Answer on Question #72845 - Physics / Mechanics | Relativity

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 equation of motion and angular speed for the point A on the wheel are given by

$$\varphi = \varphi_0 + \omega_0 t + \frac{\varepsilon t^2}{2}$$

$$\omega = \omega_0 + \varepsilon t$$

The wheel starts at the rest, so $\omega_0 = 0$.

Thus at $t = 2.0$ s the angular position of the point A

$$\varphi = \frac{\pi}{3} + \frac{4.0 \times 2^2}{2} = 9.05 \text{ rad} = 518.6°$$

or 158.6° with the horizontal.

The angular speed

$$\omega = 4.0 \times 2 = 8.0 \text{ rad/s}$$

The total acceleration

$$a = \sqrt{a_\tau^2 + a_n^2} = \sqrt{(\varepsilon R)^2 + (\omega^2 R)^2}$$

$$a = \sqrt{(4.0 \times 1.0)^2 + (8.0^2 \times 1.0)^2} = 64.1 \text{ m/s}^2$$

Answers:

8.0 rad/s

158.6° with the horizontal

64.1 m/s^2