

※ 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。

一、EXPLAIN 解釋名詞 (three points for each question. 每題 3 分) (21%)

1. Forward genetics
2. complementary DNA (cDNA)
3. clathrin
4. chromatin immunoprecipitation (ChIP)
5. Single Nucleotide Polymorphism (SNP)
6. metageomics
7. epigenetics modification

二、TRUE OR FALSE 是非題 (10%)

1. Indicate whether each of the following statements about eukaryotic cells is true (T) or false (F).
  - Q1. They have three distinct RNA polymerases.
  - Q2. Their mRNAs are generally synthesized by RNA polymerase I.
  - Q3. RNA polymerase III synthesizes only rRNAs.
  - Q4. The 5S rRNA is synthesized by RNA polymerase I
  - Q5. Their RNA polymerases initiate transcription at specific promoter sites on the DNA

三、SIMPLE-CHOICE QUESTIONS 單選題 (two points for each question. 每題 2 分) (14%)

(以 A、B、C、D、E 五種選項作答，否則一律不記分)

1. The DNA binding motif for many prokaryotic regulatory proteins, such as the lac repressor, is:
  - (A) helix-turn-helix.
  - (B) homeobox.
  - (C) homeodomain.
  - (D) leucine zipper.
  - (E) zinc finger.
2. Which of the following statements about regulation of the lac operon is true?
  - (A) Glucose in the growth medium decreases the inducibility by lactose.
  - (B) Glucose in the growth medium does not affect the inducibility by lactose.
  - (C) Glucose in the growth medium increases the inducibility by lactose.
  - (D) Its expression is regulated mainly at the level of translation.
  - (E) The lac operon is fully induced whenever lactose is present.

3. Which one of the following is not involved in steroid hormone action?
- (A) Cell surface receptors
  - (B) Hormone-receptor complexes
  - (C) Specific DNA sequences
  - (D) Transcription activation and repression
  - (E) Zinc fingers
4. Differential RNA processing may result in:
- (A) a shift in the ratio of mRNA produced from two adjacent genes.
  - (B) attachment of the poly(A) tail to the 5' end of an mRNA.
  - (C) inversion of certain exons in the final mRNA.
  - (D) the production of the same protein from two different genes.
  - (E) the production of two distinct proteins from a single gene.
5. Which of these polymerases does not require a template?
- (A) RNA pol I
  - (B) RNA pol II
  - (C) Reverse transcriptase
  - (D) Polyadenylate polymerase
  - (E) RNA replicase
6. The wavelength of absorb light of DNA, RNA, and protein are \_\_\_\_, respectively.
- (A) 230 nm, 230 nm, and 280 nm
  - (B) 260 nm, 260 nm, and 280 nm
  - (C) 230 nm, 260 nm, and 280 nm
  - (D) 260 nm, 230 nm, and 280 nm
  - (E) 280 nm, 280 nm, and 260 nm
7. Signal sequences are part of a protein that
- (A) signal the protein synthesis
  - (B) signal the protein location
  - (C) signal folding of the protein
  - (D) signal the protein denature
  - (E) signal active site of the protein

## 四、EXTENDED MATCHING QUESTIONS 配合題 (20%)

(每題答案可能不只一個，全對才給分)

## 1. Select the answer(s) that match to the question. (10%)

_____ Q1. Technique used to measure the expression of protein in the experimental samples. (2%)	(A) Western blot analysis
_____ Q2. Technique used to measure the expression of gene (mRNA) in the experimental samples. (4%)	(B) RT-PCR
_____ Q3. Technique used for detection of a specific DNA sequence in DNA samples. (1%)	(C) Southern blot analysis
_____ Q4. Technique used to investigate the interaction between proteins and DNA in the cell. (2%)	(D) Northern blot analysis
_____ Q5. Technique used for detection of a specific DNA sequence on chromosomes prepare from tissue cell. (1%)	(E) Eastern blot analysis
	(F) Yeast one-hybrid assay
	(G) Microarray
	(H) Southwest blot analysis
	(I) Chromatin immunoprecipitation (ChIP)
	(J) RNA seq
	(K) Protein array
	(L) Fluorescence <i>in situ</i> hybridization (FISH)

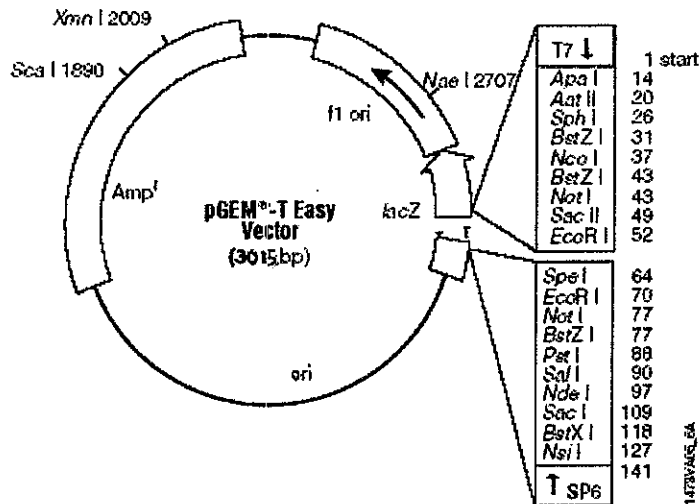
## 2. Select the answer(s) that match to the question. (10%) (two points for each question. 每題 2 分)

_____ Q1. The organelle that contains the genetic information.	(A) endoplasmic reticulum
_____ Q2. DNA-protein complex.	(B) nucleus
_____ Q3. The organelle that related to uniparental inheritance.	(C) golgi
_____ Q4. E site, P site and A site for amino acids polymerization.	(D) vacuole
_____ Q5. The presence of COP II protein.	(E) plasma membrane
	(F) plastids
	(G) mitochondria
	(H) nucleosome
	(I) ribosome
	(J) cytoskeleton

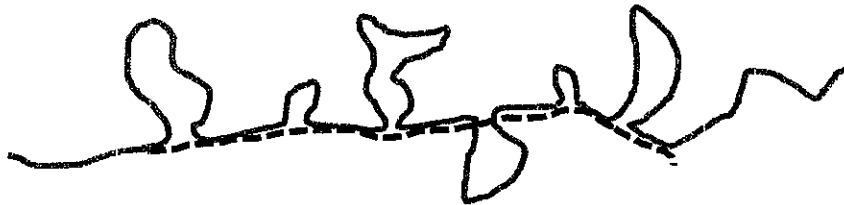
## 五、SHORT ESSAY 簡答題 (35%)

1. Polymease chain reaction (PCR) is invented by Dr. Kary B. Mullis who has awarded the 1993 Nobel Prize in Chemistry. PCR has become a very powerful and widespread method for analyzing DNA. Please give two exarnples for the applications of PCR and simply describe how PCR gets involved. (5%)

2. Describe the principle of blue/white screening for the rapid and convenient detection of recombinant bacteria in vector-based molecular cloning experiments. (5%)



3. Please describe the principle of Agrobacterium-mediated gene transformation in plant. (5%)
4. Shown below is an R loop prepared for electron microscopy by annealing a purified eukaryotic messenger RNA with DNA from a genomic clone containing the full-length gene corresponding to the mRNA.



- (a) How many exons does the gene contain? How many introns? (4%)
- (b) Where would you expect to find a polyadenylic acid sequence? (2%)
5. A small DNA molecule was cleaved with several different restriction nucleases, and the size of each fragment was determined by gel electrophoresis. The following data were obtained.

Enzyme	Fragment Size (kb)
EcoRI	1.3, 1.3
HpaII	2.6
HindIII	2.6
EcoRI + HpaII	1.3, 0.8, 0.5
EcoRI + HindIII	0.6, 0.7, 1.3

- (a) Is the original molecular linear or circular? (2%)
- (b) Draw a map of restriction sites, showing distances between sites, that is consistent with the data presented (2%)
- (c) What would have to be done to locate the cleavage sites unambiguously with respect to each other? (2%)

6. Below are 210 consecutive base pairs of DNA that includes only the beginning of the sequence of gene X. The underlines sequences represent the promoter and the ribosome binding site (RBS) for gene X. Transcription begins at and includes the T/A base pair at position 60 (bold)

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      1      10      20      30      40      50      60      70
      I-----I-----I-----I-----I-----I-----I-----I
5' ATCGGTCTCGGCTACTACATAAACGCGCGCATATATCGATATCTAGCTAGCTATCGGTCTAGGCTACTAC
3' TAGCCAGAGCCGATGATGTATTTGCGCGCGTATATAGCTATAGATCGATCGATAGCCAGATCCGATGATG
                               Promoter

      80      90      100     110     120     130     140
      -----I-----I-----I-----I-----I-----I-----I-----I
5' CAGGTATCGGTCTGATCTAGCTAGCTTCTCTCTCTCTCTCCCCGCGGGGGCTGTACTATCATGCGTCG
3' GTCCATAGCCAGACTAGATCGATCGAAGAGAAGAGAGAGAGGGGGCGCCCCGACATGATAGTACGCAGC
      RBS

      150     160     170     180     190     200     210
      -----I-----I-----I-----I-----I-----I-----I-----I
5' TCTCGGCTACTACGTAAACGCGCGCATATATCGATATCTAGCTAGCTATCGGTCTCGGCTACTACGTAA
3' AGAGCCGATGATGCATTTGCGCGCGTATATAGCTATAGATCGATCGATAGCCAGAGCCGATGATGCATTT

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- (a) What are the first 6 nucleotides of the mRNA from gene X? (2%)
- (b) If there is an insertion of the following four base pairs (5' ATGT 3') immediately after the C/G base pair at the position 100, would you expect the mRNA be longer, shorter or the same as that produced from the normal gene X? Explain and indicate by how many in bases. (3%)
- (c) If the mRNA can be translated, would you expect that the protein to be longer, shorter or the same as that produced from the normal gene X? Explain and indicate by how many in amino acids. (3%)