Velocity and acceleration with Cobra DigiCart

Physics	Mechanics	Dynamics & Motion

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/605c4cc739df4d00037ecf02

Teacher information

Application

Great acceleration during rocket launch

Velocity and acceleration

In an airplane, you're pressed into your seat as you take off. Satellites orbit the earth. This all has to do with acceleration.

In this experiment, students learn about the physical meaning of acceleration. The experiment assumes that the students have already dealt with the topic of speed.

Teacher information (1/2)   **PHYWE**

Prior knowledge	This experiment requires the concept of speed.
	Acceleration is one of the fundamental concepts in the science of motion. It indicates how fast an object changes its velocity and is measured in the unit $\frac{m}{s^2}$.
Scientific principle	The concept of acceleration is based on average acceleration. When Δv designates the change in velocity over a period of time Δt, you can use $\bar{a} = \frac{\Delta v}{\Delta t}$ to calculate the average acceleration $\bar{a}$.

Teacher information (2/2)   **PHYWE**

Learning objective	In this experiment, students learn about the physical meaning of acceleration.
Task	Students record several velocity-time graphs via the app, select a measurement range, and have the acceleration calculated for the recorded curves.

Safety instructions

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⚠️

The general instructions for safe experimentation in science lessons apply to this experiment.

PHYWE

Student Information

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Motivation

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Great acceleration during rocket launch

Velocity and acceleration

In an airplane, you're pressed into your seat as you take off. Satellites orbit the earth. This all has to do with acceleration.

In this experiment, you will learn about the physical meaning of acceleration. The experiment assumes that you have already dealt with the topic of speed.
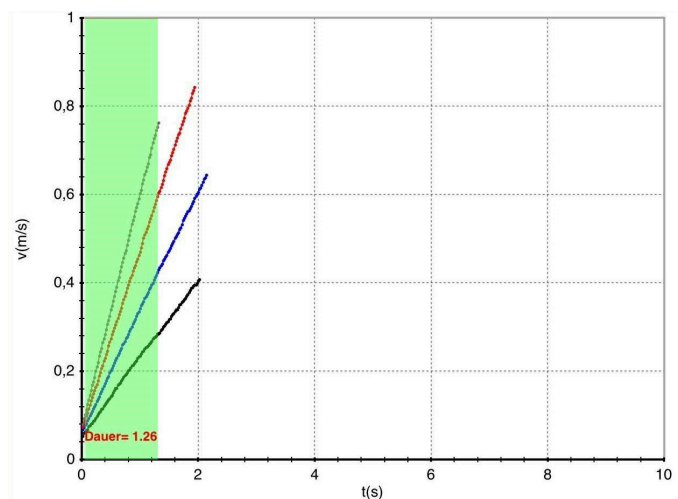

Task

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1. Record multiple velocity-time graphs via the app.

2. To do this, select a measuring range and have the acceleration calculated for the recorded curves.

Consider

average acceleration:

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

Velocity-time diagram - example

Equipment

Position	Material	Item No.	Quantity
1	Cobra DigiCart Basic Set	12940-77	1
2	Cobra DigiCartAPP	14582-61	1

Set-up (1/2)

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Setup overview

- Bring the track into a horizontal position.

- Now raise one end of the track by about 3 cm using the height-adjustable holder.

- The track is now inclined so that the DigiCart can roll down (illustration).

- Start the DigiCart app and select experiment 3. The measurement window opens.

Set-up (2/2)

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Connect the DigiCart

- Connect the DigiCart to the app.

- First, the ON switch on the DigiCart must be pressed 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 tap on the DigiCart from the list once and establish the connection via the Connect button (3.). The window can now be hidden again via the Close button (4.).
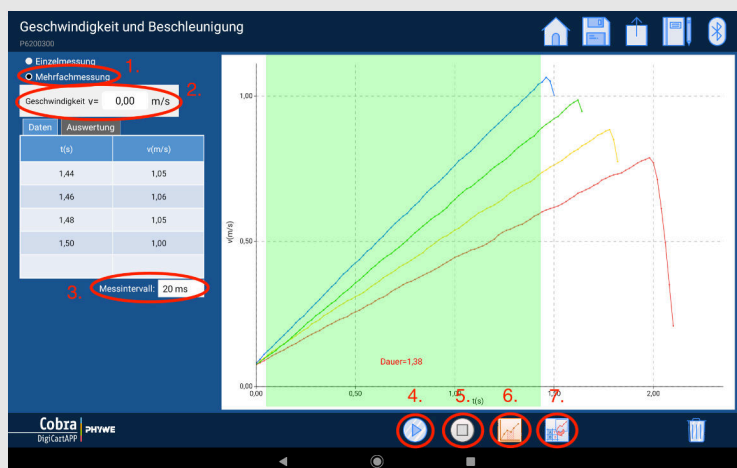
Procedure (1/4)

PHYWE
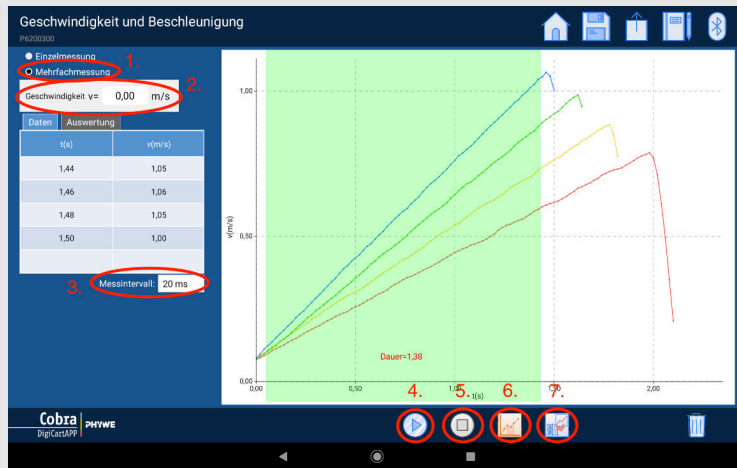
Measurement procedure

- The figure shows the steps for the measurement process.

- Since several measurements are made for this experiment, select Multiple measurements in the upper left window (1.).

- The instantaneous velocity is shown in the velocity display below (2.).

- Before each measurement the time between two measuring points can be selected (3.).
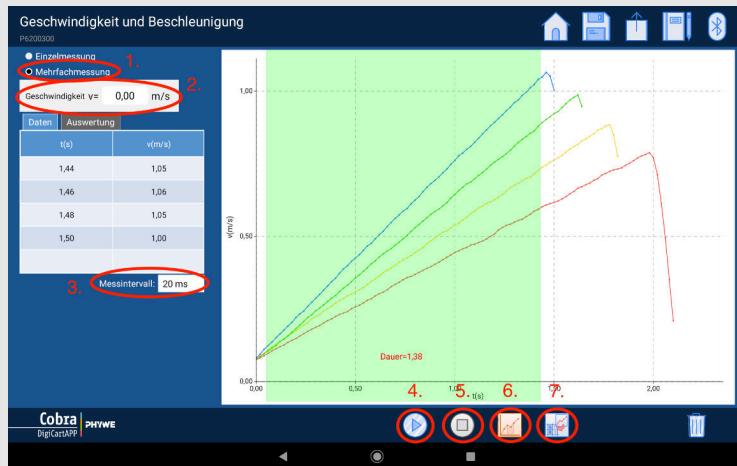
Procedure (2/4)

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Measurement procedure

- The DigiCart is positioned and held in the elevated area of the track.

- Start the measurement by clicking on "Start measurement" (4.).

- Let the DigiCart roll down the track.

- Stop the measurement by clicking on "Stop measurement" (5.) as soon as the DigiCart reaches the bottom.

- Raise one end of the track another 3 cm using the height-adjustable holder and repeat the last 4 steps.

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Procedure (3/4)

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Measurement procedure

- In this way, up to four velocity-time diagrams can now be recorded.

- On "Select measuring range" (6.) select a point in time in the position-time diagram at which the instantaneous velocity is calculated. The selection is made by crossing over the interval with the finger.

- End the measurement by clicking on the "Save" button (7.).

Procedure (4/4)

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Procedure for the evaluation

- The illustration shows the steps for the evaluation.

- The table on the left side (1.) shows the change in velocity as well as the time interval for each of the recorded curves within the selected measuring range.

- The acceleration is calculated from this.

- If the measurement is to be repeated, the data can be deleted with the help of the "Delete" button (2.) and a new series of measurements can be started.

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Report
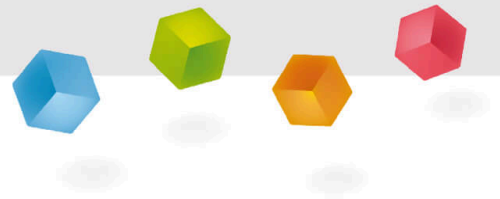
Task 1

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Which of the following statements agree with your observations?

☐ The greater the slope, the lower the acceleration.

☐ Since the acceleration is equal to the change in velocity per time interval, it increases from case to case.

☐ The change in velocity in the measuring range increases from case to case as the path becomes steeper and steeper.

✓ Check

Task 2

PHYWE

Which physical quantity is responsible for the change in velocity?

| The velocity indicates the change in velocity per distance. |

| The acceleration indicates the change in velocity per distance. |

| The velocity indicates the change in velocity per time. |

| The acceleration indicates the change in velocity per time. |

Task 3

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www.giphy.com

Drag the correct words into the gaps!

The _____ is that acceleration which the body assumes at a _____ time. For the calculation of the _____ one needs _____ points of time, start and end.

| instantaneous acceleration | | two |

| average acceleration | | specified |

✔ Check

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Task 4

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What problem related to average velocity occurs with average acceleration?

The concept of acceleration is no longer based on average acceleration but is influenced by the environment.

Details of the movement are lost, since only the start and end values are included in the calculation. Everything that happens in between is ignored.

The change in velocity in the measuring range increases from case to case as the path becomes steeper and steeper.

Slide	Score / Total
Slide 17: Observations	**0/2**
Slide 18: Change of velocity	**0/5**
Slide 19: Correlation acceleration	**0/4**
Slide 20: Problem with movements	**0/1**
Total	**0/12**

👁 Solutions   🔄 Repeat