國立成功大學 108 學年度碩士班招生考試試題

系　　所：生物化學暨分子生物學研究所

考試科目：分子生物學　　考試日期：0224，節次：2

※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、簡答題（50 分，如題標示）

1. If you have a next-generation sequencing machine in your garage and it works well, what can you do with this machine? Please describe 10 experimental techniques you want to use this sequencing instrument. Briefly explain what results can each of these 10 techniques tell you (20%).

2. Please describe the role of the following terms in gene expression: “restriction enzyme”, “enhancer”, “eRNA”, “transcription factor”, “nucleosome remodeling”, and “insulator”. (18%)

3. Which of the following phenotypes or diseases can be regulated by X chromosome inactivation? (3%)
   A. the plant height of garden peas,
   B. DNA damage repair of Thymidine dimer in Xeroderma pigmentosum, a type of skin disease caused by the cellular hypersensitivity to ultraviolet (UV) radiation,
   C. the coat color in a female calico cat having patches of black and orange color.
   D. Sickle cell disease (SCD), a group of inherited red blood cell disorders.
   E. Lynch syndrome, also known as hereditary non-polyposis colorectal cancer (HNPCC), is a type of inherited cancer syndrome associated with a genetic predisposition to different cancer types

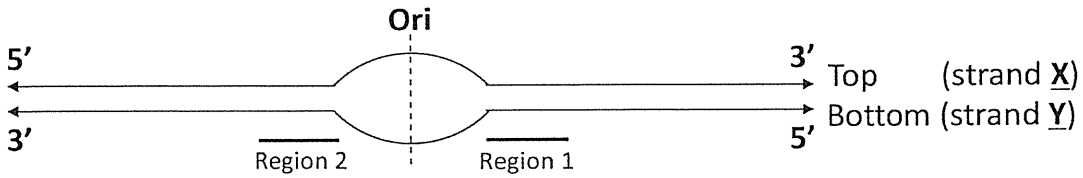
4. Which of the following factors help guard the fidelity of DNA replication? (3%)
   A. Properly balanced levels of dNTPs.
   B. the correct base-pairing between the 3’ base in the DNA template and the incoming dNTP.
   C. the proof-reading 3’ →5’ exonuclease activity of DNA polymerases Pol I and Pol III
   D. DNA repair systems
   E. All of the above.

5. Which of the following description of is not true? (3%)
   A. Primase – synthesizes short primers preferentially by using dNTPs as starting material instead of NTPs.
   B. Topoisomerase – bind to double-stranded DNA and cut the phosphate backbone of either one or both the DNA strands to release the straining tension of DNA ahead of a replication fork.
   C. DNA ligase – facilitates the joining of DNA strands together by catalyzing the formation of a phosphodiester bond using ATP or NAD+ as the energy source.
   D. Helicase – they are motor proteins that move directionally along a nucleic acid phosphodiester

backbone, and separate two annealed nucleic acid strands (DNA, RNA, or RNA-DNA hybrid) using energy derived from ATP hydrolysis.

E. Reverse transcriptase – generates complementary DNA (cDNA) from an RNA template, a process termed reverse transcription.

For questions 6 and 7, consider the following origin of replication that is found on a chromosome. The sequence of region 1 is shown below.



Region 1: 5′-...ATGACTGACA...-3′
3′-...TACTGACTGT...-5′

6. Within Region 1, which strand will be the template for leading strand synthesis, the top strand (strand X) or the bottom strand (strand Y)? (1%)

A. strand X.
B. strand Y.
C. both strands X and Y.

7. If we assume that a lagging strand fragment is made from region 1, what will be its sequence? (2%)

A. 5'-…ATGACTGACA…-3'
B. 5'-…TACTGACTGT…-3'
C. 5'-…TGTCAGTCAT…-3'
D. 5'-…ACAGTCAGTA…-3'
E. 5'-…ACTCTCAGTA…-3'

二、問答題：(50 分，每題 10 分)

8. Please compare and describe in detail the transcriptional initiation of mRNA synthesis between prokaryotic and eukaryotic genes. (10%)

9. Please compare and describe in detail the translational initiation of protein synthesis between prokaryotic and eukaryotic mRNAs. (10%)

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10. Please describe in detail the role and function of eukaryotic translation factors resemble to prokaryotic translation factors IF2, EF-Tu, EF-G and RF1. (10%)

11. Please first define a bacterial operon and then describe the structure and regulation of lac operon. (10%)

12. Please describe the mechanism and regulation of long noncoding RNA-induced X-chromosome inactivation. (10%)