4.66. Model: The magnetic computer disk is a rigid rotating body.

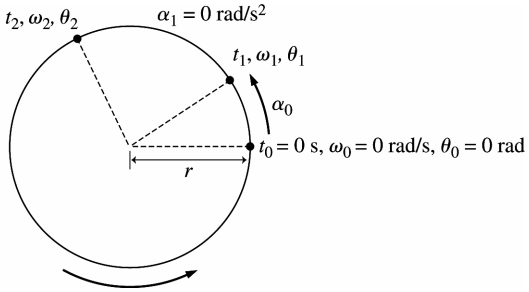
Visualize:

Known

$r = 0.04$ m $\alpha_0 = 600$ rad/s^2
$t_0 = 0$ s $t_1 = 0.5$ s
$t_2 = 1.0$ s
$\omega_0 = 0$ rad/s
$\theta_0 = 0$ rad

Find

θ_2



Solve: Using the rotational kinematic equation $\omega_f = \omega_i + \alpha\Delta t$, we get

$$\omega_1 = 0 \text{ rad} + (600 \text{ rad/s}^2)(0.5 \text{ s} - 0 \text{ s}) = 300 \text{ rad/s}$$

$$\omega_2 = (300 \text{ rad/s}) + (0 \text{ rad/s}^2)(1.0 \text{ s} - 0.5 \text{ s}) = 300 \text{ rad/s}$$

The speed of the painted dot $v_2 = r\omega_2 = (0.04 \text{ m})(300 \text{ rad/s}) = 12$ m/s. The number of revolutions during the time interval t_0 to t_2 is

$$\theta_1 = \theta_0 + \omega_0(t_1 - t_0) + \frac{1}{2}\alpha_0(t_1 - t_0)^2 = 0 \text{ rad} + 0 \text{ rad} + \frac{1}{2}(600 \text{ rad/s}^2)(0.5 \text{ s} - 0 \text{ s})^2 = 75 \text{ rad}$$

$$\theta_2 = \theta_1 + \omega_1(t_2 - t_1) + \frac{1}{2}\alpha_1(t_2 - t_1)^2$$

$$= 75 \text{ rad} + (300 \text{ rad/s})(1.0 \text{ s} - 0.5 \text{ s}) + 0 \text{ rad} = 225 \text{ rad} = (225 \text{ rad})\left(\frac{1 \text{ rev}}{2\pi \text{ rad}}\right) = 35.8 \text{ rev}$$