經濟部所屬台灣中油股份有限公司 100 年新進博士級人員甄試試題

類　　別：生物技術(A)
專業科目：生物化學及分子生物學

注意事項	
	1.本試題共 2 頁（A4 紙 2 張）。 2.本試題共 15 題，合計 100 分，各題配分標示於題後。須用藍、黑色鋼筆或原子筆**答案卷指定範圍內標題號（不必抄題）**依題目順序作答，於本試題或其他紙張作答者不予計分。 3.考試結束前離場者，試題須隨答案卷繳回，俟該節考試結束後，始得索取。 4.考試時間：150 分鐘。

一、請說明 eukaryotic mRNA 與 prokaryotic mRNA 在結構上的差異。(4 分)

二、請由氮代謝的角度，說明為何人類長時間食用高嘌呤（purine）的食物對身體不好。(5 分)

三、請利用一個你熟悉的選殖用載體(cloning vector)，說明它有哪些功能？(5 分)

四、有關澱粉的結構及其相關水解酵素：(共 6 分)

(1)請說明直鏈澱粉(amylose)和支鏈澱粉（amylopectin）在結構上的差異。（2 分）

(2)直鏈澱粉和碘液反應呈深藍色，支鏈澱粉則是呈紅棕色，請設計一個固體培養基（agar plate），用以篩選澱粉枝切酵素（debranching enzyme）生產菌，並說明其篩選原理。（4 分）

五、有關 NADH 與 NADPH 之生成及其生理角色：(共 5 分)

(1)請說明 NADH 與 NADPH 之主要生理角色及其差異之處。（2 分）

(2)請列出生物體內 glucose oxidation 過程中，會產生 NADH 或 NADPH 之反應步驟。（3 分）

六、Biorefinery is a current trend of biochemical production. Succinic acid is one of the most popular target chemicals of biomass-based biorefinery. Your boss has assigned you to develop a biorefinery process that could be used to produce succinic acid. You have an effective microbial strain that is able to produce succinic acid from sugar. However, to reduce the production cost, you will need to use agricultural wastes (containing lignocellulosic materials) as feedstock, while directly using purchased glucose as substrate is not allowed. Please give a detailed plan on how to establish this process. The plan should include the following aspects: (共 11 分)

(1)What is the main composition of lignocellulosic materials? (2 分)

(2)How to obtain fermentable sugar from agricultural wastes via biological/enzymatic approaches? What are the enzymes involved in saccharification of lignocellulosic feedstock? How do these enzymes function? (3 分)

(3)Following (2), if your boss does not allow you to use commercial cellulases, what would be your strategy to attain or develop those enzymes? (2 分)

(4) How will you design your bioprocess capable of converting agricultural wastes into succinic acid? What are your strategies to reduce the enzyme cost and operation cost?（4 分）

七、Most energy products (such as ethanol and biogas) are all produced via anaerobic metabolism. Please answer the following questions concerning anaerobic metabolism. (共 6 分)

(1)Describe what anaerobic metabolism is and what the major metabolic pathways of anaerobic metabolism are. (2 分)

(2)Describe the major differences on metabolism when it is under aerobic and anaerobic conditions. (2 分)

(3)Describe at least four typical end metabolites produced from anaerobic metabolism. (2 分)

八、The regulation of metabolism is usually strongly dependent on enzyme regulation. Please describe the types of enzyme regulation in terms of protein level and genetic level as well as the mechanism involved in each type of enzyme regulation . (8 分)

九、For the production of recombinant pharmaceuticals, the different systems involving *E. coli*, CHO cells and *Pichia pastoris* have been well-developed. Please compare the advantages and disadvantages among those systems. (10 分)

十、 Concerning about *E. coli* and phage ΦX174: (共 6 分)

(1) The DNA of phage ΦX174 has the base composition: 25% A, 33% T, 24% G and 18% C. What do these data suggest about the structure feature of the phage's chromosome? (2 分)

(2) The number of base pairs of *E. coli* chromosome is estimated to be 4.7 x10^6. Please calculate the length of the *E. coli* chromosome and its molecular weight. (4 分)

十一、When various strains of λ phage are seeded on a lawn of *E. coli*, they can form clear or turbid plaques. (共 8 分)

(1) Explain the difference between the two types of plaques. (2 分)

(2) Will a *c*I^- mutant (that is, a λ repressor mutant) of λ grow in a λ lysogen? Why or why not? (3 分)

(3) Mutations that allow λ to grow in a λ lysogen are called virulent (*vir*) mutations. To which type of *lac* operon mutation are virulent mutations similar? And explain your reason. (3 分)

十二、Post-translational modification has been known to play important roles in regulating protein function. Please give at least five examples of protein post-translational modification that have been reported. (5 分)

十三、Tryptophan (*Trp*) operon of *E. coli* 之基因表現會因應 Tryptophan 濃度而改變：(共 7 分)

(1)請說明其調控機制。(5 分)

(2)請以 *Trp* operon 為例說明 riboswitch 的概念。(2 分)

十四、RNA interference (RNAi) 是近年廣受重視的研究議題：(共 8 分)

(1)請說明 RNAi 如何發生？(4 分)

(2)請說明 microRNA (miRNA)之特性與作用方式。(4 分)

十五、關於 *E. coli* 之 DNA replication：(共 6 分)

(1)請說明何謂 priming？(2 分)

(2)請說明 DNA polymerase III 如何同步合成 leading strand 與 lagging strand？(4 分)