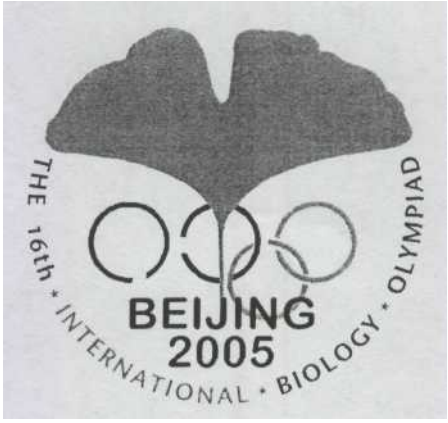
Country	Competitor# _____



16th International Biology Olympiad

Beijing

July, 2005

Practical Examination

Part II

Total time available: 90 minutes

The 16th IBO Practical Tests

First name: Last name Country: Code:

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 exchange labs; competitors from part III and part IV exchange 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.

Practical tests Part II:

Cell Biology

This part of examination contains 3 Tasks:

Task 1: Microscopes and organelles (15 points)

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

Task 3: Karyotype analysis (10 points)

Total Points available: 40

Total Time: 90 minutes

Task 1: Microscopes and Cell Structures (15 points)

Requirement

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

You are required to

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

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

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

Procedure

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

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

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

A. Light microscopy

B. Fluorescence microscopy

C. Scanning electron microscopy

D. Ultra-thin section transmission electron microscopy

E. Immuno-electron microscopy

F. Negative staining electron microscopy

G. Freeze-fracture electron microscopy

Answer the questions according to the following descriptions.

Descriptions:

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

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

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

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

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

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

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

Answer the following questions about different microscopic techniques.

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

9. ____is appropriate for visualizing details of cell and tissue surface (0.9 point).

10. ____is appropriate for analyzing the interior of cell membranes (0.9 point).

11. ____is appropriate for examining the fine structure of cells (0.9 point).

12. ___ is appropriate for the fine labelling of molecular substances in a cell (0. 9 point).

Image Sheet 2 shows the ultrastructure of a cell. Roman numbers (I-IV) indicate different organelles and/or cell components.

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

A. Lysosome

B. The Golgi apparatus

C. Mitochondrion

D. Microtubule.

E. The endoplasmic reticulum

F. Plastid

G. Riposome

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

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

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

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)

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A. Plant

B. Animal

C. Fungus

D. Eubacterium

E. Archeon

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

Materials, tools and instrument

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

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

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

Background

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 CO2 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. **Task**

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.

Procedure Please follow the procedure below:

(1) Pick up one sample from each disk and make a thin section.

(2) Use several drops of water to wash off the section from the blade onto the slide.

(3) Remove the excess water with a piece of filter paper, but keep the water around

the sample. (4) Put the cover slid onto the sample, remove excessive water and observe the

specimen with microscope.

Answer the following questions.

18. The leaves in Petri dish 1 are (3 points)

A. C3 type.

B. C4 type.

19. The leaves in Petri dish 2 are (3 points)

A. C3 type.

B. C4 type.

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

A. C3 type.

B. C4 type.

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

A. C3 type.

B. C4 type.

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

A. C3 type.

B. C4 type.

Task 3. Karyotype analysis (10 points)

Requirement:

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.

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.

Important:

You will use 1 N HCl to treat the root tips. HCl solution is very harmful to your eyes and skin. Wear gloves 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.

Procedure:

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.

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

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

(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.

(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.

(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.

(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.

(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.

(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.

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

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.

Answer the following question:

23. How many pairs of chromosomes are there in the cells (in metaphase) from this plant? (6 points)

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)

A. Count the chromosome numbers from several cells and use the average number as the chromosome number.

B. Count the chromosome numbers from several cells; the maximum

chromosome number of a cell is the chromosome number of the plant. C.

Count the chromosome numbers of several cells in metaphase; the

chromosome of the plant is the number with highest frequency.

25. The purpose of the treatment of root with 1 HC1 at 60°C 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 me 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.