Answer on Question #73033-Physics-Classical Mechanics

A wheel 2.0 m in diameter lies in the vertical plane and rotates about its central axis with a constant angular acceleration of 4.0 rad s-2. The wheel starts at rest at t = 0 and the radius vector of a point A on the wheel makes an angle of 60º with the horizontal at this instant. Calculate the angular speed of the wheel, the angular position of the point A and the total acceleration at t = 2.0s.

Solution

The angular speed of the wheel is

$$\omega = \alpha t = 4(2) = 8.0\frac{rad}{s}.$$

The angular position of the point A is

$$\phi = \phi_0 + \omega_0 t + \frac{\alpha t^2}{2}.$$

$$\omega_0 = 0.$$

$$\phi_0 = \frac{\pi}{3}.$$

$$\phi = \frac{\pi}{3} + \frac{4(2)^2}{2} = 9.0\ rad = 518°.$$

The angular position of the point A is

$$518° - 360° = 158°\ from\ the\ horizontal.$$

The total acceleration is

$$a = \sqrt{(r\omega^2)^2 + (r\alpha)^2} = r\sqrt{(\omega)^4 + (\alpha)^2}$$

$$a = 2\sqrt{(8)^4 + (4)^2} = 130\frac{m}{s^2}.$$