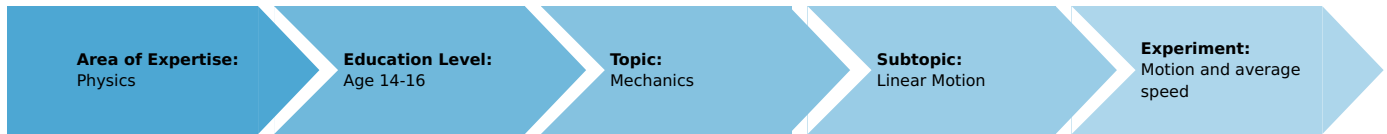


Motion and average speed (Item No.: P6200100)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Tablet PC with DigiCart App

Experiment Variations:

Keywords:

Kinematics, Inclined plane, Velocity, Average velocity

Information for teachers

Introduction



Overview of experimental setup.

Educational objective

In this experiment the students learn something about the physical significance of speed. They will also learn about the concept of average speed.

Task

Record a path-time diagram via the DigiCart app. Select the measuring range and calculate the average velocities within each section for four given interval subdivisions (sections).

Prior knowledge

This experiment does not require any prior knowledge.

Principle

Speed is one of the basic concepts of kinetics. It indicates how fast an object moves in space and is measured in meters per second.

The concept of speed is based on the average speed. If Δx denotes the change of position in a period of time Δt , you can use

$$\bar{v} = \frac{\Delta x}{\Delta t}$$

to calculate the average speed \bar{v} .

Equipment

Position No.	Material	Order No.	Quantity
1	DigiCart white		1
2	1.2 m track		1
3	Height adjustable holder		1
4	DigiCartAPP		1

Safety information

For this experiment, the general instructions for safe experimentation in science teaching apply.

Introduction

Application and task

Application

Everything in the world is on the move. It is therefore worth taking a closer look at the concept of speed.

In this experiment you will learn something about the physical significance of speed. You will also learn about the concept of average speed.

Task

Record a path-time diagram via the DigiCart app. Select the measuring range and calculate the average velocities within each section for four given interval subdivisions (sections).

Equipment

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Set-up and procedure

Set-up



Figure 1: Overview of experimental setup.

- Bring the track into a horizontal position. Now lift one end of the track by about 10 cm using the height-adjustable holder. The lane is now inclined so that the DigiCart can roll down (see Figure 1).
- Start the DigiCart App.
- Select experiment 1 from the overview. The measurement window opens.
- Connect the DigiCart to the app (see Figure 2). Two steps are required. First, press the ON switch on the DigiCart for at least 3 seconds. Then open the connection window in the app via the bluetooth symbol (1.). The DigiCart should now be displayed there. If not, you can update the list by clicking on scan (2.). Now, one chooses the DigiCart from the list and establishes the connection via the connect button (3.). You can now hide the window again by pressing the close button (4.).

Bewegung und Durchschnittsgeschwindigkeit

P6200100

Intervall-Werte:

Strecke $\Delta x =$ 0.00 m

Zeit $\Delta t =$ 0.00 s

Mittlere Geschwindigkeit $v =$ 0.00 m/s

Sektionen	Mittlere Sektionsgeschwindigkeiten				
2					
5					
10					
20					

Figure 2: Connecting to the DigiCart.

Procedure

- Figure 3 shows the steps for the measurement process.
- The DigiCart is positioned and held in the elevated area of the lane.
- Start the measurement by clicking on start measurement (1.).
- Let the DigiCart roll down the track.
- Stop the measurement by clicking on stop measurement (2.) as soon as the DigiCart has arrived at the bottom.
- Select a time interval in the path-time diagram in which the DigiCart has moved undisturbed by clicking on select measuring range (3.). The selection is made by swiping over the interval with your finger.
- Then click on the save icon (4.).
- By clicking the save icon, a new menu appears automatically at the bottom of the screen.

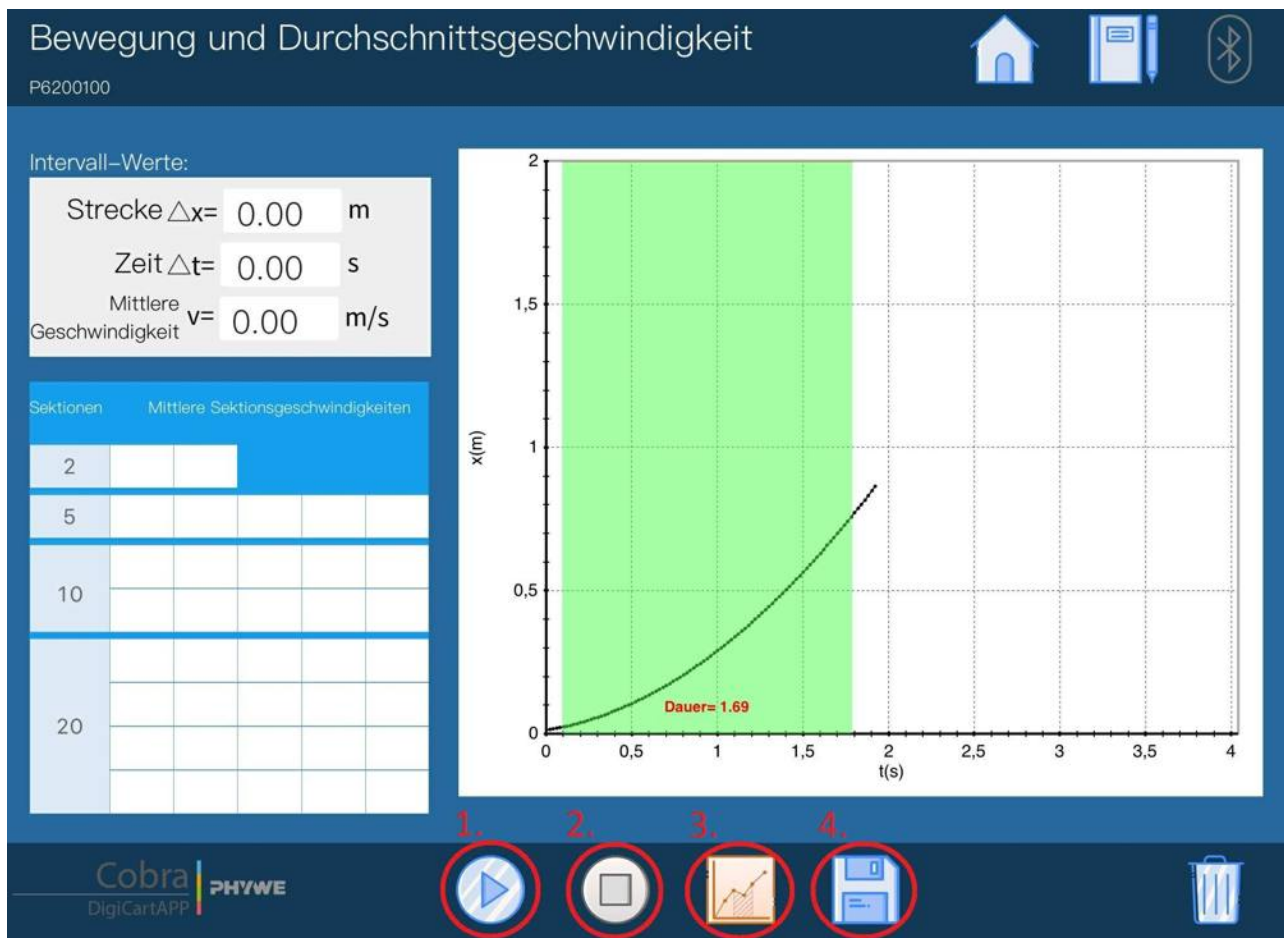


Figure 3: Measurement procedure.

Evaluation

- Figure 4 shows the steps for the evaluation.
- The interval values are automatically calculated and displayed (1.).
- By tapping on the button with the number 2, the selected measuring range is divided into two equally sized sections (2.).
- Click on the save button. The average velocities within the two sections are calculated and entered into the left table (3.).
- Repeat the last two steps for the buttons with the numbers 5, 10 and 20. The table should then be completely filled with values.

If you pick a case with a certain number of sections (for example 10), you will see that the calculated mean velocities are not constant. Rather, an increase in speed can be observed. This observation is independent of the number of sections. However, with a higher number of sections, the jumps between the individual sections become smaller.



Figure 4: Evaluation procedure.