

20-R-KM-DK-5

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Beginner

Rotation About a Fixed Axis

Inspiration: 16-5 Hibbeler



Stuck in quarantine, a retired engineer decides to jam out to his record player, only to find out that it's broken. He notices a pattern in which the record rotates, and hypothesizes that the angular distance the record travels can be described by the equation $\theta = 16 + 4t^2 + 3t^3$, where t is time in seconds. If he starts the player at $t = 0$ s, determine the number of revolutions, the angular velocity, and the angular acceleration of the record at the instant when $t = 30$ s.

$$\theta = 16 + 4t^2 + 3t^3 \quad t = 30s$$

$$\theta = 16 + 4(30)^2 + 3(30)^3 = 84616 \text{ rad}$$

$$84616 \text{ rad} \times \frac{1 \text{ rev}}{2\pi \text{ rad}} = \boxed{13467.05466 \text{ revs}}$$

$$\omega = \frac{d\theta}{dt} = 0 + 8t + 9t^2 \quad 8(30) + 9(30)^2 = \boxed{8340 \text{ rad/s}}$$

$$\alpha = \frac{d\omega}{dt} = 8 + 18t \quad 8 + 18(30) = \boxed{548 \text{ rad/s}^2}$$