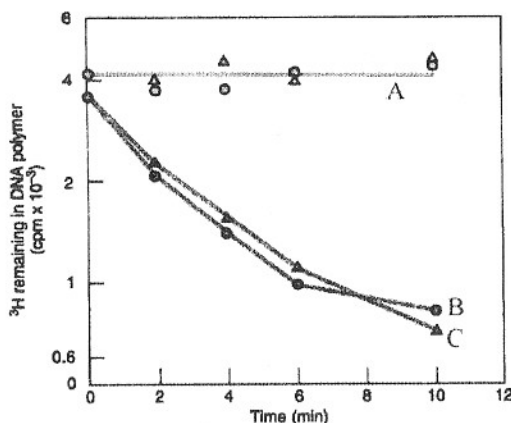
科目__分子生物學__ 科目代碼__0204、0504__共__6__頁第__5__頁 *請在【答案卷卡】內作答

Part II. Please fill in the blanks (2 points/blank)

1. The sequence of *Tetrahymena* telomere repeat is 5'-TTGGGG-3'. What kinds of radioactive nucleotides would you choose to measure the telomerase activities? _____
2. _____ results from random repair of heteroduplex DNA produced by recombination and creates an unusual 3:1 ratio of alleles observed in the *Ascomycete* fungi after meiosis.
3. _____ is the repair process to restore pyrimidine dimers in DNA without cleavage of DNA backbone.
- 4-5. Four different single-stranded plasmids, A, B, C, and D are added to a tube containing substrates for DNA replication. Oligonucleotides complementary to the plasmids A, B and C were annealed to the respective plasmid. Then, the plasmid A is preloaded with DNA polymerase III holoenzyme, and the plasmid B is preloaded with β -clamp.
4. Rank the order of plasmid being replicated (from the first to the last).
5. Can all plasmid be replicated? If not, which plasmid(s) cannot be replicated?

Part III. Please answer the following questions.

1. Purified ϵ -subunit (triangles) or DNA polymerase III core (circle) with ^3H -labeled synthetic DNAs and measured the amount of radioactivity remaining in the DNAs after increasing lengths of time. There are two types of DNAs, one is perfectly paired DNA (A) substrate and one is DNA with mismatches (B and C), added to the assay. What does this experiment demonstrate? (4 points)



2. Design two experiments with different methodologies to prove that a transcription factor, heat shock factor (HSF), binds specifically to a transcription element, heat shock element (HSE). Draw a figure or flowchart to illustrate the key reaction steps in each experiment. (6 points)

國 立 清 華 大 學 命 題 紙

96 學年度__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__6__頁第__6__頁 *請在【答案卷卡】內作答

3. List three similarities and three differences in comparison between agrose gel electrophoresis and PAGE. (6 points)
4. A chromatographic column in which oligo-dT is linked to an inert substance is useful in separating eukaryotic mRNA from other RNA molecules. On what principle does this column operate? (4 points)
5. Write down the two RNA sequences that could conceivably result from complete transcription of a DNA molecule that has the following sequence in one of the strands, 5'---AGGCTGCAATC---3'. Indicate the 5' and 3' end of each transcript. (4 points)
6. Ribonuclease P is an enzyme needed for the proper maturation of tRNAs. It has been shown that some mutations in Ribonuclease P cause increased expression of the *trp* biosynthetic operon. Please explain. (8 points)
7. Suppose that two proteins A and B are synthesized initially at the same time because the mRNA A and B are made in response to the same signal. At a later time, when the signal is no longer present, protein A is still made at nearly the same rate, and protein B is not detected. Suggest two possible mechanisms for this temporal regulation of gene expression. (8 points)