

科目： 分子生物學

系所組：營養科學

Part I (50%)

- I. Explain the following terms: (4 points for each sentence, 12 points)
- (a) Shine-Dalgarno sequence
 - (b) Polycistronic mRNA
 - (c) Hypersensitive sites in eukaryotic chromosomes
- II. Describe the process by which steroid hormones affect gene expression. (8 points)
- III. Choice questions (2 points for each question, 30 points)
1. Nucleotides in the “minus” direction are said to lie _____ the transcription start site.
- (a) downstream of
 - (b) upstream of
 - (c) downstrand of
 - (d) upstrand of
 - (e) negative to
2. RNA polymerase II:
- (a) is located in the nucleolus and transcribes the major ribosomal RNA genes.
 - (b) is located in the nucleoplasm and transcribes the protein-encoding genes through mRNAs.
 - (c) transcribes the 5S RNA genes.
 - (d) transcribes RNA genes associated with tRNA processing.
 - (e) transcribes tRNA genes and protein transport genes.
3. Transcription in eukaryotic cells which is resistant to α -amanitin is carried out by RNA polymerase:
- (a) I only.
 - (b) II only.
 - (c) III only.
 - (d) I and III.
 - (e) I, II and III.
4. The eukaryotic transcription factor that exhibits a sequence specificity for the TATA box is:
- (a) TFIIB.
 - (b) TFIIC.
 - (c) TFIID/TBP.
 - (d) RNA polymerase II.
 - (e) TFIIH.
5. All are true for translation in eukaryotic cells EXCEPT:
- (a) transcription and translation are spatially separated.
 - (b) mRNAs are monocistronic.
 - (c) transcription occurs in the nucleus.
 - (d) primary transcripts undergo processing to mature mRNAs.
 - (e) all are true.

※ 注意：1.考生須在「彌封答案卷」上作答。

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3.考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。

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6. The strand of dsDNA that is read by RNA polymerase is termed the _____ strand with RNA polymerase moving _____ along it. The polymerase forms a _____, growing in the _____ direction.
- (a) template; $5' \rightarrow 3'$; transcript; $3' \rightarrow 5'$
 - (b) template; $3' \rightarrow 5'$; transcript; $5' \rightarrow 3'$
 - (c) transcript; $3' \rightarrow 5'$; template; $5' \rightarrow 3'$
 - (d) nontemplate; $5' \rightarrow 3'$; template; $3' \rightarrow 5'$
 - (e) nontemplate; $3' \rightarrow 5'$; template; $5' \rightarrow 3'$
7. One of the termination mechanisms in bacteria utilizes the _____ factor that is an ATP-dependent helicase.
- (a) α (alpha)
 - (b) β (beta)
 - (c) γ (gamma)
 - (d) δ (delta)
 - (e) σ (rho)
8. Enzymes that catalyze the unwinding of DNA double helix are:
- (a) topoisomerases.
 - (b) helicases.
 - (c) ligases.
 - (d) gyrases.
 - (e) polymerases.
9. All are characteristics of Okazaki fragments EXCEPT:
- (a) newly synthesized short lagging strand fragments.
 - (b) synthesis performed in the $5' \rightarrow 3'$ direction.
 - (c) initiated with an RNA primer.
 - (d) about 20-30 nucleotides in length.
 - (e) binds anti-parallel to the template strand.
10. Telomeres have all of the characteristics EXCEPT:
- (a) G-rich nucleotide sequences.
 - (b) structures at the end of eukaryotic chromosomes.
 - (c) eukaryotic counterpart to the prokaryotic -complex.
 - (d) short (5-8 bp) tandemly repeated sequences.
 - (e) all are true.
11. Aminoacyl-tRNA synthetases exhibit all of these characteristics EXCEPT:
- (a) some are monomeric and others are oligomeric.
 - (b) they attach the amino acid to the 2'- or the 3'-hydroxyl of the ribose located at the 5'-end of the tRNA.
 - (c) they attach the amino acid to a terminal adenylate residue on the tRNA.
 - (d) through binding specificity, they relate specific amino acids to appropriate codons.
 - (e) they must "read" the anticodon of the tRNA.

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12. All are true for the "wobble position" EXCEPT:
- It is the third base of the codon.
 - A certain amount of play might occur in base pairing at this position.
 - The first-base anticodon U could recognize either an A or G in the wobble position.
 - The first-base anticodon G could recognize either a U or C in the wobble position.
 - All are true.
13. Nonsense suppression is the production of isoacceptor tRNAs called _____ tRNAs that read _____ codons and insert an amino acid.
- nonsense; nonsense
 - suppressor; nonsense
 - suppressor; suppressive
 - nonsense; suppressive
 - codon; anticodon
14. Peptidyl transferase is the catalytic center of the ribosome and is located:
- on the 30 S subunit near the decoding center.
 - on the 30 S subunit near the head.
 - on the 50 S subunit near the center protuberance.
 - on the 50 S subunit at the bottom of a deep cleft.
 - on the 50 S subunit at the cleft of the L7/L12 ridge.
15. Amino-acyl-tRNA synthetases catalyze the reaction of a:
- specific amino acid attachment to the 3'-OH at the 3'-CCA of a specific tRNA.
 - specific amino acid attachment to the 5'-OH at the 5'-CCA of a specific tRNA.
 - specific tRNA with ATP to form a so called "charged tRNA" that interacts with a specific site on mRNA.
 - all of the above.
 - none of the above.

Part II (50%)

I. True or False Questions (3 points for each question, 30 points)

- The cell-division cycle of a somatic cell can be divided to four distinct phases, the DNA synthesis happen in S phase.
- Histones are basic DNA-binding proteins that package DNA into chromatin. Histones can be acetylation in lysine residues by histone acetyltransferases (HATs) to activate gene expression.
- Okazaki fragments are used to synthesize lagging strands DNA during DNA replication. In bacteria, DNA polymerase III is used to remove the RNA primer from Okazaki fragment and to ligate two Okazaki fragment.
- The DNA transcription is regulated by RNA polymerases. There are three RNA polymerases be recognized in eukaryotes, and the function of RNA polymerase I is directly to generate transfer RNA (tRNA) and 5S rRNA.

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5. "Allosteric effect" is the regulation of protein, especially enzyme, by binding an effector molecule at the protein allosteric site, and this allosteric site may be the same in active site of some enzymes.
6. During the mRNA synthesis in eukaryotes, mRNA capping and polyadenylation are two important process to protect mRNA degradation. In mRNA capping process, Adenosine monophosphate (AMP) is transfer to 5'-end of mRNA by adenylyl transferase and then methylated by adenine-7-methyltransferase.
7. Methylation is a common modification of histone proteins to regulate chromatin structure and transcription in the nuclei of eukaryotic cells. Generally, methyl transferases use *S*-adenosylmethionine as the methyl donor to regulate gene expression.
8. In DNA repair system, excision repair is the simplest way to repair the damage DNA. The damaged base is recognized by glycosylase and then DNA glycosylase remove the damaged base. Moreover, the apurinic/aprimidinic endonuclease (AP endonucleases) cleavage the phosphodiester bonds flanking the abasic site and the gap are then repaired by DNA polymerase.
9. In eukaryotes, homology-directed repair is the major mechanism for repairing double-strand breaks that occur during DNA replication. Homology-directed repair generally results in repair without mutation or loss of sequences because it involves copying intact information from an undamaged identical sister chromatid.
10. Enzymes catalyze chemical reactions by lowering the activation energy barrier, and all of the enzymes are protein and are not composed of RNA or others.

II. Question and Answer (10 points for each question, 20 points)

1. In bacterial DNA repair system, SOS response is the most important mechanism to repair damage DNA. Please describe the activation of SOS response after DNA damage. (10%)
2. During the DNA metabolism, DNA polymerases are the most important core components. Three types of DNA polymerase (polymerase I, II, and III) have been investigated in *E. coli*. Please describe the function of three types of DNA polymerase in *E. coli*. (10%)

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