17 th INTERNATIONAL BIOLOGY OLYMPIAD
9-16 JULY 2006
Río Cuarto – República Argentina

PRACTICAL TEST

1

Plant Anatomy, Systematics and Physiology

Student code:	

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General remarks about the practical tests

DEAR PRATICIPANS

The practical test are organized in four different laboratories.

Nº 1- Plant Anatomy, Systematics and Physiology

Nº 2- Animal Anatomy, Ecology and Systematics

Nº 3- Biocheminstry

Nº 4- Microbiology

- You have **1 hour** in laboratories Nº 1 and Nº 2.
- You have **1 hour 30 minutes** in laboratories Nº 3 and Nº 4.
- You can score maximum **40 points** in each laboratories, which means a total of 160 points for the practical test.

Good luck !!!!!!!

Practical test Nº 1: Plant Anatomy, Systematics and Physiology

In this laboratory task you will have to work on the morphological, taxonomic and physiological aspects of higher plants in an integrated way.

Aims

A) To identify and compare vegetative organs.
B) To identify different taxa.
C) To relate leaf anatomy to photosynthetic pathways.

Materials:

- 5 samples (labeled 1-5). 1 Stem (Liliopsida), 2 Root (Magnoliopsida), 3 Root (Liliopsida), 4 Stem (Magnoliopsida), 5 Leaf (Pinophyta)
- 5 slides.
- 5 coverslides.
- 1 razor blade.
- 1 felt-tip marker for glass.
- 1 tweezers.
- 2 histological needles.
- 1 dropper with distilled water and glycerin.
- 1 Petri dish with Safranin solution (it stains lignin).
- 1 Petri dish with distilled water.
- 1 microscope.
- Figure 2: microphotografs with details of leaf sectors.

Procedure

- Cut cross sections of sample 1.
- Place the sections into the Safranin solution.
- Transfer the sections to the Petri dish with distilled water to remove the excess of stain.
- Place the sections on a slide with water and glycerin and cover with a coverslide.

Repeat the procedure to obtain histological slides of the remaining samples.
Observe the obtained histological slides with the microscope. Remember to start observing with the lowest magnification power and then, end up with the 40x objective lens.

After examining each histological slide answer the following questions:

Q1 : Fill in the organ code number in the appropriate box.

Codes:

01- stem.
02- root.
03- leaf.

04- rhizome.

Sample	1	2	3	4	5
Code	**01**	**02**	**02**	**01**	**03**

Q2 : Identify the taxon to which each sample belongs, to write its number in the appropriate box.

Taxon	Sample number:
Ginkgophyta	
Pinophyta	**5**
Cycadophyta	
Magnoliophyta - Magnoliopsida	**2-4**
Magnoliophyta-Liliopsida	**1-3**

Q3 : The endodermis is a layer of cells that performs an important physiological role. Indicate with an "X" the sample/s where this cellular layer is observed.

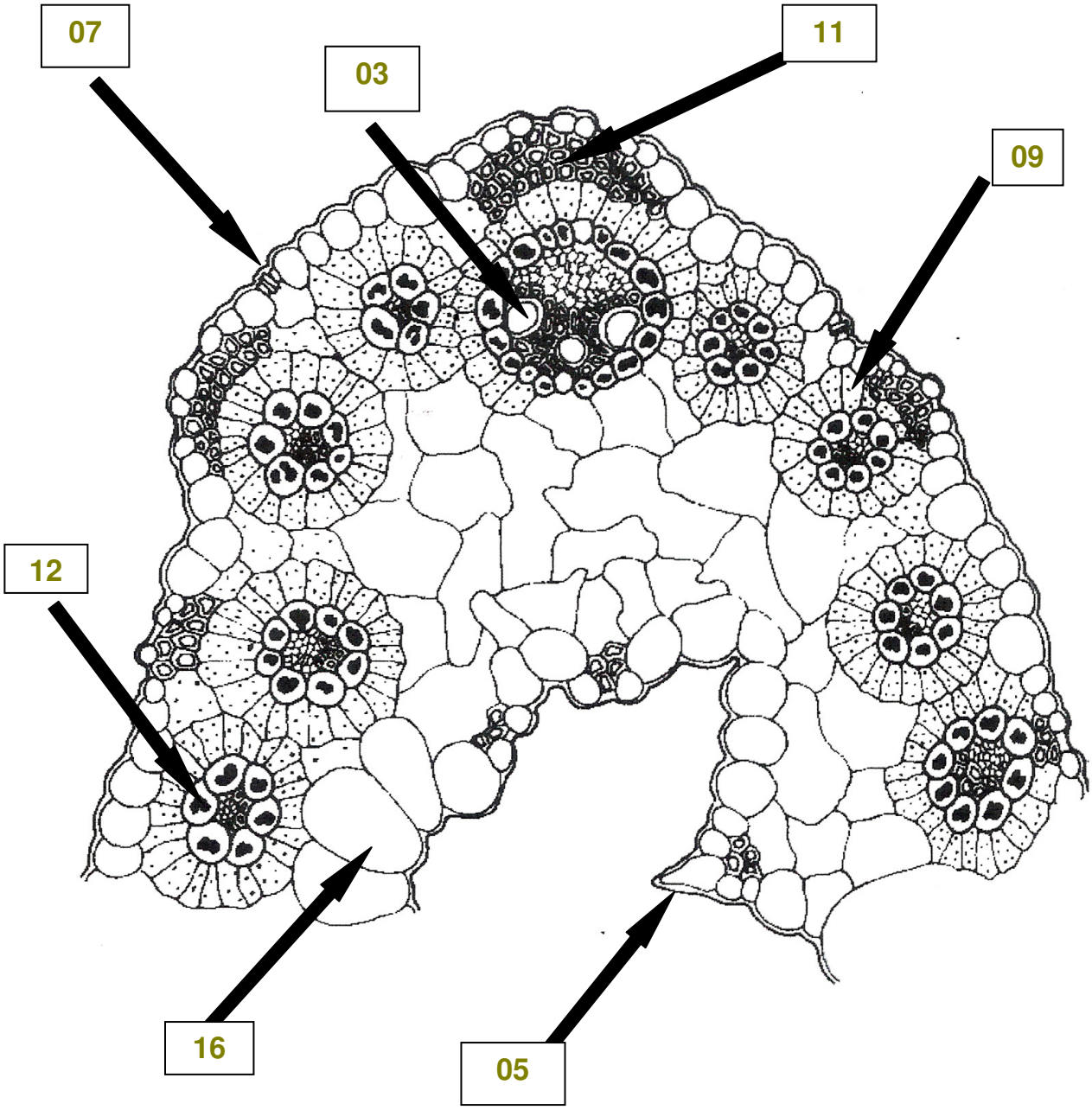
Sample	1	2	3	4	5
			X		**X**

Q 4: Plants may differentiate collenchyma and sclerenchyma as supporting tissues. Both tissues show particular cytological characteristics that allow us to identify them. Circle the option that contain/s the sample number/s where collenchymatic tissue is observed.

a) 1, 2, 3.
b) 4, 5.
c) 4.
d) 2.
e) 1, 4.

Q 5: Examine carefully the leaf anatomical structure represented in the **figure № 1.**

Figure Nº 1: leaf anatomical structure



Could this leaf structure correspond to some of the organs previously cut and be part of the same plant? Circle the correct option (in your answer sheet).

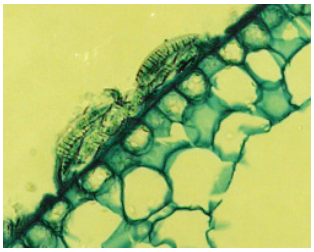
YES NO

If the answer was affirmative, indicate with an “X” the corresponding sample/s.

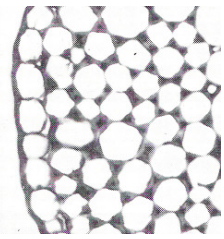
Sample	1	2	3	4	5
	X		X		

Q 6: Microphotographs with details of leaf sectors are shown **(Figure nº 2)**. Select the codes of those microphotographs corresponding to the sectors pointed out in the leaf diagram represented in **Figure nº 1** (Write the answer in your answer sheet).

Figure № 2: microphotografs with details of leaf sectors



01



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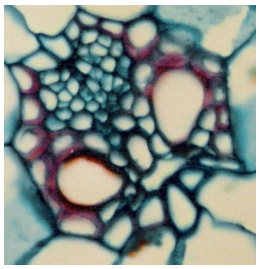

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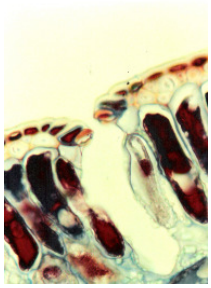

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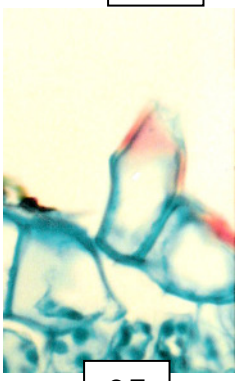

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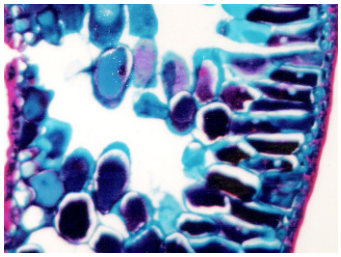

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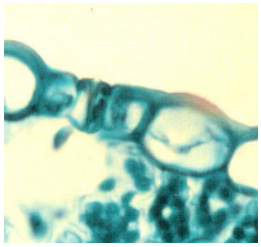

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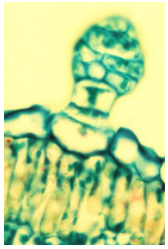

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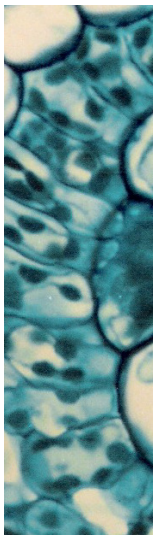

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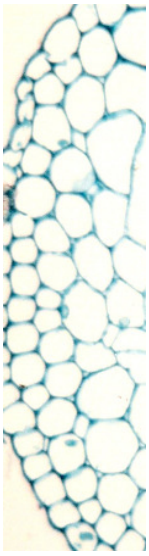

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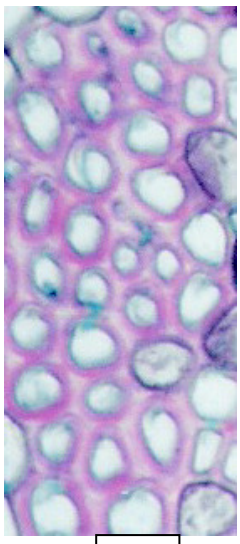

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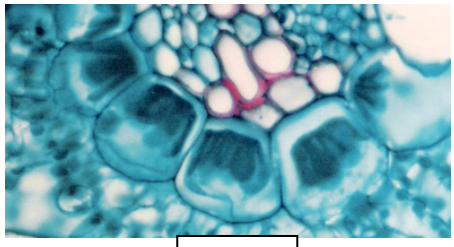

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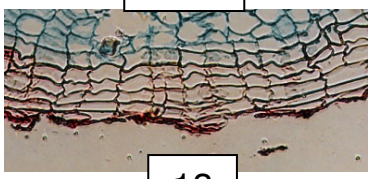

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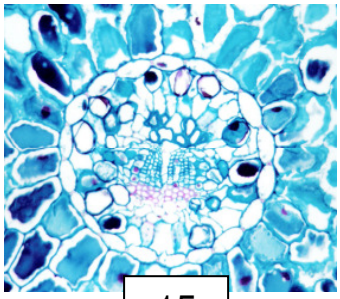

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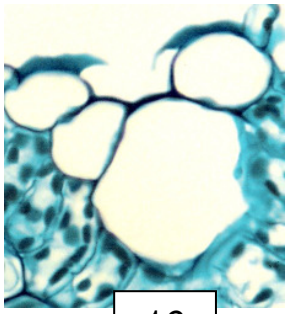

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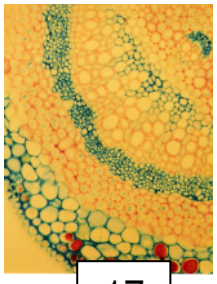
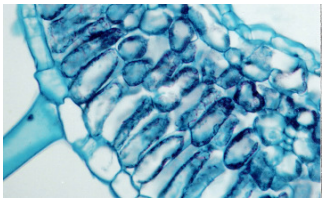


17



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Q7: Keeping in mind all the anatomical characters observed when completing **figure 1** you could infer that this leaf corresponds to a species that belongs to the Family:

a) Liliaceae.
b) Fagaceae.
c) Brassicaceae.
d) Poaceae.
e) Araceae.

Q8: Leaf anatomy is related to the environment where the plant grows and it indicates its photosynthetic pathway. Keeping this in mind, observe again the leaf structure represented in **figure 1** and select the codes that correspond to this structure.

01- It follows the Calvin Cycle photosynthetic pathway or C3 pathway.
02- It has a method of fixation of the additional carbon (not alternative) that works separated from the Calvin Cycle.
03- It shows a stratified mesophyll.
04- It shows a radiated mesophyll.
05- It shows chloroplast dimorphisms.
06- Optimum temperature for photosynthesis is between 15-25º.
07- Optimum temperature for photosynthesis is between 30º-45º.
08- It shows two well-developed sheaths around the vascular bundles.
09- It shows one sheath around the vascular bundles.
10- It does not show sheaths around the vascular bundles.
11- The decarboxylation phase takes place in different parts of the leaf.

Answer: ..... **02, 04, 05, 07, 09, 11**.....

Q9: Complete the following comparative table of the three main photosynthetic pathways of carbon assimilation, keeping in mind the codes for each character.

Enzyme responsible for the initial carboxylation:

01- Ribulose 1,5 - bisphosphate carboxylase-oxygenase (RuBP).
02- Phosfoenolpyruvate carboxylase (PEPC).
03- Sucrose-phosphate synthase (SFS).
04- RuBP and PEPC.
05- SFS and PEPC.

Leaf anatomy:

01- stratified.
02- Kranz structure.
03- succulent.

The CO_2 fixation time:

01- Day.
02- Night.

03- Day and night.

First stable product of $C0_2$ fixation:

01- Made up of six carbons.
02- Made up of four carbons.
03- Made up of three carbons.

Efficiency in water use:

01- Medium.
02- High.
03- Low.

Photosynthetic rate:

01- Medium.
02- High.
03- Low.

Character	C3	C4	CAM
Enzyme responsible for the initial carboxylation:	**01**	**02**	**01**
Leaf anatomy:	**01**	**02**	**03**
The CO_2 fixation time:	**01**	**01**	**02**
First stable product of CO_2 fixation:	**03**	**02**	**02**
Efficiency in water use:	**03**	**01**	**02**
Photosynthetic rate:	**01**	**02**	**03**

Q10: If a plant is placed into a closed chamber and exposed to the light, it is observed that the CO_2 concentration in the air inside the chamber decreases for a while due to photosynthesis. The decrease is gradual but it never reaches the zero value. A balance is reached between the CO_2 captured by photosynthesis and the one released by respiration and photorespiration. This balance is known as CO_2 compensatory point.

In the following graph the effect of the atmospheric concentration of CO_2 on the photosynthesis rate in plants C3 and C4 is observed. The arrows indicate the compensatory points of each plant.
Indicate the curve that corresponds to each plant by writing C3 or C4 in the right box.

Reference:

↑: compensatory points of each plant