

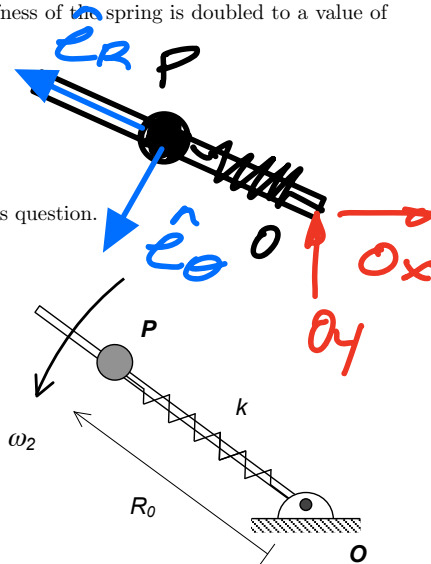
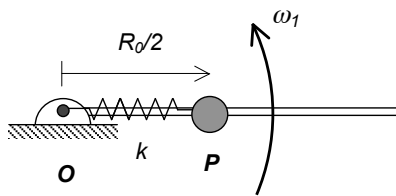
Submit hardcopy at end of class.

Question 8.1

A particle P is free to slide on a smooth, lightweight bar. The bar is free to rotate in a horizontal plane about a vertical axis passing through end O of the bar. A spring of stiffness k and unstretched length R_0 is connected between P and O. The spring is compressed to half of its unstretched length and released when the bar has a rotational speed of ω_1 . After release, P reaches a position when the spring is unstretched. At this position, the rotational speed of the bar is ω_2 .

Suppose now the experiment is repeated except the stiffness of the spring is doubled to a value of $2k$. As a result of this change, the value of ω_2 is now:

- (a) Decreased
- (b) The same**
- (c) Increased
- (d) More information is needed in order to answer this question.



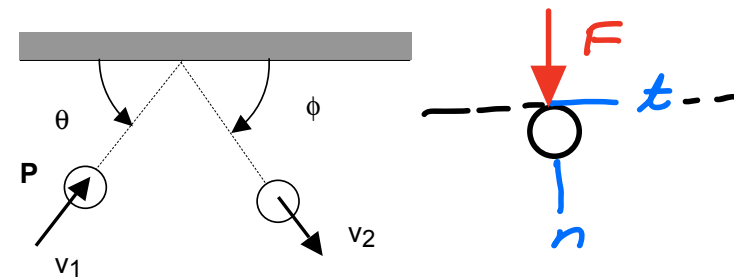
HORIZONTAL PLANE

$$\begin{aligned} \sum \vec{M}_O &= \vec{0} \Rightarrow \vec{H}_{O_1} = \vec{H}_{O_2} \\ \omega / \vec{H}_{O_1} &= m \left(\frac{R_0}{2} \hat{e}_R \right) \times \left(\frac{R_0}{2} \omega_1 \hat{e}_\theta \right) \\ &= \frac{1}{4} m R_0^2 \omega_1 \hat{k} \\ \vec{H}_{O_2} &= m (R_0 \hat{e}_R) \times (R_0 \omega_2 \hat{e}_\theta) \\ &= m R_0^2 \omega_2 \hat{k} \\ \hookrightarrow \frac{1}{4} m R_0^2 \omega_1 &= m R_0^2 \omega_2 \\ \hookrightarrow \omega_2 &= \frac{1}{4} \omega_1 \quad (\text{ind. of } \hat{k}) \end{aligned}$$

Question 8.2

Particle P (of mass m) is traveling on a smooth horizontal surface with a speed of v_1 and angle θ when it strikes a smooth wall. The coefficient of restitution between the wall and the particle is $0 < e < 1$. Circle the answer below that most accurately describes the angle ϕ at which the particle rebounds from the wall.

- (a) $\phi < \theta$**
- (b) $\phi = \theta$
- (c) $\phi > \theta$
- (d) $\phi = 0$
- (e) $\phi = 90^\circ$



$$\begin{cases} \sum F_t = 0 \Rightarrow v_{2t} = v_{1t} = v_1 \cos \theta \\ e = -\frac{v_{2n}}{v_{1n}} = -\frac{v_{2n}}{-v_1 \sin \theta} \Rightarrow v_{2n} = (e \sin \theta) v_1 \\ \tan \phi = \frac{v_{2n}}{v_{2t}} = \frac{(e \sin \theta) v_1}{(v_1 \cos \theta)} \\ = e \tan \theta < 1 \end{cases}$$