

所別：癌症生物學研究所

科目：生物化學(包含分子細胞生物學) 【考生不可攜帶電子計算機應試】

考生注意：答案必須寫在答案卷上，否則不予計分。



一. 問答題 (70%，每大題 10 分)：

1. Please explain the following terms:
  - a) Isoschizomers and Neoschizomers of restriction enzymes? (4 分)
  - b) Endocrine, Paracrine, and Autocrine signaling. (6 分)
2. Please describe the general steps of signaling from extracellular signal to cellular response.
3. The term epigenetics refers to changes in gene expression caused by mechanisms other than changes in the underlying DNA sequence. Please describe the ways (both genetic and epigenetic) in regulating gene transcription.
4. Two methods for functionally inactivating a gene without altering the gene sequence are by dominant-negative mutations and RNA interference.
  - a) Please describe how each method can inhibit expression of a gene. (5 分)
  - b) Please describe the difference between miRNA and siRNA. (5 分)
5. Please describe the pathway for the  $IP_3/DAG$  and the elevation of cytosolic  $Ca^{2+}$ .
6. DNA-repair systems are responsible for maintaining genomic fidelity in normal cells despite the high frequency with mutational events occur. Please describe the system responsible for repairing each types of mutation in mammalian cells.
7. Please describe what is “adaptive immunity” and illustrate how the immune cells collaborate in the adaptive immune response.

二. 實驗題 (30%，每大題 10 分)：

1.
  - 1) In your experiment, you need to prepare a stock solution with 0.5% NaCl in 100 ml of water, please determine how much of NaCl you need to add. (molecular weight: Na: 23 g/mol, Cl: 35.5 g/mol) (3 分)
  - 2) Please prepare a solution with 1x TBST (1x TBS solution with 0.5% Tween 20) in 1 liter final volume. Stock solution: 10x TBS and 100% Tween 20. (3 分)
  - 3) Please prepare a 500 ml of 0.5M EDTA pH8.0. (EDTA:  $C_{10}H_{14}N_2Na_2O_8 \cdot 2H_2O$  and molecular weight: 372.24 g/mol) Note: using 10N NaOH solution to adjust pH. (4 分)
2. Student A performed a DNA quantitative assay by spectrophotometry. He/She used 2 micro litter of DNA stock to make a total 100 micro litter of working solution for this measurement and the data from spectrophotometry displayed as followed
$$OD_{260} = 0.35 ; \quad OD_{260}/OD_{280} \text{ (the ratio of } OD_{260} \text{ to } OD_{280}) = 1.6$$
Please calculate the concentration of DNA stock and evaluate how's the quality of this DNA preparation based on the data.
3. It's known that reporter gene Z is regulated by both X and Y proteins. And a mutation in X protein gives the repressed expression of reporter gene Z and a mutation in Y protein gives the increased expression of reporter gene Z.  
Please interpret and draw the order of the steps (who is upstream and downstream) in regulating the expression of reporter gene Z under the following situations:
  - a) The expression of reporter gene Z is **repressed** in the presence of both X and Y mutants. (5 分)
  - b) The expression of reporter gene Z is **increased** in the presence of both X and Y mutants. (5 分)