國　立　清　華　大　學　命　題　紙

99 學年度生命科學院甲組及醫學生物科技學程碩士班入學考試

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 1~22; 總共佔 44 分)
Single-choice questions , 2% per each, total score =44%

1. Which of the following is true about the action of CAP at the *lac* promoter?
   (A) CAP monomer binds directly to the promoter then stimulates polymerase to bind.
   (B) CAP blocks the αCTD of RNA polymerase.
   (C) CAP-AMP blocks recruitment of polymerase to the promoter.
   (D) Binding of the CAP-cAMP to the *lac* activator-binding site recruits RNA polymerase.
   (E) None of the above choices is correct.

2. Which of the following is mostly likely to occur when sporulatiom occurs in *B. subtilis*?
   (A) complete shutdown of transcription
   (B) deletion of vegetative genes
   (C) complex sigma-switching
   (D) reduction of endospore formation
   (E) activation of vegetative genes

3. Which of the following are not correct about the interactions of the repressor with the operator?
   (A) The four different base pairs present two different hydrogen-binding profiles to amino acids approaching the major DNA groove.
   (B) Electrostatic interactions stabilize hydrogen bonds.
   (C) The DNA is contacted by amino acid residues of the repressor through the major groove.
   (D) The DNA is similar in shape to the standard B-form of DNA.
   (E) Hydrophobic interactions are involved.

4. Regions of the 5'-UTRs of mRNAs that alter their structures to control gene expression are called _____.
   (A) UP elements (B) Riboswitches (C) Enhancers
   (D) Operators (E) Leader sequences

5. All of the following conditions promote the denaturation of DNA except
   (A) low ionic strength solutions. (B) high pH. (C) organic solvents.
   (D) high temperature. (E) extremely low temperature.

6. In DNA base pairs, A-T pairs are joined by _____ H bonds, whereas G-C pairs are joined by_____ H bonds.
   (A) three - - - - two (B) two - - - - three (C) two - - - - two
   (D) three - - - - three (E) none of the above

7. Which of the following is not true for eukaryotic RNA polymerases (RNA pol)?
(A) Eukaryotic RNA pol II makes hnRNAs and snRNAs
(B) RNA pol II is highly sensitive to alpha-amanitin
(C) Eukaryotic RNA pol II is found in the nucleolus, while RNA pol I is located in the nucleoplasm
(D) Rpb2, a subunit of yeast RNA pol II, is homologous to the beta-subunit of *E. coli* RNA polymerase
(E) Rpb10 and Rpb12 are common subunits in all three yeast RNA polymerases

8. Which of the following statement is not true for TFIIA, TFIIB and TFIIH, general transcription factors of eukaryotic RNA polymerase II preinitation complex?
(A) TFIIH can phosphorylate the carboxyl-terminal domain (CTD) of RNA polymerase II, and allows RNA Pol II to shift from initiation to elongation mode
(B) TFIIA is essential for TATA box-binding protein (or TFIID) binding to promoters
(C) TFIIH can unwind DNA at the transcription start site to create the "transcription bubble"
(D) TFIIH is required for both promoter clearance and transcription initiation
(E) TFIIB binds to TATA box-binding protein via its C-terminal domain ($TFIIB_C$)

9. Which of the following techniques can not be used to quantify the level of gene expression?
(A) Northern blotting (B) Southern blotting (C) S1 mapping
(D) Nuclear run-off (E) RNase protection

10. Which of the following statement is true for yeast Gal4 protein?
(A) Gal4 protein is an activator controlling a set of genes related to amino acids biosynthesis
(B) Gal4 protein forms a tetramer and binds to an initiator element of the promoters
(C) Gal4 protein belongs to the zinc-containing family of DNA-binding proteins
(D) Gal4 protein contains zinc-fingers; each of these fingers contain two cysteines and two histidines which coordinate two zinc ions
(E) The recognition module of Gal4 protein contains a short alpha-helix that protrudes into the DNA major groove and makes interactions

11. Which of the following statement is not true for transcription elongation for eukaryotic RNA polymerase II?
(A) TFIIS, an elongation factor, can enhance transcription elongation of RNA pol II by limiting transcription arrest
(B) TFIIS can stimulate a latent ribonuclease (RNase) activity of RNA polymerase II to cleave off the extruded 3'-end of the nascent RNA
(C) The initiation factor TFIIF also play a role in transcription elongation
(D) TFIIS can stimulate proofreading of transcripts
(E) TFIIS changes the RNase activity of RNA polymerase II by binding to the surface of polymerase and effecting some conformation changes within

12. Which of the statements about eukaryotic promoters is not true?
(A) Enhancer for the class II genes is orientation-independent, but position-dependent
(B) Class I promoters contain a conserved sequence, called the AT-rich initiator, across different species
(C) For the "classical" class III genes (e.g. tRNA gene), their promoters are located entirely within the genes themselves
(D) For the "non-classical" class III genes (e.g. Epstein-Barr virus *EBER2* gene), their promoters resemble those found in class II genes
(E) In the class II genes, some DNA elements can act either as enhancer or silencer depending on the protein bound to it

13. One method used by researchers to demonstrate the existence of nucleosome free DNA regions is
(A) RNA Polymerase Run-off experiments.
(B) Nuclear Run on experiments.
(C) Reporter gene experiments.
(D) Anion Exchange chromatography.
(E) DNase hypersensitivity experiments

14. The first two bases and the last two bases in the splicing signal consensus sequence are
(A) GT-AG. (B) GU-AG. (C) CU-AG.
(D) GU-AC. (E) GT-TG.

15. Which of the following snRNP is mismatched with its function?
(A) U1: base pairs with 5' splice site of mRNA.
(B) U2: base pairs with the conserved sequence at splicing branch point.
(C) U4: base pairs with 3' splice site of mRNA.
(D) U5: associates with last nucleotide in one exon and the first nucleotide in the next exon.
(E) U6: base pairs with 5' end of the intron.

16. 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

17. Which of the following is the mRNA polyadenylation signal motif found in mammalian cells?
(A) AAGAAA (B) AAUAAA (C) AAUGGG
(D) UUAUUU (E) GGAUUU

18. RNA interference occurs naturally in human cells during
(A) RNA viral replication. (B) DNA viral replication.
(C) RNA viral transcription. (D) DNA viral transcription.
(E) mRNA translation.

19. Which of the following enzymes is not involved in RNA interference?
(A) Dicer. (B) Slicer (C) Argonaute. (D) Argonaute2. (E) RNase P

20. The most common type if DNA damage repair is
(A) excision repair. (B) photoreactivation.
(C) suicide enzyme repair. (D) DNA photolyase.
(E) proofreading repair.

21. Given the following cell types, which do you propose would have the highest levels of telomerase activity?
(A) monkey liver cell. (B) macrophage
(C) Schwann cell (D) colon cancer cell
(E) osteoclast

22. Molecular modeling of RuvA and a Holliday junction showed that they form a _____ that favors rapid branch migration.
(A) square planer conformation (B) L-shape conformation
(C) clover leaf conformation (D) D loop conformation
(E) Y-shape conformation

II. 實驗題 (題號 1~2, 總共佔 15%); Total score = 15%

1. The run-off transcription method can be used to estimate the accuracy and efficiency of transcription *in vitro*:
   A. Describe the experimental procedures for this method in detail. **(4 points)**
   B. The *spoIID* gene promoter of *Bacillus subtilis* is specifically recognized by σ^E, but not other σ-factors (such as σ^A, σ^B or σ^C). Describe how the run-off transcription method can be used to demonstrate the specificity of σ^E? **(4 points).**
2. You are asked to detect DNA-protein interaction by gel mobility shift assay (also called electrophoretic mobility shift assay, EMSA). Please describe the principle of this method **(3 points)** and briefly describe the experimental procedures for this method **(4 points)**.

III. 簡答題（每題 2-8 分, 題號 1~8; 總共佔 41 %;）
Answer the following questions, Total score for questions #1~8 = 41%

1. Present a model and explain how is *trp* attenuation overridden in *E. coli* under conditions of tryptophan starvation? **(5 points)**

2. Describe any two of the hypotheses to explain how an enhancer can act on a promoter hundreds of base pairs away? **(6 points)**

3. Explain how transposition can give rise to speckled maize kernels. **(5 points)**

4. Define STS, contig, and BAC. Also, describe how to identify STSs in a genome and how to use STSs in a set of BAC clones to form a contig. **(8 points)**

5. Describe the results of experiments that shows the functions of each components of eIF4F in translation initiation **(7 points)**

6. What the enzymatic activity does ribosomal RNA hold? Describe and give the results of an experiment to show that ribosomal RNA has this function. **(5 points)**

7. What is the Histone Code? **(2 points)**

8. What are the major components in a spliceosome? **(3 points)**