Dynamics

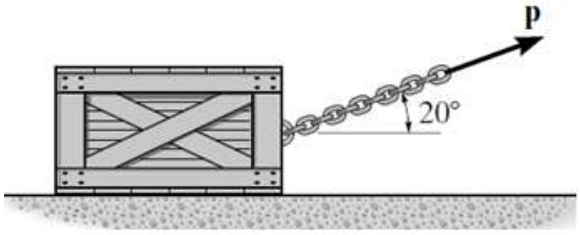
Problem 1

A particle travels along the path $y^2 = 4x$ with a constant speed of 4 m/sec, ($y > 0$). When the particle is at $x = 4\,\text{m}$, determine:

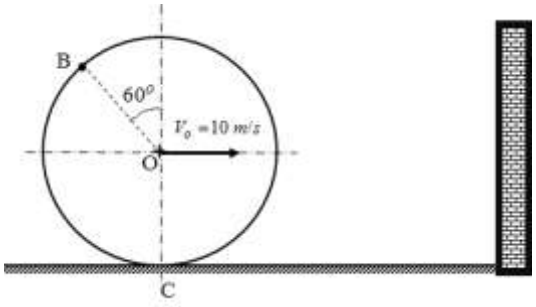
a) the *x*- and *y*-components of the velocity of the particle
b) the *x*- and *y*-components of the acceleration of the particle.

Problem 2

The crate has a mass of 80 kg and is being towed by a chain, which is always directed at 20^o from the horizontal as shown. If the magnitude of **P** is increased until the crate begins to slide, determine the crate's initial acceleration if the coefficient of static friction is $\mu_s = 0.5$ and the coefficient of kinetic friction is $\mu_k = 0.3$.



Problem 3



The figure shows a uniform disc of mass 5 kg, and radius 2 meter. It rolls without slipping with a forward velocity of its center O at a velocity of 10 m/s.

1. Determine the velocity (magnitude and direction with the horizontal) of point B shown on the disc.
2. Determine the kinetic energy of the disc.
3. Determine the angular momentum of the disc about its center O.
4. If the coefficient of restitution between the disc and the shown wall is $e = 0.8$, determine the velocity of the disc's center O just after impact with wall.

Problem 4

The system shown consists of a uniform rod of mass m and length $2R$. The rod is hinged at O and is welded to a uniform thin disc at A. The disc mass is m and its radius is R:

i. Determine the center of mass of the system $L_{cg} = ...$

ii. Determine the system mass moment of inertia about axis O, $I_{OO} = ...$

Regardless of the previous answers consider the following data:

The total mass of the system is 15-kg, $L_{c.g.} = 150\,cm$, radius of gyration about O is $K_{OO} = 180\,cm$, then:

iii. Determine the distance of center of percussion from O, $q = ...cm$

iv. If the system is released from rest at $\theta = 0^{\circ}$, determine the angular acceleration of the system in terms of θ

v. If the system is released from rest at $\theta = 0^{\circ}$, determine the tangential reaction force along $\underline{e}_t$ when $\theta = 45^{\circ}$ using Newton's second law.

vi. If the system is released from rest at $\theta = 0^{\circ}$, determine the tangential reaction force along $\underline{e}_t$ when $\theta = 45^{\circ}$ using the concept of center of percussion and compare the answer with the previous answer of item (v).

vii. If the system is released from rest at $\theta = 0^{\circ}$, determine the normal reaction force along $\underline{e}_n$ when $\theta = 45^{\circ}$.