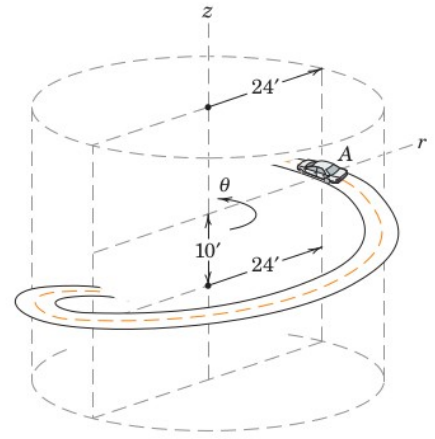# DYNAMICS (ME232)

Tutorial-2: Kinematics of particles

1. The car A is ascending a parking-garage ramp in the form of a cylindrical helix of 24-ft radius rising 10 ft for each half turn. At the position shown the car has a speed of 15 mi/hr, which is decreasing at the rate of 2 mi/hr per second. Determine the $r-, \theta-$ and z-components of the acceleration of the car.


2. The rod of the fixed hydraulic cylinder is moving to the left with a constant speed $v_A = 25$ mm/s. Determine the corresponding velocity of slider B when $s_A = 425$ mm. The length of the cord is 1050 mm, and the effect of the radius of the small pulley A may be neglected.
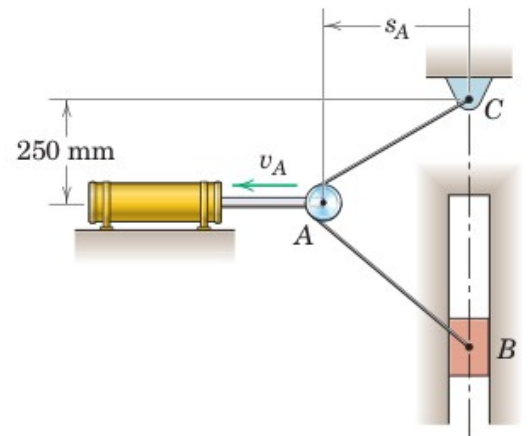

3. A particle which moves with curvilinear motion has coordinate in meters which vary with time t in seconds according to $x = 2t^2 + 3t - 1$ and $y = 5t - 2$. Determine the coordinates of the center of curvature C at time $t = 1$ s.

4. The cam is designed so that the center of the roller A which follows the contour moves on a limaçon defined by $r = b - c\cos\theta$, where b>c. If the cam does not rotate, determine the magnitude of the total acceleration of A in terms of θ if the slotted arm revolves with a constant counterclockwise angular rate $\ddot{\theta} = \omega$.
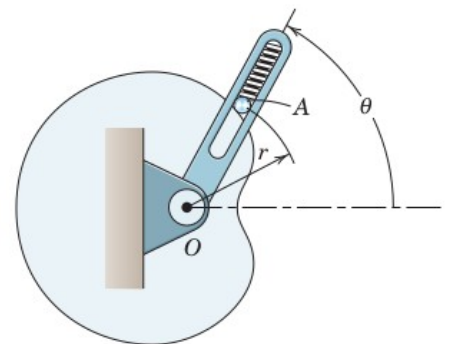
5. A jet plane flying at a constant speed v at an altitude $h = 10$ km is being tracked by radar located at O directly below the line of flight. If the angle θ is decreasing at the rate of 0.020 rad/s when $\theta = 60°$, determine the value of $\ddot{r}$ at this instant and the magnitude of the velocity $\mathbf{v}$ of the plane.
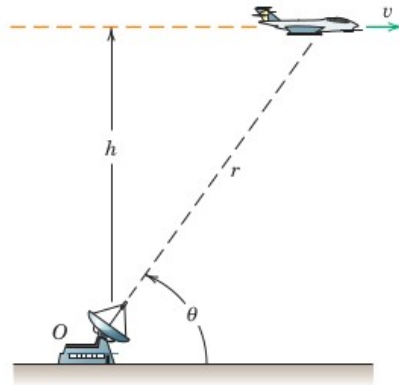
6. The base structure of the firetruck ladder rotates about a vertical axis through O with a constant angular velocity $\omega = 10$ deg/s. At the same time, the ladder unit OB elevates at a constant rate $\dot{\phi} = 7$ deg/s, and section AB of the ladder extends from within section OA at a constant rate of 0.5 m/s. At the instant under consideration, $\phi = 30°$, $\overline{OA}=9$m, and $\overline{AB} = 6$m. Determine the magnitudes of the velocity and acceleration of the end B of the ladder.
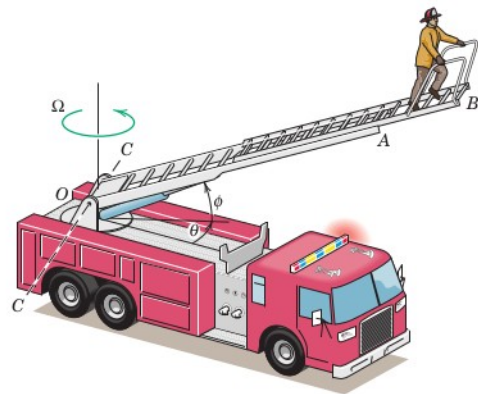
7. The power winches on the industrial scaffold enable it to be raised or lowered. For rotation in the senses indicated, the scaffold is being raised. If each drum has a diameter of 200 mm and turns at the rate of 40 rev/min. Determine the upward velocity v of the scaffold.
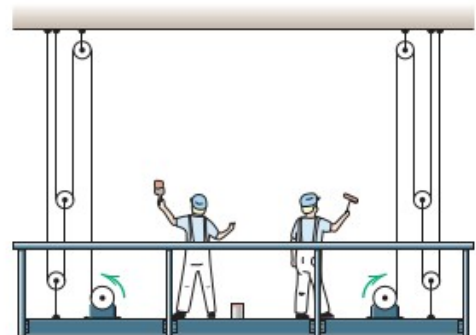
8. The motion of pin P is controlled by the two moving slots A and B in which the pin slides. If B has a velocity $v_B = 3$ m/s to the right while A has an upward velocity $v_A = 2$ m/s, determine the magnitude v_p of the velocity of the pin.