

Übungen zur Experimentalphysik I (Mechanik)

Aufgabenblatt 3 von 6

Abgabe im OLAT: Montag, 23.11.2020, 18:00 Uhr



1) Danger in the elevator

The lamp comes off the ceiling in an elevator. The cabin is 2.5 m high. How long does it take the lamp to hit the floor? Calculate the falling times for the following cases: At the time the lamp got loose,

- the elevator was moving with constant velocity $v_0 = 0$ m/s, $v_0 = 0.5$ m/s upwards, $v_0 = -0.5$ m/s downwards.
- the elevator was accelerating with constant a_0 upwards.
- the elevator was accelerating with constant a_0 downwards. Consider the cases $a < g$, $a = g$ and $a > g$ explicitly and explain.

2) Worst-case scenario for Deutsche Bahn

A freight train is travelling with several locomotives (500 t) and waggons (5000 t).

- The locomotives are pulling the waggons uphill with a slope of 0.5° . Determine the force between the locomotives and the waggons.
- How high would the acceleration of the locomotives be if the coupling between the locomotives and the waggons broke suddenly?

3) Bam!

A train with a weight of 20 t drives against a buffer stop. The two buffer springs (each with a spring constant of $k = 3,0 \cdot 10^6$ N/m) should stop the train within 10 cm. At which maximum speed may the train hit the buffer stop? Determine the time at which the train stops. (Do not use energies for the calculations.)

4) Projectile motion

The equations of motion for a projectile in the y - z -plane is described by:

$$\vec{x}(t) = \left(0, v_0 t \cos(\alpha), -\frac{g}{2} t^2 + v_0 t \sin(\alpha) \right)$$

The starting point is at $x = y = z = 0$, the projectile hits the ground at $z = 0$.

- Determine the equations for the time of flight, the maximum height and the maximum throwing distance.
- Determine the angle at which to throw the object to reach the maximum distance.

5) Mathematical Pendulum

Carry out experiments with a mathematical pendulum to verify that the oscillation period $T = 2\pi\sqrt{l/g}$

- is independent of the mass.
- is dependent on the length l .

Document your experiments with a video or with photos.