7.1 Uniform Linear Motion

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Printed: Oct 31, 2013 1:20:03 PM
interTESS (Version 13.06 B200, Export 2000)

Task

Task

What does the term "speed" mean?

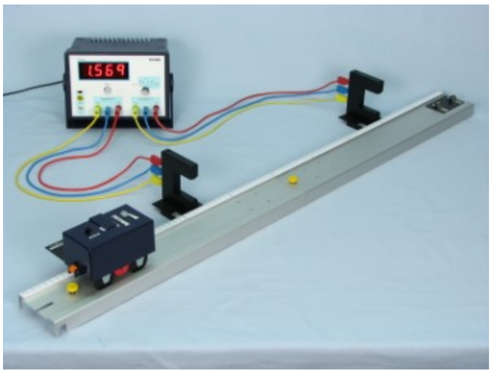
Motion means that a body changes position in space. This change requires a certain amount of time. A position is determined by the indication of distances or lengths.

Measure the time which a car needs to cover a given distance if it moves evenly.

Let the car move faster and determine again the distance and the time.

Express in grafic form the principles which have been established.

Speed is measured by determining the distance and time associated with a motion.



Use the space below for your own notes.

Logged in as a teacher you will find a button below for additional information.

Additional Information

The pupils should develop the notion of linear uniform motion experimentally, by deriving the speed of the powered car from the measurement of the distance and time. The experiment should be carried out with different distances and car speeds.

From the measurement values obtained the pupils should recognize that the speed within the distances measured in these experiments is constant and that therefore the term "uniform" applies to them.

Note

1. This experiment requires the mearurement car with the 11061.00 power train, because the measured distances must be covered repeatedly with a reproducible constant speed.
2. The 1000 mm track is made up of 2 pieces, track 1 (11302.00) and track 2 (11303.00). In addition, track 2 has 2 bars on its underside the halves of which are inserted underneath track 1.

Material

Material from "TESS-Mechanik ME 2" (order nr. 13272.88) and "TESS-Mechanik ME 4" (order nr. 13283.88)

Position No.	Material	Order No.	Quantity
3	Timer 2-1, incl. power supply	13607-99	1
4	Compact photoelectric gate	11207-20	2
5	Foot plate for the compact photoelectric gate	11207-22	2
6	Connecting cable, red, 32 A, 1000 mm	07363-01	2
7	Connecting cable, yellow, 32 A, 1000 mm	07363-02	2
8	Connecting cable, blue, 32 A, 1000 mm	07363-04	2
9	Track 1, *l* = 500 mm	11302-00	1
10	Track 2, l = 500mm	11303-00	1
Additional Material			
1	Car, motor driven	11061-00	1
2	Shutter plate for car, motor driven	11061-03	1

Material required for the experiment

Setup

Set up the track according to Fig 1 + 2.

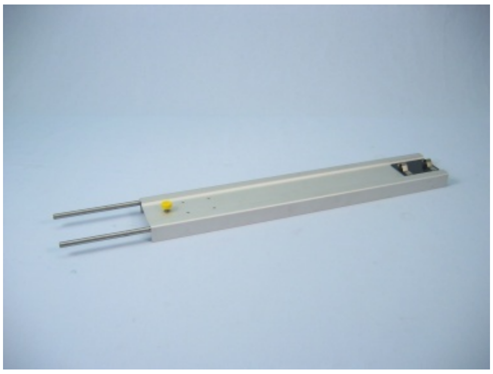


Fig. 1

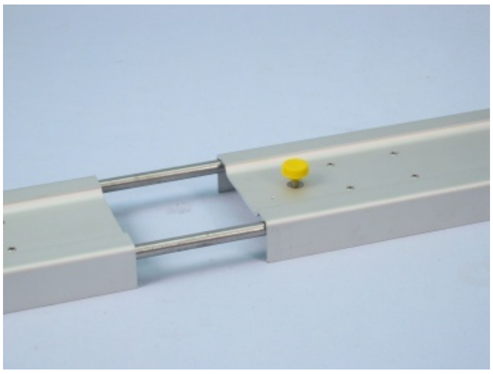


Fig. 2

Screw the foot plates onto the photoelectric gates, so that they can stand next to the track (Fig. 3) and connect the photoelectric gates to the timer (Fig. 4).


Fig. 3

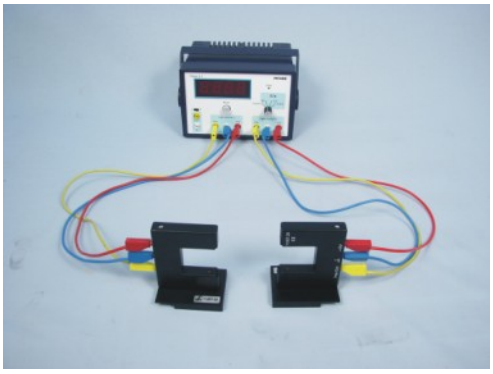


Fig. 4

On the timer, move the switch over where it says "Start" to the position to the right (⤓).

Put the rotating switch on the "⎍⎍" position, the third from the left. This way, the device shows the time between the interruption of the light beam at the first gate and second. In this experiment, this is the time which the car needs to cover the distance between the gates.

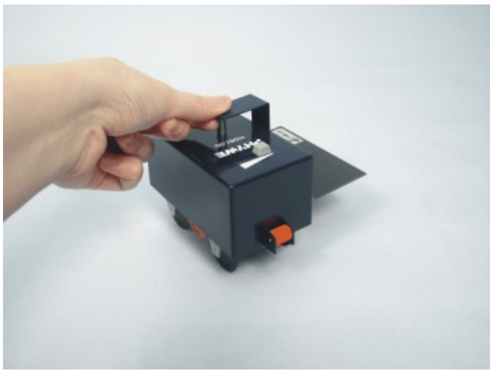


Fig. 5

Procedure

Place the gates at a distance of 10 cm from one another (Fig. 6). They should be at least 10 cm away from the car's starting point. To measure the distance, use the middle seam of the gate and the measuring scale on the track.

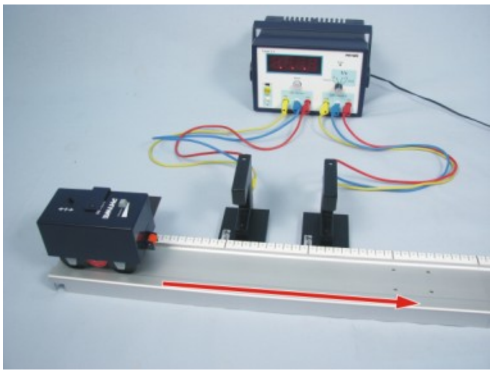


Fig. 6

Before every measurement, press the reset button on the timer.

Set the speed regulator on the car to the lowest speed (narrow end of the symbol, Fig. 7).

Fig. 7

Start the motor by moving the motion direction switch to the desired direction.

Place the car with the motor running on the end of the track and let it run by the gates, so that the plate on the edge of the car interrupts their light beams.

Take down the time t shown on the timer. This is the time which the car has needed to cover the 10 cm distance. Round the figure off to the first decimal. Record the results on table 1 and repeat the experiment with distances, s, of 20, 30, 50 and 70 cm. Record the measurements on table 1.

Set the speed regulator on the car to approximately the middle of the symbol (middle speed) (Fig. 8).

Fig. 8

Measure the times needed for the car to cover the distances, s, of 10, 20, 30, 50 and 70.

Results

Table 1

(Lower speed)

s in cm	*t* in s	v in cm/s
10		
20		
30		
50		
70		

Table 2

(Middle speed)

s in cm	*t* in s	*v* in cm/s
10		
20		
30		
50		
70		

Table 1

(Lower speed)

s in cm	*t* in s	v in cm/s
10	1,2	8,3
20	2,4	8,3
30	3,6	8,3
50	6,0	8,3
70	8,1	8,6

Table 2

(Middle speed)

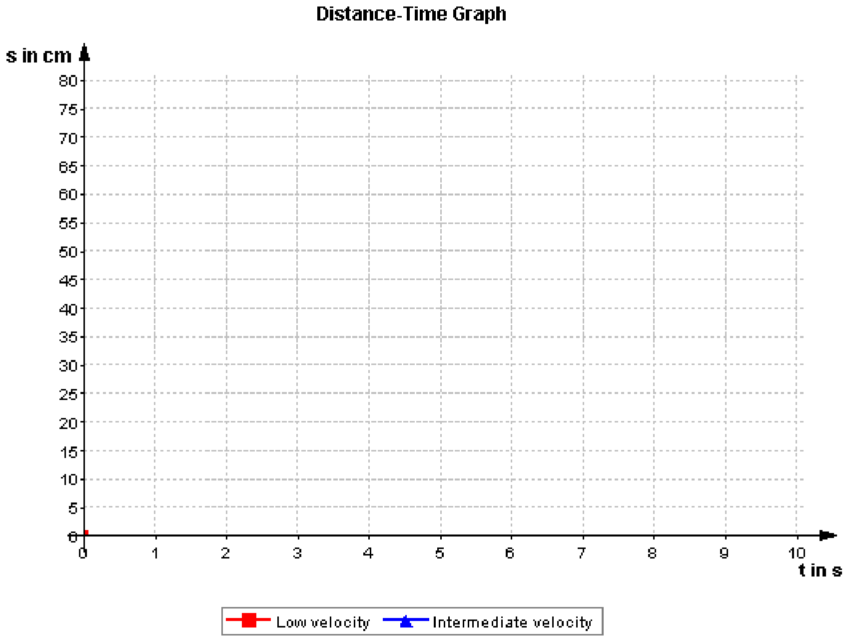
s in cm	*t* in s	*v* in cm/s
10	0,6	17
20	1,2	17
30	1,9	16
50	2,7	19
70	3,8	18

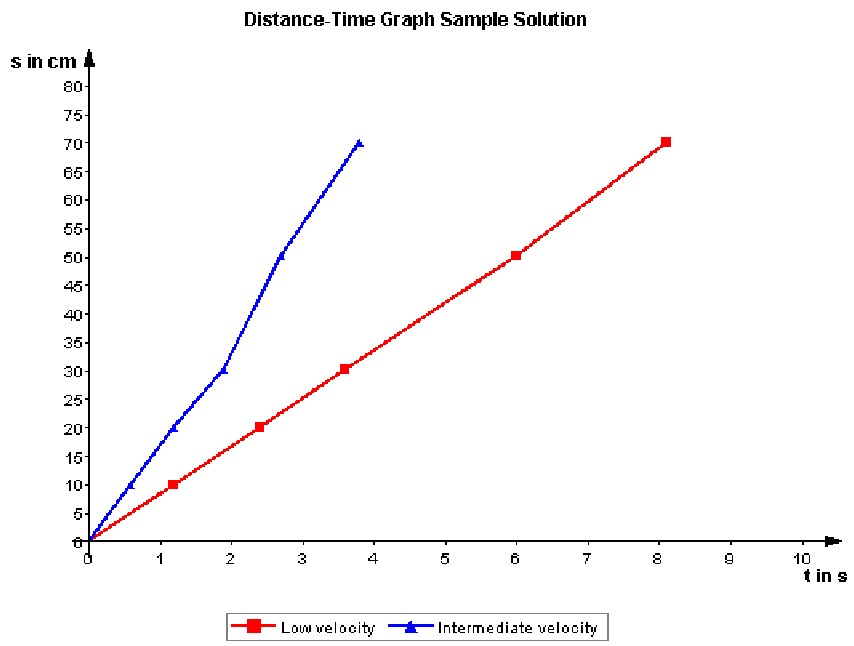
Evaluation

Question 1

Caculate the quotients of the distance, s, and the time, t: v = s/t. This quotient is called speed. Complete tables 1 and 2.

See tables 1 and 2.





Question 2

The measurement values were entered into an s-t graph (see distance-time graph) and were connected by a series of curves. What curves were generated?

See the distance-time graph. The series of curves are straight lines.

Question 3

What can you say abou the relation between the distance, s, and the time, t?

The time, t, is proportional to the distance, s.

Question 4

In which experiment portion (according to table 1 or 2) is the speed of the car faster?

The car's speed, v, is greater in the experiment according to table 2.

Question 5

What effect does a lesser speed have on the distance-time graph?

The straight lines associated with lesser speeds have less of a slope.

Question 6

Find the differences $s_2 - s_1 = \Delta s$ and $t_2 - t_1 = \Delta t$, and then find the quotients, $\Delta s / \Delta t$, for the distances measured. Enter the values on table 3 (lower speed) and 4 (higher speed), and compare these. What results do you get?

Compare the results calculated for $\Delta s / \Delta t$ with the slopes of the straight lines on the distance-speed graph.

The speeds for the different distances at this level of accuracy are equal, i.e., the speed is the same for all partial distances, see tables 3 and 4. The slopes of both lines remain constant, which corresponds to the statements made with regard to the calculation of the partial speeds.

Table 3

(Lower speed)

Δs in cm	Δt in s	Δs / Δt in cm/s
30 – 10 = 20		
50 – 30 = 20		
70 – 50 = 20		

Table 4

(Middle speed)

Δs in cm	Δt in s	Δs / Δt in cm/s
30 – 10 = 20		
50 – 30 = 20		
70 – 50 = 20		

Table 3

(Lower speed)

Δs in cm	Δt in s	Δs / Δt in cm/s
30 – 10 = 20	2,4	8,3
50 – 30 = 20	2,4	8,3
70 – 50 = 20	2,1	9,5

Table 4

(Middle speed)

Δs in cm	Δt in s	Δs / Δt in cm/s
30 – 10 = 20	1,3	15
50 – 30 = 20	1,5	13
70 – 50 = 20	1,1	18

Question 7

The motion observed in this experiment is called "uniform". Can you formulate a generally applicable statement about such motion, based on your measurements and their evaluation?

When a body moves at a constant speed, i.e., when its speed in all portions of the distance is the same, then its speed can be called "uniform". The distance covered is proportional to the time.