（一）單選題 (30%) ※注意：請於試卷「選擇題作答區」依題號作答。

1. The double-stranded DNA genome of phage P1 has a molecular mass of about $6X10^4$ kD. How many phosphorus atoms does the genome contain?
   A. 91,500 atoms
   B. 9,150 atoms
   C. 183,000 atoms
   D. 18,300 atoms
   E. 366,000 atoms

2. Which of following point mutations could not lead to premature termination of translation of the mRNA from that gene? (Stop codons are TAA, TAG and TGA)
   A. Deletion
   B. Insertion
   C. A to T substitution in the coding region of the template strand
   D. A to C substitution in the coding region of the template strand
   E. A to G substitution in the coding region of the template strand

3. Nonsense mutations may be suppressed by nonsense suppressors. Most nonsense suppressors have a mutation in
   A. anticodon of tRNA
   B. acceptor arm of tRNA
   C. rRNA of the small ribosomal subunit
   D. rRNA of the large ribosomal subunit
   E. microRNA

4. You have a piece of DNA. Its partial sequence is shown below. You would like to use PCR amplification to obtain fragment #1.

5'CGTATTGCGACT----------TATCCGAAGCTGA----------CCGAATACTGCTA 3'
3' GCATAACGCTGA----------ATAGGCTTCGACT----------GGCTTATGACGAT 5'
_____ fragment #1 _____

Which of the following primer pairs will you use for PCR? The primer sequence below is written from 5' (left) to 3'(right).
   A. CGTATTGCGACT and TATCCGAAGCTGA.
   B. CGTATTGCGACT and TCAGCTTCGGATA.
   C. AGTCGCAATACG and TATCCGAAGCTGA.
   D. AGTCGCAATACG and TATCCGAAGCTGA.
   E. AGTCGCAATACG and TATCCGAAGCTGA.

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5. Which method will you use to detect local DNA melting at the promoter by RNA polymerase in a test tube?
   A. polymerase chain reaction
   B. reverse-transcription polymerase chain reaction
   C. primer extension
   D. Measure the absorbance of 260-nm light
   E. Measure the absorbance of 280-nm light

6. Which enzyme cleaves mRNA during RNA interference?
   A. dicer
   B. argonaute
   C. RNase III
   D. RNA helicase
   E. RNAse H

（二）多選題 (20 %) ※注意：請於試卷「選擇題作答區」依題號作答。

7. Which of following occur during meiotic recombination?
   A. RAG-1- and RAG-2-dependent single-strand nick of one chromatid.
   B. double-stranded break of one chromatid
   C. heteroduplex formation
   D. demethylation of nucleotides
   E. branch migration

8. Which of the following pairs of lesion and repair system in *E. coli* are correct?

	Lesion	repair
A.	deamination of cytosine	Uracil DNA glycosylse
B.	AP site	glycosylase
C.	G-T mispair as replication error	methyl-directed mismatch repair
D.	5'-TT-3' dimmer	general excision repair
E.	Aflatoxin B1 adduct	photolyase

9. Which of following are correct?
   A. E. coli DNA primase uses DNA as template to synthesize RNA.
   B. Eukaryotic telomerase uses RNA as template to synthesize DNA.
   C. E. coli DNA polymerase III does not require a primer to synthesize DNA.
   D. E. coli DNA primas does not require a primer to function.
   E. Eukaryotic telomerase requires a primer to function.

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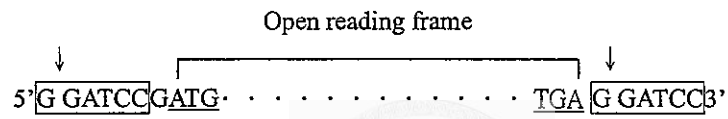
10. Which of following may result in constitutive synthesis (持續性的合成) of *lac* products from a mutant *lac* operon in the absence of lactose.
    A. Repressor is not made or synthesized
    B. Repressor present in overexpressed at a high level.
    C. Repressor is mutated and can not bind the operator
    D. Repressor is mutated and bind to the operator all the time.
    E. Operator is mutated and cannot be bound by repressors.

（三）簡答題 (50 %) ※ 注意：請於試卷上「非選擇題作答區」依序作答，並應註明作答之大題及小題題號。

1. You have a cDNA clone. Its partial sequence is shown in Figure 1.

Figure 1



Only one DNA strand, written 5'→3' left to right is presented here. The DNA has two BamHI sites, one before the initiation codon and one after the stop codon. The two codons are underlined. The Bam HI recognition sequences are boxed, and BamHI cutting sites are indicated by arrows.

You are to insert the BamHI fragment of the cDNA into the BamHI site of a bacterial expression vector to generate a fusion protein with 6 histidine in the N terminus. You have three expression vectors 1, 2, and 3 to choose for cloning. They differ in sequence between ATG (boxed) and BamHI (boxed) as shown below.

Vector 1----AGGAGG------ATGCACCACCACCACCACCACGGATCC------
Vector 2----AGGAGG------ATGCACCACCACCACCACCACGGGATCC------
Vector 3 ----AGGAGG-----ATGCACCACCACCACCACCACGGGGATCC------

A Shine-Dalgarno sequence (AGGAGG) is about 8 bases upstream of the boxed ATG of the vectors. CAC is a histidine codon.

A. Which vector will you use to express the BamHI fragment of the cDNA in the correct reading frame? (5%)
B. How many additional amino acids will be present before the methioinine encoded by the first ATG (underlined) of the cDNA in the fusion protein? Assume that the fusion protein is not cleaved in bacteria. (5%)

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2. What causes the eukaryotic RNA Polymerase II to turn from an initiation complex into an elongation complex? (5 %) Which TFII complex performs this function? (5 %)

3. During DNA replication, helicase pulls the two strands of DNA apart.
(A). What is the consequence of this force applied to the adjacent DNA? (5%)
(B). Which enzyme is involved in solving this problem? (5%)

4. Most transcription factors bind to the major groove of DNA through hydrogen bonds. A hydrogen bond is formed between a hydrogen-bond donor (hydrogen atom) and a hydrogen-bond acceptor (oxygen or nitrogen atom).
(A). Draw a G-C base pair. Indicate the hydrogen-bond donor present in the major groove. (5%)
(B). If the glutamine side chain of a transcription factor make a hydrogen bond with this hydrogen-bond donor in (A). Which atom of the glutamine side chain contacts the G-C base pair ? (5%)

5. You have a 50 kD DNA-binding protein and a 100 bp DNA fragment that may be bound by the protein. To analyze the protein and its binding to the DNA, you run three gels. Gel 1 is to analyze purity of your protein. Gel 2 is to test if the protein binds to the DNA using the electrophoresis gel mobility shift assay (EMSA) or gel retardation assay. Gel 3 is for DNAse footprinting to identify the DNA sequence bound by the protein. Please answer the following questions. (10 %)
A. Which gels will be loaded with labeled DNA during electrophoresis?
B. Which gel is a native gels? A native gel is a gel containing no chemicals which may denature proteins.
C. Which gel has the smallest pore size?
D. Will you run a polyacrylamide gel or agarose gel for gel 1.
(Please answer numbers 1, 2, or 3 in questions A-C.)

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