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International Junior Science Olympiad,  
Pune, India

Time : 3 hrs  
Marks :40

## Experimental Tasks



**Task:** **A** This task is divided into three parts. **Total marks: 14**

- A1:** To determine the centre of gravity of a triangular plate, A.
- A2:** To record the time period of oscillation for different suspension points for the plate.
- A3:** To analyze the above data and results.

### A.Q1 Determination of CG:

[1.0 mark]

Mark "X" on **Sheet 1** at the appropriate position to denote the CG (large sized sheet).

CG within 5 mm

[1.0]

CG within 10 mm

[0.5]

### A.Q2 Table A.1: Oscillation measurements:

[4.0 marks]

	h (m)	h <sup>2</sup> (m <sup>2</sup> )	Time taken for 50 oscillations (s)				T = T1/50 (s)	T <sup>2</sup> (s <sup>2</sup> )	hT <sup>2</sup> (ms <sup>2</sup> )
			1 <sup>st</sup> (t1)	2 <sup>nd</sup> (t2)	3 <sup>rd</sup> (t3)	Mean (T1) (t1+t2+t3)/3			
<b>H1</b>	<b>0.243</b>					<b>53.65</b>			
<b>H2</b>	<b>0.155</b>					<b>47.77</b>			
<b>H3</b>	<b>0.179</b>					<b>49.08</b>			
<b>H4</b>	<b>0.098</b>					<b>45.48</b>			

For each value of h within  $\pm 5$  mm

[0.25 x 4.0= 1.0]

For each value of T1 within  $\pm 1$  s

[0.5 x 4.0= 2.0]

For each value of T1 within  $\pm 2$  s

[0.25 x 4.0= 1.0]

For calculating h<sup>2</sup> and hT<sup>2</sup>

[0.25 x 4.0= 1.0]

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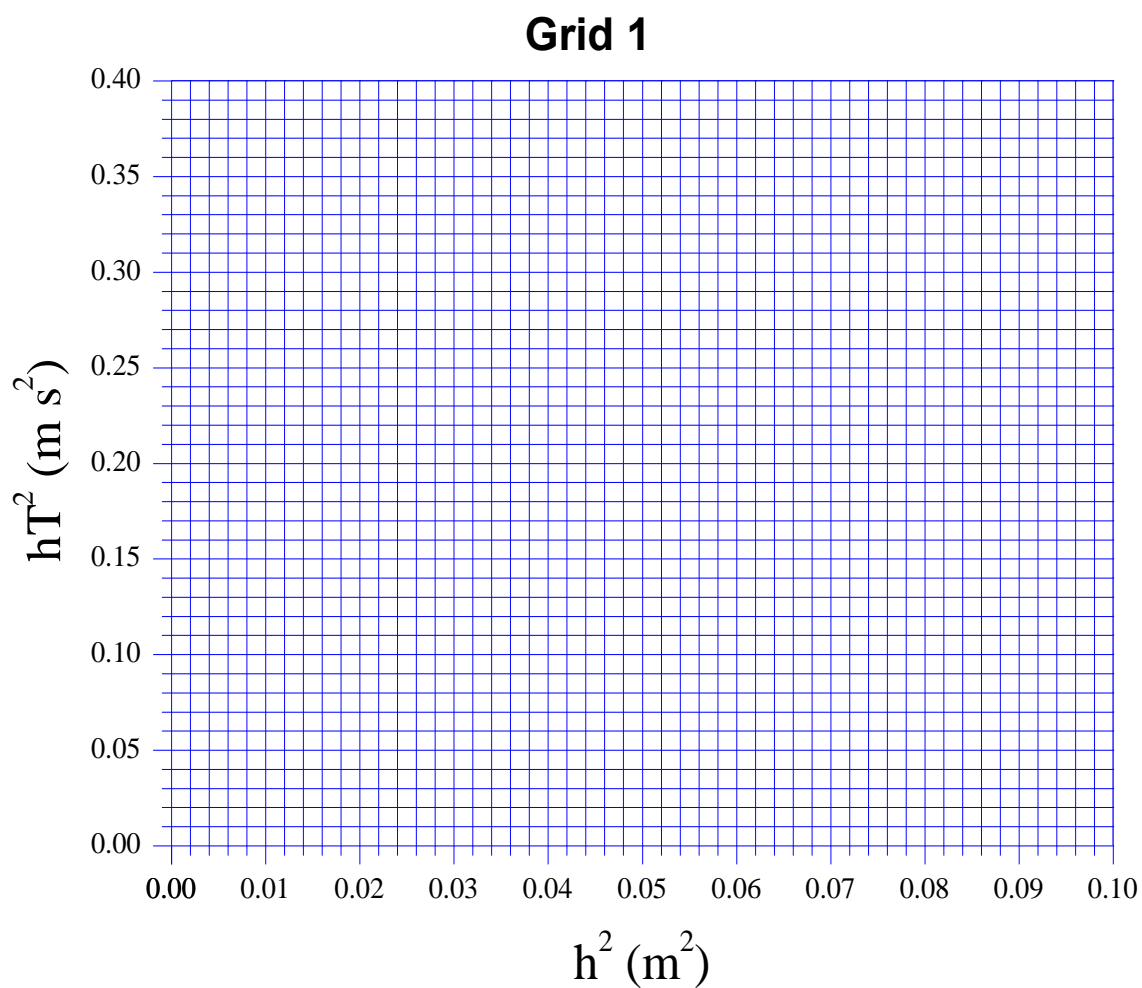
## Experimental Tasks



### A.Q3 Results of the data analysis

(a) Grid1:  $hT^2$  (y-axis) versus  $h^2$  (x-axis)

[2.0 marks]



Plotting 4 points correctly  
For best fit straight line

[0.25 x 4.0= 1.0]  
[1.0]

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### A.Q4 Table A.2: Calculations from Grid 1 [3.0 marks]

Quantity	Numerical value	FULL CREDITS		HALF CREDITS
Slope of the graph ( $s$ )	$4.06 \pm 0.2$	[0.5]	$4.06 \pm 0.4$	[0.25]
y-intercept of the graph ( $c$ )	$0.040 \pm 0.005$	[0.5]	$0.040 \pm 0.01$	[0.25]
Acceleration due to gravity ( $g$ )	$9.8 \pm 0.5$	[1.0]	$9.8 \pm 1.0$	[0.5]
Radius of gyration ( $K$ )	$0.10 \pm 0.01$	[1.0]	$0.10 \pm 0.02$	[0.5]

Values outside the above mentioned range = Zero

### A.Q5(a) Table A.3:

[3.0 marks]

Holes	h (m)	h' (m)
H1	<b>0.243</b>	<b>0.045</b>
H4	<b>0.098</b>	<b>0.11</b>

Each correct value of h' within  $\pm 10$  mm [0.5 x 2 = 1.0]

Values outside the above mentioned range = Zero

(b) Sheet 1: Mark the positions of points of oscillation J1 and J4 on Sheet 1. Label them as J1 and J4 clearly.

[1 x 2 = 2.0]

### A.Q6 Table A.4: Lengths of equivalent simple pendulums [1.0 mark]

Holes	h (m)	L (m)
H1	<b>0.243</b>	<b>0.288</b>
H4	<b>0.098</b>	<b>0.209</b>

For each correct calculation within  $\pm 0.015$  m [0.5]

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## Experimental Tasks



Time : 3 hrs  
Marks : 40

### Task

**B**

In this set of experiments we will investigate,

**Total Marks: 20**

- A1:** The buffering capacity of milk
- A2:** Enzymatic digestion of milk proteins
- A3:** Determining the calcium content of milk

### B1 The buffering capacity of milk

**B.Q1.A** pH of water =  [0.25 Mark]  
[6.0 – 7.0: 0.25, Other values = Zero]

**B.Q1.B** pH of sodium carbonate =  [0.25 Mark]  
[>10: 0.25, Other values = Zero]

**B.Q1.C** pH of acetic acid =  [0.25 Mark]  
[2 – 4: 0.25, Other values = Zero]

**B.Q1.D** pH of milk =  [0.25 Mark]  
[6.0 – 8.0: 0.25, Other values = Zero]

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## Experimental Tasks

Time : 3 hrs  
Marks : 40

## B.Q2 Observation Table B.1

[2.0 Marks]

	Stepwise addition to 40 ml water			
	Sodium carbonate solution		Acetic acid solution	
	Stepwise volume added in ml	pH value	Stepwise volume added in ml	pH value
<b>1</b>	0		0	
<b>2</b>	0.1		0.1	
<b>3</b>	0.1		0.1	
<b>4</b>	0.1		0.1	
<b>5</b>	0.1		0.1	
<b>6</b>	0.1		0.1	
<b>7</b>	0.1		0.1	
<b>Total</b>	.....	Volume of Na <sub>2</sub> CO <sub>3</sub> solution added to reach pH 10.0	.....	Volume of CH <sub>3</sub> COOH solution added to reach pH 4.0

Marks will be given based on the volume of the solution required to get the desired pH in each case.

Range of volume: 0.3 - 0.5 ml for each solutions [1 x 2 = 2.0]

0.2 - 0.3 ml or 0.5-0.6 ml for each solutions [0.5 x 2 = 1.0]

Other values = zero.

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## Experimental Tasks



Time : 3 hrs

Marks : 40

## B.Q3 Observation Table B.2

[2.0 Marks]

	Stepwise addition to 40 ml Milk			
	Sodium carbonate solution		Acetic acid solution	
	Stepwise volume added in ml	pH value	Stepwise volume added in ml	pH value
<b>1</b>	0		0	
<b>2</b>	0.5		0.5	
<b>3</b>	0.5		0.5	
<b>4</b>	0.5		0.5	
<b>5</b>	0.5		0.5	
<b>6</b>	0.5		0.5	
<b>7</b>	0.5		0.5	
<b>Total</b>	.....	Volume of Na <sub>2</sub> CO <sub>3</sub> solution added to reach pH 10.0	.....	Volume of CH <sub>3</sub> COOH solution added to reach pH 4.0

Marks will be given based on the volume of the solution required to get the desired pH in each case.

Range of volume: 1.5 - 2.5 ml for each solutions

[1 x 2 = 2.0]

1.0 - 1.5 ml or 2.5-3.0 ml for each solutions [0.5 x 2 = 1.0]

Other values = zero

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## Experimental Tasks



Time : 3 hrs  
Marks : 40

### Questions:

#### B.Q4

[1.0 Mark]

Comparing the observations in Table B.1 and B.2 which of the following statements describe the role played by milk?

- a) You require more acetic acid solution to lower the pH of milk to 4 than to lower the pH of water to 4.

True (T)

False (F)

- b) Less sodium carbonate solution is required to raise the pH of milk to 10 than to raise the pH of water to 10

True (T)

False (F)

#### B.Q5

[1.0 Mark]

As compared to water, milk resists change in pH of the resulting solution when acetic acid is added. This is because components of milk:

- a) lead to increase in concentration of the  $\text{OH}^-$  ions in the resulting solution
- b) prevent increase in concentration of the free  $\text{H}^+$  ions in the resulting solution
- c) lead to decrease in concentration of  $\text{CH}_3\text{COO}^-$  ions in the resulting solution

Write the correct option in the appropriate box

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## Experimental Tasks



Time : 3 hrs  
Marks : 40

### B2 Enzymatic digestion of Milk protein

B.Q6.A

$I_w =$

[0.5 Mark]

$I_w > 0.6 \text{ mA}$  [0.5]

$I_w = 0.2-0.6 \text{ mA}$  [0.25]

B.Q6.B

$I_o =$

[0.5 Mark]

Anything below 0.2mA or the value based on the curve

[0.5]



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Marks : 40**B.Q7 Observation Table B.3****[2.0 Marks]**

	<b>Time (in s)</b>	<b>Current (in mA)</b>		<b>Time (in s)</b>	<b>Current (in mA)</b>
1.			16.		
2.			17.		
3.			18.		
4.			19.		
5.			20.		
6.			21.		
7.			22.		
8.			23.		
9.			24.		
10.			25.		
11.			26.		
12.			27.		
13.			28.		
14.			29.		
15.			30.		

20 Readings [0.1 x 20 = 2.0]

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## Experimental Tasks

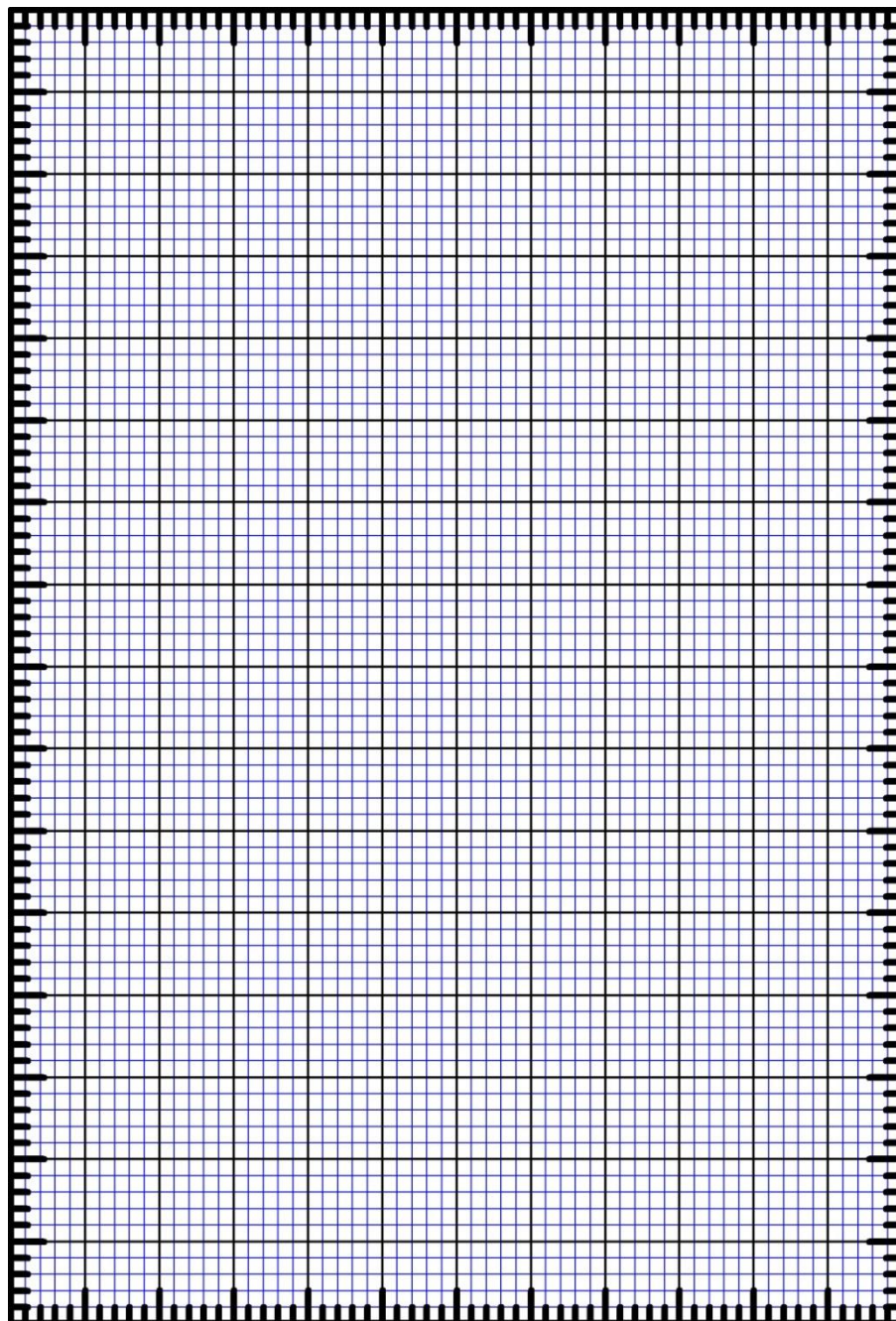


Time : 3 hrs  
Marks : 40

B.Q8

Graph plotting:

[3.5 Marks]



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## Experimental Tasks



Time : 3 hrs  
Marks : 40

Plot a graph of current versus time.

Labels on each axis

[0.25]

Scale on each axis

[0.25]

Marks for occupying more than 60 % of graph paper

[0.25]

Drawing smooth curve

[0.25]

Based on the plot, within  $I_w$  and  $I_o$  ranges and the nature of the curve

[0.1 x 20 = 2.0]

### B.Q9

[1.0 Mark]

Mark a point K on the graph paper where the casein concentration is maximum, a point L where casein concentration is minimum and a point M where the casein concentration is half-way between the maximum and minimum values.

Based on the plot, all 3 correct

[1.0]

2 correct

[0.5]

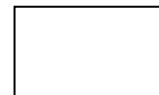
1 correct

[0.25]

### B.Q10

[1.0 Mark]

If the increase in current is proportional to the amount of digested casein and maximum current represents complete digestion of casein, deduce from the graph the time taken for digestion of 50% casein.



Time taken based on the value of M in the above question

[1.0]

Other values = Zero

Country Team ID Code: 1) 2) 3) International Junior Science Olympiad,  
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Marks : 40**B3 Estimation of calcium content in milk****B.Q11 Observation Table B.4****[3.5 Marks]**

Sr. No.		Titration I	Titration II	Titration III
1	Initial burette reading ml			
2	Final burette reading ml			
3	Difference in burette reading ml			

Average burette reading: (A).....ml of 0.001 M Na<sub>2</sub>EDTA

Average difference in burette reading (m1) = (6.8 – 7.2) [2.0 marks]

Average difference in burette reading (m1) = (6.6 – 7.4) [1.5 marks]

Average difference in burette reading (m1) = (6.2 – 7.8) [1.0 marks]

Average difference in burette reading (m1) = (6.0 – 8.0) [0.5 marks]

Any other Average difference in burette reading: [0.0 marks]

An average value deduced using anomalous reading will result in deduction of 0.25 mark.

**B.Q12****[1.0 Mark]**Deduce the amount in milligrams of Ca<sup>2+</sup> per 10 ml of the diluted solution (the atomic weight of Ca is 40).

0.756 mg based on 7.0 ml in the previous question or for correctly calculated value based on the previous question [1.0]

Wrong calculations [0.5]

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Time : 3 hrs

Marks : 40

## Experimental Tasks

Task **C** : Extraction of lycopene from tomato

Total Marks: 6.0

Absorbance of extract:

C.Q1 Observation Table C.1

[3.5 Marks]

	Current in mA	Blue LED	White LED
1	$I_s$	0.8 – 1.0 mA	0.6 mA and above
2	$I_l$	0.0 – 0.08 mA	~ 0.4 mA
Percentage of light transmitted		0 to 8% [0.25]	30 – 70% [0.25]

Is (Blue LED) 0.8 – 1.0 mA

[1.5]

Is (Blue LED) 0.6 – 0.8 mA and 1.0 – 1.2 mA

[0.75]

Is (White LED) 0.6 mA and above

[1.5]

Is (White LED) 0.3-0.6 mA

[0.75]

Percentage transmitted in each case

[2 x 0.25 = 0.5]

## Questions

C.Q2

[1.0 Mark]

If the test tube **Ab** (containing the solvent) was removed from between the photodiode and the white LED,

- The current measured would be less than  $I_s$
- The current measured would be more than  $I_s$
- The current measured would be equal to  $I_s$

Write the correct option in the box below.

a)

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Marks : 40

## Experimental Tasks



### C.Q3

[1.5 Marks]

Which of the following can you *deduce from your observations in the experiments* on transmitted light. Indicate your answers as YES (Y) or NO (N) in the table below.

- a) Lycopene absorbs more blue light relative to other parts of the visible spectrum.
- b) Lycopene preferentially absorbs light in the red and yellow parts of the spectrum.
- c) Lycopene is an antioxidant.
- d) Red and yellow parts of the spectrum are absorbed relatively less compared to blue parts of the spectrum.
- e) Blue light passes through the solution better compared to red light.
- f) Lycopene absorbs light equally across the spectrum.

a)	Y
b)	N
c)	N
d)	Y
e)	N
f)	N

Each correct option

[0.25]