

※ 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、選擇題：(12分，每題2分)

1. Capping is important because
 - a). it likely protects the telomere ends from becoming shortened.
 - b). it likely prevents DNA repair mechanisms from initiating at the telomeres.
 - c). it likely results in increased processivity on the eukaryotic chromosome.
 - d). all of the above
 - e). none of the above
2. The proofreading function of DNA polymerase involves all of the following *except*:
 - a). a 3'→5' exonuclease.
 - b). base pairing.
 - c). detection of mismatched base pairs.
 - d). phosphodiester bond hydrolysis.
 - e). reversal of the polymerization reaction.
3. Which of the following statement(s) about DNA polymerase III is (are) **TRUE**?
 - I. DNA polymerase III has greater accuracy than RNA polymerase.
 - II. Pol III is the primary replicase of *E. coli*.
 - III. Pol III does not contain 5' to 3' exonuclease activity.
 - a). I, II.
 - b). II, III.
 - c). III only.
 - d). I only.
 - e). I, II, III.
4. In molecular biology labs researchers often use *E. coli* strains that are RecA minus (*recA*⁻) when transforming a cloned gene into a plasmid which explains why
 - I. a Rec A-strain would have fewer replication errors.
 - II. a Rec A-strain would have less opportunity forming DNA mutations.
 - III. a Rec A-strain would increase error repair.
 - a). I only.
 - b). II only.
 - c). III only.
 - d). I, II
 - e). II, III

5. A new DNA polymerase exhibits: (1) high processivity, (2) low fidelity, and (3) ability to replace RNA with DNA. Which of the following is probably TRUE?
- It has 3' exonuclease activity.
 - It has 5' exonuclease activity.
 - It has RNA primase activity.
 - It is not associated with a clamp.
 - both A and B
6. Which of the following statements is not true concerning homologous recombination?
- It can be intramolecular.
 - It can be bimolecular.
 - Only one cross-over event can occur.
 - It results in genetic variation.
 - It is a reciprocal event.

二、問答題（88 分）

- DNA double stranded breaks (DSBs) can be repaired by either non-homologous end joining (NHEJ) or homologous recombination (HR). Please describe the proteins involved and their detail mechanisms. (each mechanism for 6%). Lately, specific DSB-inducing nuclease systems, such as the transcription activator-like effector nucleases (TALENs), the clustered regularly interspaced short palindromic repeats (CRISPR)/Cas, and the Zinc-finger nucleases (ZFNs) technologies, have been applied in genome editing. Please also describe how these specific DSB-inducing DNA nuclease can facilitate genome editing. (6%)
- Please describe the definition and function of long noncoding RNA in eucaryotes. (10%)
- Please describe the difference in transcription between RNA polymerase II and RNA polymerase III in eucaryotes. (10%)
- Please describe how the transcription is regulated by histone code? (10%)
- Please describe a signal pathway transduced from cell membrane to nucleus. (10%)
- Please first draw and name the molecular structure of a general prokaryotic operon, then further draw and name the molecular structure of a polycistronic mRNA transcribed by a prokaryotic operon. (10%)
- Please describe briefly the five different most common methods that can be used for measuring or detecting gene expression in eukaryotic cells. (10%)

8. Please describe the key steps or processes that involve in controlling or regulating the accuracy during protein synthesis (translation). (10%)