FE: Dynamics and Kinematics
Spring 2024 — Quiz

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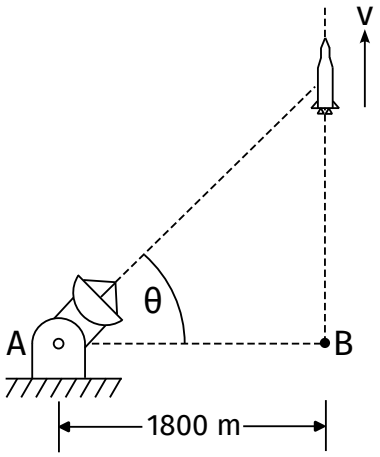
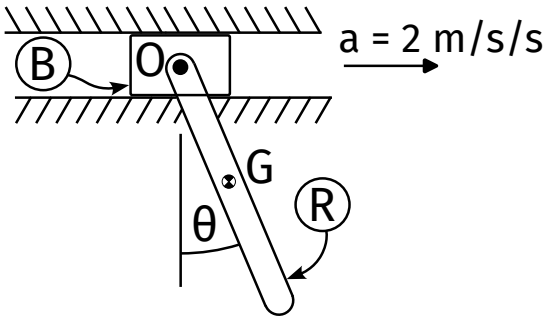
1. (*Particle Kinematics*) A rocket is fired vertically upward from a launching pad at B, and its flight is tracked by the radar at point A. Find the magnitude of the velocity of the rocket when $\theta = 45°$ if $\dot{\theta} = 1/10$ rad/s.



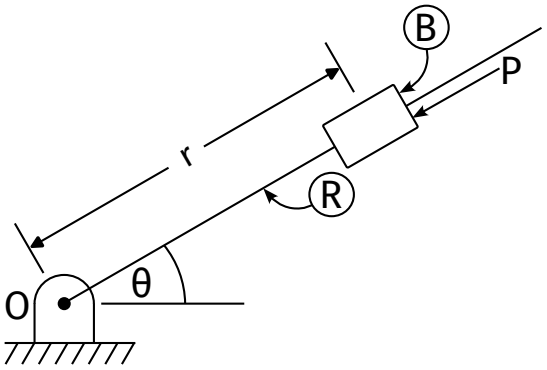
   a. 36 m/s
   b. 180 m/s
   c. 90 m/s
   (d.) 360 m/s

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 $\theta = 0°$ (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 ($\theta = 0°$).



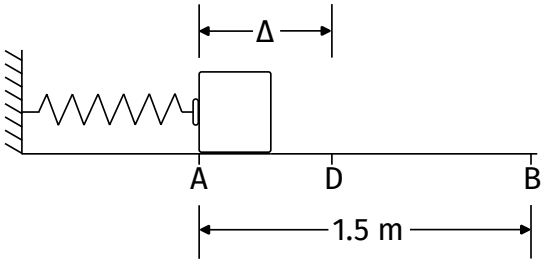
   a. 3.0 m/s ←
   b. 0.5 m/s →
   (c.) 0.5 m/s ←
   d. 2.5 m/s →

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 instaht when $\theta = 30°$ and $r = 400$ mm, determine the magnitude of the applied force P. The coefficient of kinetic friction between B and R is $1/10$.



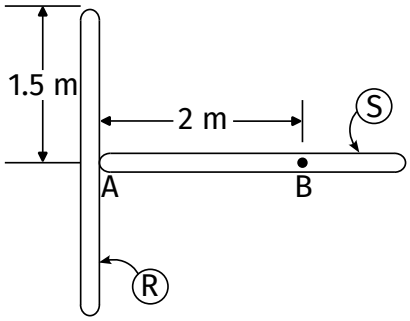
   (a.) 9.9 N
   b. 11.9 N
   c. 10.5 N
   d. 0.3 N

4. (*Work-Energy*) A block of mass 2 kg is pressed against a linear spring of constant $k = 200$ 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.



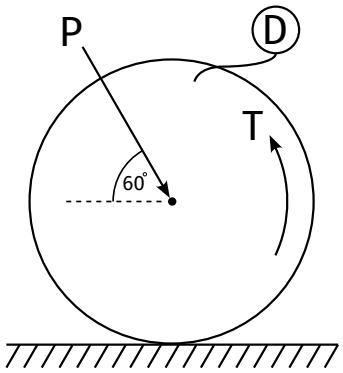
a. 0.22 m
(c.) 0.26 m
b. 0.12 m
d. 0.08 m

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.



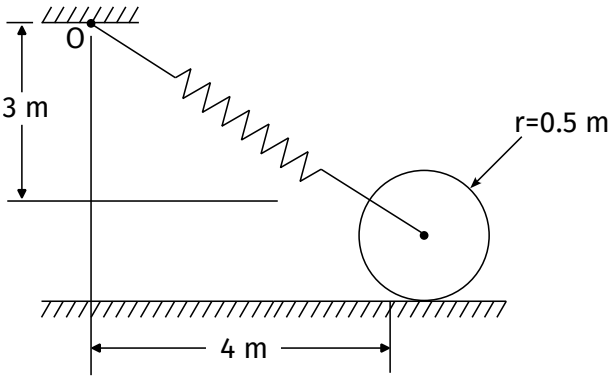
a. 19 kg m^2
c. 18 kg m^2
(b.) 23 kg m^2
d. 15 kg m^2

6. (*Dynamics*) A homogeneous cylinder rolls without slipping on a horizontal floor under the influence of a force $P = 6$ N and a torque $T = 0.5$ 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