Answer on Question #48310-Physics-Mechanics-Kinematics-Dynamics

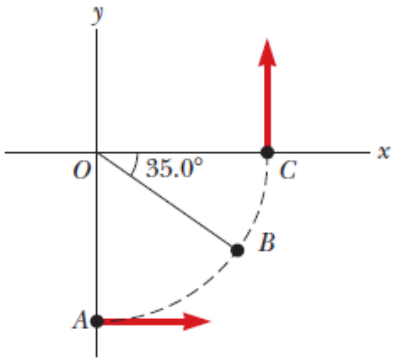
A car initially traveling eastward turns north by traveling in a circular path at uniform speed as in the figure below. The length of the arc ABC is 258 m, and the car completes the turn in 33.0 s.

(a) What is the acceleration when the car is at B located at an angle of 35.0°? Express your answer in terms of the unit vectors i hat and j hat.

(b) Determine the car's average speed.

(c) Determine its average acceleration during the 33.0-s interval.

Solution



The length of the arc is for a 90 degree or $\left(\frac{\pi}{2}\right)$ radians is

$$l = r\theta = 258\left(\frac{\pi}{2}\right) = 405.3\ m.$$

So the constant speed is

$$v = \frac{l}{t} = \frac{405.3}{33.0} = 12.3\frac{m}{s}.$$

Acceleration at a uniform speed on a circular curve is

$$a = \frac{v^2}{r} = \frac{12.3^2}{258} = 0.59\frac{m}{s^2},$$

and the direction will be towards the center of the curve which will be perpendicular to the instantaneous velocity:

$$\theta = 35° + 90° = 125°.$$

The acceleration when the car is at B located at an angle of 35.0° is

$$\vec{a} = a(\cos 125°\,\vec{\imath} + \sin 125°\,\vec{\jmath})\frac{m}{s^2} = 0.59(\cos 125°\,\vec{\imath} + \sin 125°\,\vec{\jmath})\frac{m}{s^2} = (-0.34\vec{\imath} + 0.48\vec{\jmath})\frac{m}{s^2}.$$

Answer: (a) $(-0.34\vec{\imath} + 0.48\vec{\jmath})\frac{m}{s^2}$; (b) $12.3\frac{m}{s}$; (c) $0.59\frac{m}{s^2}$.