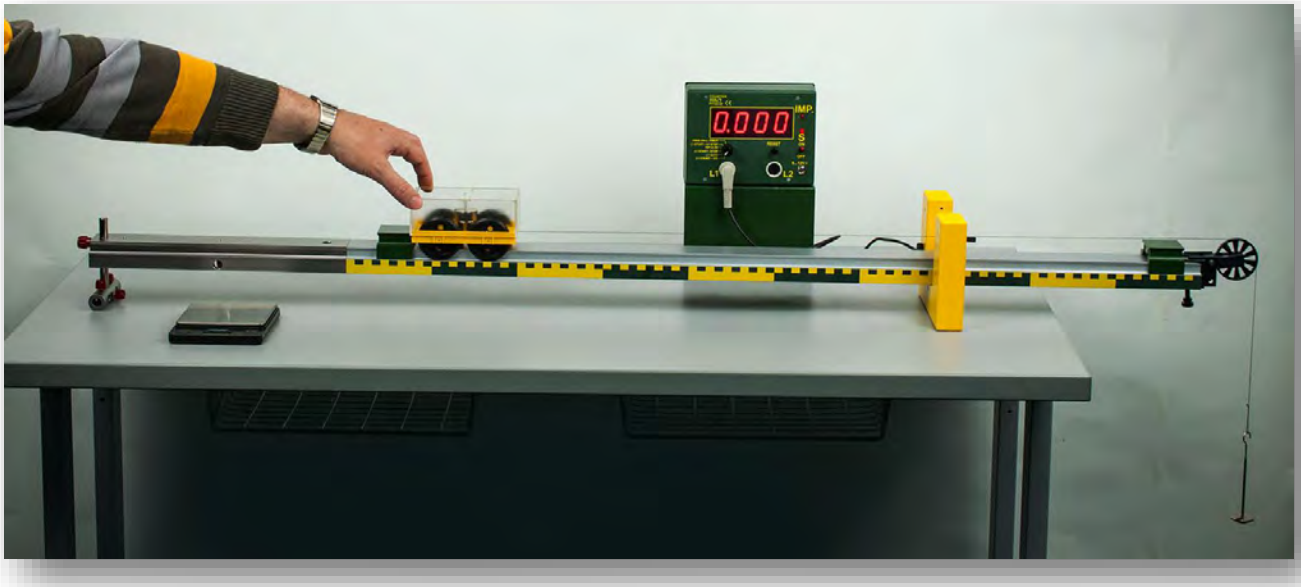
POTENTIAL AND KINETIC ENERGY (LIGHT GATES)

MED 04.14a



Material

Item-no.	Qty.	Description
DS101-3B	1	Stand rail with scale, L=1000 mm
P7210-5C	1	Stand rail NTL, L=300 mm, SE
P5310-1S	1	Rail bond SE, universal
DM355-5S	1	Pulley with very low friction
DS102-2G	2	Clamp saddle
DM300-2A	1	Dynamics trolley, demo, 50 g
P1312-2A	1	Car body for trolley SE
P1120-2F	2	Slotted weight 50 g, SE
P1120-2D	4	Slotted weight 10 g, SE
P1120-2C	1	Holder for slotted weights, 10 g, SE
P1320-4A	2	Light gate "demo" 04
P3120-2Z	1	Universal timer "inno"
P3120-5B	1	S-shaped assembly platform
DS201-10	1	Support rod, round, L=100 mm, D=10 mm
P7230-1K	1	Bosshead round NTL, SE
P7100-1A	1	Cord, roll, high tensile strength
P7502-1A	1	Pair of scissors, SE
P1100-1E	1	Measuring tape, L=300 cm
DM125-4C	1	Digital balance 02, 2000/0.1 g

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Purpose

To investigate the conversion of potential energy into kinetic energy.

Preparation

Connect the 100 cm stand rail and the 30 cm stand rail with the support of the rail bond; afterwards fix the pulley on the right end of the track.
Place the clamp saddle before the pulley.
Fix the 100 mm support rod in the centre hole of the round bosshead.
Insert the support rod with the attached bosshead in the hole on the left side of the track.

Place the light gate on the table; afterwards place the track on the light gate.Now move the light gate to the 70cm mark; make sure that the small bridges of the light gate are exactly on this mark.

Place the trolley on the left side of the track.
Now raise the track to balance out the friction of the trolley; when pushing the trolley slightly it has to travel with constant speed on the track.

In case that the movement of the trolley becomes slower the friction has to be balanced out further (by raising the track on the left side further). Cut off a 150 cm piece of the cord and make loops at both ends, the remaining length from one loop to the other one should be 130 cm.

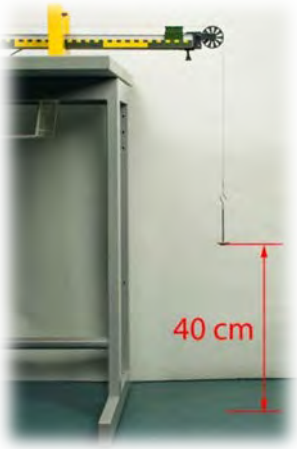
Tie the cord to the “tower” of the trolley, place it over the pulley and tie the cord to the holder for slotted weights on the other side; make sure that the pulley protrudes over the edge of the table. Attach two slotted weights of 50g to the tower of the trolley; afterwards attach the car body.

Place the universal timer “inno” on the S-shaped assembly platform for a better visibility and connect the light gate to the universal timer, afterwards put the switch into the “L1 GATE” position.

Before starting the experiment make sure that the trolley can pass through the light gates without touching them.

Experiment

The mass of the trolley should be 200 g (Trolley 100 g + Slotted weights 100 g).
The mass of the holder for slotted weights is 10 g; add another slotted weight of 10 g so that the effective force is 0.2 N.



The load should be exactly 40 cm above the floor.
To achieve this push the trolley so far to the right that the bottom of the holder for slot weights lies on the floor, but the cord is taut.
The trolley should now be about 5 - 15 cm BEFORE the light gate.

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Turn on the universal timer and adjust the brightness controller of the light gate so that the diode is just not lighting up; afterwards push the “Reset”-button on the universal timer.

Move the trolley 40 cm to the left.
After making sure that the distance from the holder for slotted weights to the bottom is exactly 40 cm let the trolley move down the track.

Result
The trolley initially carried out a uniform accelerated movement.
From the point in time when the plate for slotted weights hit the floor, the trolley continued to move at an almost constant speed.

Determine the final speed of the measuring car from the darkening time and the car length.

$$v = \frac{s}{t} = \frac{.....m}{.....s} = \text{.....} \text{ m/s}$$

Compare the result with the calculated final speed from the energy theorem:

kinetical energy = potential energy

$$\frac{M.v^2}{2} = m.g.h \qquad v = \sqrt{\frac{2.m.g.h}{M}}$$

m = 0.02 kg (holder + slotted weight)
M = 0.22 kg (trolley + holder + slotted weight)
h = 0.4 m

The experiment can be repeated with a changed weight of the trolley.

Conclusion
When converting potential energy into kinetic energy the final speed depends on the height, the accelerating mass m and the accelerated mass M.

Note
The total mass of the trolley and the drive weight should be measured with a precise balance as there are manufacturing tolerances for these parts.

The mass to be accelerated consists of the trolley and the mass of the drive weight.