

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. 單選題 (30%，每題兩分)

1. Which one of the following components is required for DNA synthesis?

- (A) deoxyribonucleotide triphosphates (dNTPs)
- (B) DMSO
- (C) ribonucleotide triphosphates (rNTPs)
- (D) Reverse transcriptase
- (E) uridine-5'-phosphate

2. Please identify which one of the sequences encodes the amino acid tryptophan according to the left table.

		second position			
		U	C	A	G
first position	U	UUU Phe UUC Phe UUA Leu UUG Leu	UCU Ser UCC Ser UCA Ser UCG Ser	UAU Tyr UAC Tyr UAA stop UAG stop	UGU Cys UGC Cys UGA stop UGG Trp
	C	CUU Leu CUC Leu CUA Leu CUG Leu	CCU Pro CCC Pro CCA Pro CCG Pro	CAU His CAC His CAA Gln CAG Gln	CGU Arg CGC Arg CGA Arg CGG Arg
	A	AUU Ile AUC Ile AUA Met AUG Met	ACU Thr ACC Thr ACA Thr ACG Thr	AAU Asn AAC Asn AAA Lys AAG Lys	AGU Ser AGC Ser AGA Arg AGG Arg
	G	GUU Val GUC Val GUA Val GUG Val	GCU Ala GCC Ala GCA Ala GCG Ala	GAU Asp GAC Asp GAA Glu GAG Glu	GGU Gly GGC Gly GGA Gly GGG Gly
		third position			
		U	C	A	G

(A) 5'-TTA-3'

(B) 5'-CAT-3'

(C) 5'-ATA-3'

(D) 5'-CCA-3'

(E) 5'-CGA-3'

3. Several assays have been developed to identify proteins that bind to DNA. Which method involves the antibody in analyzing protein-DNA complexes?

- (A) EMSA
- (B) ChIP assay
- (C) Luciferase assay
- (D) nuclease protection footprinting
- (E) Gel filtration

4. Which of the following statements correctly describes the role of telomerase?

- (A) It synthesizes the Okazaki fragment that is to prevent loss of genetic information at the 5' end of DNA.
- (B) It synthesizes new DNA (using a DNA template) at the 3' end of the chromosome.
- (C) It synthesizes new DNA (using a RNA template) at the 3' end of the chromosome.
- (D) It synthesizes new DNA (using a rDNA template) at the 3' end of the chromosome.
- (E) It synthesizes new DNA (using a RNA template) at the 5' end of the chromosome.

5. The most highly conserved splice and branch site sequences recognized within the introns of human nuclear pre-mRNA by spliceosomes include which of the following?

- (A) 5' splice site GU or AU, 3' splice site AG or AC, branch site A
- (B) 5' splice site GU or AU, 3' splice site AG or AC, branch site A or G
- (C) 5' splice site GU, 3' splice site AG, branch site U
- (D) 5' splice site AU, 3' splice site AC, branch site A
- (E) 5' splice site AU, 3' splice site AG, branch site G or C

6. Peptide bond formation is catalyzed by \_\_\_\_\_ and occurs between the \_\_\_\_\_ sites of the ribosome.

- (A) ribosomal proteins; A and P sites
- (B) ribosomal proteins; P and E sites
- (C) ribosomal RNA (rRNA); P and E sites.
- (D) ribosomal RNA (rRNA); A and E sites
- (E) ribosomal RNA (rRNA); A and P sites

7. In which set of conditions does the *lac* operon in *E. coli* produce high levels of *lacZ* transcripts?

- (A) in the absence of both lactose and galactose
- (B) in the presence of both lactose and glucose
- (C) in the presence of lactose and absence of glucose
- (D) in the absence of lactose and presence of glucose
- (E) in the absence of lactose and presence of galactose

8. The Edman degradation method is used for what purpose?

- (A) determining the sequence of peptides
- (B) determine RNA structure and function
- (C) determining a protein's function
- (D) determine DNA sequences
- (E) Analyze the secondary structure of protein

9. Which of the following statements is not true for Cre-*LoxP* in genetic engineering?

- (A) Cre is used experimentally to delete genes in eukaryotic organisms.
- (B) Cre is a 65 bp sequences being recognized by the recombinase.
- (C) Cre can be regulated by tissue specific promoters to knock out gene of interest in specific tissues.
- (D) The recombination sites on the DNA, where Cre acts, are called *loxP* sites.
- (E) The Cre and the *LoxP* are derived from bacteriophage P1

10. Which of the following components is not involved in gene silencing?

- (A) miRNA
- (B) dsRNA
- (C) dicer
- (D) U6RNA
- (E) Argonaute

11. Which enzyme do bacteria use to introduce negative supercoils into covalently-closed circular DNA?

- (A) topoisomerase I
- (B) topoisomerase II
- (C) DNA reductase
- (D) DNA gyrase
- (E) none of the above

12. What percentage of the human genome is identical in all people?

- (A) 85%
- (B) 90%
- (C) 95%
- (D) 99%
- (E) 99.9%

13. Term used to describe the structure of chromatin:

- (A) "squirrels on a tree"
- (B) "rings on a pole"
- (C) "beads on a string"
- (D) "bumps on a log"
- (E) none of the above

14. Dicer catalyzes:

- (A) Sequence-dependent single-stranded RNA cleavage.
- (B) Sequence-dependent double-stranded RNA cleavage.
- (C) Sequence-independent double-stranded DNA cleavage.
- (D) Sequence-independent single-stranded DNA cleavage.
- (E) None of above.

15. Which of the following statements is correct regarding the role of miRNAs in humans?

- (A) Each miRNA is specific for a distinct target mRNA; collectively they regulate less 20% of all human genes.

- (B) Each miRNA is specific for a distinct target mRNA; collectively they regulate more than 80% of all human genes.
- (C) A single miRNA may regulate hundreds of distinct target mRNAs; collectively they regulate less 20% of all human genes.
- (D) A single miRNA may regulate hundreds of distinct target mRNAs; collectively they regulate more than 80% of all human genes.
- (E) None of above

II. 簡答題 (40%，每題五分)

- (1) What are the two main characteristics of a molecular that determines its velocity of moving in a gel?
- (2) What kind of chemical modification must be done on the C-terminal domain of the largest RNA polymerase subunit for chain elongation to occur?
- (3) Which type of non-coding RNA has been shown to help maintain germline stability in animals?
- (4) Which part of a gene transcript is targeted by microRNA?
- (5) How does DNA methylation at the promoter of a gene affect its expression?
- (6) How does histone deacetylation affect transcription?
- (7) What happens when Cisplatin combines with DNA?
- (8) What is main usage of CRISPR/Cas9?

III. 解釋名詞 (30%，每題五分)

- (1) Topoisomerases. (2)  $\lambda$  repressor (3) Epigenetics (4) Shine–Dalgarno sequence (5) heterochromatin
- (6) imprinting