

※ 注意：選擇題請於試卷之「選擇題作答區」依序作答。

請依題號順序作答

一、選擇題 (22%，每題 2 分，答錯不倒扣)

1. Which of the following does NOT involve introns?

- (A) Alternative splicing (B) Intervening sequences
(C) Antisense oligonucleotides (D) Heteroduplexes (E) Ribozymes

2. Ribosomal RNAs in eukaryotes and prokaryotes are different in all of the following ways EXCEPT _____.

- (A) Location in cell (B) Size of subunits (C) Function
(D) Number of proteins associated with ribosomes (E) None of the above

3. Promoters for eukaryotic mRNA synthesis:

- (A) Are more complex than prokaryotic promoters
(B) Can require binding of multiple transcription factors to form a transcription complex
(C) Have specific DNA sequences such as the "TATA" box that are recognized by proteins
(D) Are the stretches of DNA to which RNA polymerase binds to initiate transcription
(E) All of the above

4. During the initiation of protein synthesis in eukaryotic cells eIF4E, eIF4A and eIF4B associate with which of the following? _____

- (A) The poly-A tail on the mRNA
(B) The Shine-Delgarno sequence
(C) The 10S rRNA molecule in the small ribosomal subunit
(D) The f-met-initiator tRNA molecule
(E) The 5' cap on the mRNA

5. Which of the following is NOT involved in regulating the synthesis of RNA in the eukaryotic nucleus?

- (A) Active genes in euchromatin, and inactive genes in heterochromatin
(B) Amplification of some genes such as rRNA genes
(C) Use of different RNA polymerases to transcribe different classes of RNA
(D) Spliceosomes that stimulate synthesis of intron-containing hnRNAs
(E) Enhancers that can stimulate specific promoters

6. A frameshift mutation is one of the most severe types of mutations because _____.

- (A) They occur only in gametes
(B) More than one gene is affected
(C) They cannot be reversed
(D) More than one amino acid or entire proteins are affected
(E) Translation is stopped

7. The cDNA fragment that includes the ricin gene is 5.7 kilobases. If the entire fragment codes for the ricin polypeptide, the approximate number of amino acids in the polypeptide would be _____.

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(A) 570 (B) 1,900 (C) 2,500 (D) 5,700 (E) 17,100

8. The Shine Delgarno element is:

- (A) In prokaryotic cell complementary to 18S rRNA subunit
- (B) In prokaryotic cell complementary to 16S rRNA subunit
- (C) In eukaryotic cell complementary to 18S rRNA subunit
- (D) In prokaryotic cell complementary to 28S rRNA subunit
- (E) None of the above

9. Which nucleotide is the "wobblest" (most promiscuous in its interactions)?

- (A) Guanine (B) Inosine (C) Thymine (D) Uracil (E) Cytosine

10. Which of the following features would you NOT expect to find in heterogeneous nuclear RNA (hnRNA)?

- (A) Intron (B) Polycistronic coding (C) Polyadenylation at 3'-end
- (D) 5-' cap structure (E) U nucleotides

11. Which of the following is NOT an outcome of posttranslational modifications of a protein?

- (A) Removal of N-terminus amino acid
- (B) Removal of introns
- (C) Addition of metals to create tertiary or quaternary structures
- (D) Addition of phosphate groups
- (E) None of the above

二、簡答題 (57%)

1. Below are 200 consecutive base pairs of DNA that includes only the beginning of the sequence of gene Y. The underlined and italicized sequence (from position 10-44) represents the promoter for gene Y and the underlined sequence (from position 71-90) encodes the gene Y ribosome binding (RBS) site. Transcription begins at and includes the A/T base pair at position 50 (bold).

1	10	20	30	40	50	60	70
I-----I-----I-----I-----I-----I-----I-----I							
5'	GCTACTACATA <u><i>TAAACGCGCGCATATATCGATATCTAGCTAGCTATCGGTC</i></u> AAT CCTACTACATCGGTCTCG						
3'	CGATGATGT <u><i>ATTGCGCGCGTATATAGCTATAGATCGATCGATAGCCAG</i></u> T TAGGATGATGTAGCCAGAGC						
<i>Promoter</i>							
	80	90	100	110	120	130	140
-----I-----I-----I-----I-----I-----I-----I							
5'	<u><i>CAGGTATCGGTCTGATCTAGCTAGCTTCTCTTCTCTCTCTCCCCGCGGGGGCTG</i></u> ACTATCATGGCTCG						
3'	<u><i>GTCCATAGCCAGACTAGATCGATCGAAGAGAAGAGAGAGAGGGGGCGCCCCGACATGATAGTACCGAGC</i></u>						
<i>RBS</i>							
	150	160	170	180	190	200	
-----I-----I-----I-----I-----I-----I							
5'	TGTGGGCTACTACGTA <u><i>AACGCGCGCATATATCGATATCTAGCTAGCTATCGGTCTCGGCT</i></u>						
3'	ACACCCGATGATGCATTTGCGCGCGTATATAGCTATAGATCGATCGATAGCCAGAGCCGA						

Non	T		C		A		G	2nd
T	TTT	Phe	TCT	Ser	TAT	Tyr	TGT	Cys
	TTC	Phe	TCC	Ser	TAC	Tyr	TGC	Cys
	TTA	Leu	TCA	Ser	TAA	TER	TGA	TER
	TTG	Leu	TCG	Ser	TAG	TER	TGG	Trp
C	CTT	Leu	CCT	Pro	CAT	His	CGT	Arg
	CTC	Leu	CCC	Pro	CAC	His	CGC	Arg
	CTA	Leu	CCA	Pro	CAA	Gln	CGA	Arg
	CTG	Leu	CCG	Pro	CAG	Gln	CGG	Arg
A	ATT	Ile	ACT	Thr	AAT	Asn	AGT	Ser
	ATC	Ile	ACC	Thr	AAC	Asn	AGC	Ser
	ATA	Ile	ACA	Thr	AAA	Lys	AGA	Arg
	ATG	Met	ACG	Thr	AAG	Lys	AGG	Arg
G	GTT	Val	GCT	Ala	GAT	Asp	GGT	Gly
	GTC	Val	GCC	Ala	GAC	Asp	GGC	Gly
	GTA	Val	GCA	Ala	GAA	Glu	GGA	Gly
	GTG	Val	GCG	Ala	GAG	Glu	GGG	Gly

- a) What are the first 6 nucleotides of the mRNA from gene Y? (3%)
 b) What are the first 4 amino acids encoded by gene Y? (3%)

You have found two different mutations of gene Y, mutation 1 and mutation 2.

c) In mutation 1, there is an insertion of the following three base pairs immediately after the C/G base pair at position 100 (shown in bold).

5' TCT 3'
 3' AGA 5'

- i) Would the mRNA expressed from this version of gene Y be longer, shorter, or the same as that produced from the normal gene Y? Explain and if longer or shorter, indicate by how many in bases. (3%)
 ii) If the mRNA can be translated, would you expect the protein to be longer, shorter, or the same as that produced from the normal gene Y? If longer or shorter, indicate by how many in amino acids. (3%)
 iii) Do you expect that the protein produced will have the same function as the normal protein Y? Explain your thinking. (3%)

d) In mutation 2, there is an insertion of the following four base pairs immediately after the A/T base pair at position 130 (shown in bold).

5' ATGC 3'
 3' TACG 5'

- i) Would the mRNA expressed from this version of gene Y be longer, shorter, or the same as that produced from the normal gene Y? Explain and if longer or shorter, indicate by how many in bases. (3%)
 ii) If the mRNA can be translated, what are the first four amino acids produced? (3%)
 iii) Would you expect the protein to be longer, shorter, or the same as that produced from the normal gene Y? If longer or shorter, indicate by how many in amino acids. (3%)
 iv) Do you expect that the protein produced will have the same function as the normal protein Y? Explain your thinking. (4%)

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2. Describe the ways in which DNA is compacted to produce the 10-nm fiber and the 30-nm fiber (describing the proteins or structures involved). (6%)

3. You are characterizing a transcriptional repressor in your favorite organism.

a) What technique would you perform to identify proteins that physically interact with the repressor? Briefly explain the principle of the method. (4%)

b) Using this approach, you identify an interacting protein that appears to have deacetylase activity. How could this enzyme be involved in transcriptional repression? Why? (4%)

4. The replisome is the combination of all of the proteins that function at the replication fork and it contains numerous distinct activities.

a) What are the functions of DNA helicase and primase within the replisome and what are their roles in DNA replication? (6%)

b) What are some of the advantages of having multiple proteins working together to carry out the various aspects of the replication process? (3%)

5. Briefly describe the major achievements of the following Nobel Prize laureates.

a) Arthur Kornberg (in Physiology or Medicine 1959) (3%)

b) Elizabeth H. Blackburn and Carol W. Greider (in Physiology or Medicine 2009) (3%)

三、解釋名詞：(21%，每小題 3 分)

1. Dicer

2. Argonaute

3. Guide RNA in RISC

4. Sigma factor

5. DNA glycosylase

6. Real time PCR

7. Pyrosequencing

試題隨卷繳回