# 22-R-WE-JL-24

There has been a UFO sighting and this time it was caught on video! You are the lead investigator of the incident. The UFO in the video starts to spin with an angular velocity of $\omega = 4$ rad/s but by the end is spinning with an angular velocity of $\omega = 11$ rad/s and theorists are speculating that an engine of some sort is applying a constant moment which is what causes it to spin. You estimate that it has a mass of $m = 220$ kg and a radius of gyration of $k_G = 3$ m. In the video you observe the UFO to rotate 3 revolutions. Given the information and speculations present, what is the applied moment, and what is the work done by the moment?

SIDE VIEW

TOP VIEW
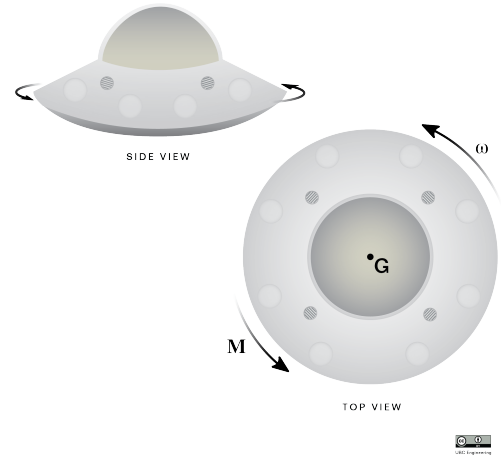
Solution

Since we are assuming a constant moment, this implies constant angular acceleration and we can solve for α:

$$\omega^2 = \omega_0^2 + 2\alpha(\Delta\theta)$$

$$\alpha = \frac{\omega^2 - \omega_0^2}{2\Delta\theta} = \frac{11^2 - 4^2}{2 \cdot 3(2\pi)} = 2.79 \ [\text{rad/s}^2]$$

Solving for the moment we have:

$$\sum M_G = I_G\,\alpha \implies M = (m\,k^2)\alpha$$

$$M = (220 \cdot 3^2)(2.79) = 5.515 \ [\text{kN*m}]$$

Then solving for the work:

$$U_M = M(\Delta\theta) = 5.515(3 \cdot 2\pi) = 103.95 \ [\text{kJ}]$$

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