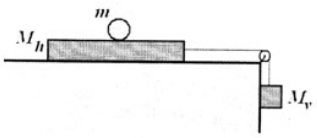
METÓDY RIEŠENIA FYZIKÁLNYCH ÚLOH zima22 – Príklady 4

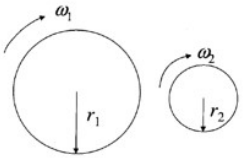
Cvičenie 3.11.2022

Príklad 1

A block of mass M_h slides without friction on a horizontal table. It is connected by a massless rope passing over a massless frictionless pulley to a second hanging mass M_v pulled downward by gravity. A sphere of mass m and radius R, initially at rest, rolls without sliding on the top surface of the first block. Find the resulting acceleration of the mass M_v and the center of mass of the sphere.



Two uniform cylinders spin independently about their axes (the axes are parallel to each other). The first has radius r_1 and mass m_1, the other has radius r_2 and mass m_2. Initially they rotate in the same sense of rotation with angular speeds ω_1 and ω_2 respectively. They are then brought together so that they touch. After the steady state is achieved, what is the final angular velocity of cylinder 1, ω_1'?



Príklad 2

PROBLEM: An electric field $\boldsymbol{E} = E_0\,\hat{\boldsymbol{x}}\,e^{-i\omega t}$ is applied at the interface of a vacuum ($z > 0$) and a conductor ($z < 0$) of conductivity σ. (The conductor is nonmagnetic, *i.e.* $\mu = 1$.)

(a) For $\sigma \gg \omega$, calculate how deeply the electric field penetrates into the conductor. (*I.e.* calculate the depth at which the electric field has decreased to $1/e$ of its amplitude at the surface.)

(b) Calculate the power dissipated per unit area of the conductor.

Príklad 3

PROBLEM: A point charge $-2q$ is at the origin, $\mathbf{r} = 0$, and two point charges, each $+q$, are at $\mathbf{r} = \pm a\hat{z}$. Consider the limit $a \to 0$, with $Q = qa^2$ held fixed.

(a) Find the scalar potential $\phi(\mathbf{r})$ in spherical coordinates.

(b) This system of charges is now placed inside a grounded, conducting spherical shell, of radius b (with $b \gg a$). Now find the scalar potential $\phi(\mathbf{r})$ everywhere, both inside and outside of the shell (again, in spherical coordinates).