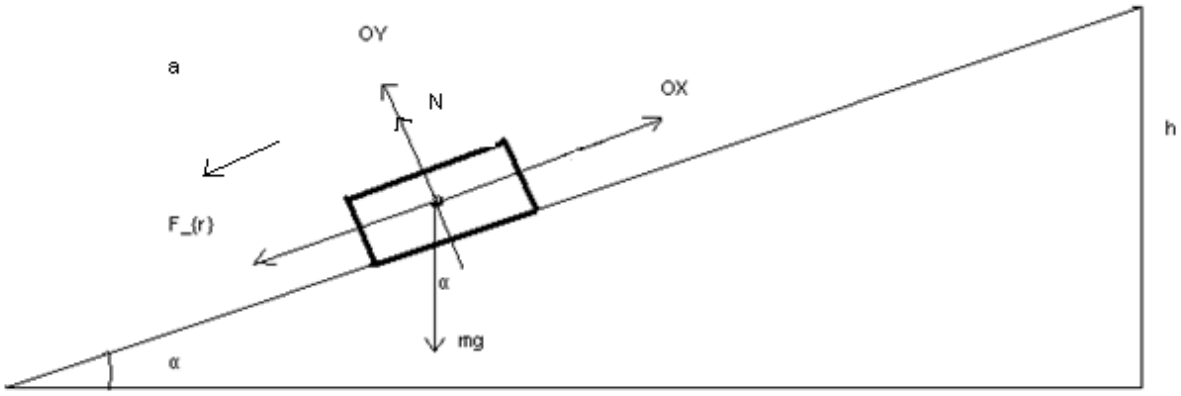
Question

1) A 1 kg box starts up a 2 degrees incline with a speed of 5 m/s. How far will the box slide up the incline if the coefficient of kinetic friction between the box and incline is 0.4?

2) A disc starting from rest rotates about its axis with constant angular acceleration. In 3 s, it rotates 27 rad. During that time, determine a) the angular acceleration b) the instantaneous angular velocity of the disc at the end of the 3 s.

Answer

1)



The second Newton's Law

$$OX: -ma = -F_r - mg * \sin(\alpha)$$

$$OY: N = mg * \cos(\alpha)$$

$$F_r = \mu N \rightarrow a = g(\sin(\alpha) + \mu * \cos(\alpha))$$

The equation for instantaneous velocity

$$v_f = 0 = v_0 - at \rightarrow a = \frac{v_0}{t}$$

From the last two equations we obtain

$$t = \frac{v_0}{g(\sin(\alpha) + \mu * \cos(\alpha))}$$

And distance that box reached

$$\boldsymbol{x = v_0 t - \frac{at^2}{2} = \frac{v_0 t}{2} = \frac{v_0^2}{2g(\sin(\alpha) + \mu * \cos(\alpha))} \approx 2.93\ m}$$

2) a)

The equation of motion for rotational motion

$$\varphi = \varphi_0 + \omega_0 t + \frac{\beta t^2}{2}$$

In this case we obtain

$$\varphi = \frac{\beta t^2}{2} \rightarrow \boldsymbol{\beta} = \frac{2\varphi}{t^2} = \mathbf{6}\ \frac{\boldsymbol{rad}}{\boldsymbol{s^2}}$$

2) b)

The equation for instantaneous velocity

$$\boldsymbol{\omega_3} = \beta t = \mathbf{18}\ \frac{\boldsymbol{rad}}{\boldsymbol{s}}$$