Answer on Question #72594 Physics / Mechanics | Relativity

Wheel $R = 2.0$ m in diameter lies in the vertical plane and rotates about its central axis with a constant angular acceleration of $= 4.0\ \text{rad} \cdot \text{s}^{-2}$. The wheel starts at rest at $t = 0$ and the radius vector of a point A on the wheel makes an angle of $60° = \pi/3$ 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 $t = 2.0$ s.

Solution:

The equation of motion for the point A

$$\varphi = \varphi_0 + \omega_0 t + \frac{\varepsilon t^2}{2} = \frac{\pi}{3} + 0t + \frac{4.0t^2}{2} = \frac{\pi}{3} + 2t^2$$

The angular speed of the wheel

$$\omega = \omega_0 + \varepsilon t = 4t$$

Total acceleration

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

At the instant $t = 2.0$

$$\varphi = \frac{\pi}{3} + 2 \times 2^2 = \frac{\pi}{3} + 2 \times 2^2 = 9.05\ \text{rad} = 518°$$

$$\omega = 4 \times 2 = 8\frac{\text{rad}}{\text{s}}$$

$$a = \sqrt{4^2 + (8^2 \times 2)^2} = 128\ \text{m/s}^2$$

Answers:

$518°$

$8\frac{\text{rad}}{\text{s}}$

$128\ \text{m/s}^2$

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