12. (a) The rotational acceleration is found from Eq. 11-13:

$$\alpha = \frac{2\Delta\theta}{(\Delta t)^2} = \frac{2(25\text{ rad})}{(5.0\text{ s})^2} = 2.0\ \text{rad/s}^2.$$

(b) The average rotational velocity is

$$\langle\omega\rangle = \frac{\Delta\theta}{\Delta t} = \frac{25\text{ rad}}{5.0\text{ s}} = 5.0\ \text{rad/s}.$$

(c) Using Eq. 11-12, the instantaneous angular velocity at the end of the 5.0 s is

$$\omega_2 = (2.0\ \text{rad/s}^2)(5.0\text{ s}) = 10\,\text{rad/s}\ .$$

(d) According to Eq. 11-13, the angular displacement during the following 5.0 s is

$$\Delta\theta = \omega_2\Delta t + \tfrac{1}{2}\alpha(\Delta t)^2 = (10\,\text{rad/s})(5.0\text{ s}) + \tfrac{1}{2}(2.0\,\text{rad/s}^2)(5.0\text{ s})^2 = 75\text{ rad}.$$

18. The wheel begins from rest at time t_1, with a constant acceleration of $\alpha = 4.0\,\text{rad/s}^2$. In the interval between t_2 and t_3, where $t_3 - t_2 = 4.0$ s, the wheel turns through an angle of $\theta_3 - \theta_2 = 80$ rad.

(a) We seek the value of ω_2, which we obtain from Eq. 11-13:

$$\theta_3 - \theta_2 = \omega_2(t_3 - t_2) + \tfrac{1}{2}\alpha(t_3 - t_2)^2.$$

Solving this for ω_2 yields

$$\omega_2 = \frac{(\theta_3 - \theta_2)}{(t_3 - t_2)} - \frac{1}{2}\alpha(t_3 - t_2) = \frac{(80\text{ rad})}{(4.0\text{ s})} - \frac{1}{2}(4.0\,\text{rad/s}^2)(4.0\text{ s}) = 12\,\text{rad/s}.$$

(b) We obtain $(t_2 - t_1)$ using Eq. 11-12:

$$(t_2 - t_1) = \frac{\omega_2}{\alpha} = \frac{12\,\text{rad/s}}{4.0\,\text{rad/s}^2} = 3.0\text{ s}.$$

23. (a) Since $\theta = (0.30\,\text{rad/s}^2)t^2$, we differentiate to find $|\omega| = (0.60\,\text{rad/s}^2)t$. At $t = 5.0\text{s}$, $|\omega| = (0.60\,\text{rad/s}^2)(5.0\text{ s}) = 3.0\,\text{rad/s}$.

(b) Eq. 11-18 gives the translational speed as $v = |\omega| r = (3.0\text{ rad/s})(10\text{ m}) = 30\text{ m/s}$.

(c) We differentiate the rotational velocity to find $|\alpha| = 0.60\text{ rad/s}^2$. Then, the tangential acceleration at $t = 5.0$ s is, using Eq. 11-19,

$$|\vec{a}_t| = |\alpha| r = (0.60\text{ rad/s}^2)(10\text{ m}) = 6.0\text{ m/s}^2.$$

(d) The radial acceleration is given by Eq. 11-20:

$$|\vec{a}_r| = \omega^2 r = (3.0\text{ rad/s})^2(10\text{ m}) = 90\text{ m/s}^2.$$

24. (a) The rotational speed is

$$|\omega| = \frac{v}{r} = \frac{(2.90\times10^4\,\text{km}/3600\text{ s})}{3220\text{ km}} = 2.50\times10^{-3}\text{ rad/s}.$$

(b) The radial acceleration is given by Eq. 11-20:

$$|\vec{a}_r| = \omega^2 r = (2.50\times10^{-3}\text{ rad/s})^2(3.22\times10^6\text{ m}) = 20.2\text{ m/s}^2.$$

(c) Assuming the rotational velocity is constant, the rotational acceleration and the tangential acceleration vanish, since

$$\alpha = \frac{d\omega}{dt} = 0\,\text{rad/s}^2 \text{ and } |\vec{a}_t| = |\alpha| r = 0\,\text{m/s}^2.$$

41. According to Table 11-2(*i*), the rotational inertia of a uniform slab about an axis through the center and perpendicular to the large faces is given by $I_{com} = \frac{1}{12}M\left(a^2 + b^2\right)$. A parallel axis through the corner is a distance

$$h = \sqrt{(a/2)^2 + (b/2)^2}$$

from the center. Therefore,

$$I = I_{com} + Mh^2 = \tfrac{1}{12}M\left(a^2 + b^2\right) + \tfrac{1}{4}M\left(a^2 + b^2\right) = \tfrac{1}{3}\left(a^2 + b^2\right).$$