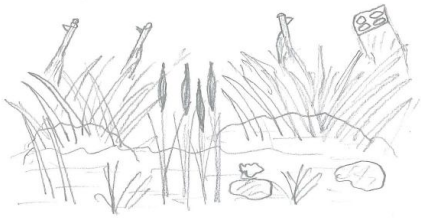
METÓDY RIEŠENIA FYZIKÁLNYCH ÚLOH 1 leto19 – Príklady 1

Cvičenie 21.2.2019

Príklad 1

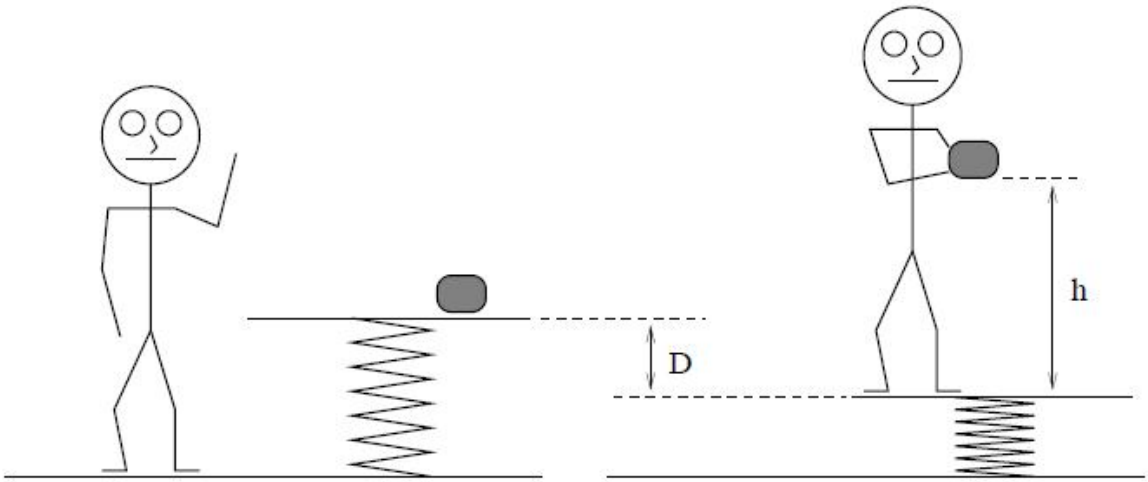
Montana duck hunters are all perfect shots. Ten Montana hunters are in a duck blind when 10 ducks fly over. All 10 hunters pick a duck at random to shoot at, and all 10 hunters fire at the same time. How many ducks could be expected to escape?

For the calculation assume, as per tradition, the ducks are perfect spheres.



Príklad 2

A platform is attached to the ground by an ideal spring of constant k; both the spring and the platform have negligible mass; assume that your mass is m_p. Sitting on the platform is a rather large lump of clay of mass $m_c = rm_p$, with r some positive constant that measures the ratio m_c/m_p. You then gently step onto the platform, and the platform settles down to a new equilibrium position, a vertical distance D below the original position. Throughout the problem assume that you never lose contact with the platform.



a. You then slowly pick up the lump of clay and hold it a height h above the platform. Upon releasing the clay you and the platform will oscillate up and down; you notice that the clay strikes the platform after the platform has completed exactly one oscillation. Determine the numerical value of the ratio h/D.

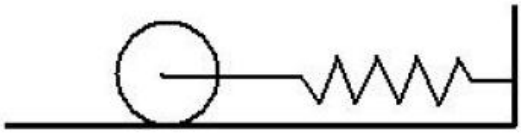
b. Assume the resulting collision between the clay and the platform is completely inelastic. Find the ratio of the amplitude of the oscillation of the platform after the collision (A_f) to the amplitude of the oscillations of the platform before the collision (A_i). Determine A_f/A_i in terms of the mass ratio r and any necessary numerical constants.

c. Sketch a graph of the position of the platform as a function of time, with $t = 0$ corresponding to the moment when the clay is dropped. Show one complete oscillation *after* the clay has collided with the platform. It is not necessary to use graph paper.

d. The above experiment is only possible if the mass ratio r is less than some critical value r_c. Otherwise, despite the clay having been dropped from the height determined in part (a), the oscillating platform will hit the clay before the platform has completed one full oscillation. On your graph in part (c) sketch the position of the clay as a function of time relative to the position of the platform for the mass ratio $r = r_c$.

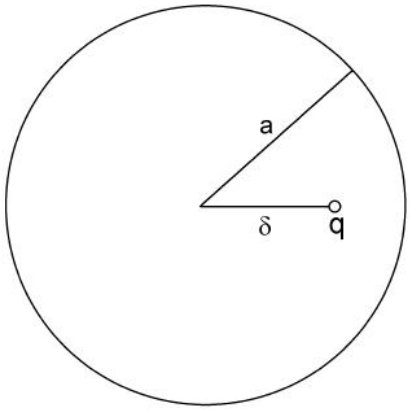
Príklad 3

. A uniform solid cylinder of mass $M = 2.00\,kg$ and radius $R = 10.0\,cm$ is connected about an axis through the center of the cylinder to a horizontal spring with spring constant $4.00\,{}^{N}/_{m}$. The cylinder is pulled back, stretching the spring $1.00\,m$ from equilibrium. When released, the cylinder rolls without slipping. What is the speed of the center of the cylinder when it returns to equilibrium?



Príklad 4

46. V kovovej dutej guli, ktorá je izolovaná a nenabitá, je umiestnený bodový náboj q vo vzdialenosti δ od jej stredu (*obr. 46*). Vypočítajte silu, ktorou guľa pôsobí na náboj. Aká bude táto sila, ak sa guľa uzemní?



Príklad 5

PROBLEM: An inextensible massless string of length ℓ passes through a hole in a horizontal table. A point mass m_1 on one end of the string moves frictionlessly along the table (*i.e.* with two degrees of freedom), and another point mass m_2 dangles vertically from the other end. (See the sketch below.)

(a) Write the Lagrangian for this system.

(b) Under what conditions will the hanging mass remain stationary?

(c) Starting from the situation in part (b), the hanging mass is pulled down slightly and then released. State clearly what is conserved during this process.

(d) Compute the subsequent motion of the hanging mass.