

題號： 459

國立臺灣大學 107 學年度碩士班招生考試試題

科目： 分子生物學(D)

題號：459

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※ 注意：全部題目均請作答於試卷內之「非選擇題作答區」，請標明題號依序作答。

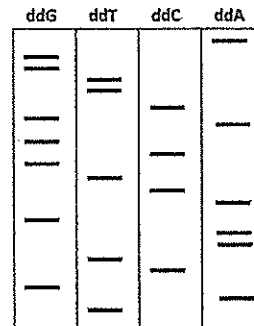
(1) Choice (14 points)

1. Which of the following **Two** statements are **Not** true? (2 points/each answer) (4 points in total)
 - A. Euchromatin, rather than Heterochromatin, is a tightly packed of chromatin.
 - B. In general, heterochromatin is less active than euchromatin.
 - C. The basic repeat element of chromatin is the nucleosome.
 - D. H1 histones are tightly bound to DNA.
 - E. H2A, H2B, H3, and H4 form the core of a nucleosome.
 - F. Posttranslational modifications of histones act in diverse biological processes, such as gene regulation and DNA repair.
2. Which of the following is observed in prokaryotes but **NOT** in eukaryotes? (2 points)
 - A. UGA is an example of a stop codon only found in prokaryotes
 - B. An mRNA can be translated by only one ribosome at a time in prokaryotes
 - C. The 5' end of a prokaryotic mRNA can be translated while the 3' end is still being transcribed
 - D. Translation does not require any protein factors in prokaryotes
 - E. In prokaryotes, ribosomes move along an mRNA in the 3' to 5' direction
3. During translation in prokaryotes, the ribosome binds to (2 points)
 - A. The TATA box
 - B. The mRNA cap
 - C. The terminator sequence
 - D. The enhancer sequence
 - E. The Shine-Dalgarno sequence
4. Which of the following would be most effective for sequencing the exact 5'-end of an mRNA transcript? (2 points)
 - A. PCR
 - B. Primer extension
 - C. Cloning
 - D. Southern blot
 - E. Northern blot
5. Codons that specify the same amino acid are said to be: (2 points)
 - A. Wobbly
 - B. Isoaccepting
 - C. Hypothetical
 - D. Synonymous
 - E. Anonymous
6. For a double-stranded DNA sequence of nucleotide, how many reading frame is possible? (2 points)
 - A. One
 - B. Two
 - C. Three
 - D. Four
 - E. Five
 - F. Six

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(2) Answer the following questions (28 points)

1. The diagram beside shows an autoradiograph of a DNA sequencing gel. What is the sequence of the template stand? (5' → 3') (3 points)



2. You are asked to design 4 PCR primers (20 nucleotides) to amplify the coding region with a point mutation in C base of the following gene. You are planning to replace C with T base. Please write down the sequences of the primers and briefly describe your designing planning. (indicate the 5' and 3' end of the primers)? (4 points)

5'-ATGTCTGCATTGACTCCGTGGGACCCCTTCCGGGAACTGGATGAATTGCAAACCGCCTGGCGACGATGTTCCGGACGAATACCCAGCG
 ACAGGGCGCCCGTACCGGCAACGAAGCCATGACCACGGCGGACTGGGCTCCAATGGCGGACATCAGCGAGGATGAGAACGCATTCTTCCT
 CAAGCTGGATCTGCCGGAGGTCCCCAGGGATGCCGTGCGCGTCAGCGCGGAAAACGGTGTGCTCA^CCATCAGCGGCGAGCGCAAACCTGGA
 AAAAGAGGAGCAGGGCAAGAAGTTCACCGCATCGAACGTGCCTATGGCCGCTTTGTGCGCAGCTTTGTCTTGCTGACAACGTTGATCCG
 ACCAAGGTGACGGCTTCCATGAAAGACGGCGTGCTGGAAGTGC GGCTTGTC AAGGCCGAGCAAGCCAAACCGAAACAGATTGAAATCTCA
 GTCAACTAA-3'

3. How are introns removed and how are exons joined together? Please describe the mechanism if the unspliced RNA undergoes "major splicing" to form the spliced RNA. (5 points). Please also briefly describe three real cases as to why RNA splicing is important? (3 points) (8 points in total)
4. (a) Please Compare and Contrast DNA replication and Transcription. (6 points). (b) Describe the role of a DNA helicase at a replication fork. (2 points) (c) As a result of DNA helicase activity, topoisomerases are also required during replication. Explain how topoisomerases help DNA helicases function more efficiently. (3 points) (d) During PCR, you don't have to add DNA helicase to the reaction. Explain why not? (2 points) (13 points in total)

(3) Explain the following terms: (8 points)

1. Epigenetic regulation: (2 points)
2. Illegitimate recombination: (2 points)
3. Caspr/Cas9: (2 points)
4. hnRNP: (2 points)

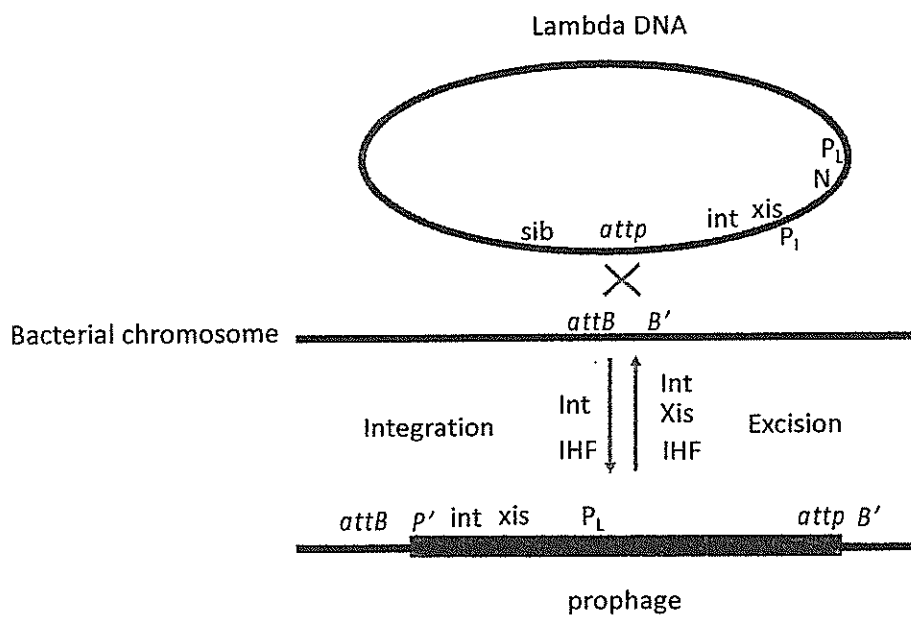
- (4) Compare nonsense-mediated decay and nonstop-mediated decay. (10 points)

- (5) Two principle types of polycomb group (PcG)-containing complex, termed Polycomb repressive complex (PRC)1 and 2, have been identified in *Drosophila* and in mammals. What are the functions of PRC1 and PRC2? (10 points)

(6) Many viruses have evolved strategies to express their genes but prevent host gene expression by inducing translational shut-off. Internal ribosome entry site (IRES) was first identified in the 5' untranslated region in picornaviruses. What is IRES and its functions? (10 points)

(7) During translation initiation in eukaryotic cells, eIF2 phosphorylation needs to be tightly regulated in response to extracellular stimuli, such as amino acids deprivation, ER stress, or viral infection. For example, Gcn4 is a transcription factor involved in amino acid biosynthesis in yeast. There are four uORFs upstream the coding sequence of Gcn4. How does the translation of GCN4 be regulated under starvation and nonstarvation conditions? (10 points)

(8) Phage lambda is the lysogen-forming phage and has two distinct life cycle, lysogenic and lytic cycle. Lambda phage requires Int and IHF for integration into bacterial chromosome after infection. However, lambda phage needs Int, IHF and excisase (Xis) for excision. How does lambda phage retroregulate the expression of Int and Xis? IHF: integration host factor; sib: RNase III site (10 points)



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