Answer on question #56955, Physics / Classical Mechanics

Question At t = 0 s a flywheel is rotating at 25 rpm. A motor gives it a constant acceleration of 0.5 rad/s2 until it reaches 70 rpm. The motor is then disconnected. How many revolutions are completed at t = 21 s

Solution The equation for revolution while accelerating is

$$\theta = \nu_0 t + \alpha t^2/2$$

where $\alpha = 0.5$ rad/s^2 $= 0.5 \cdot 60/2\pi$ rpm/s is acceleration. We can find t - time of accelerating:

$$t = \frac{\nu_f - \nu_0}{\alpha} = \frac{70 - 25}{0.5 \cdot 60/2\pi} \approx 9.42\, s = 0.157\, m$$

So, before acceleration stopped, number of revolutions was

$$\theta_1 = \nu_0 t + \alpha t^2/2 = 25 \cdot 0.157 + 0.5 \cdot 60/2\pi \cdot 0.157^2/2 \approx 3.98$$

After this, number of completed revolutions:

$$\theta_2 = t_{left} \nu_f$$

where $t_left = 21 - 9.42 = 11.58\, s = 0.193$ m. So we find

$$\theta_2 = 0.193 \cdot 70 = 13.51$$

In total

$$3.98 + 13.51 = 23.49$$

revolutions at 21 second, 23 full revolutions.