The examination questions comprise three parts (Part I (40%): problem 1-6, Part II (30%): problem 1-7, and Part III (30%): problem 1-4).

Part I (Problems 1 to 6, total 40 points)

1. What are the three essential elements of a chromosome that have been put to construct a yeast artificial chromosome? Brief describe their functions. (6 points)

2. About 2 - 7% of the cytosines of animal cell DNA are methylated. Most of the methyl groups are found in CG sequences. Describe the importance of gene methylation. (6 points)

3. Describe the mechanisms that the pre-mRNA is processed to mature mRNA. (8 points)

4. Apoptosis is achieved by an active pathway that executes a program for cell death. Please describe the functions of the following gene products that regulate apoptosis: Fas, ced-3, bcl-2 and Crm A. (8 points)

5. What is the typical sequence of a telomere? How do eukaryotic cells control the overall length of the telomere? (6 points)

6. Give an example to demonstrate how successive phosphorylations and dephosphorylations of proteins control cell cycle. (6 points)

Part II. (Problems 1-7, total 30 points)

1. "___" suggests that a gene of unknown function is found by cloning DNA from the region to which the gene has been mapped by linkage analysis. Which is the best fit for "___" (4 points)

(1) Positional cloning
(2) Forward genetics
(3) Somatic cell mapping
(4) Chromosomal jumping
(5) Substrative hybridization.

2. Hybrid dysgenesis is a phenomenon of the germ cells of fruit fly. The events responsible for the induction of mutation in dysgenesis have been identified as the insertion of [A] element. The [A] element have 4 exons. Due to [B], an active transposase is produced in the germ cells, and an inactive enzyme (or a repressor) produced in somatic cells. (6 points)

Which is the best fit for [A]? (1) copia; (2) Ty ; (3) P ; (3) Ds.
Which is the best fit for [B]? (1) transposition; (2) alternative splicing; (3) recombination ; (4) RNA editing

3. As genes are too long to be encompassed by a single cosmid clone, these clones must be ordered and linked together to reconstruct the original sequence. The process is called "__" construction. It is the bottom-up mapping strategy. (3 points)

The word in the "__" is (1) cotig; (2) centig; (3) Contig; (4) countig.

4. For studying DNA:protein interaction with the mobility shift assay, describe the control experiment(s) to ensure that the signal of the assay is a specific one instead of an artifact (4 points).

5. In the basic steps of PCR (polymerase chain reaction) for DNA amplification, which step determines the specificity of the reaction product? Give answer with a brief explanation (5 points).

6. What is C-value paradox? (4 points)

7. Describe the implication of $Cot_{1/2}$ value in the DNA renaturation. (4 points)

Part III. (Problems 1 to 4, total 30 points)

1. Please fill in the blanks. (12 points)

(1). A restriction map and an RFLP map significantly different in the first one is a _(a)_ map while the latter is a _(b)_ map.

(2). The meaning of aminoacyl-tRNA is determined by its _(c)_.

(3). The DNA-binding protein that initiates the transcription of bacterial genes is called a _(d)_.

(4). A transposon that duplicates itself and leaves a copy behind at the old site creates a _(e)_ transposition.

(5). When comparing genes that are conserved between species, the _(f)_ are more likely to be related to one another.

2. Single- or multiple-choice questions. (10 points)

(1). Replication of DNA:

(a). Involves the synthesis of two daughter strands which associate in a double helix.

(b). follows the principle that a new daughter strand is assembled on each parental strand.

(c). is dependent on the species-specific genetic code.

(d). is the most common source for base mispairing.

(e). is a process that describes gene expression.

(2). Which base(s) in the anticodon contribute to the degeneracy (wobbling) in codon reading?

(a). first

(b). second

(c). third

(d). first and second

(e). second and third

(3). A ribosome is

(a). an rDNA-containing organelle in which rDNA synthesis and mRNA translation occur.

(b). a macromolecular, two-subunit complex comprising more than 50 different proteins and several rRNAs.

(c). a nuclear protein complex which facilitates intron splicing.

(d). a structure consisting of three (prokaryotes) or four (eukaryotes) RNAs which facilitates protein synthesis.

(e). an RNA structure that guides the template selectivity of RNA polymerase I, II and III in eukaryotic cells.

(4). Replication of DNA employs

(a). DNA polymerases

(b). RNA polymerases

(c). *Sau3*AI

(d). exonuclease MFI

(e). RNase P

(5). Which enzyme requires a primer?

(a). restriction enzyme

(b). terminal transferase

(c). reverse transcriptase

(d). DNaseI

(e). Taq polymerase

3. Please explain promoters and enhancers, and briefly describe the method(s) commonly used to define promoter elements. (4 points)

4. To isolate a desired clone, why is it important to use a library generated by partial digestion of genomic DNA? (4 points)