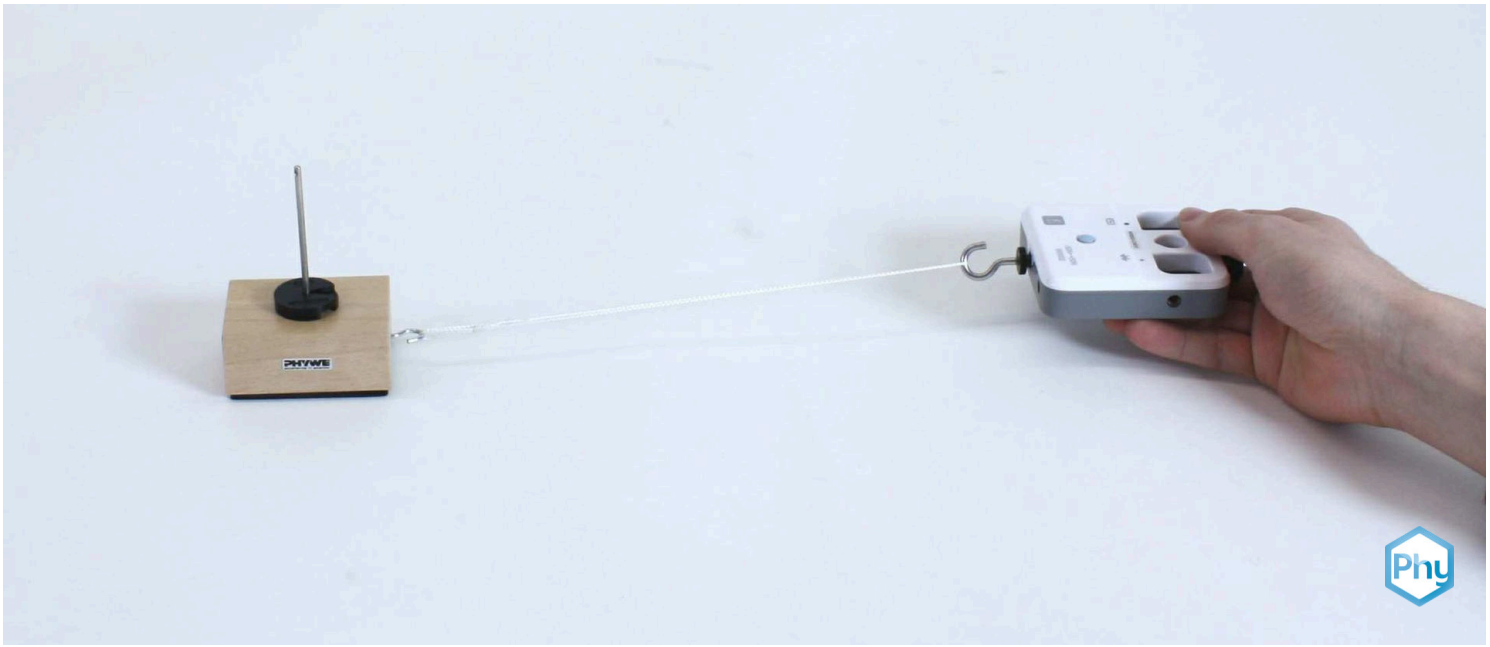
Friction with Cobra SMARTsense



Physics > Mechanics > Forces, work, power & energy

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/5ef49b6dc9e42400030fa825

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Teacher information

Application

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Why can't we drive endlessly on a straight stretch of road after just a few pedals?

Wouldn't it be nice if you could sit down on your bike and just roll on endlessly after a few pedals? (Provided, of course, that you are on level ground.) But no, without constant pedalling you will stop quite quickly even on level ground, and in general you have to build up strength to start moving. The whole thing is due to the friction between tire and ground. In general, every movement on the ground is connected with friction and thus with loss of energy. On the other hand, friction also has something to offer. When braking, it is responsible for bringing the bicycle or car to a halt - a good thing at 130 km/h on the motorway.

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Application

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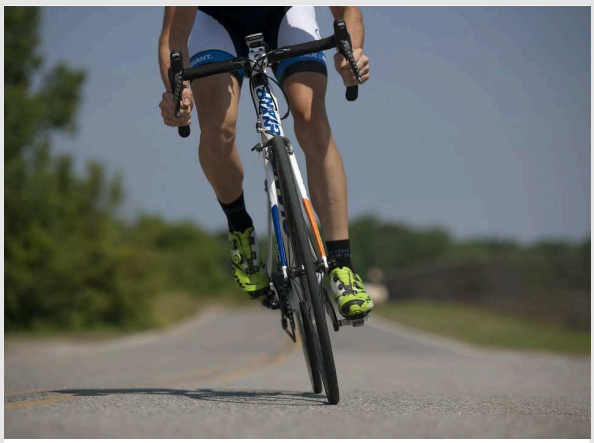

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Other teacher information (1/2)

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Prior knowledge

Friction is dependent on the surface and weight, but independent of the contact surface. Furthermore, the difference between F_1 (static friction) and F_2 (sliding friction) can be shown.

Learning objective

Here the students should learn about the essential properties of friction. This is to be illustrated with the aid of the sensor "Cobra SMARTsense-Force" using small experiments.

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Other teacher information (2/2)

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Scientific

When bodies stick, slide or roll on each other, friction occurs. In this process, forces act between the bodies, which are called frictional forces. Frictional forces are always directed in such a way that they counteract the movement and inhibit or prevent it.

Notes on the procedure

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- Attention should be paid to the taring of the force sensor - zero speed should also experience zero friction.
- Since friction is independent of speed, it is not important for the tests.
- It is only important that the block is pulled evenly: If the speed is constant, the dynamic frictional force and the tractive force cancel each other out exactly, you get a constant value.

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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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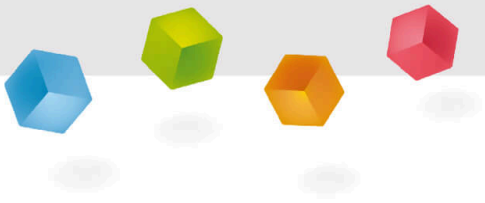

Student Information

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Motivation

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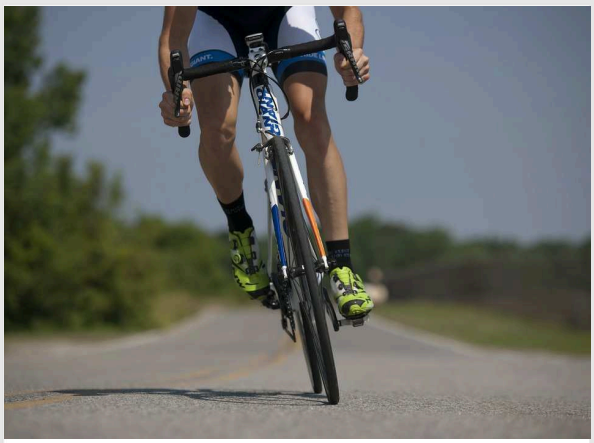

Why can't we drive endlessly on a straight stretch of road after just a few pedals?

Wouldn't it be nice if you could sit down on your bike and just roll on endlessly after a few pedals? But no, without constant pedalling you will stop quite fast even on level ground and in general you first have to summon up strength to start the movement.

The whole thing is due to the friction between the tyre and the ground: if there were no static friction, it would be impossible for a human being to move on a surface.

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Material

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - Force and Acceleration, ± 50N / ± 16g (Bluetooth + USB)	12943-00	1
2	Friction block	02240-01	1
3	Holding pin	03949-00	1
4	Slotted weight, black, 50 g	02206-01	1
5	Fishing line, l. 20m	02089-00	1
6	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up (1/2)

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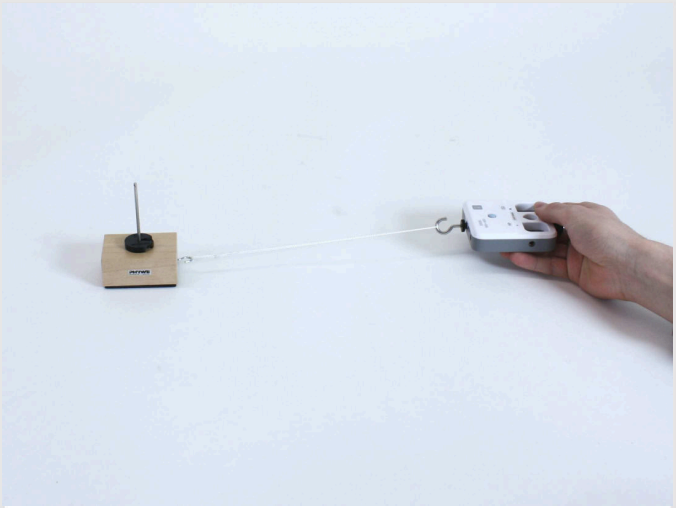
- Cut a 15 cm long thread from the fishing line and make a loop at both ends. It is really important not to make the thread too long.
- Now hang one end of the string on the hook of the force sensor, as you can see in the picture on the right.
- Place the friction block with the wooden underside on the table and attach the other loop of the fishing line to the hook of the friction block. Make sure that the fishing line is not taut between the friction block and the force sensor.



Experiment set-up

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Set-up (2/2)

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- For this experiment you use the Cobra SMARTsense-Force Sensor.
- Turn on your Cobra SMARTsense-Force sensor. Open the "measure" App . And select the force gauge as sensor.

Cobra SMARTsense-Force

Procedure (1/2)

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- Make sure that the force sensor is selected in your app.
- The thread between sensor and friction block is not tensioned. Select "Set to zero" in the app. Now the force should be displayed 0.000 N above your diagram.
- Start the measurement.
- Now pull very slowly on your dynamometer so that the thread tensions and the friction block starts to move. Try to let the block glide evenly (at a constant speed) over the table.
- Make sure that no further force is exerted, so that the fishing line does not remain taut as soon as the friction block comes to a stop.
- Stop the measurement and save it.

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Procedure (2/2)

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- Make a note of which measurement belongs to which experiment, so that you can distinguish the graphs later. Also create a suitable project in which you can save all measurements of this experiment.
- Repeat the measurement in the same way with the rubber side of the friction block and save your measurement in your project as well.
- Cut out a piece of paper to fit the size of the rubbing block and place the wooden side of the rubbing block on it. Repeat the measurement.
- Next, carry out the test with the rubber side of the friction block and a slot weight of 50g. Insert the thicker end of the retaining bolt into the hole in the friction block. Now the slotted weight can be put on without any problems.
- The last step is to try it by placing the friction block on one of its long sides, thus reducing the contact surface with the table.

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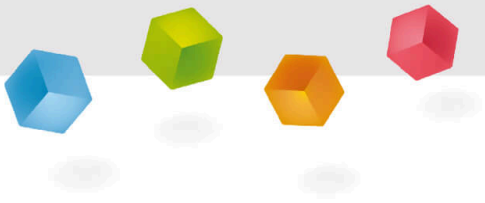

Report

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Task 1

- Use the app to call up the first measurements with the wooden bottom and the rubber side of the friction block one after the other.
- Select the "Measure" tool to determine F1 and F2 respectively.
- Enter the values in Table 1.

material	F_1 [N]	F_2 [N]
Wood		
Rubber		

Table 1: F_1 and F_2 (with the wooden bottom and with the rubber side of the friction block)

Task 2

Now measure the sliding friction F_2 for the test:

- with the paper,
- the weight
- and the long side.

Enter these values in Table 2.

material	F_2 [N]
paper slit weight	
50g wood	
grain	

Table 2: F_2 when rubbing with paper, a slotted weight and the long side of the friction block

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Task 3

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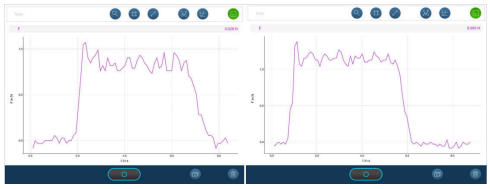

- wooden side of a friction block
- rubber side of a friction block

Umdrehen

Karte 1 von 2

Compare your measurements with the graphs on the left and see which measurement variants match.
Solution - Turn over

Tip: The graph shows the force that was needed to pull the friction block. If it lies still, the force is also 0 N. When you start pulling it, the force increases abruptly, and is then approximately constant while you pull it at a constant speed.

Task 4

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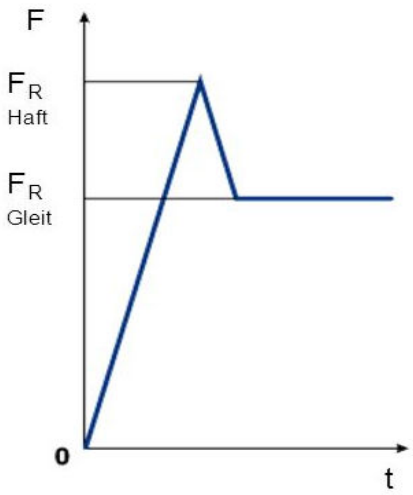

interrelationship of forces

Draw the right answers into the gaps.

The maximum force acting when a friction block is started is the so-called _____ F_1. The _____ force that acts during the movement when the friction block is pulled evenly is the _____ F_2. When you stop pulling, the force goes back to _____.

sticking friction | constant | 0 N | sliding friction

Check

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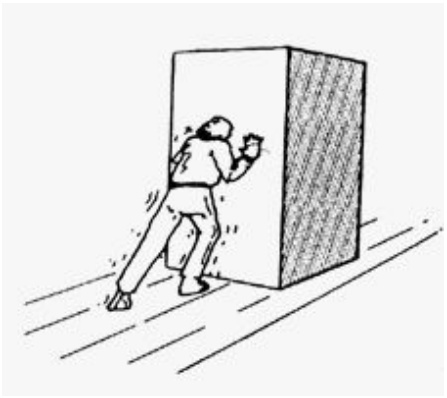
Task 5



static friction

- is always directed so that it inhibits the movement of the body relative to the other body
- is a force that prevents the sliding of touching bodies.
- is a force that occurs at the contact surfaces between bodies that move relative to each other.

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