



# INTERNATIONAL JUNIOR SCIENCE OLYMPIAD

## Jakarta - Indonesia

### December 5 - 14, 2004

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## THEORETICAL EXAMINATION

December 9, 2004

### EXAMINATION RULES

1. All competitors must be present at the front of examination room ten minutes before the examination starts
2. No competitors are allowed to bring any tools except his /her personal medicine or any personal medical equipment.
3. Each competitor has to sit according to his or her designated desk.
4. Before the examination starts, the competitor has to check the stationary and tools (pen, eraser, ruler, sharpener, pencil, calculator, and note book) provided by the organizer.
5. Each competitor has to check the question and answer sheets. Rise your hand, if you find any missing sheets. Start after the bell.
6. The competitor must write down their name and country (in Latin) on each answer sheets. The answer must be written on one side of the answer sheet.
7. During examination, competitors are not allowed to leave the examination room except for emergency case and for that they will be accompanied by the examination supervisor.
8. The competitors are not allowed to bother other competitor and disturb the examination. If assistance is needed, competitor may raise his/her hand and the supervisor will come to help.
9. There will be no question or discussion about the examination problems. The competitor must stay at their desk until the examination time is over, although he/she has finished the examination or does not want to continue working.
10. The end of the examination time will be a signal (bell rings). You are not allowed to write anything on the answer sheet after the allotted time has finished. All competitors must leave the room quietly. **The question and answer sheets must be left on your desk.**



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## **THEORETICAL EXAMINATION**

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**Read carefully the following instructions:**

1. The time available is 2.5 hours.
2. Check that you have a complete set of the test questions and the answer sheet.
3. Use only the pen provided.
4. Write down your name, country and signature in the answer sheet.
5. The question must be answered on one side of the answer sheet.
6. Use 3 significant figures in your results.
7. **All competitors are not allowed to bring any stationary and tools provided outside. After completing your answer, all of the question and answer sheets you must put them on desk.**



<b>Name</b>		<b>Signature:</b>  <b>JUROR</b>
<b>Country</b>		

## **THEORETICAL EXAMINATION**

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### **ANSWER SHEET (1/16)**

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#### **PROBLEM I ( 10 Points)**

##### **IA. Human Digestive Systems ( 6 Points)**

1. 

a	g	2	1
---	---	---	---

 2.0 Points

2. 

g	8 or 6	6 or 8	f or d	d or f
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 2.0 Points

3. 

c	9	7	3	g
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 2.0 Points

##### **IB. Plant's structure**

1.Monocots 

a	b	d	e	f
---	---	---	---	---

 2.0 Points

2.Dicots 

c	g	h	i	j
---	---	---	---	---

 2.0 Points



<b>Name</b>		<b>Signature:</b>
<b>Country</b>		

## **THEORETICAL EXAMINATION**

December 9, 2004

**ANSWER SHEET (2/16)**

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### December 5-14, 2004

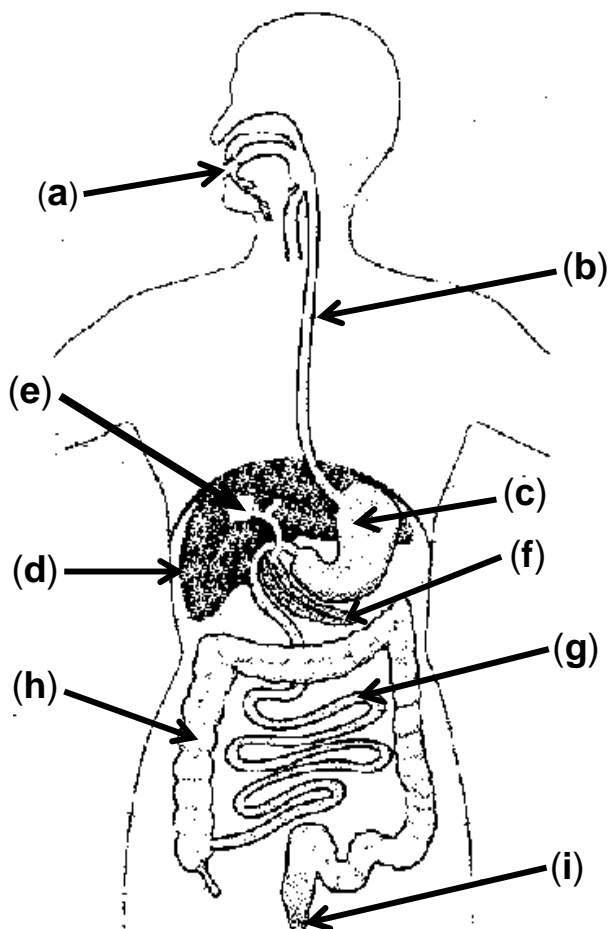
## THEORETICAL EXAMINATION

December 9, 2004

### Problem I. (10 points)

#### I.A Human digestive system. (6 points)

The diagram and the table below show the organs and enzymes or compounds in the human digestive system.



Number	Enzyme or Compounds
1	Amylase
2	Ptyalin
3	Trypsin
4	Maltase
5	aminopeptidase
6	Bile salts
7	HCl
8	Lipase
9	Pepsin

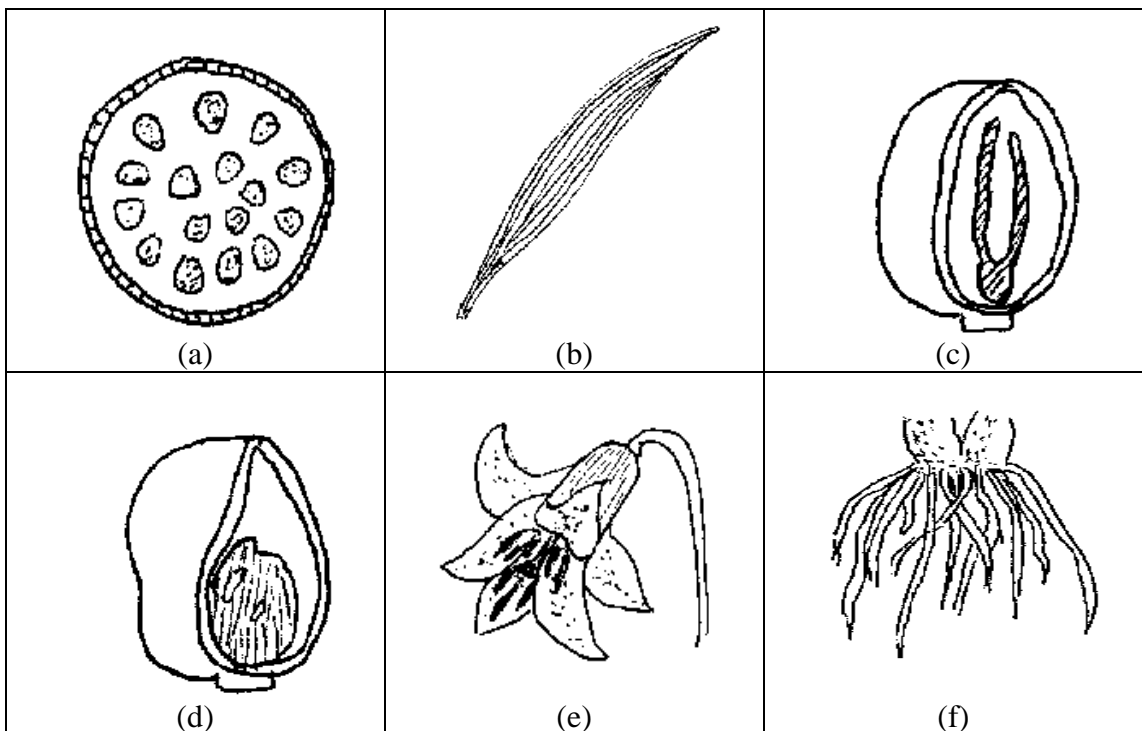
Fill the box with the correct **letter/s** (organs) and **number/s** (enzyme/s or compound/s):

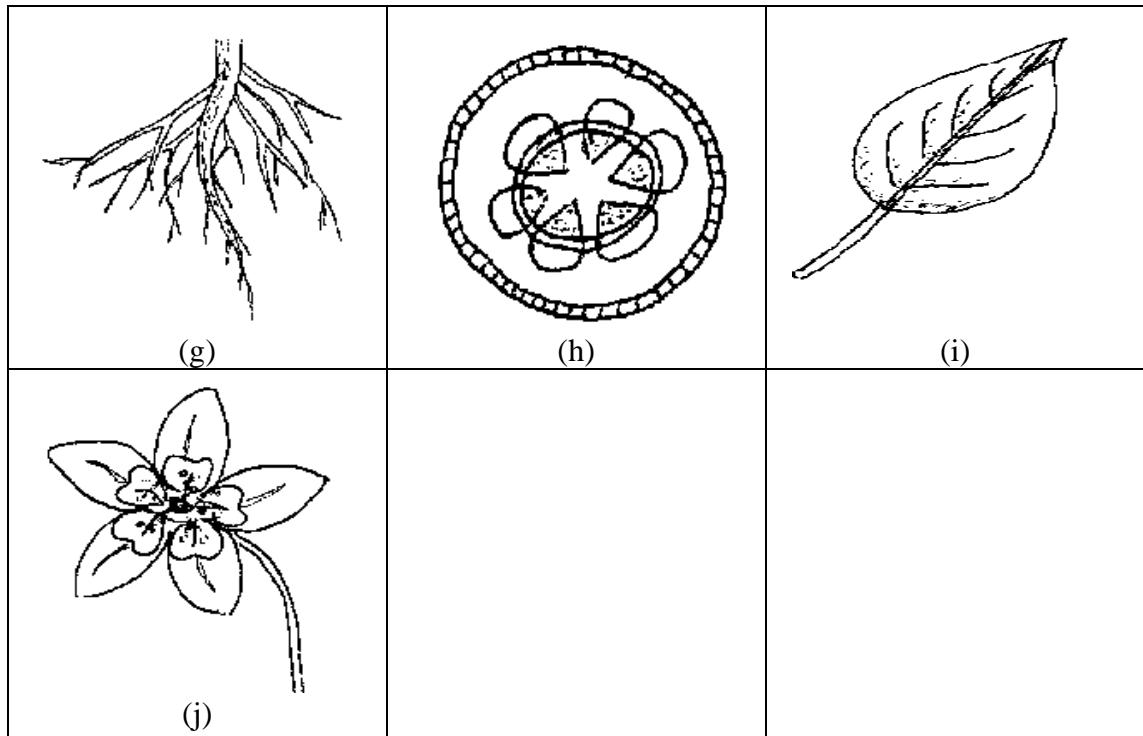
A person eats a meal containing carbohydrates, fats, and proteins.

1. Carbohydrates are broken down into disaccharides in the organs .....and ....., by enzymes or compound ..... and ....., respectively. *(2 points)*
  
  2. Fats can be broken down into fatty acids and glycerol in the organ ..... by the enzymes or compounds .....and ....., which are produced by the organs ..... and ....., respectively. *(2 points)*
  
  3. Proteins in a meal are first digested in the organ ..... by the enzyme or compound ....., which is activated by enzyme or compound ....., The resulting products are further digested into oligopeptides by the enzyme or compound ..... produced in the organ .....
- (2 points)*

**IB.** The plant structures (the sketch is not the real size).

*(4 points)*





Fill in a box for appropriate plant's organs of:

1. Monocots :

*(0.4 x 5 = 2 Points)*

2. Dicots :

*(0.4 x 5 = 2 Points)*

**Problem II. (10 points)**

A policeman was sitting in his car at rest when a robber's car passed by with a constant velocity of 120 km/h (at time  $t = 0$  s, position  $S = 0$  m), neglecting the length of the cars. He tried to catch the robber but it took 3 s to start moving his car. The police car moved with a constant acceleration and took 20 s to get a velocity of 200 km/h. After that the police car drove behind the robber with this velocity.

The robber saw him and tried to drive away by increasing his car velocity 5 seconds after the police car started to move. He reached his maximum car velocity of 150 km/h within 10 s with a constant acceleration. After that he moved with this maximum velocity.

**(Show all your calculation steps)**

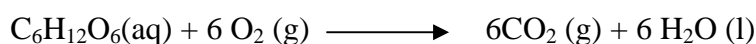
1. Calculate the car velocity and acceleration as a function of time for those cars (the robber's and police cars) in SI (System International) units. (2 Points)
2. Draw the graphs of velocity and acceleration as a function of time for the cars. (2 Points)
3. Determine the position of the cars as a function of time. (2 Points)
4. Draw the graph for question No. 3 (the position of the cars as a function of time). (2 points)
5. When and at which position will the police car overtake the robber's car? (2 Points)

**Problem III. (10 points)**

**III.A (5 points)**

Combustion reaction of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) produces carbon dioxide gas.

The occurring reaction is:



**(Show all your calculation steps)**

1. Calculate the energy produced when 1 mole of glucose is oxidized.

$$[\Delta H^\circ_{\text{reaction}} = \Delta H^\circ_{\text{products}} - \Delta H^\circ_{\text{reactants}}] \quad (2 \text{ points})$$

2. Calculate the volume of air (25<sup>0</sup>C, 1 atm) needed to oxidize 10.0 g of glucose

(Oxygen content in air is 21.0 % volume) (2 points)

3. Calculate the volume of dry carbon dioxide gas produced in the combustion of 10.0 g glucose at temperature 37<sup>0</sup>C and pressure at 1 atm.

( PV = nRT ) (1 point)

**Data:** Enthalpy formation ( $\Delta H_f^\circ$ ) of glucose = - 1273 kJ mol<sup>-1</sup>

$$\Delta H_f^\circ \text{CO}_2(\text{g}) = - 393.5 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ \text{H}_2\text{O}(\text{g}) = - 271.8 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ \text{H}_2\text{O}(\text{l}) = - 285.8 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ \text{O}_2(\text{g}) = 0 \text{ kJ mol}^{-1}$$

Universal gas constant, R = 0.0821 liter.atm.mol<sup>-1</sup> K<sup>-1</sup>

Volume of 1 mole gas at 25 °C, 1 atm = 24.5 liters



**III.B (5 points)**

10.0 milliliters of basic solution,  $X(OH)_2$ , is titrated with 0.100 M hydrogen chloride (HCl) solution using bromothymol blue as an indicator. When 8.00 ml of HCl solution was added, the color of the indicator was immediately changed.

**(Show all your calculation steps)**

1. Calculate the molar concentration ( $C_X$ ) of the basic solution,  $X(OH)_2$  **(1.5 points)**
2. What is the pH of the solution at the equivalent point? **(0.5 point)**
3. What is the color of solution at the end point of titration (the colors of bromothymol blue are yellow at  $pH < 6$  and blue at  $pH > 7.6$ ). **(0.5 point)**
4. Predict the period and group of the metal X in the periodic table. Mass of  $X(OH)_2$  in 10.0 ml solution is 0.0685g **(2 points)**
5. What metal is X? **(0.5 point)**