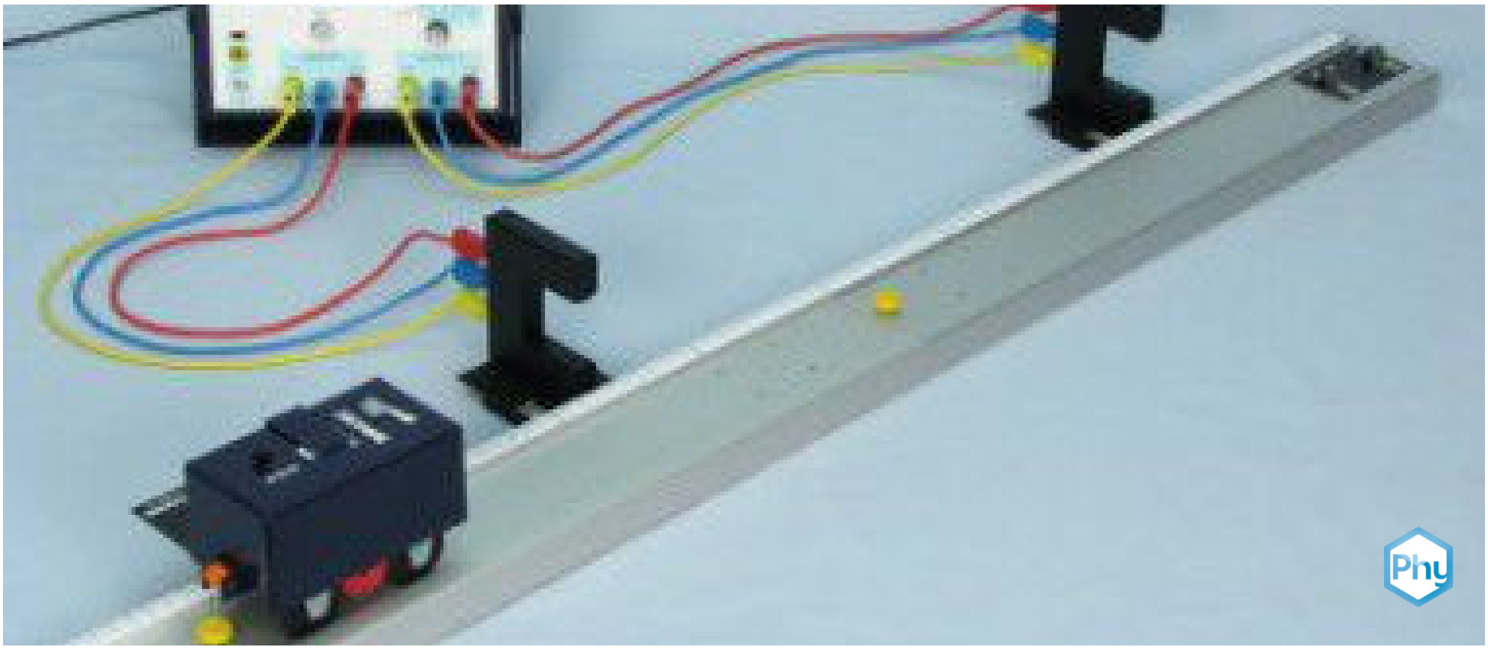
Uniform linear motion with thetimer 2-1



Physics | Mechanics | Dynamics & Motion

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

This content can also be found online at:

http://localhost:1337/c/5fda7f6db5c96200036a6704

Teacher information

Application

Conveyor belt

We find uniform rectilinear movements in technology wherever something is moved uniformly from one place to another, such as in conveyor belts: Here an object or material moves in a constant direction at a constant speed, which is specified by the belt.

By using two light barriers, the average speed of an object between the two barriers can be determined. This measurement method can be used in a slightly more complex way, for example, to measure the average speed of individual vehicles in road traffic over a longer section of road.

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Other teacher information (1/2)

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Prior knowledge

The students should know how a light barrier works. In addition, initial experimental experience in handling the Timer 2-1 is helpful.

Notes on structure and implementation:

The speed of the measurement trolley can be quite dependent on the state of charge of the batteries/accumulators of the measurement trolley.

Scientific principle

The measuring carriage is driven by an electric motor and travels over the roadway at a constant speed. Accordingly, the same shadowing times and thus speeds are always measured with a constant speed setting of the measuring carriage.

Other teacher information (2/2)

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Learning objective

Students should work out the properties of uniform rectilinear motion and experimentally learn speed as a ratio of s/t from the distance and time measurement (distance-time diagram) of a carriage with drive. The students should recognise that the speed within the measured distance is constant in this experiment.

Tasks

1. Measurement of the time taken by the experimental trolley to cover a given distance using two light barriers at the beginning and end of the respective distance.
2. Calculation of the speed from the measured time between the interruption of one and the other light barrier and the distance travelled.
3. Creation and discussion of the path-time diagram.

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Safety instructions

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

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Student Information

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Motivation

Conveyor belt

As you know, speed refers to the movement of an object and implies how quickly or slowly it reaches one place from another. In the case of vehicles on the road, the speed is constantly changing. A typical example of a constant speed movement is a conveyor belt, which is an effective means of transporting all kinds of goods in many areas.

They are used, for example, to convey rock or coal from mines or in the logistics of large transport companies. The transported material moves on the conveyor belt at a constant speed. In this experiment you will learn how to determine a uniform straight-line motion.

Tasks

1. Measure the time t required for the experimental trolley to travel a certain distance s, with the help of two light barriers at the beginning and end of the respective track.
2. Calculate the quotient s/t from the measured time t between the interruption of the light barriers and the path length s.
3. Present the determined regularities in graphical form.

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Equipment

Position	Material	Item No.	Quantity
1	Car, motor driven	11061-00	1
2	Shutter plate for car, motor driven	11061-03	1
3	PHYWE Timer 2-1	13607-99	1
4	Light barrier, compact	11207-20	2
5	Adapter plate for Light barrier compact	11207-22	2
6	Connecting cord, 32 A, 1000 mm, red	07363-01	2
7	Connecting cord, 32 A, 1000 mm, yellow	07363-02	2
8	Connecting cord, 32 A, 1000 mm, blue	07363-04	2
9	Track, l 900 mm	11606-00	1

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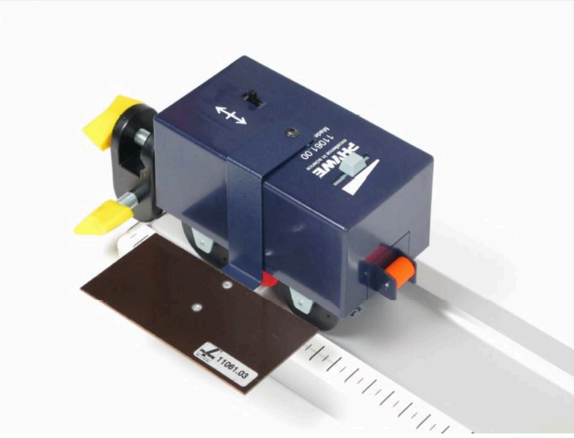
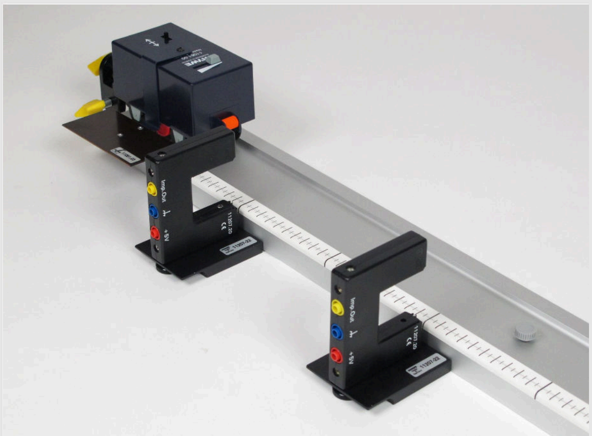
Set-up (1/4)



Fasten shut-off panel

Attach the shade screen to the test car and then place it at one end on the flat roadway.

Set-up (2/4)



Connect light barrier with adapter plates

Screw the adapter plates to the two forked light barriers in such a way that they can be easily positioned next to the roadway and the diaphragm on the carriage can pass through the light barriers without bumping into them.

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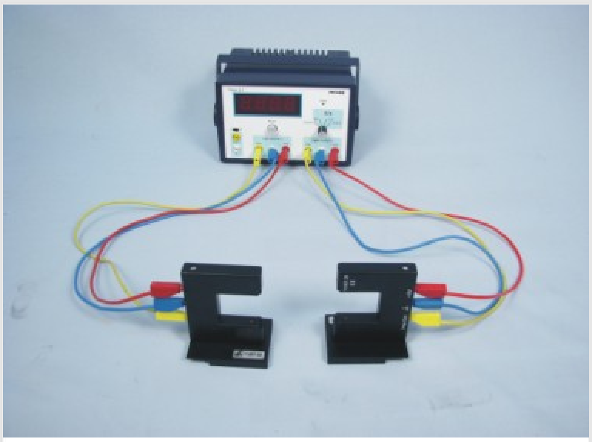
Set-up (3/4)

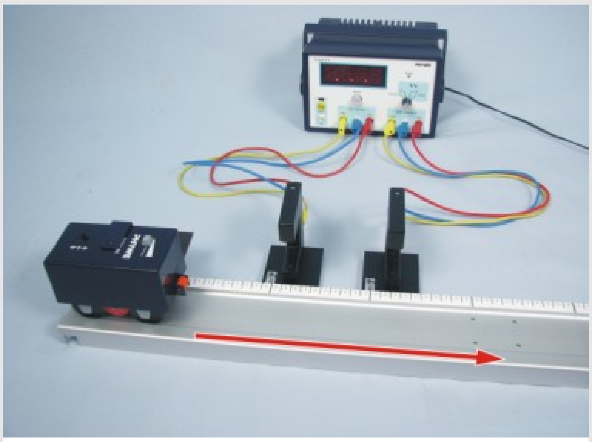


Connect forked light barrier to timer 2-1

Connect both light barriers to the timing device.

Set the slide switch above the field labeled "Start" on the timing device.

Set-up (4/4)



Adjusting the device

Set the rotary switch to the third position from the left. Then the device displays the time that elapsed between the interruption of the first and the second light barrier. In this experiment, this is the time it took the car to travel the distance between the two light barriers.

Set up the light barriers at a distance of 10 cm from each other. The starter light barrier must be the one that is closer to the measuring carriage. In addition, the starter photocell should be at least a few centimetres away from the measuring trolley. To measure the distance between the light barriers, you can orientate yourself on the centre seams of the light barriers and use the measuring tape on the track.

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Procedure (1/3)

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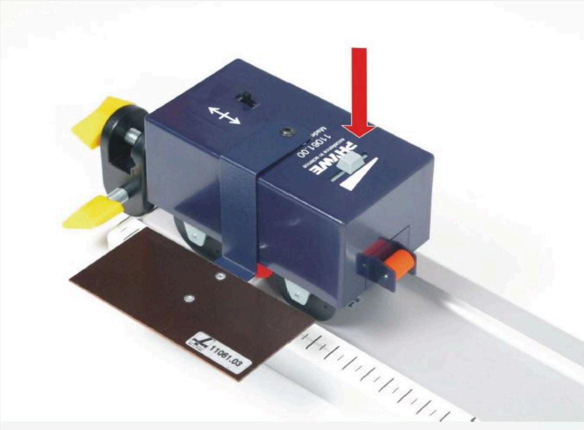

Adjusting the speed on the trolley

- Set the speed slider on the trolley to the lowest speed (left stop).
- Press the "Reset"-button on timer 2-1.

Procedure (2/3)

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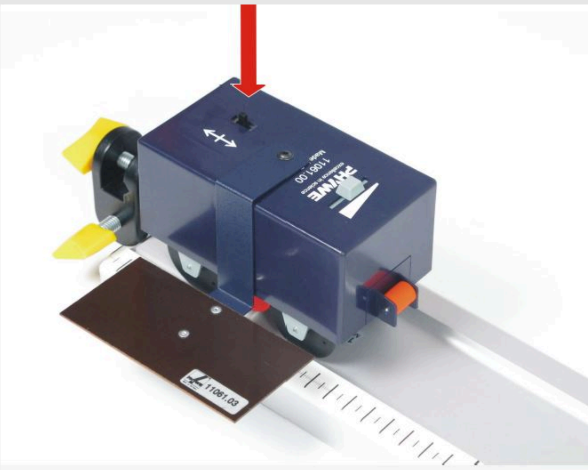

Starting the car

- Now start the car with the direction switch in the desired direction.
- After the cover on the measuring carriage has passed both light barriers, the timer 2-1 displays the measured time.
- Note the measured value in the report in Table 1.

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Procedure (3/3)

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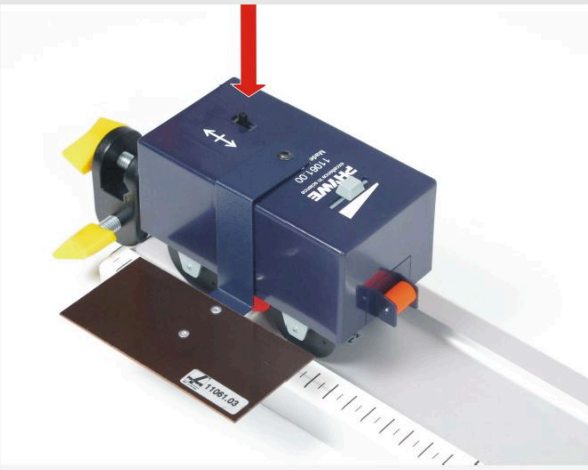

Starting the car

- Repeat the experiment for the distances s of 20 cm, 30 cm, 50 cm and 60 cm. Also note these measurements in the report in Table 1.
- Now set the speed controller on the measuring car approximately to the middle position.
- Measure the times taken by the trolley for the measurement distances of 10 cm, 20 cm, 30 cm, 50 cm and 60 cm.
- Note these readings in Table 1.

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Report

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Table 1

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Enter the measured values for the travel times at the low speed ($t_1\ [s]$) and at the average speed ($t_2\ [s]$) in the respective table. Then calculate from the routes s and the corresponding travel times t the speed as quotients $v = s/t$ and enter them as well.

$s\ [cm]$	$t_1\ [s]$	$v_1\ [cm/s]$
10		
20		
30		
50		
60		

$s\ [cm]$	$t_2\ [s]$	$v_2\ [cm/s]$
10		
20		
30		
50		
60		

Task 1

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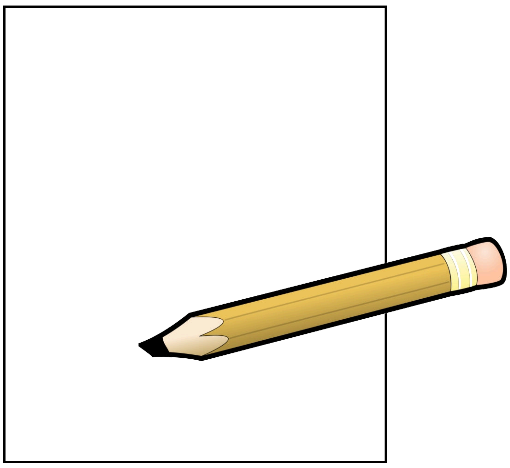
Now take a sheet of paper and create a diagram on it. In this diagram, you represent the distance traveled s ($y$axis) as a function of time t ($x$axis).

Draw the curves for the low and medium speed.



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Task 2

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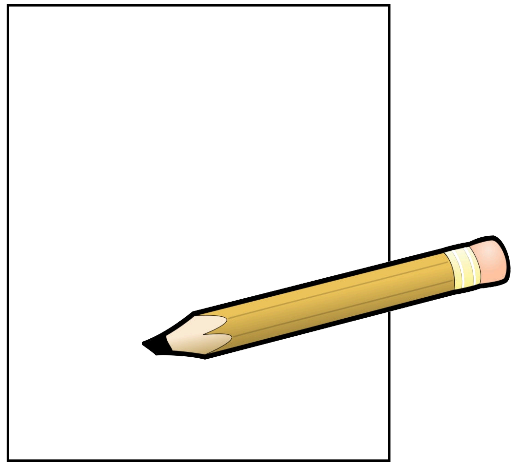
What is the approximate shape of the curve?

- Linear Function.
- Quadratic function.
- Constant function.

Check



Task 3

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Which of the statements is true for the path-time diagram found?

- The way s is the time t proportional.
- The path travelled s grows square with time t.
- There is no connection between path s and time t.

Check

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Task 4

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In Table 1 you have calculated the speed as the respective ratio $v = s/t$.

Which statements are true for this experiment?

- ☐ The speed depends on the travel time.
- ☐ The greater the speed, the less time is needed to cover the same distance.
- ☐ The greater the travel distance, the greater the speed.
- ☐ The speed within a trip can be considered constant.

Check

Table 2

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This table refers to the partial test with the average speed of the measuring trolley.

Support for the legs listed in the table Δs enter the required times that the measuring carriage needs for these sections in the second column.

To do this, you look up the travel times in Table 1 that the measuring wagon took to reach the respective route and calculate the time difference accordingly. Δt.

Indicate the speed of the section in the third column ($v = \Delta s / \Delta t$).

$\Delta s\ [cm]$	$\Delta t\ [s]$	$v = \Delta s / \Delta t\ [cm/s]$
20 - 10 = 10		
30 - 20 = 10		
50 - 30 = 20		
60 - 50 = 10		

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Task 5

What is the relationship between the diagram sections (for the measurement car at the mean speed in the diagram) and the section speeds calculated in Table 2?

- ○ The diagrams have the same result.
- ○ The diagrams have different results.
- ○ There is no analogy whatever.

Check

Task 6

Which statement is true?

- ○ The term "uniform" has nothing to do with line section speeds.
- ○ The line section speeds differ greatly, which is why the movement is called uniform.
- ○ The line segment velocities are (approximately) equal: There is a uniform movement.

Check

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Slide	Score / Total
Slide 20: Waveform	**0/1**
Slide 21: Path-time diagram (1)	**0/1**
Slide 22: Path-time diagram (2)	**0/2**
Slide 24: Correlation of the test results	**0/1**
Slide 25: Line section speed	**0/1**

Total **0/6**

Solutions Repeat Export text

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