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ME 274 - Quiz09a
Spring 2026 - 11:30 class

Name SOLUTION

Question 9.1

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.

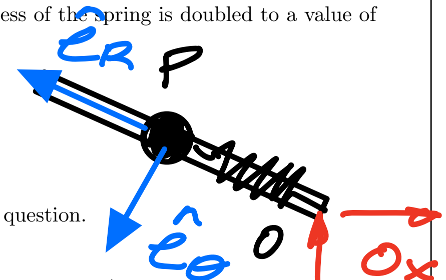
Suppose now the experiment is repeated except the stiffness of the spring is doubled to a value of $2k$. As a result of this change, the value of ω_2 is now:

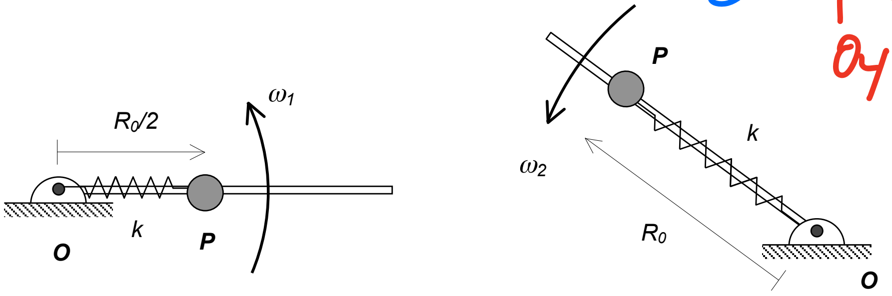
(a) Decreased

[✓ (b) The same]

(c) Increased

(d) More information is needed in order to answer this question.





HORIZONTAL PLANE

$$\sum \vec{M}_O = \vec{0} \Rightarrow \vec{H}_{O_1} = \vec{H}_{O_2}$$

$$\text{w/ } \vec{H}_{O1} = m\left(\frac{R_0}{2}\hat{e}_R\right)\times\left(\frac{R_0}{2}\omega_1\hat{e}_\theta\right)$$

$$= \frac{1}{4} m R_0^2 \omega_1 \hat{k}$$

$$\vec{H}_{O2} = m(R_0\hat{e}_R)\times(\dot{R}_2\hat{e}_R + R_0\omega_2\hat{e}_\theta)$$

$$= mR_0^2\omega_2\hat{k}$$

$$\hookrightarrow \frac{1}{4} mR_0^2\omega_1 = mR_0^2\omega_2$$

$$\hookrightarrow \omega_2 = \frac{1}{4}\omega_1 \quad \text{(ind. of } k\text{)}$$

Question 9.2

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.

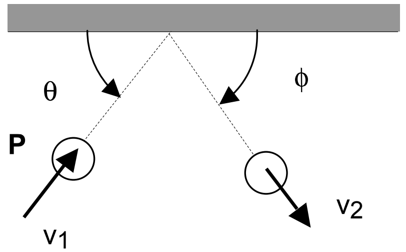
[✓ (a) $\phi < \theta$]

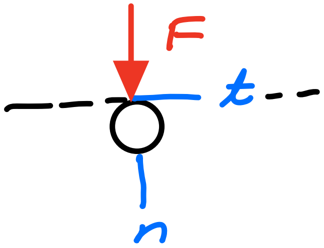
(b) $\phi = \theta$

(c) $\phi > \theta$

(d) $\phi = 0$

(e) $\phi = 90°$





$$\sum F_t = 0 \Rightarrow v_{2t} = v_{1t} = v_1\cos\theta$$

$$e = -\frac{v_{2n}}{v_{1n}} = -\frac{v_{2n}}{-v_1\sin\theta} \Rightarrow v_{2n} = (e\sin\theta)v_1$$

$$\tan\phi = \frac{v_{2n}}{v_{2t}} = \frac{(e\sin\theta)v_1}{(\cos\theta)v_1}$$

$$= \underset{<1}{\boxed{e}}\tan\theta$$