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(B)
專業科目：植物學及生物化學

注意事項	1.本試題共 2 頁（A4 紙 2 張）。 2.本試題共 13 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、請說明植物初級生長(primary growth)與次級生長(secondary growth)的差異。（8 分）

二、有關高等植物細胞：(共 10 分)
(1)有那 2 種胞器(organelles) 直接參與能量（ATP）的生合成。(2 分)
(2)此係它們各自參與細胞的那一種生化反應。(2 分)
(3)在其反應過程中，得以產生這些能量（ATP）的機制為何。(2 分)
(4)上述生化反應對維持植物生存的重要性是什麼。(4 分)

三、請依下列問題比較 C3 植物、C4 植物與 CAM(crassulacean acid metabolism)植物之異同：(共 12 分)
(1)植物類型（以氣候而言）與植物解剖構造。（4 分）
(2)在光合作用途徑與效率。（4 分）
(3)生態上之意義。（4 分）

四、有關痲瘋樹（*Jatropha curcas* L.）：(共 10 分)
(1)相較於玉米、甘蔗及油菜籽等，痲瘋樹似乎更適合作為綠色能源作物（green energy crop），請說明其原因。(4 分)
(2)痲瘋樹是多年生異花授粉植物，可行種子有性繁殖與營養器官無性繁殖，今欲改良其種子產量與含油率，在育種方面試舉出三種可行方法並加以說明。(6 分)

五、Abscisic acid (ABA, 離層酸), a stress hormone, can be induced by many environmental stresses. Please describe as many as possible the effects of ABA in plant physiology. (10 分)

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

七、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)

八、請利用一個你熟悉的選殖用載體(cloning vector)，說明它有那些功能。(5 分)

九、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)與支鏈澱粉（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）

十、有關 NADH 及 NADPH 之生成及其生理角色：(共 5 分)

(1)請說明 NADH 及 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）

十一、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)

十二、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)

十三、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）