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Exercises and Complements for the Introduction to Physics I  
for Students  
of Biology, Pharmacy and Geoscience

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Sheet 5 / 15.10.2020

Zoom - Q&A on the Exercises: **20.10.2020/21.10.2020**

**Exercise 21.** A bullet gets shot vertically up. At a height of  $h = 2000$  m the potential and the kinetic energy are equal ( $E_P = 0$  at  $h = 0$ ). What is the velocity at  $h = 2000$  m and what was the initial velocity  $v_0$ ?

**Exercise 22.** A concrete slab (density  $\rho = 2.2 \cdot 10^3$  kg/m<sup>3</sup>), with the dimensions  $2.0 \times 1.0 \times 0.2$  m<sup>3</sup>, is pulled out from a 5 m deep construction pit above a 30° inclined plane. The coefficient of sliding friction is  $\mu = 0.25$ . Calculate the needed work.

**Exercise 23.** An object with the mass  $m = 10$  kg gets accelerated by a spring on a horizontal slide-way. Initially the spring got compressed by  $\Delta s = 5$  cm and has a spring constant of  $k = 2450$  Ncm<sup>-1</sup>. After detaching from the spring the object is sliding for 2 m on a horizontal surface. Afterwards it is sliding up an inclined surface which has an angle of  $\alpha = 30^\circ$ . The coefficient of sliding friction on the entire surface is  $\mu = 0.3$ .

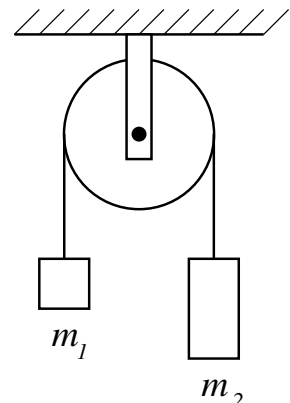
- (a) Sketch the situation.
- (b) Calculate the height  $\Delta h$  at which the object stops moving on the inclined surface.

**Exercise 24.** A homogeneous block made of oak wood with  $m_Z = 600$  g is hanging from a cord, which has a length of  $l = 50$  cm. A bullet, with  $m_B = 5$  g and a velocity of  $v = 320$  m/s, enters in the resting block (The shot goes through the center of mass). Calculate the angle of deflection of the oak block!

**Exercise 25.**

Two masses  $m_1$  and  $m_2$  are connected through a thin rope. The rope goes above a rotatable wheel which moves without friction, see figure (neglect the mass of the wheel and of the rope).

- (a) What happens if  $m_1 = m_2$ ?
- (b) Calculate by using the law of conservation of energy the acceleration if  $m_1 \neq m_2$ .



**Solutions:**

Exercise 21. 198 m/s and 280 m/s

Exercise 22. 61.85 kJ

Exercise 23. 1.65 m

Exercise 24. 73°