Country _____	Competitor# __ __ __

16th International Biology Olympiad

Beijing

July, 2005

Practical Examination

Part II

Total time available: 90 minutes

The 16th IBO Practical Tests (實作題)

First name (名):

Last name (姓):

Country (國):

Code (考生編號):

Important:

1. Write your name and code on both task paper and answer paper sheets.
2. Make sure that all the results should be written on the answer paper unless otherwise instructed.
3. There are 4 parts in practical test. Each part has 90 min. You should start your **first** test according to last digit of your competitor code. For example, if you have a code of 221, your first practical test will be part I, if you have a code of 223, your first practical test will be part III.
4. Your **second** practical test is as follows: competitors from part I and part II switch labs; competitors from part III and part IV switch labs;
5. You go to your **third** practical test according to the following rules:

   If the last digit of your competitor code is 1, you go to practical test part III.

   If the last digit of your competitor code is 2, you go to practical test part IV.

   If the last digit of your competitor code is 3, you go to practical test part I.

   If the last digit of your competitor code is 4, you go to practical test part II.

You should follow the instructions from your guides when switching labs.

重要指示：

1. 在試卷及答案卷上都必須要寫姓名及考生編號。

2. 除非另有指示，所有答案必須要寫到答案紙上。

3. 實作題分為四個部分，每部分 **90** 分鐘。考生編號的最後一位數字，就是你應該開始的第一個實作部分。例如編號 **221** 的考生，第一個實作題是第一部分，編號 **223** 的考生，第一個實作題是第三部分。

4. 有關你第二個實作題的指示如下：第一部分與第二部分的考生交換實驗室；第三部分與第四部分的考生交換實驗室。

5. 有關你第三個實作題，必須遵守的指示如下：

如果考生編號的最後一位數字是 **1**，你應該做第三部分。

如果考生編號的最後一位數字是 **2**，你應該做第四部分。

如果考生編號的最後一位數字是 **3**，你應該做第一部分。

如果考生編號的最後一位數字是 **4**，你應該做第二部分。

在轉換實驗室時，必須遵守助教的指示。

Practical tests Part II:

Cell Biology

This part of examination contains 3 Tasks:

本實驗題包含三項作業

Task 1: Microscopes and cellular structure (13.5 points)

作業 1：顯微鏡使用及胞器辨識 (13.5 分)

Task 2: Identification of plants with thin sections (15 points)

作業 2：藉由組織切片辨識植物種類 (15 分)

Task 3: Karyotype analysis (8 points)

作業 3：核型分析 (8 分)

Total Points available: 36.5

本實驗題總分 36.5 分

Total Time: 90 minutes

本實驗題時間限制為 90 分鐘

Task 1: Microscopes and Cell Structures (15 points)

作業 1：顯微鏡使用及胞器辨識(15 分)

Requirement　　作答要件

In this task, you are provided with cell images obtained with different microscopy. You are required to

本實驗操作中，你將獲得藉由不同種類顯微鏡所拍攝之細胞影像，你必須完成以下項目：

(1) Distinguish these cell images and choose one appellation of the techniques for obtaining each image,

辨識這些細胞影像並指出該影像是使用何種技術所拍攝。

(2) Select one of the techniques for a certain purpose of study,

根據特定實驗要求，選取一項適用的技術。

(3) Distinguish among organelles in a given cell image and answer questions.

在一張細胞影像圖片中辨識各種胞器並回答問題。

Procedure　　實驗流程

You are supplied with two image sheets, *Image Sheet 1* and *Image Sheet 2*.

有兩張細胞影像圖片分別為*影像圖片 1*、*影像圖片 2*

On *Image Sheet 1*, seven images (denoted 1-7) of cells or organisms are printed.

在*影像圖片 1* 中有七張細胞或生物體的影像(編號 1-7)

These images are obtained with different microscopic techniques with the appellations listed below:

這些圖片分別是使用不同的顯微鏡技術所拍攝，包括

A. Light microscopy　光學顯微鏡
B. Fluorescence microscopy　螢光顯微鏡
C. Scanning electron microscopy　掃描式電子顯微鏡
D. Ultra-thin section transmission electron microscopy
超薄切片穿透式電子顯微鏡

E. Immuno-electron microscopy　免疫染色電子顯微鏡

F. Negative staining electron microscopy　負染電子顯微鏡

G. Freeze-fracture electron microscopy　冷凍切片電子顯微鏡

Answer the questions according to the following descriptions.

請根據下列描述回答問題

Descriptions:　描述如下

1. Image 1 is most likely to be obtained with _____. (0.9 point).

影像 1 最可能是使用何種方法取得

2. Image 2 is most likely to be obtained with _____. (0.9 point).

影像 2 最可能是使用何種方法取得

3. Image 3 is most likely to be obtained with _____. (0.9 point).

影像 3 最可能是使用何種方法取得

4. Image 4 is most likely to be obtained with _____. (0.9 point).

影像 4 是使用何種方法取得

5. Image 5 is most likely to be obtained with _____. (0.9 point).

影像 5 最可能是使用何種方法取得

6. Image 6 is most likely to be obtained with _____. (0.9 point).

影像 6 最可能是使用何種方法取得

7. Image 7 is most likely to be obtained with _____. (0.9 point).

影像 7 最可能是使用何種方法取得

Answer the following questions about different microscopic techniques.

請針對不同顯微鏡技術的特性回答下列問題：

8. ____ is appropriate for locating specific molecules in both cells and tissues (0.9 point).

____選出最適合用於觀察特定分子在細胞或組織中位置的技術。

9. ____ is appropriate for visualizing details of cell and tissue surface (0.9 point).
____選出最適合用於觀察細胞表面或組織表面構造的技術

10. ____ is appropriate for analyzing the interior of cell membranes (0.9 point).
____選出最適合用於分析細胞膜內部構造的技術

11. ____ is appropriate for examining the fine structure of cells (0.9 point).
____選出最適合用於觀察細微的細胞構造的技術

12. ____ is appropriate for the fine labelling (ultra-structural localization)of molecular substances in a cell (0. 9 point).
____選出最適合用於標定觀察細胞內特定分子(或巨型構造區位)的技術。

Image Sheet 2 shows the ultrastructure of a cell. Roman numbers (I-IV) indicate different organelles and/or cell components.
影像圖片 2 為一個細胞的超微結構，分別以羅馬數字(I-IV)標示不同的胞器或細胞組成分子。

A list of organelles and/or cell components is given below (A through G). Answer the following questions.

下列表格為細胞胞器及組成成分，分別以英文(A 至 G)標號。請將正確的英文標號填入答案欄中

A. Lysosome 溶小體
B. The Golgi apparatus 高基氏體
C. Mitochondrion 粒線體

D. Microtubule　微管

E. The endoplasmic reticulum　內質網

F. Plastid　質體

~~G. Ribosome~~

13. The structure indicated by Roman number I is a _____. (0. 9 point).

羅馬數字 I 所標示的構造為_____ (請填入正確的英文標號)

14. The structure indicated by Roman number II is a _____. (0. 9 point).

羅馬數字 II 所標示的構造為_____ (請填入正確的英文標號)

15. The structure indicated by Roman number III is a _____. (0.9 point).

羅馬數字 III 所標示的構造為_____ (請填入正確的英文標號)

~~16. The structure indicated by Roman number IV is a _____. (0.9 point).~~

~~17. The cell shown in *Image Sheet 2* is likely to be a cell of _____. (choose one from below) (0.6 point).~~

~~A. Plant~~

~~B. Animal~~

~~C. Fungus~~

~~D. Eubacterium~~

~~E. Archeon~~

Task 2: Determination of plant types with thin sections of plant leaves (15 points)

作業 2：藉由植物葉片的組織切片辨識植物種類

Materials, tools and instrument　實驗材料及方法

(1) Five (No.1-No.5) Petri dishes, each of which contains some leaf samples.

5 個培養皿（編號 1-5）各有植物葉片的樣本

(2) A microscope with objective lens at 10x, 20x, 40x. .

顯微鏡的物鏡分別為 10x, 20x, 40x

(3) Forceps, razor blade, test tube rack, slide, slide cover, filter paper.

鑷子、刀片、試管架、載玻片、蓋玻片、濾紙

Background　背景介紹

There are three major types of photosynthesis metabolism in the plants, called C3 metabolism, C4 metabolism and crassulacean acid metabolism. You are now required to determine which plants are C3 plants and which plants are C4 plants. The difference between them is that CO_2 fixation and sugar synthesis are performed in different cells in these two types of plants. The different structures of the leaves between C3 and C4 plants lead to different metabolism.

植物界中有 C3、C4 及 CAM 三類行光合作用的植物，它們的主要差別為由不同的細胞負責二氧化碳的固定及糖分的合成，可藉由葉片中不同的構造來判別負責上述作用的細胞。請據以判別哪些植物為 C3 或 C4 植物。

Task　實驗操作

There are five Petri dishes on the table. Each Petri dish contains pieces of leaves

from a plant. You are required to determine the leaves are from C3 plants or C4 plants.

桌上有五個培養皿，各有一種植物的葉片樣本，你需要判別其為 C3 或 C4 植物。

Procedure　實驗流程

Please follow the procedure below:　請根據下述實驗流程進行操作：

(1) Pick up one sample from each disk and make a thin section.
請於每一培養皿中取出一片葉片樣本並作成切片

(2) Use several drops of water to wash off the section from the blade onto the slide.
使用數滴水將黏附在刀片上的切片沖洗至載玻片上

(3) Remove the excess water with a piece of filter paper, but keep the water around the sample.
載玻片上的樣本需浸置於適量的水中，可使用濾紙吸除過多的水分

(4) Put the cover slid onto the sample, remove excessive water and observe the specimen with microscope.
蓋上蓋玻片，吸除過多水分，用顯微鏡觀察

Answer the following questions　請回答下列問題：

18. The leaves in Petri dish 1 are　(3 points)
培養皿 1 中的植物為何種植物
A. C3 type.
B. C4 type.

19. The leaves in Petri dish 2 are　(3 points)
培養皿 2 中的植物為何種植物
A. C3 type.
B. C4 type.

20. The leaves in Petri dish 3 are (3 points)

培養皿 3 中的植物為何種植物

A. C3 type.

B. C4 type.

21. The leaves in Petri dish 4 are (3 points)

培養皿 4 中的植物為何種植物

A. C3 type.

B. C4 type.

22. The leaves in Petri dish 5 are (3 points)

培養皿 5 中的植物為何種植物

A. C3 type.

B. C4 type.

Task 3. Karyotype analysis (10 points)

操作 3：核型分析

Requirement 作答須知:

In this task, you are asked to perform karyotype analysis. The materials are root tips from a plant. You need use a microscope to observe the cells of the root meristem tissue and find those cells in mitosis.

本次操作，你需進行核型分析。實驗材料為某一植物的根尖，使用顯微鏡觀察根尖的分生組織並找出哪些細胞正處於有絲分裂。

Materials, instruments and tools

(1) Root tips (approximately 5-10 mm in length) in a 1.5 ml centrifuge tube.

(2) A microscope with objective lens at 10x, 20x, 40x).

(3) A Carbol Fuchsin (a dye) solution. **(It is in a 1.5-ml centrifuge tube, labelled as CF)**

(4) Forceps, razor blade, test tube rack, slide, slide cover, filter paper.

(5) A 1.5-ml centrifuge tube containing approximately 1 ml 1 N HCl solution.

實驗材料及方法

(1)放置於 1.5ml 離心管中的根尖

(2)顯微鏡目鏡分別為 10x, 20x, 40x

(3)放置於 1.5ml 離心管中的 CF 染料(Carbol Fuchsin)

(4)鑷子、刀片、試管架、載玻片、蓋玻片、濾紙

(5)有 1N 鹽酸的 1.5ml 離心管

Important　重要事項　：

You will use 1 N HCl to treat the root tips. HCl solution is very harmful to your eyes and skin. Wear gloves and put protective goggles on when you handle HCl solution. If you make direct contact with HCl solution with any part of your body, please report it immediately to any instructor in the exam room.

請佩帶手套及護目鏡，使用鹽酸處理樣本，若不慎碰觸，請馬上向現場指導員報告。

Procedure　實驗流程　：

You are provided with three root tips of a plant. The following procedure should be followed so that you can make appropriate specimen to observe chromosomes from cells in mitosis.

有三個根尖樣本，你必須仔細進行下述實驗流程，方可觀察到有絲分裂細胞的染色體。

(1) Use the forceps to put one or two root tips into the small bottle containing 1 N HCl.

用鑷子將一或兩個植物根尖樣本置放於含有鹽酸的小瓶子中。

(2) Put the bottle into the water bath, which has been adjust to 60℃, for 8 min. Note, your laboratory has several water baths with temperature adjusted to 60℃. The water baths are on the instructor's desk.

在指導員的桌子上有多台已調好水溫的水浴可供使用，將瓶子置放於 60℃ 水浴中 8 分鐘，請確認水浴的溫度。

(3) Very carefully take the root tips out of HCl solution with forceps and put them into the provided beaker containing distilled water. Gently shake it for 1 min.

根尖樣本非常脆弱，需非常小心的用鑷子將浸置於鹽酸中的樣本，移至裝有蒸餾水的燒杯中，輕輕地搖動燒杯 1 分鐘。

(4) Take the root tips out of distilled water. Important: the root tips are now very fragile. It is recommended that you use the forceps to pick the roots and don't touch the tips of the roots.

將根尖自蒸餾水中取出移置載玻片上，因根尖非常易碎，所以建議你用鑷子取出時，勿碰觸到根尖，注意你只有三個根尖樣本。

(5) Put one root tip on a slide. Cut the tissue of the root tip that is rich in dividing cells. This region is within 1 mm from the top of the root tip. Discard other parts of the root.

距根尖 1mm 處的組織富含分裂中的細胞，取此部分放置於載玻片上，可去除其他部分。

(6) Put one drop of Carbol Fuchsin solution onto the root tissue you just cut off and let it stain for 7 min. Squash the tissue gently with forceps so that the tissue is disbursed.

加 一滴 CF 染料於樣本上染色 7 分鐘，可用鑷子輕壓使樣本完全染色。

(7) Cover the disbursed tissue with a slide cover. Push the slide cover gently with a pencil or forceps until the tissue is completely disbursed and separated.

蓋上蓋玻片，使用鉛筆或鑷子輕壓玻片，使組織完全分離

(8) Put the slide between two pieces of filter paper and put it on a flat surface. Gently press the upper filter paper down so that the tissue is further squashed. In the meantime, extra dye solution is also removed and absorbed by the filter paper.

在一平整的桌面上，將玻片夾入兩張濾紙中間，輕輕的在最上層的濾紙上施加壓力，使得組織進一步分離，此時過多的染料將會被濾紙吸收。

(9) Observe your slide specimen with microscope. Note, you might need all objective lens.

將玻片放置於顯微鏡下觀察，注意你可能使用到各種倍數的物鏡

Note: You are provided with three root tips to prepare your specimen. If you fail to make a good specimen for your observation, please repeat the procedure and make another preparation. However, the time for your experiment is limited.

注意：你只有三個根尖樣本，假如失敗可重做，請把握時間。

Answer the following question: **回答列問題：**

23. How many pairs of chromosomes are there in the cells (in metaphase) from this plant? (6 points) 此植物在有絲分裂中期，細胞內有**幾對**染色體？(6 分)

A. 3

B. 4

C. 5

D. 6

E. 7

F. 8

G. 9

24. If you found that different metaphase cells had different number of chromosomes, how do you determine the exact number of chromosomes? (2 points)
假如發現不同的細胞內有不同的染色體，你如何決定染色體數目？

A. Count the chromosome numbers from several cells and use the average number as the chromosome number.
使用平均數方式推算染色體數目

B. Count the chromosome numbers from several cells; the maximum chromosome number of a cell is the chromosome number of the plant.
用最大的數值表示染色體數目

C. Count the chromosome numbers of several cells in metaphase; the chromosome of the plant is the number with highest frequency.
計算處於中期的細胞染色體數目，用出現頻率最高的數目代表染色體的數目

~~25. The purpose of the treatment of root with 1 HCl at 60℃ for 8 min is: (2 points)~~

~~A. Stimulate cells so that you can observe more cells in metaphase.~~

~~B. Dissolve cellulose of cell walls so that the cells are easily separated.~~

~~C. Remove ions of the cell wall so that the cells are separated.~~

~~D. Dissolve the hemicellulose of cell walls so that the cells are easily separated.~~

~~E. Puncture some tiny holes on plasma membrane so that Carbol Fuschin could penetrate into the cell.~~