國立嘉義大學九十七學年度
生化科技學系碩士班招生考試試題

科目：分子生物學

1. (14%) (a) (2 %) What is the involvement of DNA supercoiling in biological activity? (b) (4 %) Please draw a DNA with an interwound supercoiling of +2 (c) (6 %) If the E coil genomic DNA (3.15×10^6 bp) is a interwound supercoiled DNA with "superhelical density" (σ) of -0.06, and the DNA is a B form helix (with 10.5 bp per turn), calculate the Lk, Tw, and Wr. (d) (2 %) If the sample in (c) is treated with gyrase the σ value would be less or more than -0.06?

2. (6 %) Besides polymerase III, class III gene transcription requires three transcription factors, i.e. TFIIIA, TFIIIB, and TFIIIC. Which of these factor(s) is/are correlated to the following functions or properties?

   (a) The factor(s) not involved in the transcription of tRNA genes

   (b) The factor(s) by itself does/do not bind to tRNA gene. Its binding is totally dependent of other factor.

   (c) The factor(s) that is the last to join the preinitiation complex.

   (d) The factor(s) that contain(s) TBP and other TAFs.

   (e) The factor(s) that remain(s) bound on the gene after elongation phase has proceeded, and ready for another round of transcription.

   (f) The factor(s) that required for the transcription of 5S RNA genes.

3. (a) (10%) Please explain how eukaryotic RNA polymerase I, II, II initiate their basal level of transcrition ? (b) (10%) What are features correlated with phosphorylation of the RNA polymerase II C-terminal domain (CTD)?

4. (20 %) You perform a 5'-deletion analysis of the proximal regulator region of a eukaryotic gene.

   (1) What is the primary reason for doing such an experiment? (2 %)

   (2) To assay the effects of your 5'-deletion mutants, you make reporter plasmids, each of which contains one of your deletion mutants. Diagram your reporter plasmid and label ALL important parts of the reporter plasmid, using GFP (Green Fluorescent Protein) as the reporter. (5 %)

   (3) What is meant by the phrase "using GFP as the reporter" and what is the assay. (2 %)

   You find GFP expression for 5'-deletions up to -200, partial expression for a -195 deletion mutant, and no GFP expression for 5'-deletions -185 or more.

   (4) What do the negative numbers mean? (2 %)

   (5) What is the correct interpretation of the GFP expression results? (2 %)

   (6) Diagram below the agarose gel results of a gel retardation expression with these 3 plasmids and the regulatory protein involved. (5 %)

   (7) The regulatory protein has two primary domains. What are the functions of these domains? (2 %)

5. (20%) How do the prokaryotic cells ensure the high-fidelity of copying DNA during replication?

6. (20%) Indicate where in a eukaryotic cell you would be most likely to find each of the following types of RNA. (hint: nucleus, cytoplasm, or others)

   (1) hnRNA : _____

   (2) tRNA : _____

   (3) mRNA : _____

   (4) pre-RNA : _____

   (5) snRNA : _____

   (6) nascent rRNA: _____

   (7) rRNA : _____

   (8) 45S pre-RNA: _____