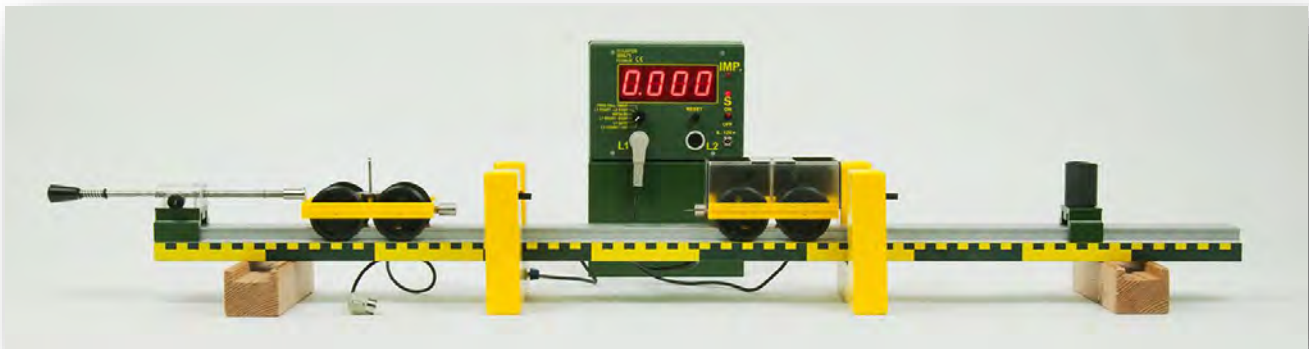




Material

Item-no.	Qty.	Description
DS101-3B	1	Stand rail with scale, L=1000 mm
DM300-2A	2	Dynamics trolley, demo, 50 g
P1312-2A	1	Car body for trolley SE
P1120-2F	1	Slotted weight 50 g, SE
P1311-2F	1	Adapter for inelastic collision, set of 2
P3120-2Z	1	Universal timer "inno"
P3120-5B	1	S-shaped assembly platform
P1320-4A	2	Light gate "demo" 04
P1321-3K	2	Block for light gates
DS103-1H	1	Holder for guide rail
DM362-1E	1	Baffle block
DM344-1S	1	Projectile launcher 02

Purpose

To bring the experimental evidence for the conservation of momentum after an inelastic impact

Preparation

Position the two blocks for light gates at a distance of 80 cm on the table and place the light gate in between the blocks as shown on the image to the left.

Place the stand rail with scale on the blocks for light gates.

Mount the projectile launcher on the left end of the stand rail. Afterwards mount the holder for guide rail at the 85 cm mark of the stand rail and fix the baffle block on the holder



Place the car body on one of the dynamics trolleys; make sure that the small rod of the trolley points through the hole of the car body.

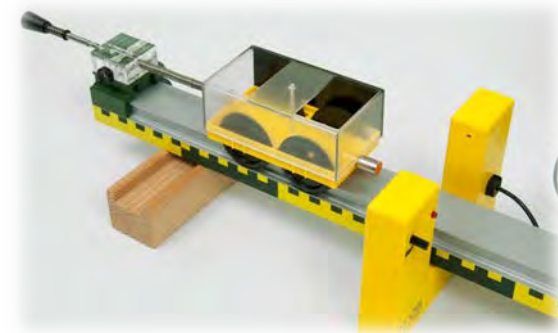
Mount the Plasticine-part of the adapter at the front of the trolley.



Initially the launching piston of the projectile launcher is fully extended; place the dynamics trolley at the end of the launching piston.

Position the light gate so that the diodes of it are just in front of the dynamics trolley (approximately at the 32 cm mark).

Place the right light gate at the 35 cm mark of the stand rail.



Push the launching button of the projectile launcher in and pull up the launching piston, fix the piston at the 4th notch.

Place the universal timer on the S-shaped assembly platform.

Connect the light gate with the "L1"-socket of the universal timer and set the switch on the universal timer to "L1 Gate".

Move your finger through the light gate to check if it is working properly.

When passing through with the finger the red LED has to flash up – this time of darkening is measured by the timer. In case that this is not working properly the luminosity has to be adjusted (check at the end of this experiment how this can be done).

Experiment 1 - A



Push the „Reset“-button on the timer; afterwards push the dynamics trolley completely against the launching piston. By pressing the launching button the dynamics trolley gets pushed away.

The universal timer measures the "darkening time" - the time in which the trolley moves through the laser barrier of the light gate.



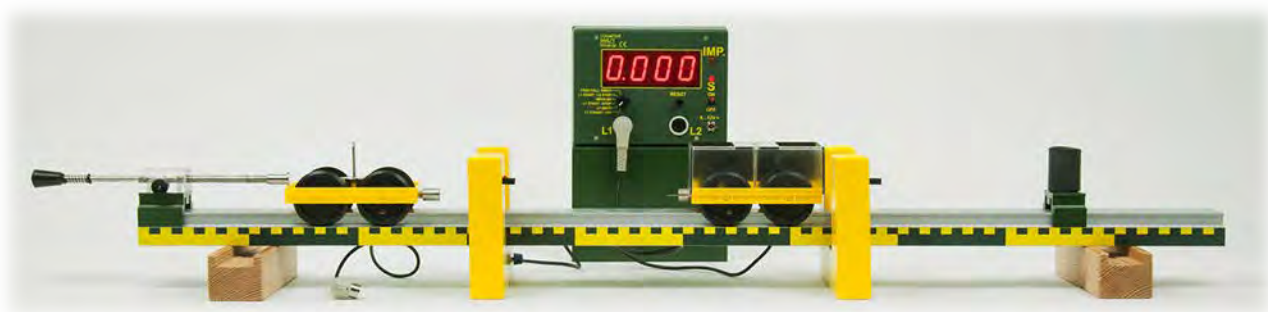
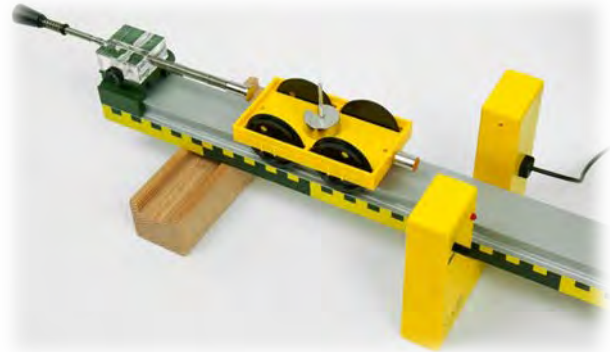
Based on the length of the dynamics trolley (125 mm) and the darkening time the current speed of the dynamics trolley can be calculated

$$V_1 = 0.125 \text{ m} / \dots\dots\dots \text{ s} = \dots\dots\dots \text{ m/s}$$

Experiment 1 - B

Remove the car body from the trolley and place a slotted weight of 50g on the trolley; thus the mass stays roughly the same as before.

Pull up the projectile launcher and fix the piston at the 4th notch as before – the trolley is positioned right after the piston of the projectile apparatus.



Now connect the right light gate instead of the left light gate to the "L1"-socket of the timer.

Place the car body on the second dynamics trolleys; make sure that the small rod of the trolley points through the hole of the car body.

Mount the needle-part of the adapter at the front of the trolley.

The second dynamics trolley is positioned just before the second light gate, the two parts of the adapter (plasticine part and needle part) should face towards each other.

Push the „Reset“-button on the timer; afterwards push the dynamics trolley completely against the launching piston. By pressing the launching button the dynamics trolley gets pushed away.

The right light gate of the universal timer measures the "darkening time" - the time in which the trolley moves through the laser barrier of the light gate.



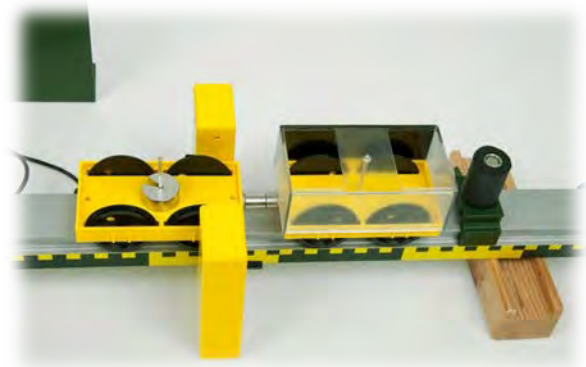
Result

The left trolley hits the right trolley; both cars then continue to move at a lower speed.

In the event of an impact the needle penetrates the plasticine until both cars have reached the same speed. The deformation work is done at the expense of kinetic energy and is not recovered due to the inelasticity.

However since the system is still complete, the law of momentum applies:

The force of the pushing trolley and the equally large counteracting force of the resting trolley ensure that both cars trolleys the same speed (V_2).



Based on the length of the dynamics trolley (125 mm) and the darkening time the current speed of the dynamics trolley can be calculated

$$V_2 = 0.125 \text{ m} / \dots\dots\dots \text{ s} = \dots\dots\dots \text{ m/s}$$

$$v' = \frac{m_1 \times v_1 + m_2 \times v_2}{m_1 + m_2}$$

Combined momentum after the impact = sum of the single momentum before the impact

In this experiment the following applies $m_1 = m_2$ $v_2 = 0$ thus is $v' = \frac{v_1}{2}$

The pushing trolley gets braked to half its speed;
the (initially) resting trolley is accelerated to this speed after the impact.

Additional experiments

The experiments can be performed with different masses also.

Adjusting the sensitivity of the light gate

Turn the regulator clockwise until it does not go any further; the LED must light up now.

Afterwards the regulator is slowly turned counter-clockwise until the LED no longer lights up.

The sensitivity is at the highest in this setting.

The adjustment must be carried out especially when experimenting with very high or very low room brightness.