INTERNATIONAL JUNIOR SCIENCE OLYMPIAD
Jakarta - Indonesia
December 5 - 14,2004

Solutions for THEORETICAL EXAMNINATION

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	g or d	d or g

2.0 Points

3.

c	9	7	3	f

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

Problem II (10 points)

Conversion: 1 km/h = 5/18 m/s

(1) The velocities and accelerations as function of time (2 Points)

Robber's car

At time: $0s < t \leq 8s \rightarrow$ constant speed

$v_r(t) = 120$ km/h $= 33.33\ ms^{-1}$

$a_r(t) = 0\ ms^{-2}$ **(1/3 Points)**

At time: $8s < t \leq 18s \rightarrow$ constant acceleration

$v_r(8) = 33.33\ ms^{-1}$

$v_r(18) = 150$ km/h $= 41.67\ ms^{-1}$

$a_r=(41.67-33.33)ms^{-1}/(18-8)s=0.83\ ms^{-2}$

$v_r(t) =33.33+0.83(t-8)$ **(1/3 Points)**

At time: $t >18s \rightarrow$ constant speed

$v_r(t) = 41.67\ ms^{-1}$ **(1/3 Points)**

Police car

At time: $0s < t \leq 3s \rightarrow$ at stop condition

$v_p = 0\ ms^{-1}$

$a_p = 0\ ms^{-2}$ **(1/3 Points)**

At time: $3s < t \leq 23s \rightarrow$ constant acceleration

$v_p(3)=0\ ms^{-1}$

$v_p(23) = 200$ km/h $= 55.56$m/s

$a_p=(55.56-0)\ ms^{-1}/(23-3)s=2.78\ ms^{-2}$

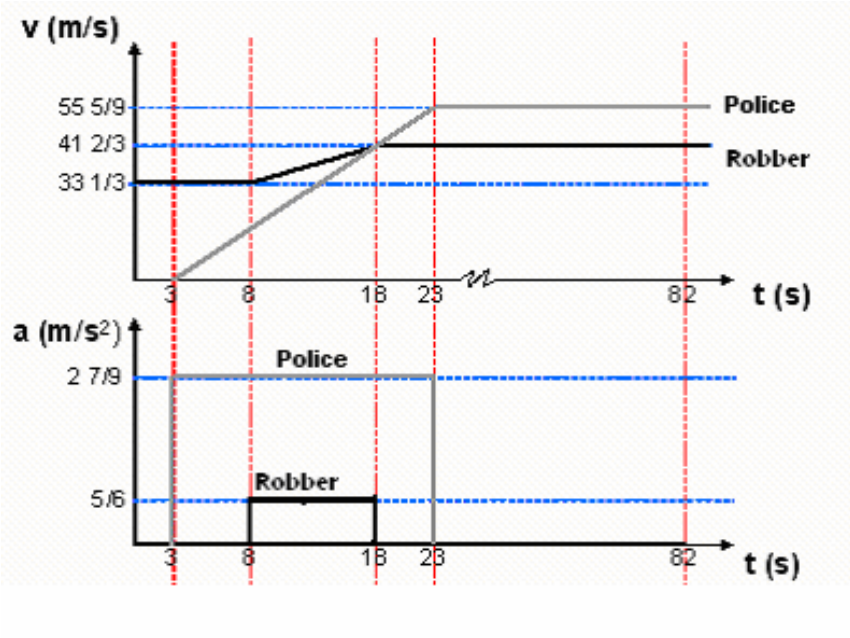
$v_p(t) = 55.56+2.78(t-23)$ **(1/3 Points)**

At time: $t > 23s \rightarrow$ constant velocity

$a_p = 0\ m/s^2$.

$v_p(t) = 55.56$m/s **(1/3 Points)**

(2) Figure of velocity and acceleration as a function of time (2 points)



(3) Position as a function of time (2 points)

Robber's car

At time: $0s < t \leq 8s$ → constant speed, $v_r(t) = 33.33\ ms^{-1}$

$S_r(t) = 33.33x\ t$

$S_R(8)=266.67$ m **(1/3 points)**

At time: $8s < t \leq 18s$ → constant acceleration

$S_r(t)=266.67+33.33x(t-8)+1/2 \times 0.83 \times (t-8)^2$ **(1/3 points)**

$S_r(18)=641.67$ m

At time: $t > 18s$ → constant speed

$S_r(t) = 641.67+41.67x(t-18)$ **(1/3 points)**

Police car

At time: $0s < t \leq 3s$ → at stop condition

$S_p(t) = 0$ m **(1/3 points)**

At time: $3s < t \leq 23s$ → constant acceleration

$S_p(t) =1/2 \times 2.83 \times (t-3)^2$

$S_p(23)= 555.56$ m **(1/3 points)**

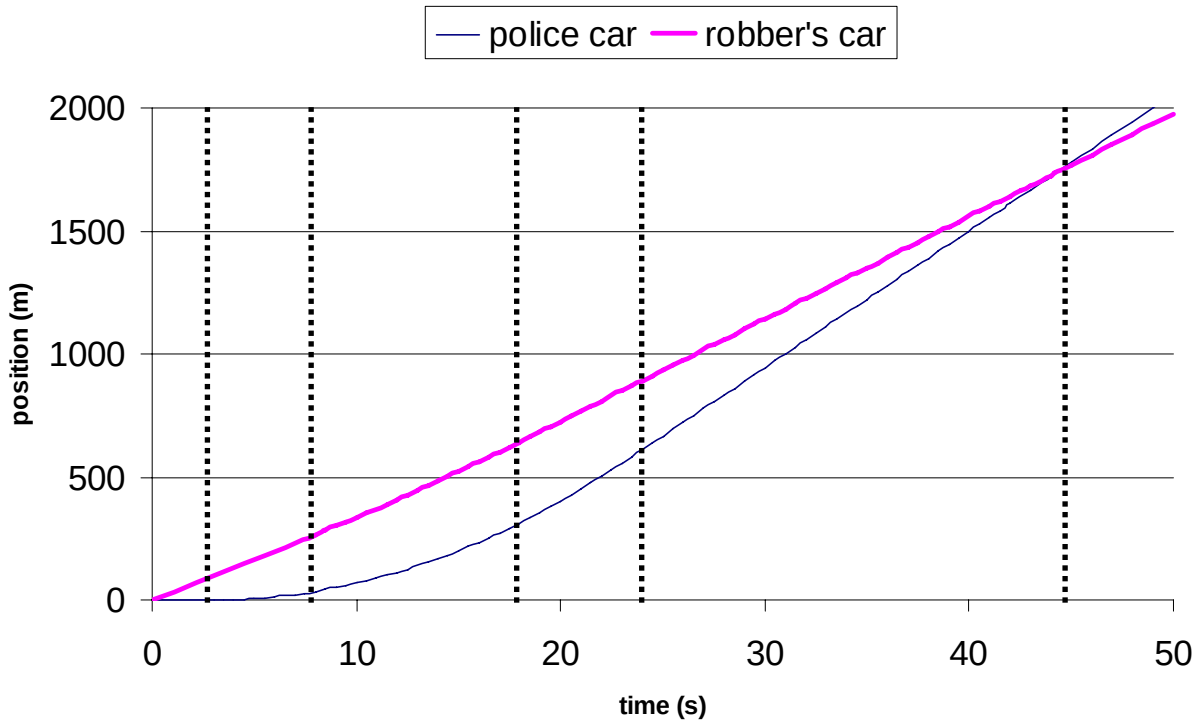
At time: $t > 23s$ → constant velocity

$S_p(t) = 555.56+55.56x(t-23)$ **(1/3 points)**

(4) Graph of positions vs time (2 points)

$S_r(t) = 33.33 \times t$; $0 \le t \le 8$
$S_r(t) = 266.67 + 33.33 \times (t-8) + 1/2 \times 0.83 \times (t-8)^2$; $8 \le t \le 18s$
$S_r(t) = 641.67 + 41.67 \times (t-18)$; $t > 18s$

$S_p(t) = 0$; $0 \le t \le 3s$
$S_p(t) = 1/2 \times 2.83 \times (t-3)^2$; $3 \le t \le 23s$
$S_p(t) = 555.56 + 55.56 \times (t-23)$; $t > 23s$



(5) Police car overtake the Robber's car **(2 points)**

$S_r(t) = 641.67 + 41.67 \times (t-18)$
$S_p(t) = 555.56 + 55.56 \times (t-23)$;
Police car meets Robber's car when $S_p(t) = S_r(t)$

$$S_p(23) + \tfrac{500}{9}(t-23) = S_r(18) + \tfrac{125}{12} \times (t-18)$$

$$555\tfrac{5}{9} + \tfrac{500}{9}(t-23) = 641\frac{2}{3} + \tfrac{125}{3} \times (t-18)$$

$$555\tfrac{5}{9} - \tfrac{11500}{9} + \tfrac{500}{9}t = 641\tfrac{2}{3} + \tfrac{125}{3}t - \tfrac{2250}{3}$$

$$(\tfrac{500}{9} - \tfrac{375}{9})t = \tfrac{6500}{9} + \tfrac{1925}{3} - \tfrac{6750}{9}$$

$$\tfrac{125}{9}t = \tfrac{5525}{9}$$

t = 44.2s **(1 point)**

at position,

$$S_p(44.2) = 555\tfrac{5}{9} + 55\tfrac{5}{9} \times (t-23) = 1733\tfrac{1}{3} \text{ m}$$

$$S_r(44.2) = 641\tfrac{2}{3} + 41\tfrac{2}{3} \times (t-18) = 1733\tfrac{1}{3} \text{ m}$$ **(1 point)**

Alternatively for (5)
All calculations start from t = 23s

Position can be calculated from the area under graph v vs t:
Police car meets Robber's car when $S_p(t) = S_R(t)$

$$555\tfrac{5}{9} + \tfrac{500}{9}t = \tfrac{800}{3} + \tfrac{(18-8)}{2}\left(\tfrac{100}{3} + \tfrac{125}{3}\right) + \tfrac{125}{3}(23-18) + \tfrac{125}{3}t$$

$$= \tfrac{2550}{3} + \tfrac{125}{3}t$$

t = 21.2s **(1 point)**

Therefore, total time required to chase the robber is 23s + 21.2s = 44.2s
At position,

$$S_p = 555\tfrac{5}{9} + 55\tfrac{5}{9} \times t = 1733\tfrac{1}{3}\text{ m}$$

$$S_r = \tfrac{2550}{3} + \tfrac{125}{3}t = 1733\tfrac{1}{3}\text{ m}$$ **(1 point)**

Alternatively for (5)
All calculations start from t = 23s
Relative velocity at t=23s, $V_{rel} = (55\tfrac{5}{9} - 41\tfrac{2}{3})\text{m/s} = \tfrac{125}{9}\text{ m/s}$
Position at t = 23s,

$S_p = 555\tfrac{5}{9}$ m

$S_r = \tfrac{800}{3} + \tfrac{(18-8)}{2}\left(\tfrac{100}{3} + \tfrac{125}{3}\right) + \tfrac{125}{3}(23-18) = \tfrac{2550}{3}$ m

Their relative velocity, $V_{rel} = 55\tfrac{5}{9} - 41\tfrac{2}{3} = \tfrac{125}{9}$ m/s
Relative positions, $S_{rel} = \tfrac{2550}{3} - \tfrac{5000}{9} = \tfrac{2650}{9}$ m
Time they meet, $t_{meet} = \tfrac{2650/9}{125/9} = 21\tfrac{1}{5}$ s = 21.2 s
Therefore, total time required to chase the robber is 23s + 21.2s = 44.2 s **(1 point)**
At position,

$$S_p = 555\tfrac{5}{9} + 55\tfrac{5}{9} \times t = 1733\tfrac{1}{3}\text{ m}$$

$$S_r = \tfrac{2550}{3} + \tfrac{125}{3}t = 1733\tfrac{1}{3}\text{ m}$$ **(1 point)**

In Summary:

Time T (s)	Robber				Police			
	v (km/h)	v (m/s)	a (m/s2)	S (m)	v (km/h)	v (m/s)	a (m/s2)	S (m)
0	120	$33\,1/3$	0	0	0	0	0	0
3	120	$33\,1/3$	0	100	0	0	$0 - 2\,7/9$	0
8	120	$33\,1/3$	$0 - 5/6$	$266\,2/3$				
18	150	$41\,2/3$	$5/6 - 0$	$641\tfrac{2}{3}$				
23	150	$41\,2/3$	0	850	200	$55\,5/9$	$2\,7/9 - 0$	$555\,5/9$
$44\tfrac{1}{5}$	150	$41\,2/3$	0	$1733\tfrac{1}{3}$	200	$55\,5/9$	0	$1733\tfrac{1}{3}$

Problem III. (10 points)

III.A (5 points)

1. **(2 point)**

$C_6H_{12}O_6(aq) + 6\ O_2(g) \longrightarrow 6\ CO_2\ (g) + 6\ H_2O\ (l)$

$\Delta H^o_{reaction} = (6\ \Delta H_f{}^oCO_2 + 6\Delta H_f{}^o\ H_2O) - (\Delta H_f{}^oC_6H_{12}O_6 + 6\ \Delta H_f{}^oO_2)$ **(1 point)**

$\Delta H_{reaction} = [6(-393.5) + 6\ (-285.8)] - (-1273)$ **(0.5 point)**

$\Delta H_{reaction} = (-2361-1714.8) + 1273$

$\Delta H_{reaction} = -\ 2802.8 \approx 2803\ kJ.mol^{-1}$ **(0.5 point)**

2. **(2 points)**

$C_6H_{12}O_6(aq) + 6\ O_2(g) \longrightarrow 6\ CO_2\ (g) + 6\ H_2O\ (l)$

Mol glucose = $\frac{10}{(6\times12+12\times1+6\times16)} = \frac{10}{180} = 0.0556$ mol **(0.5 point)**

O_2 is needed = (6 x 0.0556) = 0.333 mol **(0.5point)**

The volume of air (V_{air}) = ($\frac{100}{21.0}$ x 0.333 mol x 24.5 liters.mol^{-1})

= 38.8 liters **(1 point)**

or

=38,9 liters

3. **(1 point)**

Volume of dry CO_2

PV = nRT ;

$V = \frac{nRT}{P}$ **(0.5 point)**

$V = \frac{0.333\times0.0821\times310}{1} = 8.47$ liters **(0.5 point)**

or: V = 8.47 – 8.49 liters

IIIB: (5 points)

1. **(1.5 points)**

10 ml $X(OH)_2$ solution is titrated with 8 ml of 0.1 M HCl.

Molar concentration (C_M) of $X(OH)_2$ solution was 0.04 M

$X(OH)_2 \longrightarrow X^{2+} + 2\ OH^-$ **(0.5 point)**

$N_1\ V_1 = N_2\ V_2$

$2.C_M.10 = 8 \times 0.1$

$C_M = \frac{8 \times 0.1}{2 \times 10} = 0.04\ M$ **(1 point)**

2. **(0.5 point)**

pH of the solution at the equivalent point:

Since the $X(OH)_2$ is a strong base, after all base (OH^-) is neutralized, the pH of the solution is 7:

$$X(OH)_2 + 2HCl \longrightarrow XCl_2 + 2H_2O$$

at equivalent point, the concentration of $OH^- = H^+$

pH = 7 **(0.5point)**

3. **(0.5 point)**

At the end point the color of solution is green (green = yellow +blue)

The pH of solution at the end point is in between 6 -7.6. The color of solution is a mixture of yellow and blue, giving a **green** color. **(0.5 point)**

4. **(2 points)**

Mass of sample $X(OH)_2$, m = 0.0685 g

$C_M = \left[\frac{m\ g}{M\ g.mol^{-1}}\right] \times \frac{1000\ ml}{10\ ml}$ **(0.5 point)**

$M = \frac{m}{C_M} \times \frac{1000}{10}$

$M = \frac{0.0685}{0.0400} \times \frac{1000}{10} = 171\ g.mol^{-1}$ **(0.5 point)**

molar mass of $X(OH)_2$, M = 171 $g.mol^{-1}$
Relative mass of $X(OH)_2$= 171
Relative mass of X = 171 – (2·17) = 137 **(0.5 point)**
Element of X is in the **6th** period and **IIA** (or **II**) group **(0.5 point)**

5. **(0.5 point)**

The metal is Ba (Barium) **(0.5 point)**

INTERNATIONAL JUNIOR SCIENCE OLYMPIAD
Jakarta - Indonesia
December 5-14,2004

EXPERIMENTAL EXAMINATION
December 11, 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) provided by the organizer.
5. Each competitor has to check the question and answer sheets. Raise 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 the examination supervisor will accompany them.
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.**

INTERNATIONAL JUNIOR SCIENCE OLYMPIAD
Jakarta - Indonesia
December 5 - 14,2004

EXPERIMENTAL EXAMINATION
December 11, 2004

Read carefully the following instructions:

1. The time available is 3.5 hours.
2. Check that you have a complete set of the experimental instructions and the answer sheets.
3. On your desk, a complete set of the apparatus and experimental materials are already setup as described in the experimental instructions. Do not touch them before the examination starts.
4. Use only the pen provided.
5. Write down your name, country and signature on the answer sheet.
6. The question must be answered on one side of the answer sheet.
7. You should be careful in using the apparatus and materials:
    a. Glass is easily broken: Erlenmeyer flask, test tube
    b. NaOH, $Ba(OH)_2$: corrosive materials
    c. $Ca(OH)_2$: an irritant material
8. Error analysis is not necessary but you should consider appropriate significant figures.
9. Use the provided graph papers (5 sheets) for drawing your experimental results.
10. **All competitors are not allowed to bring any stationary and tools provided outside. After completing your answer, all questions and answers sheets you must put them on desk.**

Name		**Signature:**
Country		

EXPERIMENTAL EXAMINATION

December 11, 2004

ANSWER SHEET

OBSERVATION SHEET FOR BIOLOGY

1. [2.0 Point]

2. a. **(1.0 Point)**

The maximum amount of sugar in 250 g salak:

……. X ……	=	…… g

(0.5 point)

The maximum percentage of sugar content in salak in 1L solution of salak:

……. X ……	=	……%

(0.5 point)

b. (**2.0 Points**)

The real amount of sugar cane added to 1 L of salak solution:

……..X…….	=	…… g

(0.5 point)

……..X…….	=	…… g

(0.5 point)

Sugar content in the solution (maximum):

……g + ……g	=	…… g

(0.5 point)

Percentage of of total sugar (maximum) in 1 L salak solution which is used for fermentation on this experiment:

…… x ……%	=	…….%

(0.5 point)

Name		**Signature:**
Country		

EXPERIMENTAL EXAMINATION

December 11, 2004

ANSWER SHEET

OBSERVATION SHEET FOR PHYSICS

1. The level of the palm oil in the U-tube when the right and left side is same: ……..…

2. The initial level of the palm oil:……..(t = 0 s)

OBSERVATION SHEET FOR PHYSICS

Table of Physics Experiment (2 Points)

No	level (mm)	time (s)	V (m^3)	P (Pa)			
1	……..	0					
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

Name		**Signature:**
Country		

EXPERIMENTAL EXAMINATION

December 11, 2004

ANSWER SHEET

OBSERVATION SHEET FOR CHEMISTRY

Section I (3.4 points)

1. Observation sheet (0.9 point)

Test Tubes	Solution	Observation	Result	
			Yes	No
A	$Ca(OH)_2$	is there any white precipitate?		
B	$Ba(OH)_2$	is there any white precipitate?		
C	NaOH	is there any white precipitate?		

2. The white precipitate(s) is(are) probably……. …….. **(0.5 point)**

3. The gas produced from fermented Salak fruit solution is probably …… **(0.5 point)**

4. Reactions : . **(1.5 points)**

$Ba(OH)_2$ (aq) + $\rightarrow$

$Ca(OH)_2$ (aq) + $\rightarrow$

NaOH (aq) + $\rightarrow$

Section II (2.6 points)

1. Observation sheet: mark on the proper color (1.0 point)

Test Tube	**Indicator**	**Color changed to**		
D	Methyl orange	red	orange	yellow
E	Methyl red	red	orange	yellow
F	Bromothymol blue	yellow	green	blue
G	Phenolphthalein	no change	pink	red

2. The pH range of fermented Salak fruit solution is …… **(1.0 point)**

3. Based on the pH range of the fermented Salak fruit solution, what is the product of fermentation (choose the true one of A, B, or C) **(0.6 point)**

A. acid

B. base

C. salt

INTERNATIONAL JUNIOR SCIENCE OLYMPIAD
Jakarta - Indonesia
December 5 - 14,2004

Experimental Examination

Please read carefully before you do the experiment

INTRODUCTION

The fruit in front of you, **Salak** or snake fruit (*Salacca edulis*), is an exotic fruit from Indonesia. This fruit is used as a raw material for making cider (fermented fruit juice) in this experiment. Its sugar content can be utilized as a part of carbon source in the fermentation process productions by a certain microorganism such as yeast. The cider contains alcohol. During the fermentation, a certain gas will be produced.

BIOLOGY
(5 points)

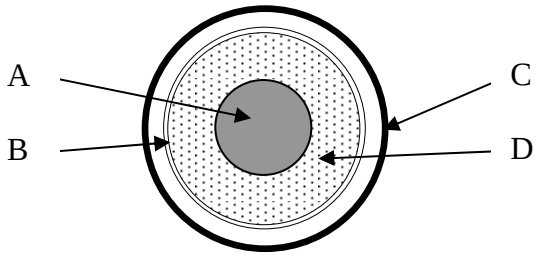
Problem

1. You are given **the whole** and **the cross section** of salak fruit. You are shown a drawing of a hypothetical fruit with complete parts of the fruit. You may peel off the hard covering of the fruit **carefully**. Split the segments of the fruit and peel off the thin semi-transparent layer. Observe the other parts of the fruit. Draw and label schematically the cross section of the salak fruit in front of you by using the notation in column I correspond to the data in column II of Table 1. **(2.0 Points)**

Table 1.

I	II
A	Seed
B	Mesocarp
C	Epicarp/ Exocarp
D	Endocarp
E	Endoderm

Hypothetical Fruit



2. The sugar content in the flesh of Salak is about 20% by mass. Pure extract of salak fruit juice was obtained from exactly 250 g of salak flesh. This extract was diluted to a final volume of 1 liter by adding water. A good taste of cider can be obtained by adding 15% (of mass) more of sugar cane to total of 1 liter of solution (by mass) during dilution process. Usually the purity of sugar cane is 97%. The density of solution is assumed to be one (1) g/cm^3.

Questions:

a. Calculate the initial maximum percentage of sugar in one liter of broth or solution of salak fruit (w/v). **(1.0 Point)**

b. What is the maximum % sugar in one (1) liter of Salak solution which is used for fermentation on this experiment? **(2.0 Points)**

PHYSICS
(9 Points)

The change of volume, pressure and the number of molecules of the gas produced in the fermentation process as a function of time can be measured and calculated.

Objectives:
a. To determine the change of volume of the gas as a product of fermentation process.
b. To determine the average production rate of the gas (in mol/s).

Apparatus and materials:
a. A set of U–tube filled with palm oil consists of a support with a scale and a plastic tube connected to a rubber stopper (left hand side of the readings are given in cm).
b. An Erlenmeyer flask of 100 mL
c. A stopwatch
d. A set of graph – paper
e. A cup of Vaseline grease
f. A fermented Salak fruit solution in an Erlenmeyer flask of 200 mL

Note:
1 atm = 1.013×10^5 N/m^2
Ideal gas equation: PV = nRT
R is universal gas constant = 8.314 J.mol^{-1}.K^{-1}
g is acceleration of gravity = 9.81 m.s^{-2}
Diameter of the tube is 6.00 mm.
Density of the palm oil is 890 kg.m^{-3}.

Experimental procedure:
1. Write down the level of the palm oil on the U-tube scale on your observation sheet when the surface levels of the palm oil in the right and left side of the U-tube are equal.

   NOTICE: The left side of the U-tube is connected with a rubber stopper through a plastic tube.
2. Remove the balloon from the Erlenmeyer flask containing the fermented Salak fruit solution.
3. Pour carefully the solution into the Erlenmeyer flask (100 mL) up to 60 mL mark. You find a marker at the U-tube scale (metal ruler) at 50 cm scale (green marked). This marker is used for the value of total air volume (***v***) between the surface of the solution in Erlenmeyer flask (at 60 mL scale) and the scale of 50 cm on the U-tube, ***v* = 75.0 mL**.
4. Connect the rubber stopper to the Erlenmeyer flask and make sure there is no gas leakage. If necessary, use the Vaseline grease. You will observe the level change of the palm oil inside the U-tube.

5. Decide your initial time (t = 0 s) and record the level of the palm oil in the left side of the U-tube as the initial level. Write it on the table in the observation sheet.
6. Record the time required for every 10 mm level changes of the palm oil in the left side of the U-tube for 10 data on your observation sheet. **Do not touch Erlenmeyer flask during this experiment, because it will momentarily change the volume of the produced gas.**
7. **After you have finished the experiment, remove the rubber stopper from the Erlenmeyer flask.**
8. **Keep the remaining fermented solution for the chemistry experiment**

Questions:

1. Based on your initial level of the palm oil, calculate the initial gas volume from your experiment. [1 point]
2. Determine the change of volume of the gas with time using a suitable graph. [2.5 points]
3. Determine the average production rate (mol/s) of the gas from the fermentation process by using a suitable graph. In this experiment, assume that the gas is an ideal gas. Use the room temperature is 27.0^{o}C for your calculation. [3.5 points]

   (For correct measurement results: [2 points])

   (Give all steps including formulas to answer the questions). Use the available table to answer the questions. You may use the blank columns.

For analyzing data, you have to use SI (system international) units

If you do not use SI units in all calculations, tables, graphs you will lose 0.25 point.

CHEMISTRY
(6 Points)

Objectives:

To identify the gas produced and to determine pH range of fermented salak fruit solution.

Apparatus and Materials:

No	Apparatus	No	Materials
1	Rubber stopper equipped with 3 plastic tubes (1)	1	Phenolpthalein
2	Test tubes (7)	2	Methyl red
3	Test tubes rack (1)	3	Methyl orange
		4	Bromothymol blue
		5	Calcium hydroxide (lime water)
		6	Sodium hydroxide (soda lime)
		7	Barium hydroxide
		8	Tissue paper

Be careful with the chemical solutions**!!!**

$NaOH$ and $Ba(OH)_2$ are corrosive.

$Ca(OH)_2$ is irritant.

Section I. Identification of gas produced in fermentation (3.4 point)

Experimental procedure

1. On your experimental table, there are test tubes labeled as A, B, C and a rubber stopper equipped with 3 plastic tubes.
    a. Test tube A contains calcium hydroxide solution
    b. Test tube B contains barium hydroxide solution and
    c. Test tube C contains sodium hydroxide solution.

2. Take the remaining fermented salak fruit solution in the 100 mL Erlenmeyer flask from previous experiment. Plug in tightly the Erlenmeyer flask with a rubber stopper equipped with 3 plastic tubes. Immerse each plastic tubes to test tube A, B and C respectively. Make

sure that the plastic tube is immersed properly in each basic solution. If there is a gas leakage, spread thin Vaseline grease to the surface of the rubber stopper.

3. Shake gently the Erlenmeyer and observe the reaction between the bubbling gas and basic solutions in the test tubes for about 5 minutes.

Questions

1. Write down your observation in the table. **(0.9 point)**
2. Based on your observation between gas and basic solution, predict what the precipitated compound(s) is (are) **(0.5 point)**
3. Based on your observation, predict the gas produced by the fermentation process. **(0.5 point)**
4. Write down the balanced equation of the reaction occurred in each basic solution. **(1.5 points)**

Section II . Identification of pH of fermented solution (2.6 point)

Experimental procedure

In plastic bottles, there are four acid-base indicators, namely: phenolphthalein, bromothymol blue, methyl red, and methyl orange. Take 4 test tubes those are labeled D,E,F and G.

1. Fill the test tubes (D, E, F, G) with the fermented salak solution about one third of tube volume.
2. To each solutions, add five drops of indicators and shake gently.
3. Observe the color of solution in each test tube (use data of pH range indicators below):

Indicator	Range of pH	Changes in color
Methyl orange	3.1 – 4.4	red to yellow
Methyl red	4.4 – 6.2	red to yellow
Bromothymol blue	6.0 – 7.6	yellow to blue
Phenolphthalein	8.3 – 10.0	colorless to pink

Questions

1. Write down your observation in the table. (1.0 point)

2. Based on the color of indicator in the solutions , predict the pH range of fermented Salak fruit solution. (1.0 point)

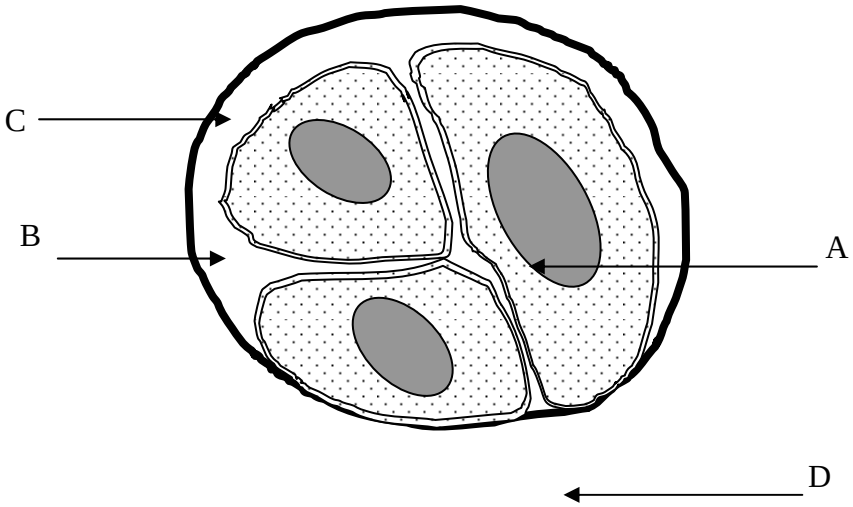
3. Based on the pH of fermented Salak fruit solution, what is one of the fermented products? (0.6 point)
    a. **acid**
    b. **base**
    c. **salt**

INTERNATIONAL JUNIOR SCIENCE OLYMPIAD
Jakarta - Indonesia
December 5 - 14,2004

Solutions for EXPERIMENTAL EXAMNINATION

BIOLOGY

1. [2.0 Points]



2. a. **(1.0 Point)**

The maximum amount of sugar in 250 g salak:

20/100 X 250 g	=	50 g	(0.5 point)

The maximum percentage of sugar content in salak in 1L solution of salak:

50g/1000 g X 100%	=	5 %	(0.5 point)

b. (**2.0 Points**)

The real amount of sugar cane added to 1 L of salak solution:

15/100 X 1,000 g	=	150 g	(0.5 point)
97/100 X 150 g	=	145 g	(0.5 point)

Sugar content in the solution (maximum):

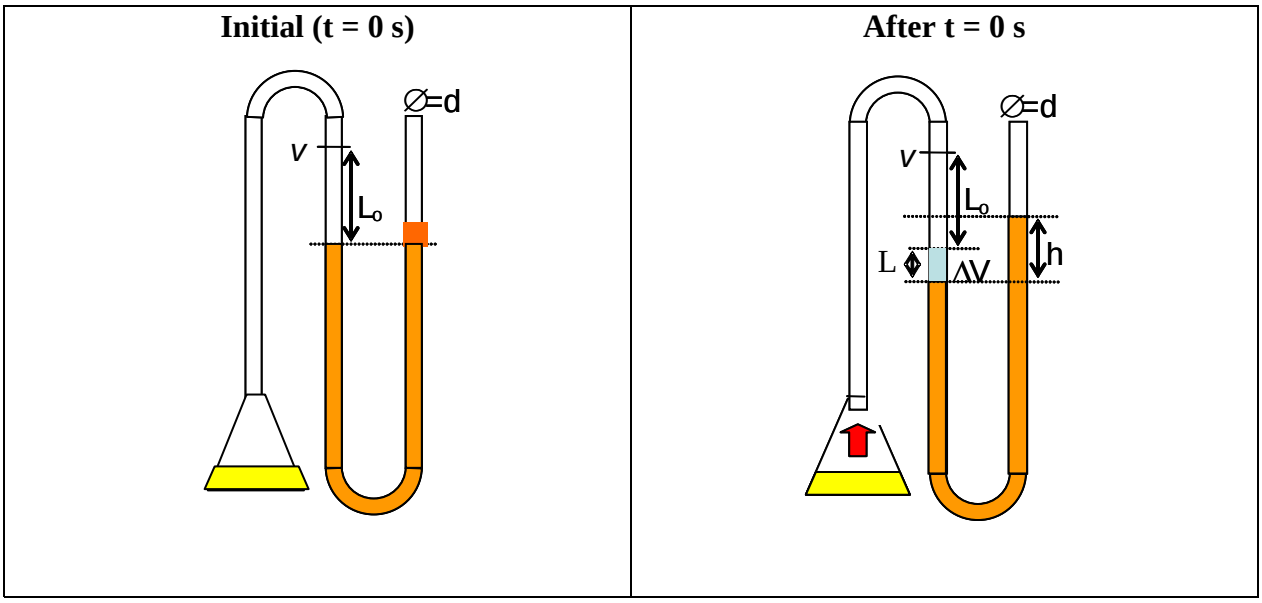
145 g + 50 g	=	195 g	(0.5 point)

Percentage of total sugar (maximum) in 1 L salak solution which is used for fermentation on this experiment:

195 g/1,000 g x 100 %	=	19.5 %	(0.5 point)

Physics

Solution:
Total Mark = 9.0 Points



Typical Experimental results:

1. **[0.0 Point]** Level of the palm oil when the level in right and left side is same. Depend on the experimental set up.
   31.0 cm

2. **[0.0 Point]** The initial level of the palm oil (t = 0s). Depend on student's experiment.
   L_o = 21.0 cm

3. **[1 Point]** Formula for initial volume: $V_{initial} = v + \{(\pi d^2/4)\, L_o\}$, L_o is the length between *v* and the initial level (t = 0 s)
   $V_{initial}$ = 0.000083 m^3

4. **[0.5 Point]** Formula for the total gas pressure: $P = P_o + \rho gh$

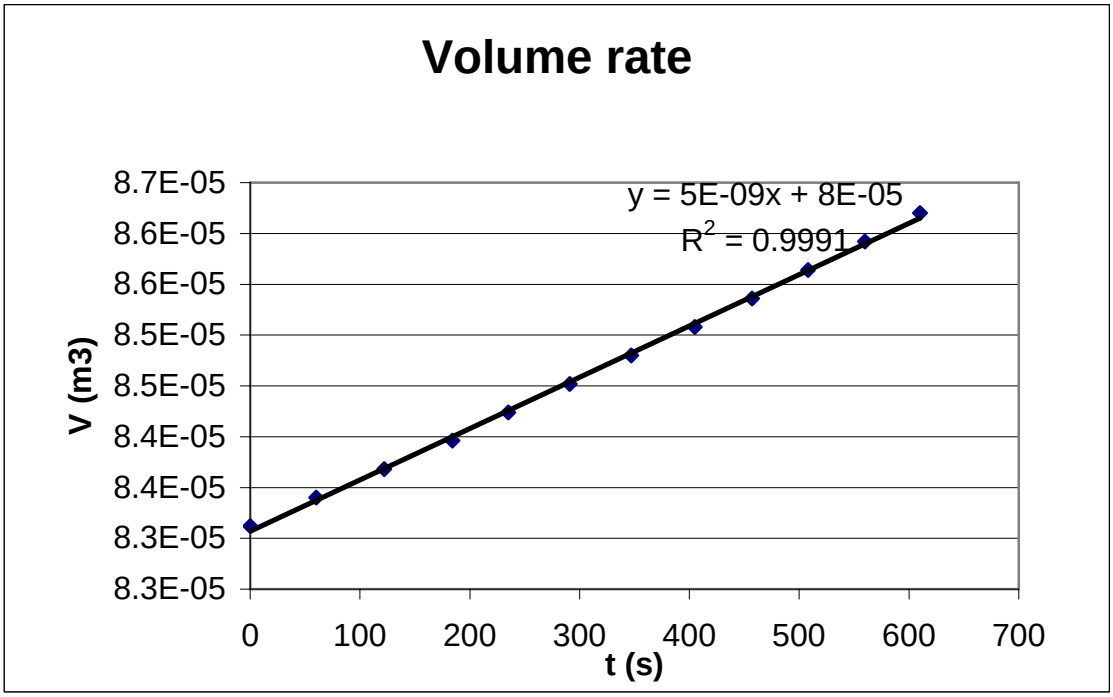
   where: P_o = pressure of the atmosphere, ρ = density of the palm oil.

   [2 Points] Tabel of Physics Experiment

Start: 10:30

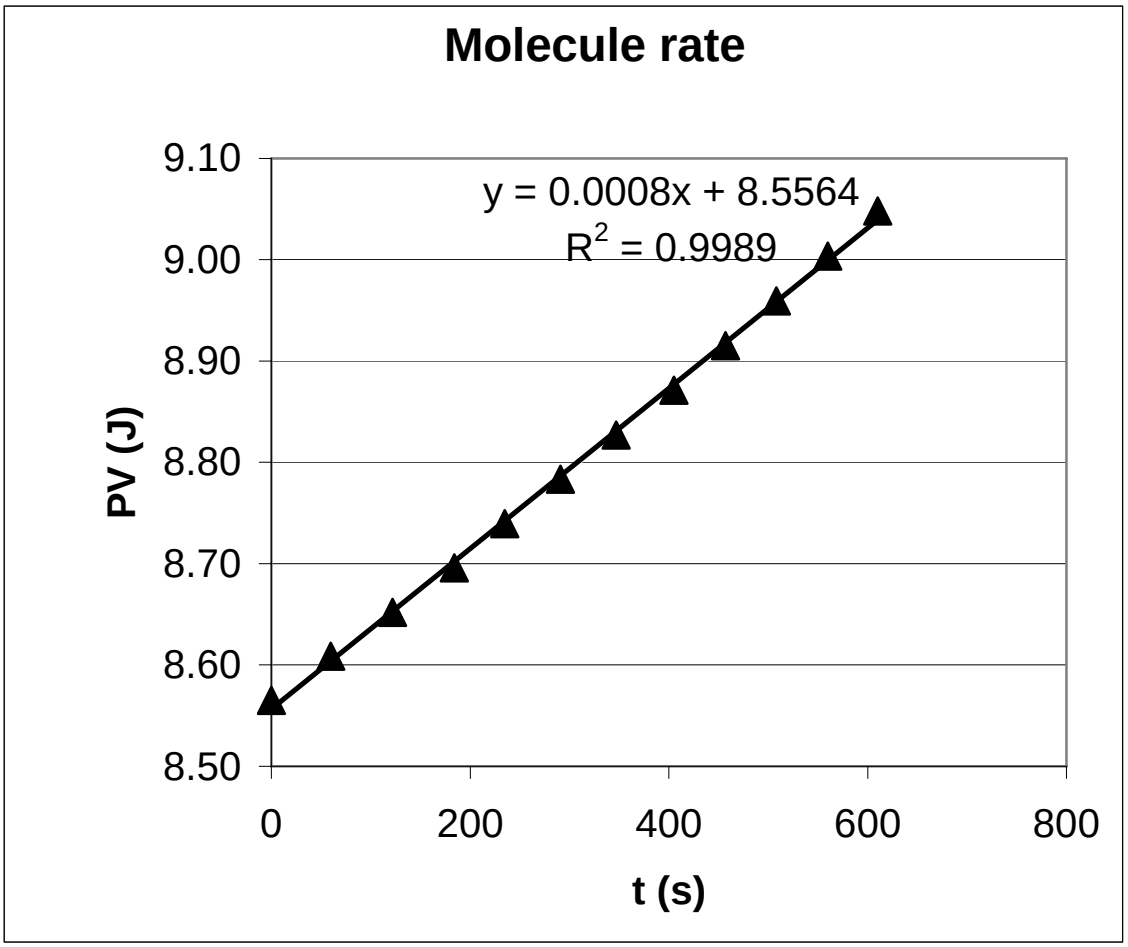
No.	h (cm) (left side)	T (s)	V (m3)	P(Pa)	PV(J)
0	21.0	0	0.0000831	1.030E+05	8.57
1	20.0	60	0.0000834	1.032E+05	8.61
2	19.0	122	0.0000837	1.034E+05	8.65
3	18.0	184	0.0000840	1.036E+05	8.70
4	17.0	235	0.0000842	1.037E+05	8.74
5	16.0	291	0.0000845	1.039E+05	8.78
6	15.0	347	0.0000848	1.041E+05	8.83
7	14.0	405	0.0000851	1.043E+05	8.87
8	13.0	457	0.0000854	1.044E+05	8.92
9	12.0	508	0.0000856	1.046E+05	8.96
10	11.0	560	0.0000859	1.048E+05	9.00
11	10.0	610	0.0000862	1.050E+05	9.05

5. **[1 Point]** A graph of Volume (m^3) vs. Time (s) in a graph-paper.



6. **[1 Point]** Idea of determining Volume rate of the gas, $\Delta V/\Delta t$, gradient of the graph of V vs. t.
7. **[0.5 Point]** Gas volume rate: $\Delta V/\Delta t =$ 5.05 E-09 m^3/s.

8. **[1 Point]** A graph of PV (J) vs. time (s) in a graph-paper or any other suitable graph.



9. **[1 Point]** Idea of determining the average gas production rate:
   Ideal gas: PV = nRT , from the graph PV vs. t we find the gradient m, therefore PV = mt,
   so, $nRT = mt \rightarrow \Delta n/\Delta t = m/RT$.

10. **[1 Point]** Average gas production rate: $\Delta n/\Delta t =$ 4.34 E-07 mol/s.

Chemistry

Section I (3.4 points)

1. Observation sheet (0.9 point)

Test Tubes	Solution	Observation	Result	
			Yes	No
A	$Ca(OH)_2$	is there any white precipitate?		
B	$Ba(OH)_2$	is there any white precipitate?		
C	NaOH	is there any white precipitate?		

2. The white precipitate(s) is(are) probably……. …….. **(0.5 point)**

3. The gas produced from fermented Salak fruit solution is probably …… **(0.5 point)**

4. Reactions : . **(1.5 points)**

$Ba(OH)_2$ (aq) + $\rightarrow$

$Ca(OH)_2$ (aq) + $\rightarrow$

NaOH (aq) + $\rightarrow$

Section II (2.6 points)

1. Observation sheet: mark on the proper color (1.0 point)

Test Tube	**Indicator**	**Color changed to**		
D	Methyl orange	red	orange	yellow
E	Methyl red	red	orange	yellow
F	Bromothymol blue	yellow	green	blue
G	Phenolphthalein	no change	pink	red

2. The pH range of fermented Salak fruit solution is …….. **(1.0 point)**

3. Based on the pH range of the fermented Salak fruit solution, what is the product of fermentation (choose the true one of A, B, or C) **(0.6 point)**

A. acid
B. base
C. salt