

Answer on Question #66183-Physics Mechanics-Relativity

A solid body rotates about a stationary axis so that its angular velocity depends on the rotation angle ϕ as $\omega = \omega_0 - a\phi$, where ω_0 and a are positive constants. At the moment $t = 0$ the angle $\phi = 0$. the time dependence of rotation angle is:

Solution

$$\omega = \omega_0 - a\phi$$

$$\omega = \frac{d\phi}{dt} = \omega_0 - a\phi$$

$$dt = \frac{d\phi}{\omega_0 - a\phi}$$

$$\int dt = \int \frac{d\phi}{\omega_0 - a\phi}$$

$$t + c = -\frac{1}{a} \ln(\omega_0 - a\phi)$$

$$\ln(\omega_0 - a\phi) = -a(t + c)$$

$$\omega_0 - a\phi = Ce^{-at}$$

$$\phi = \frac{\omega_0}{a} - Ce^{-at}$$

$$\phi(0) = \frac{\omega_0}{a} - C = 0 \rightarrow \frac{\omega_0}{a} = C$$

Thus,

$$\phi = \frac{\omega_0}{a} (1 - e^{-at}).$$

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