EXAM III Physics 218 2016

Last Name.....First Name.....Section Number.....

USEFUL INFORMATION

$$If \quad f(x) = kx^n \qquad \frac{df}{dx} = nkx^{n-1}$$

$$If \quad f(x) = kx^n \qquad \int_A^B f(x)dx = \frac{1}{n+1}k(B^{n+1} - A^{n+1})$$

$$\int_{\vec{r}_1}^{\vec{r}_2} \vec{F}_{tot} \cdot d\vec{r} = \frac{1}{2}mv^2(\vec{r}_2) - \frac{1}{2}mv^2(\vec{r}_1)$$

If $\vec{F}$ is conservative:

$$\int_{\vec{r}_1}^{\vec{r}_2} \vec{F} \cdot d\vec{r} = -[U(\vec{r}_2) - U(\vec{r}_1)]$$

and

$$F_x = -\frac{\partial U}{\partial x} \qquad F_y = -\frac{\partial U}{\partial y}$$

$$\vec{L} = \vec{r} \times \vec{p} \qquad \vec{\tau} = \vec{r} \times \vec{F}$$

1.

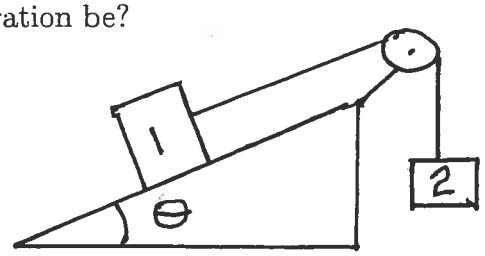
2.

3.

4.

1. (25 points)Derive the expressions for the $\vec{i}_r$ and $\vec{i}_\theta$ components of the velocity and acceleration.

2. (25 points)Two blocks, mass m_1 and m_2, are connected by a massless, unstretchable string. The string goes over a pulley that has radius R and moment of inertia I about its center. There is no slipping of the string in contact with the pulley. There is no friction about the axle of the pulley. There is friction between block 1 and the inclined plane, with coefficient of friction μ. Assuming block 2 moves down, what will its acceleration be?

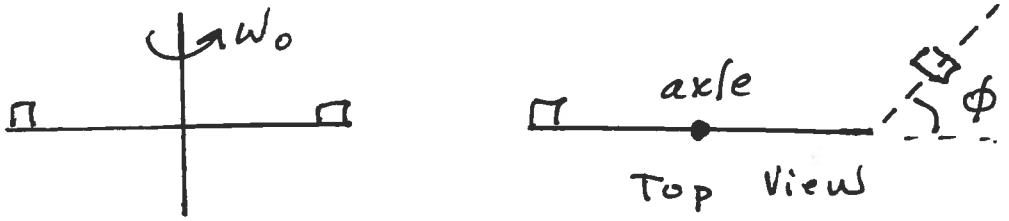


Free Body Diagrams (If appropriate). Law or Definition

Application

Result

3. (25 points)You may ignore gravity in this problem. A rod of length S has moment of inertia I_R about its center. The rod is free to rotate about a vertical axle through its center. Two small blocks, each of mass m are glued to the rod at the positions shown. The entire system is set rotating about the axle with angular velocity ω_0. At some instant one of the blocks comes loose and flies off with a velocity of magnitude v_0 at the angle ϕ shown below. What will be the angular velocity of the remaining block?



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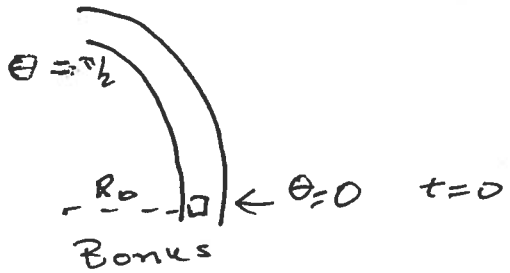
4. (25 points)In a manufacturing facility boxes are placed, at rest, on a conveyor belt which carries them around a circular path of radius R. The conveyor belt starts at rest and, when a box is placed on it at $t = 0$, a motor supplies a torque so that the belt has an angular acceleration $\alpha = c_1 t$. If the coefficient of friction between the box and the belt is μ, at what time would the box begin to slip? No Algebra Please! Bonus: What would be the time for the box to begin to slip if instead of a circular belt the radius varied according to $R = R_0(1 + \sin\theta)$?



Free Body Diagrams (If appropriate). Law or Definition

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