Motions
Uniformly accelerated motion

Relationship between displacement and time - Measurement using an electronic stopwatch

Objects of the experiment
1. Measuring the time $t$ required by a body for covering a path $s$
2. Representing the relation between path and time in an $s$-$t$-diagram

Setup

Carrying out the experiment
- Align the track horizontally.
- Adjust the voltage at the holding magnet so that the trolley is just held.
- Define the starting point with the movable interrupter flag on the trolley, and read it from the scale of the track.
- Position the light barrier at a distance of 10 cm from the starting point.
- Release the motion by pressing the START/STOP key at the stopwatch.
- Wait until the interrupter flag passes the light barrier, and read the time from the stopwatch.
- Reset the stopclock to zero by pressing the RESET key.
- Position the light barrier at distances of 22.5 cm, 40 cm, 62.5 cm, and 90 cm from the starting point.
- Repeat the measurement for each distance.

Measuring example

<table>
<thead>
<tr>
<th>Path $s$ in cm</th>
<th>Path $s$ in cm</th>
<th>*Time $t$ in s</th>
<th>Time $t$ in s</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$1^2$·10</td>
<td>2.1</td>
<td>1.21</td>
</tr>
<tr>
<td>22.5</td>
<td>$1.5^2$·10</td>
<td>3.2</td>
<td>1.5·2.1</td>
</tr>
<tr>
<td>40</td>
<td>$2^2$·10</td>
<td>4.2</td>
<td>2·2.1</td>
</tr>
<tr>
<td>62.5</td>
<td>$2.5^2$·10</td>
<td>5.2</td>
<td>2.5·2.1</td>
</tr>
<tr>
<td>90</td>
<td>$3^2$·10</td>
<td>6.2</td>
<td>3·2.1</td>
</tr>
</tbody>
</table>

* Time $t$: rounded mean value from three measured values

Evaluation

In uniformly accelerated motion, the path increases proportionally to the square of the time: $s \sim t^2$.

From the measured values the mean velocity $\bar{v}$ can be calculated:

$$\bar{v} = \frac{s}{t}.$$