Country _____

Competitor# __ __ __

16th International Biology Olympiad

Beijing

July 2005

Practical Examination

Part IV

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. 實作題題四個部分，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 Test, Part IV

實驗題，第四部分

Plant Biology

植物學

Task 1. Plant anatomy and physiology (20 points)

實驗 1.植物解剖與生理（20 分）

Materials and tools　材料與器材

You are provided with a set of tools and experimental materials. You will need to use other tools and instruments, including stereoscope, microscope, Petri dishes, forceps, slides, slide covers, and filter paper.

You are provided with a Petri dish containing an aquatic plant.

本實驗提供一套器材與實驗材料，你尚須利用其他器材與儀器：包括解剖顯微鏡、顯微鏡，培養皿、鑷子、載玻片 、蓋玻片及濾紙。

本實驗會提供一盤含水生植物的培養皿。

Finish the following tasks.　完成下列實驗

(1) Observe the plant with stereoscopy first and answer questions 1 through 3.

(2) Take one plant and put it on a slide, cut some roots off and put them on another slide and cover the slide with a cover slid. Press the cover slightly and observe the slide under microscope. Answer questions 4 and 5.

(3) Take one plant and put it on a slide, cut a leaf and put it on another slide. Cover it with a slide cover and press it gently. Observe the specimen you made and answer questions 6 through 8.

(1) 先利用解剖顯微鏡觀察此植物，並回答第 1~3 題。

(2) 取此植物置於載玻片上，切下些許根部，將其置於另一載玻片上並蓋上蓋玻片。輕壓此蓋玻片，再將此標本置於顯微鏡下，回答第 4~5 題。

(3) 取此植物置於載玻片上，切下一葉片，將其置於另一載玻片上並蓋上蓋玻片。輕壓此蓋玻片，再將此標本置於顯微鏡下，回答第 6~8 題。

Questions 1-3 are about external description of the plant.

第 1~3 題是關於此植物的外觀描述。

1. The stem of the plant is: (2 points)

   A. Vertical

   B. Horizontal

   C. Rosulate（shorten stem）

   D. Absent

   此植物的莖是：（2 分）

   A. 直立的

   B. 水平的

   C. 叢生(短莖)的

   D. 無莖的

2. Which of the following description about its root is correct? (2 points)

   A. It contains chlorophyll

   B. It is a adventitious root

   C. It is a rhizoid

   D. It is a spindle-shaped root.

   關於此植物的根之描述，下列何者正確？（2 分）

   A. 它含有葉綠素

   B. 它是不定根

C. 它是假根

D. 它是紡錘形的根

3. Which of the following description on its leaves is/are correct? (2 points)

(1) The leaves don’t have petiolules.

(2) Their leaves are bipinnate.

(3) Some leaves don’t have chlorophylls

(4) There are needle-shaped leaves.

A. 1, 2, 3, 4

B. 1, 2

C. 1, 3

D. 2, 4

E. 1, 2, 3

關於此植物的葉之描述，下列何者正確？（2 分）

(1) 這些葉片無小葉柄

(2) 這些葉片為羽狀複葉

(3) 有些葉片無葉綠素

(4) 這些葉片為針葉

A. 1，2，3，4

E. 1，2

F. 1，3

G. 2，4

H. 1，2，3

Questions 4-5

第 4~5 題

4. Which of the following is correct? (2 points)

A. This plant is a vascular plant

B. This plant contains vessels

C. This plant is bryophyte based on its root structure.

D. None of the above is correct.

下列何者正確？（2 分）

(1) 此植物為維管束植物

(2) 此植物含有導管

(3) 依據根的構造，此植物為蘚苔植物

(4) 以上皆非

5. A researcher grew the plant for many generations and found that no seeds were produced. Which of the following could be true based on your observation? (2 points)

(1) The researcher could have missed the seeds produced.

(2) This plant is a seedless plant.

(3) This plant does not have sexual reproduction.

A. 1, 2, 3

B. 1, 3

C. 1, 2

D. 2,

E. 3

某研究員栽植此植物數代，發現無種子生成。根據你的觀察，下列何者正確？（2 分）

(1) 此研究員可能錯過種子的產生。

(2) 此植物為無種子植物

(3) 此類型植物並無有性生殖

A. 1，2，3

B. 1，3

C. 1，2

D. 2

E. 3

Questions 6-8.

第 6~8 題

6. Besides the plant tissues and cells, you should be able to observe some other immobile cells. Which of the following descriptions is/are correct about these cells? (2 points)

(1) They are unicellular.

(2) They are mostly short non-branched filaments.

(3) Some of them are branched.

(4) Their nuclei are easily observed.

A. 1

B. 1, 2, 3, 4

C. 2, 3

D. 2, 3, 4

E. 2

除了此植物的組織與細胞，你還可能觀察到其他固定不動的細胞。下列有關於這些細胞的描述哪一（哪些）正確？（2 分）

(1) 它們是單細胞

(2) 它們大部分是短而無分枝的絲狀物

(3) 它們有些具有分枝

(4) 它們的細胞核易於觀察

A. 1

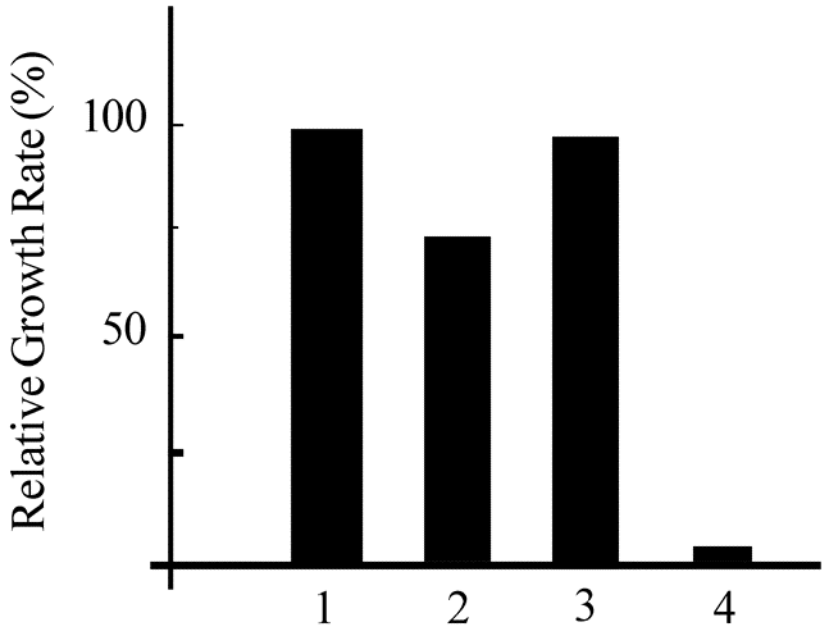
B. 1，2，3，4

C. 2，3

D. 2，3，4

E. 2

7. A researcher grew the plants under different conditions and obtained results shown in the figure below.



Condition 1, grown with medium A containing combined nitrogen (nitrate). The growth rate under this condition was used as 100% growth.

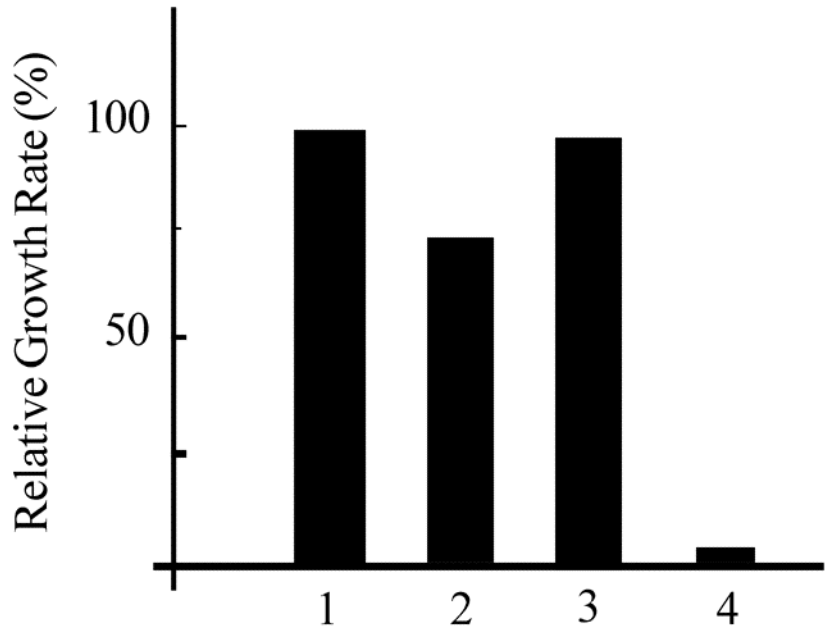
Condition 2, grown with medium A without combined nitrogen.

Condition 3, grown with medium A containing combined nitrogen. Ampicillin was added to a concentration of 5 M.

Condition 4, grown with medium A without combined nitrogen. Ampicillin was added to a concentration of 5 M.

Note, medium A is the standard medium for this plant.

7. 有一研究員於不同的環境中栽植此植物，獲致下圖之結果，圖中的 relative growth rate 是指相對生長速率。



條件 1，生長於含氮化合物（硝酸鹽）的培養基 A 中，此條件下的生長速率為 100%生長率。

條件 2，生長於不含氮化合物（硝酸鹽）的培養基 A 中。

條件 3，生長於含氮化合物（硝酸鹽）的培養基 A 中，並添加 5 μM 濃度的盤尼西林。

條件 4，生長於不含氮化合物（硝酸鹽）的培養基 A 中，並添加 5 μM 濃度的盤尼西林。

注意：培養基 A 是此植物的標準培養基。

Which of the following statements is/are correct based on the results? (4 points)

(1) Ampicillin is inhibitory to plant growth only under nitrogen limiting condition.

(2) The plant can grow without combined nitrogen.

(3) The root system of this plant could fix nitrogen.

(4) There are at least some microorganisms associated with the plant and they can fix nitrogen.

(5) Nitrogenase activity is directly inhibited by Ampicillin.

A. 1, 3, 5

B. 1, 5

C. 2,

D. 1,2,4

E. 4,5

下列敘述哪一（哪些）正確？（4 分）

(1)盤尼西林抑制此植物的生長僅發生在氮素受限的條件下。

(2)此植物能生長在不含氮化合物的條件下。

(3)此植物的根系能固氮。

(4)至少有一些能與此植物共生的微生物並固氮。

(5)固氮酵素的活性直接被盤尼西林所抑制。

A.1，3，5

B.1，5

C.2

D.1,2,4

E.4，5

8. If you would like to obtain a culture of the plant that does not contain any associated organisms, what is the condition to achieve it? (4 points)

A. Grow it with combined nitrogen plus some ampicillin.

B. Grow it with combined nitrogen.

C. Grow it without combined nitrogen.

D. Grow it without combined nitrogen plus ampicillin.

若你想獲得一個無共生菌的植物培養基，有何條件可達成之？（4 分）

A. 生長在含氮化合物並添加盤尼西林的培養基上。

B. 生長在含氮化合物的培養基上。

C. 生長在不含氮化合物的培養基上。

D. 生長在不含氮化合物並添加盤尼西林的培養基上。

Task 2 Plant pigment characterization (20 points)

作業 2: 植物色素特性（20 分）

Materials and tools　材料與工具

You are provided with 6 tubes of pigments, labeled pigment I through pigment VI. You are also provided with a colorless solution in another tube labeled as control. You will need to use the following instruments:

Adjustable Spectrophotometer; Cuvette cells; Adjustable pippetes; Filter paper;

本實驗提供 6 管裝有色素之試管，分別標示為色素（pigment）1 至色素 6，並提供 1 管的無色溶液作為控制組（control）。你必需使用下列儀器：

可調式光電比色計；比色管；可調式微量吸管；濾紙

Perform the following tasks:

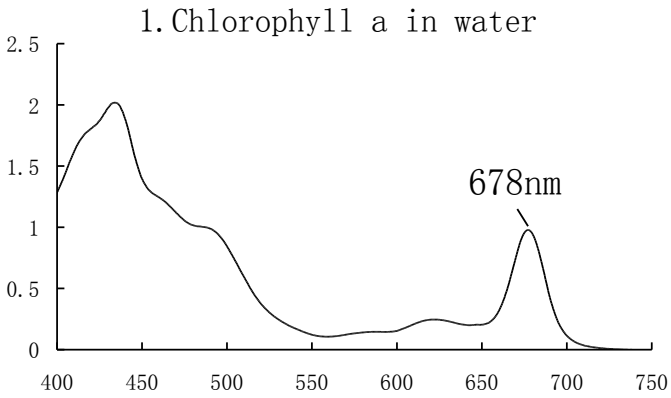
完成下列實驗：

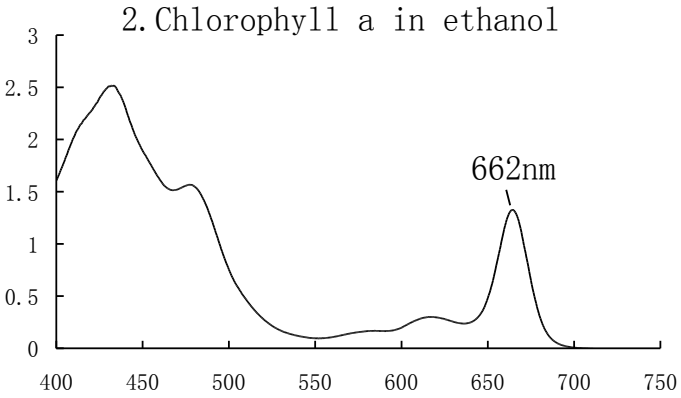
a. Exam the absorption spectra shown in the figure below. The five absorption spectra are obtained from different organisms and the pigment names are given in the figure. The major absorptions of these spectra are given. Among the five pigments in the figure, phycocyanin and phycoerythrin are water-soluble; chlorophyll and carotene are soluble in organic solvents; chlorophyll-protein complexes are soluble in aqueous solution when treated with detergent.
b. Use the adjustable pippete to transfer 1 ml of each pigment solution to cuvette cells. Measure the absorptions at the wavelengths in the table below. Record the results of your measurements in the table.

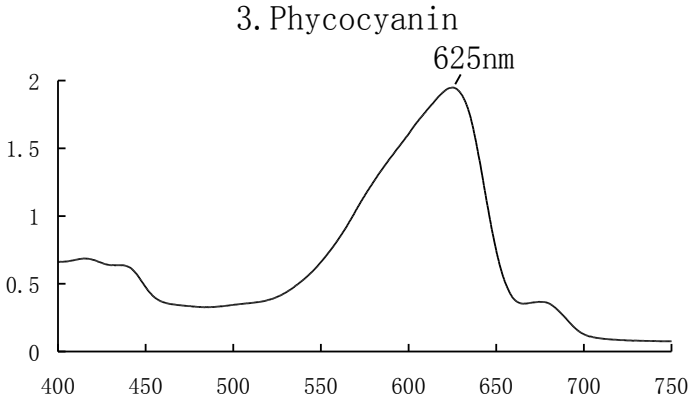
a. 檢驗下列所示吸收光譜圖，此 5 個吸收光譜圖是由不同的有機物上所測得，這些色素的名稱列在圖上。在圖上的這 5 種色素 phycocyanin（藻藍素）與 phycoerythrin（藻紅素）是水溶性的，chlorophyll（葉綠素）與 carotene（胡蘿蔔素）可溶於有機溶劑，chlorophyll-protein complex（葉綠素－蛋

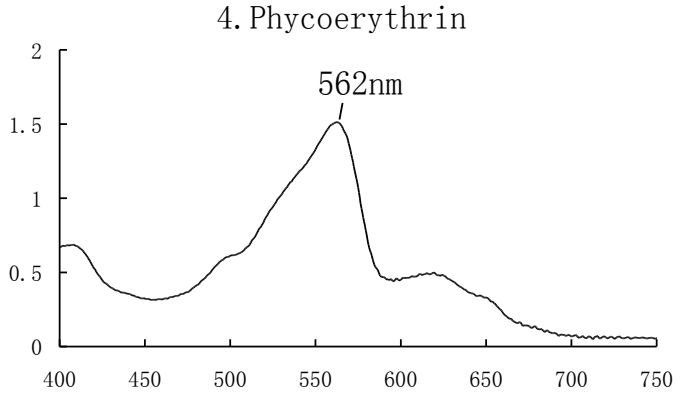
白質複合物）若以清潔劑處理可溶於水。

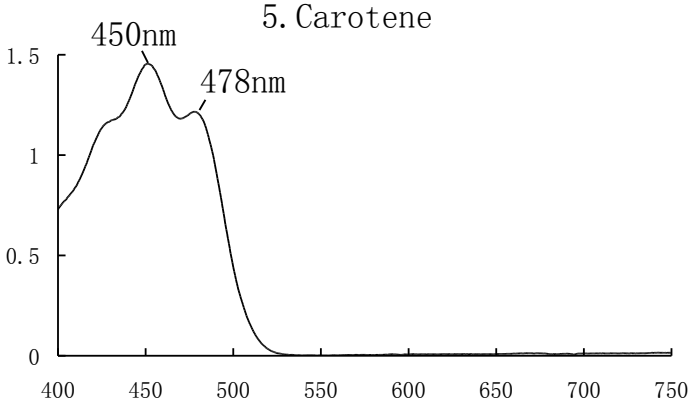
b. 利用可調式微量吸管各吸取 1 ml 不同的色素溶液至各比色管中，測量各比色管在不同波長的吸光度，並記錄之。











Solution	450nm	562nm	595nm	625nm	662nm	678nm
I						
II						
III						
IV						
V						
VI						

Answer the following questions:

回答下列問題：

Question 9. Which of the pigments would be most efficient in absorbing red light? (2 points)

下列哪一種色素吸收紅光的效率最高？（2 分）

A. Phycocyanin
B. Phycoerythrin
C. Carotene
D. Chlorophyll

Question 10. Phycocyanin solution is: (2 points)

Phycocyanin 溶液是：（2 分）

A. Solution I（溶液 1）

B. Solution II（溶液 2）

C. Solution III（溶液 3）

D. Solution IV（溶液 4）

E. Solution V（溶液 5）

F. Solution VI（溶液 6）

G. 以上均非

Question 11. Phycoerythrin solution is: (2 points)

Phycoerythrin 溶液是：（2 分）

A. Solution I（溶液 1）

B. Solution II（溶液 2）

C. Solution III（溶液 3）

D. Solution IV（溶液 4）

E. Solution V（溶液 5）

F. Solution VI（溶液 6）

G. 以上均非

Question 12. Chlorophyll solution (in ethanol) is: (2 points)

Chlorophyll（葉綠素）溶液（溶於酒精）是：（2 分）

A. Solution I（溶液 1）

B. Solution II（溶液 2）

C. Solution III（溶液 3）

D. Solution IV（溶液 4）

E. Solution V（溶液 5）

F. Solution VI（溶液 6）

G. 以上均非

Question 13. Carotene solution is: (2 points)

Carotene 溶液是：（2 分）

A. Solution I（溶液 1）

B. Solution II（溶液 2）

C. Solution III（溶液 3）

D. Solution IV（溶液 4）

E. Solution V（溶液 5）

F. Solution VI（溶液 6）

G. 以上均非

Question 14. Protein-Chlorophyll complex in detergent-treated solution is: (2 points)

以清潔劑處理葉綠素－蛋白質複合物的溶液是：（2 分）

A. Solution I（溶液 1）

B. Solution II（溶液 2）

C. Solution III（溶液 3）

D. Solution IV（溶液 4）

E. Solution V（溶液 5）

F. Solution VI（溶液 6）

G. 以上均非

Question 15. Which of the following is/are present in all algae and higher plants? (2 points)

下列何者存在於所有藻類與高等植物中？（2 分）

(1) Chlorophyll

(2) Carotene

(3) Phycoerythrin

(4) Phycocyanin

A. 1，2，3，4

B. 1，3，4

C. 1

D. 1，4

E. 1，2

Question 16. A cyanobacterium contains chlorophyll, carotenoids and phycocyanin as major pigments. When a culture of the cyanobacterium is extracted with 80% acetone and centrifuged, what color do you expect to see in the pellet? (3 points)

藍綠菌所含 Chlorophyll、Carotenoids（類胡蘿蔔素，Carotene 的類似物）及 Phycocyanin 是其主要色素，若藍綠菌以 80% 丙酮萃取並離心，沉澱物是何顏色？（3 分）

A. Orange 橘色

B. Blue 藍色

C. Green 綠色

D. Purple 紫色

E. Colorless 無色

Question 17. In analysis of proteins with isoelectric focusing (IEF) gel electrophoresis, one often uses colored proteins with known pI values as pI standard. Among these proteins are phycocyanin and phycoerythrin. No chlorophyll proteins are used as IEF gel standard. Which of the following is the reason why no chlorophyll-proteins are used as IEF gel pI standard? (3 points)

利用等電點聚焦（IEF）膠體電泳法分析蛋白質中，常用已知的有色蛋白質之等電點值（pI）做為標準 pI 值。這些做為標準 pI 值的蛋白質通常為 Phycocyanin 與 Phycoerythrin，但沒有人會用葉綠素－蛋白質複合物當做 IEF 的標準 pI 值之用。下列有關於沒有人會用 Chlorophyll protein 當做 IEF 的標準 pI 值之用的理由是什麼？

A. Green color is not visible in IEF gel. 綠色無法在 IEF 膠體上呈現
B. Chlorophyll molecules are too small to be focused.
葉綠素分子太小無法等電聚焦
C. It is often difficult to obtain enough materials of chlorophyll-proteins from plants. 一般無法由植物獲取足量的葉綠素－蛋白質複合物
D. Chlorophyll molecules are not covalently attached to proteins.
葉綠素分子並非以共價鍵方式與蛋白質結合