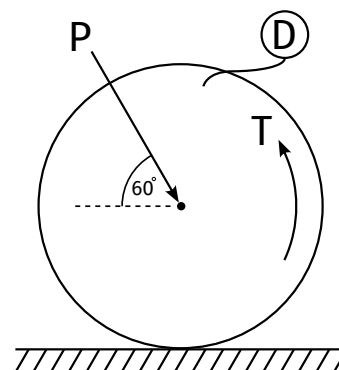


FE: Dynamics and Kinematics

Spring 2024 — Quiz

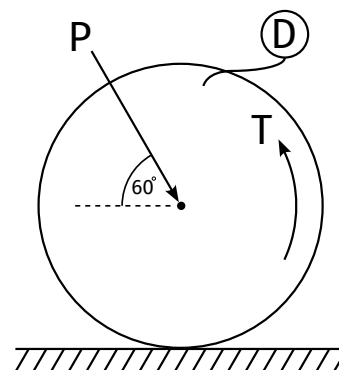
1. (*Particle kinematics*) A rocket is fired vertically upward from a launching pad at B , and its flight is tracked by the radar at point A . Find the magnitude of the velocity of the rocket when $\theta = 45^\circ$ if $\dot{\theta} = 1/10$ rad/s.

- a. 36 m/s c. 90 m/s
b. 180 m/s d. 360 m/s



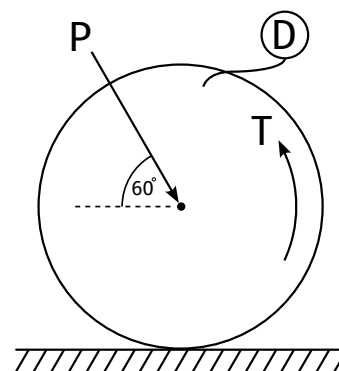
2. (*Rigid-body kinematics*) The block B is constrained to move along a horizontal rectilinear path with a constant acceleration of 2 m/s^2 to the right. The slender rod, R , of length 2 m is pinned to B at O and can swing freely in the vertical plane. At the instant when $\theta = 0^\circ$ (rod is vertical), the angular velocity of the rod is zero but its angular acceleration is 2.5 m/s^2 clockwise. Find the acceleration of the midpoint G of the rod at this instant ($\theta = 0^\circ$).

- a. $3.0 \text{ m/s} \leftarrow$ c. $2.5 \text{ m/s} \leftarrow$
b. $0.5 \text{ m/s} \rightarrow$ d. $2.5 \text{ m/s} \rightarrow$



3. (*Rigid-body kinematics*) The rod R rotates in the vertical plane about a fixed axis through the point O with a constant counterclockwise angular velocity of 5 rad/s . A collar B of mass 2 kg slides down the rod (toward O) so that the distance between B and O decreases at the constant rate of 1 m/s . At the instant when $\theta = 30^\circ$ and $r = 400 \text{ mm}$, determine the magnitude of the applied force P . The coefficient of kinetic friction between B and R is $1/10$.

- a. 9.9 N c. 10.5 N
b. 11.9 N d. 0.3 N



4. (*Work-Energy*) A block of mass 2 kg is pressed against a linear spring of constant $k = 200 \text{ N/m}$ through a distance Δ on a horizontal surface. When the block is released at A , it travels along the straight horizontal path ADB and traverses point B with a velocity of 1 m/s. If the coefficient of kinetic friction between the block and the floor is $2/10$, find Δ .

- a. 0.22 m c. 0.26 m
b. 0.12 m d. 0.08 m

5. (*Moment of Inertia*) Two identical rods, each of mass 4 kg and length 3 m, are rigidly connected as shown in the figure. Determine the moment of inertia of the rigid assembly about an axis through the point A and perpendicular to the plane of the paper.

- a. 19 kg m^2 c. 18 kg m^2
b. 23 kg m^2 d. 15 kg m^2

6. (*Dynamics*) A homogeneous cylinder rolls without slipping on a horizontal floor under the influence of a force $P = 6 \text{ N}$ and a torque $T = 0.5 \text{ N m}$. The cylinder has radius 1 m and mass 2 kg. If the cylinder started from rest, what is its angular velocity after 10 s?

- a. 8.3 rad/s c. 1.7 rad/s
b. 6.8 rad/s d. 0.68 rad/s

7. (*Work-Energy*) A solid homogeneous cylinder is released from rest in the position shown and rolls without slip on a horizontal floor. The cylinder has a mass of 12 kg. The spring constant is 2 N/m, and the unstretched length of the spring is 3 m. What is the angular velocity of the cylinder when its center is directly below the point O ?

- a. 1.33 rad/s c. 1.78 rad/s
b. 1.63 rad/s d. 2.31 rad/s

