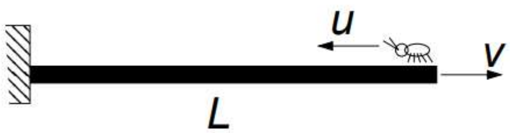
METÓDY RIEŠENIA FYZIKÁLNYCH ÚLOH 1 leto21 – Príklady 6

Cvičenie 29.4.2021

Príklad 1



A rubber band with initial length L has one end tied to a wall. At $t = 0$, the other end is pulled away from the wall at speed V (assume that the rubber band stretches uniformly). At the same time, a bug located at the end not attached to the wall begins to crawl toward the wall, with speed u relative to the band. Will the bug reach the wall, under what conditions and in what time?

Príklad 2

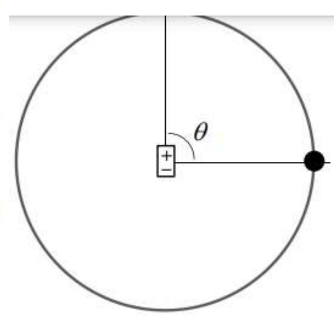
Nápady mi došli, teraz to nechám na Vás. Vymyslite tri príklady podobného druhu ako doteraz: zadanie a niekoľko možností správneho výsledku, z ktorých je práve jeden správny. Ideálne toto zadanie zdieľajte v skupine skôr, aby sme sa ostatní na to stihli pozrieť dopredu a rozmysleli si to.

Príklad 3

A cylinder of radius a and mass m contains a point mass, also of mass m located a distance $a/2$ from the symmetry axis. The cylinder is placed on an incline, which is initially horizontal, but is very slowly raised. Assuming the cylinder cannot slide on the incline, at what inclination angle α does the cylinder begin to roll down the incline?

Príklad 4

: A small electrically charged bead with the mass m and charge Q can slide on a circular insulating string without friction. The radius of the circle is r. A point-like electric dipole is at the center of the circle with the dipole moment P lying in the plane of the circle. Initially the bead is at the angle $\theta = \pi/2 + \delta$, where δ is infinitely small, as shown schematically on the figure.



(a) How does the bead move after it is released? Find the bead velocity as a function of the angle θ.

(b) Find the normal force exerted by the string on the bead.

Príklad 5

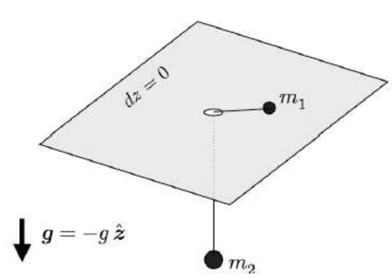
PROBLEM: An inextensible massless string of length ℓ passes through a hole in a horizontal table. A point mass m_1 on one end of the string moves frictionlessly along the table (*i.e.* with two degrees of freedom), and another point mass m_2 dangles vertically from the other end. (See the sketch below.)

(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.

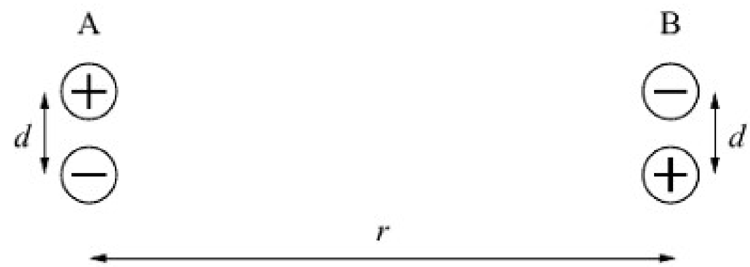
(d) Compute the subsequent motion of the hanging mass.



Príklad 6

An *electric dipole* consists of two charges of equal magnitude q and opposite sign, held rigidly apart by a distance d. The *dipole moment* is defined by $p = qd$.

Now consider two identical, oppositely oriented electric dipoles, separated by a distance r, as shown in the diagram.



a. It is convenient when considering the interaction between the dipoles to choose the zero of potential energy such that the potential energy is zero when the dipoles are very far apart from each other. Using this convention, write an exact expression for the potential energy of this arrangement in terms of q, d, r, and fundamental constants.

b. Assume that $d \ll r$. Give an approximation of your expression for the potential energy to lowest order in d. Rewrite this approximation in terms of only p, r, and fundamental constants.

c. What is the force (magnitude and direction) exerted on one dipole by the other? Continue to make the assumption that $d \ll r$, and again express your result in terms of only p, r, and fundamental constants.

d. What is the electric field near dipole B produced by dipole A? Continue to make the assumption that $d \ll r$ and express your result in terms of only p, r, and fundamental constants.