T.C.
GEBZE TECHNICAL UNIVERSITY
PHYSICS DEPARTMENT

PHYSICS LABORATORY I
EXPERIMENT REPORT

THE NAME OF THE EXPERIMENT

Newton's Second Law of Motion

PREPARED BY

NAME AND SURNAME :

STUDENT NUMBER :

DEPARTMENT :

GROUP NO :

TEACHING ASSISTANT :

DATE OF THE EXPERIMENT : ….. / ….. / ……….

DATE : ….. / ….. / ……….

Signature:

Equipment

-Air track with standard accessories

-Air blower

-Two **SpeedGates** incl. connection cable

-Two mounting brackets for **SpeedGate**

- Weights

-Thread

Experimental procedure

Figure 1: *The experimental set-up of Newton's second law of motion.*

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Figure 2: SpeedGate

1. On a SpeedGate screen, the upper line is switched using the single dash button **I**, and the lower line is changed using the double dash button **II** . To reset the values on the screen, the **X** button is pressed.
2. Configure SpeedGate-A with "Speed" on the upper line using the single dash button **I**, and "Previous Value" on the lower line using the double dash button **II**.
3. Configure SpeedGate-B with "Speed" on the upper line using the single dash button **I**, and "Interval Before" on the lower line using the double dash button **II**.
4. In this configuration, a long press of the **X** button on the Speed Gate-A after the measurements will reset both.
5. Add three 10g and one 5g weighted masses to the holder weighing 2 grams.
6. Record the total masses as m_{glider} and m_{holder} in Table 1, where the mass of the glider (m_{glider} = 200 gr)
7. Open by pressing the red button located behind the air pump.
8. After the sled passes through two sensors and hits the bumper, write the value written under "Interval Before" in SpeedGate-B into the "Interval Time" column of Table 1.
9. Next, calculate the average of the "Speed" values in both SpeedGate-A and SpeedGate-B, then record this average under the "Velocity" column in Table 1.
10. Then reduce weight of the holder by 5 gr for each measurement, add the weights you have taken from holder to the glider, repeat the procedure until 5 gr mass remains on the holder.

    (So there will be no change in the weight of your system M_{system}.)

Table 1 : *Measured intervals time and average velocity*

	Total mass of m_{glider} (gr) (=m_{glider} +5 g)	Total mass of m_{holder} (gr) (=m_{holder} -5 g)	Interval Time (ms)	Average Velocity (m/s)
1				
2				
3				
4				
5				
6				
7				

Write the masses of the glider m_{glider} and the holder m_{holder} in Table 1, paying attention to the added weights on them. The mass of the theoretical system $M_{system\ Theo}$ is the sum of the holder m_{holder}, the glider m_{glider} and the weights attached to them.

Please calculate the experimental accelerations ($\mathbf{a_1}$, ... , $\mathbf{a_7}$) according to the measured intervals and velocities saved in **Table 1**. Write down the intermediate steps.

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A reminder :

$$v_0 = 0, \text{ mass is at rest.} \quad v = v_0 + a\,t \quad \Rightarrow \quad a = \frac{v}{t}$$

1) **a_1** = ……………………………………………………………………………

2) **a_2** = ……………………………………………………………………………

3) **a_3** = ……………………………………………………………………………

4) **a_4** = ……………………………………………………………………………

5) **a_5** = ……………………………………………………………………………

6) **a_6** = ……………………………………………………………………………

7) **a_7** = ……………………………………………………………………………

A reminder :

$$F = m_{holder}\ g$$

where **g** is gravitational acceleration (**$g = 9.81\ m/s^2$**),

1) **F_1** = ……………………………………………………………………………

2) **F_2** = ……………………………………………………………………………

3) **F_3** = ……………………………………………………………………………

4) **F_4** = ……………………………………………………………………………

5) **F_5** = ……………………………………………………………………………

6) **F_6** = ……………………………………………………………………………

7) **F_7** = ……………………………………………………………………………

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Draw a graph using the calculated acceleration and force values above. Note that acceleration values are on ***the x-axis*** and force values are on ***the y-axis***.

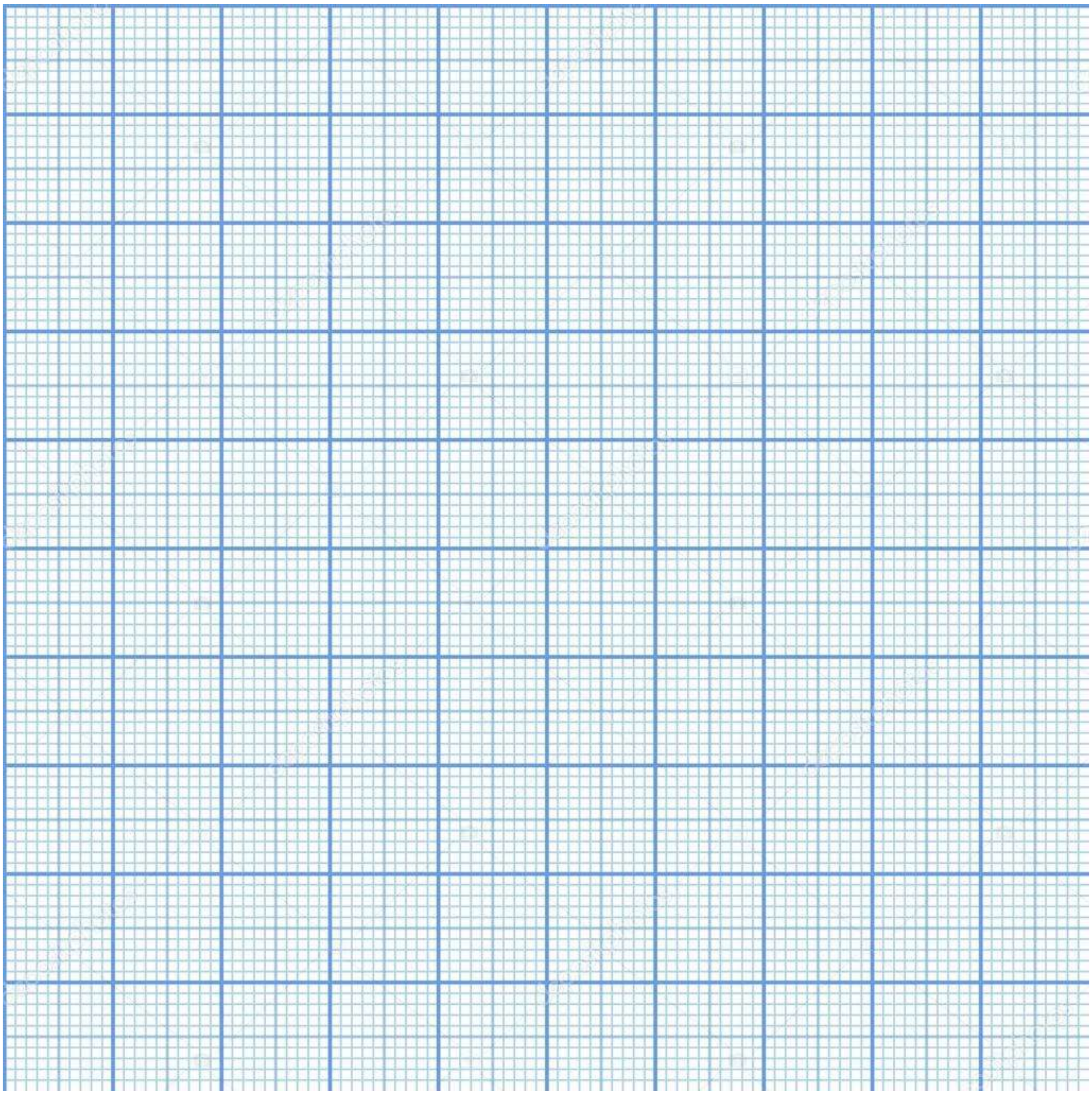

Figure 2: *F*-*a* graph

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Calculate the slopes of the lines that fit the data points on your F vs. a graphs, which are plotted in the previous step. In the following formulae, the x_i 's represent the acceleration a, while the y_i's represent the force F exerted on the system. n is the number of data used in calculations.Write down the intermediate steps.

$$\sum_{i=1}^{n} x_i y_i =$$

$$m = \frac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2} =$$

$$\sum_{i=1}^{n} x_i^2 =$$

Using Eq. (4), this slope gives the experimental total mass of the system M_{system},

where $M_{system} = m_{holder} + m_{glider}$.

$M_{system\ Exp}$ = ………………………………………………

$M_{system\ Theo}$ = ………………………………………………

$$\%error = \left| \frac{M_{system\ Theo} - M_{system\ Exp}}{M_{system\ Theo}} \right| 100 =$$

➯ Write down and explain Newton's laws of motion !

N_1)……………………………………………………………………………………

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……………………………………………………………………………………………

N_2) ……………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

N_3) ……………………………………………………………………………………

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Conclusion, Comment and Discussion:

(**Tips**: Give detail explanation about what you've learned in the experiment and also explain the possible errors and their reasons.)

-Give detail explanation about what you've learned in the experiment

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-Explain the possible errors and their reasons in the experiment

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Questions

Q1) In the calculations, why only the mass of m_{holder} was taken into account when calculating the force F?

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Q.2) Could the friction on the moving object truly be ignored in this experiment? Explain!

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