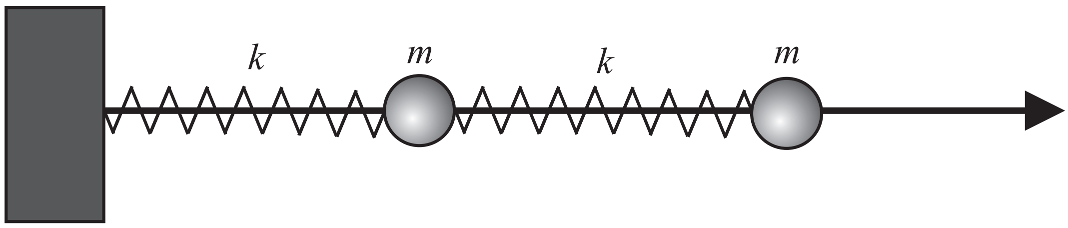
Kungl Tekniska Högskolan **2013 10 06**
Mekanik

Rigid body dynamics, SG2150

Hand in assignments, set 3, HT 2013

Due Wednesday 16 October

1) Calculate the *complete general solution* for the two degree of freedom coupled oscillator problem in the figure below.



The spring on the left is attached to a fixed wall at its left end. The two identical particles of mass m can slide with negligible friction along the horizontal track. The two springs of stiffness k are also identical.

It should be clear from the general solution which type of motion corresponds to which frequency. Draw a clarifying figure.

Hint:
If your solution is correct the two eigen frequencies are $\omega_{\pm} = \phi^{\pm 1}\omega_0$ where $\phi = (\sqrt{5}+1)/2$ is the golden ratio and where $\omega_0 = \sqrt{k/m}$.

Problem 2 on next page.

2) Two homogeneous circular discs in a vertical plane, both of radius r and mass M, with rough circumferences, are kept in contact by a linkage AB between the midpoints. The linkage is a thin homogeneous rod of mass m and length $2r$. The midpoint of one of the discs is fixed and a rotational motion about this midpoint is enforced in such a way that its orientation angle is $\theta(t)$. Assume that $\alpha = \ddot{\theta}$ is constant. Find the equations of motion and calculate the angular velocity $\dot{\varphi}$ of the linkage as a function of the angle φ.

Assume that before $t = 0$ the system is at rest with the linkage AB hanging vertically down. How large must the angular acceleration α be in order for the linkage AB to become horizontal in the ensuing motion?

Answer:

$$\alpha > \frac{4g}{\pi r}\left(1 + \frac{m}{2M}\right)$$