Motions
### *Inertia and Newton's law*

Relationship between acceleration, force and mass -
Measurement using an electronic stopwatch

D 1.3.4.2.a
Physics experiments
Secondary

Objects of the experiment

1. Measuring the time t required by a body of mass m_1 or m_2, respectively, to cover a certain path s if the force F acting on the body is changed
2. Calculating the acceleration a of the body
3. Representing the relation between acceleration and force in an a-F-diagram

Setup
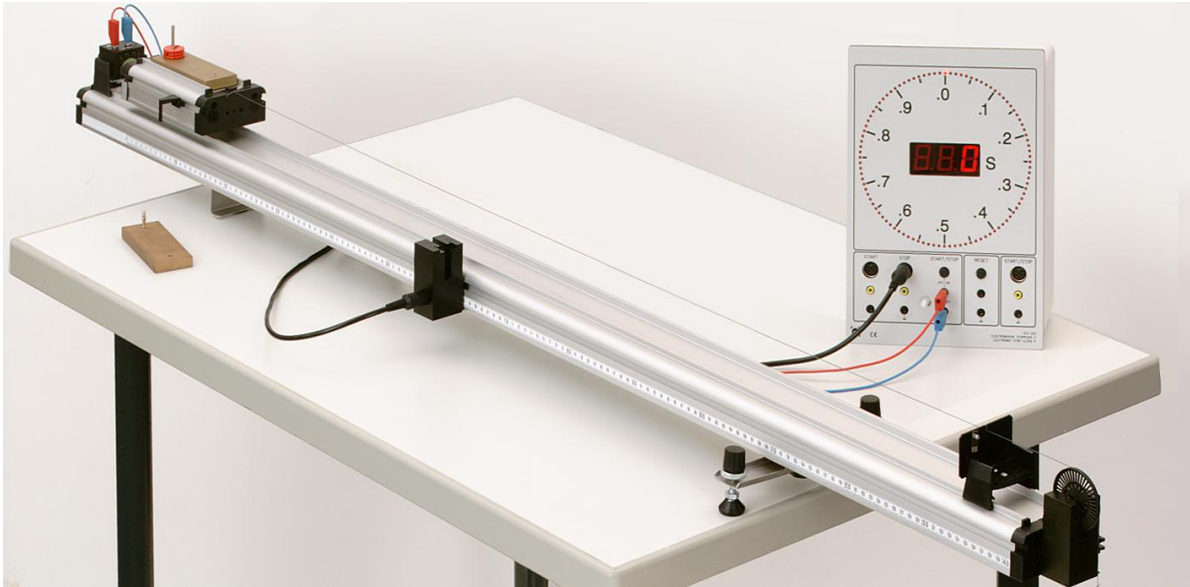
Apparatus

1 Track, 1.5 m	337 130
1 Trolley	337 110
1 Additional weights, pair	337 114
1 Holding magnet	683 41
1 Holder for combination spoked wheel	337 463
1 Combination spoked wheel	337 464
1 Combination light barrier	337 462
1 Slotted mass hanger, 10 g, small	315 410
4 Slotted weights, 10 g, red	315 416
1 Electronic stop-clock P	313 033
1 Connecting leads, 19 A, 50 cm, black, pair	501 451
1 Multi-core cable, 6-pole, 1.5 m	501 16
1 Fishing line, set of 2	309 48ET2
1 Plug-in axles, set of 2	340 811ET2

Carrying out the experiment

- Adjust the voltage at the holding magnet so that the trolley with the additional weight is just held.
- Define the starting point with the movable interrupter flag on the trolley, and read it from the scale of the track.
- Position the light barrier at a distance of 50 cm from the starting point.
- Release the motion by pressing the START/STOP key at the stopclock.
- Wait until the interrupter flag passes the light barrier, and read the time from the stopclock.
- Reset the stopclock to zero by pressing the RESET key.
- Enhance the accelerating force step by step by putting the slotted weights 10 g from the trolley on slotted mass hanger one after another.
- Repeat the measurement for each force.
- Enhance the mass of the trolley by putting another additional weight on it.

- Repeat the experiment.
- Calculate the accelerations a from the quotients $\frac{2s}{t^2}$.

Measuring example

*m_1 = 1050 g, *m_2 = 1550 g

Path s in cm	50	50	50	50
*Force F in N	0.2	0.3	0.4	0.5
Time t_{m1} in s	2.53	2.02	1.72	1.53
Time t_{m2} in s	3.01	2.48	2.10	1.87
Acceleration a_{m1} in cm/s²	15.6	24.3	34.4	43.5
Acceleration a_{m2} in cm/s²	11.1	16.1	22.7	28.6

*Force F: round values

Evaluation
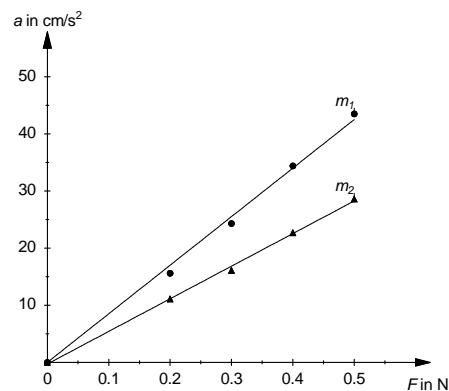
In the case of uniformly accelerated motion, the acceleration varies proportionally to the acting force: $a \sim F$.

The greater the mass of a body, the smaller its acceleration if the force is the same.

KR 107