METÓDY RIEŠENIA FYZIKÁLNYCH ÚLOH 2 zima23 – Príklady 2

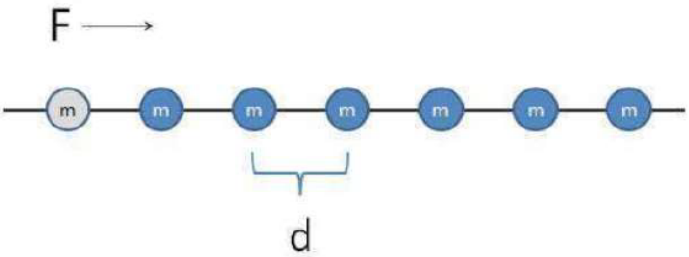
Cvičenie 5.10.2023

Príklad 1

PROBLEM: Beads of equal mass m are strung at equal original distances d on a long horizontal wire. The beads are initially at rest but can move along the wire without friction. The leftmost bead is continuously accelerated (towards the right) by a constant force F. The other beads do not feel F, but do undergo collisions with the leftmost bead and each other. As a result of the collisions, a compression wave propagates to the right down the wire. What are the speeds of the leftmost bead and the front of the 'shock wave' after a long time, if the collisions of the beads are:

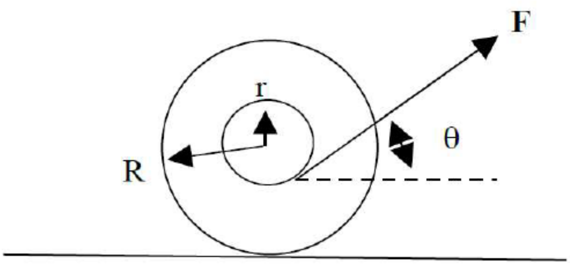
(a) completely inelastic,

(b) perfectly elastic?



Príklad 2

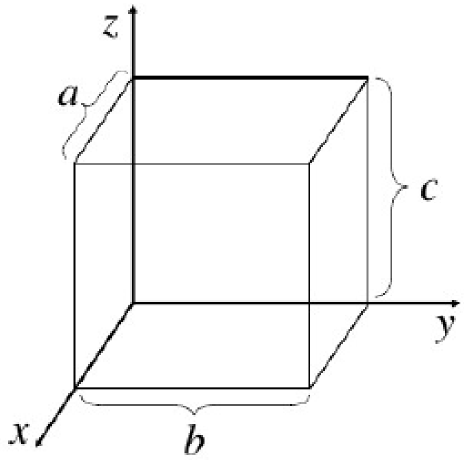
A toy consists of two concentric cylinders with inner radius r and outer radius R. A string is wound around the inner radius and the outer radius can roll without slipping on a rough floor. The string is pulled at angle θ with respect to the horizontal.



a. Draw the free body diagram.
b. Calculate the angular acceleration.
c. Prove that there exists a critical angle θ_c, where if $\theta < \theta_c$ the cylinder rolls away from the direction it is pulled, and if $\theta > \theta_c$ the cylinder rolls toward the direction it is pulled.
d. Determine θ_c

Príklad 3

Consider a box with side lengths a, b, and c along the x, y, and z axes. Suppose there is no electric charge inside the box and that $\phi = 0$ on the surface of the box except at $z = 0$ where $\phi = V_1 \sin\left(\frac{\pi x}{a}\right) \sin\left(\frac{\pi y}{b}\right)$, and at $z = c$ where $\phi = V_2 \sin\left(\frac{2\pi x}{a}\right) \sin\left(\frac{2\pi y}{b}\right)$. Find ϕ everywhere inside the box.



Príklad 4

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.