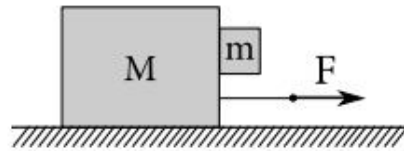


## METÓDY RIEŠENIA FYZIKÁLNYCH ÚLOH zima20 – Príklady 4

Cvičenie 12.11.2020

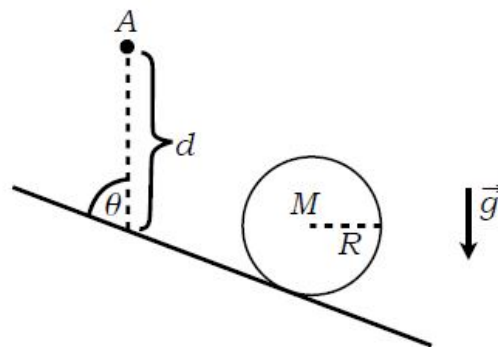
### Príklad 1

Kúzníci Žaba a Jano si pripravili nový trik, „levitujúcu kocku“. Na začiatku položili na ľad veľkú kocku s hmotnosťou  $M$ , k nej priložili „levitujúcu“ kocku s hmotnosťou  $m$ , a ihneď začali ťahať za lano pripevnené k veľkej kocke ako na obrázku. Akou minimálnou silou  $F$  musia ťahať, aby sa im trik vydaril, ak vedia, že koeficient trenia medzi kockami je  $f$ ?



### Príklad 2

A homogenous disk of radius  $R$  and mass  $M$  rolls without slipping on an inclined surface that makes an angle  $\theta$  with respect to the vertical. The disk is constrained to be in contact with the inclined plane at all times. The disk is attracted to a point  $A$  located at a vertical distance  $d$  above the surface.



Assume that the force of attraction is proportional to the distance from the disk's center of mass to the force at point  $A$ ; i.e. assume that  $F = -kr$ , where  $r$  is the distance from the point  $A$  to the disk's center of mass.

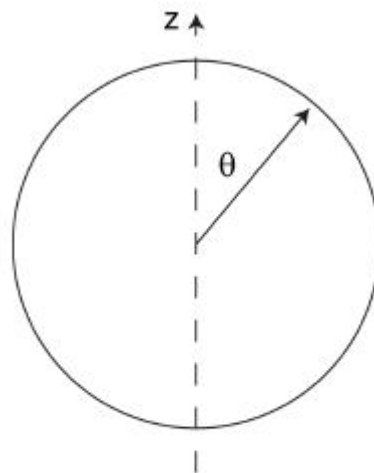
- Determine the equilibrium position of the disk, with respect to the position on the surface directly under point  $A$  (as shown in the figure above).
- Find the frequency of oscillations around the position of equilibrium.

### Příklad 3

Consider a sphere of radius  $R$ . The potential on the surface of the sphere varies as (see figure below)

$$\phi(\theta) = \phi_0 \cos^2 \theta$$

The region inside and outside the sphere is empty.



- Compute the potential inside and outside of the sphere.
- Compute the electric field inside the sphere.
- Using Gauss' law, show that while the electric field inside the sphere is non-zero, no charge is contained inside the sphere.

### Příklad 4

A helicopter can hover when the power output of its engine is  $P$ . A second helicopter is an exact copy of the first one but its linear dimensions are twice larger. What power output is needed to enable this second helicopter to hover? *Hint:* Use your intuition to decide which physical parameters (e.g., density of air, density of helicopter, etc.) of the system are important and then apply a dimensional analysis.