39. **ORGANIZE AND PLAN** There are two stages here: an acceleration stage, followed by a constant spinning stage. The number of revolutions in the first stage can be found with Equation 8.9, since we know the initial angular velocity (zero), the acceleration, and the time. In the second stage, the angular velocity is the final speed attained in the first stage. We can figure out ω using Equation 8.8. To find the number of revolutions, we just multiply by the time (see Equation 8.3).

Known: First stage with acceleration: $\omega_0 = 0$ rad/s, $\alpha = 615$ rad/s^2, $t_1 = 2.10$ s. Second stage without acceleration: $t_2 = 7.50$ s.

SOLVE Using Equation 8.9 for the first stage:

$$\Delta\theta_1 = \tfrac{1}{2}\alpha t_1^2 = \tfrac{1}{2}(615 \text{ rad/s}^2)(2.10 \text{ s})^2 = 1360 \text{ rad}\left[\frac{1 \text{ rev}}{2\pi \text{ rad}}\right] = 216 \text{ rev}$$

At the end of this stage, the angular velocity will be:

$$\omega = \omega_0 + \alpha t = (615 \text{ rad/s}^2)(2.10 \text{ s}) = 1290 \text{ rad/s}$$

Now using Equation 8.3, we can find the number of revolutions in the second stage:

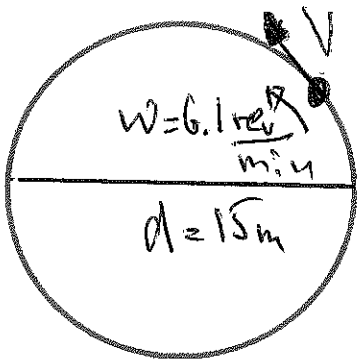
$$\Delta\theta_2 = \omega t_2 = (1290 \text{ rad/s})(7.50 \text{ s}) = 9680 \text{ rad}\left[\frac{1 \text{ rev}}{2\pi \text{ rad}}\right] = 1540 \text{ rev}$$

The total number of revolutions is then:

$$\Delta\theta_1 + \Delta\theta_2 = 216 \text{ rev} + 1540 \text{ rev} = 1756 \text{ rev}$$

REFLECT Most of the revolutions occur in the second stage, since the first stage is relatively short. The total number of revolutions is pretty high, but then remember the zzz of the dentist's drill. Ouch!

An object rotates along a circle that is 15 m in diameter. If the rotational speed is 6.1 rev/min, what is the linear velocity of the object in m/s?



$$V = w.\ R$$

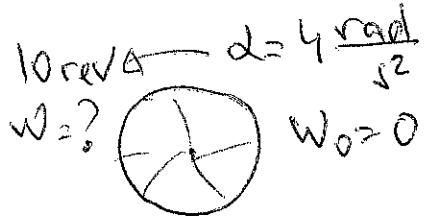
$$w = 6.1 \text{ rev/min} = ((6.1).2\pi)/60 \text{ sec} = 0.64 \text{ rad/s}$$

$$V = 0.64 \text{ rad/s} .\ (15/2) = 4.8 \text{ m/s}$$

(17)

19. A wheel starts from rest and has an angular acceleration of 4.0 rad/s^2. When it has made 10 rev its angular velocity is:

1) 16 rad/s
2) 22 rad/s
3) 32 rad/s
4) 250 rad/s



Ans: 2

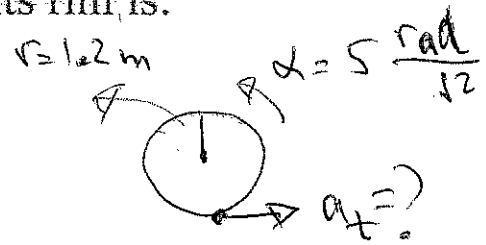
$\omega_f^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$ | $\omega_f^2 - \omega_0^2 = 2\alpha\Delta\theta$

($\omega_0 = 0$; $\theta - \theta_0 = 10\,\text{rev}$)

$\omega_f = \sqrt{2 * \alpha * (10 * 2\pi)} \approx 22 \frac{\text{rad}}{\text{s}}$

35. A flywheel of radius 1.2 m has a constant angular acceleration of 5.0 rad/s^2. The tangential acceleration of a point on its rim is:

1) 5.0 rad/s^2
2) 3.0 m/s^2
3) 5.0 m/s^2
4) 6.0 m/s^2

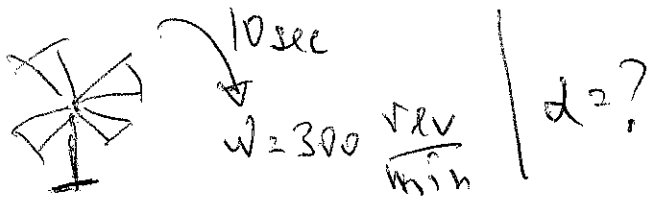


Ans: 4

$$a_t = \alpha \cdot r = 5.0 * 1.2\,m = 6\ \frac{m}{s^2}$$

10. Ten seconds after an electric fan is turned on, the fan rotates at 300 rev/min. Its average angular acceleration is:

1) 3.14 rad/s^2
2) 30 rad/s^2
3) 30 rev/s^2
4) 50 rev/min^2



Ans: 1 $\quad w_0 = 0$

$$w = 300 \frac{rev}{min} = \frac{300 * 2\pi}{60\ s} \left[\frac{rad}{s}\right]$$

$$\alpha = \frac{w - w_0}{t(=10\ sec)} = \frac{300 \cdot 2\pi}{60 \cdot 10} = 3.14 \frac{rad}{s^2}$$