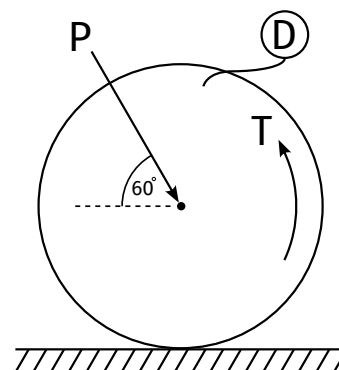


# FE: Dynamics and Kinematics

## Spring 2024 — Quiz

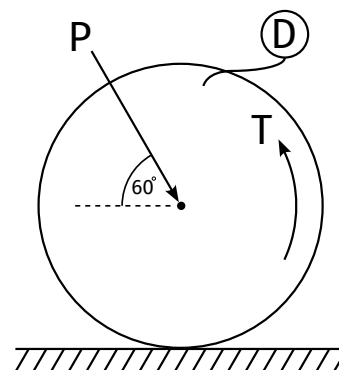
1. (*Particle Kinematics*) A rocket is fired vertically upward from a launching pad at  $B$ , and its flight is tracked by the radar at point  $A$ . Find the magnitude of the velocity of the rocket when  $\theta = 45^\circ$  if  $\dot{\theta} = 1/10$  rad/s.

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



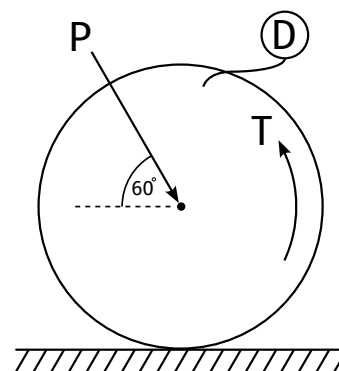
2. (*Rigid-Body Kinematics*) The block  $B$  is constrained to move along a horizontal rectilinear path with a constant acceleration of  $2 \text{ m/s}^2$  to the right. The slender rod,  $R$ , of length 2 m is pinned to  $B$  at  $O$  and can swing freely in the vertical plane. At the instant when  $\theta = 0^\circ$  (rod is vertical), the angular velocity of the rod is zero but its angular acceleration is  $2.5 \text{ m/s}^2$  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  $5 \text{ rad/s}$ . A collar  $B$  of mass  $2 \text{ kg}$  slides down the rod (toward  $O$ ) so that the distance between  $B$  and  $O$  decreases at the constant rate of  $1 \text{ m/s}$ . 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  $\Delta$  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  $\Delta$ .

- 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.  $19 \text{ kg m}^2$                       c.  $18 \text{ kg m}^2$   
b.  $23 \text{ kg m}^2$                       d.  $15 \text{ kg m}^2$

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

