RECITATION 9

Ch. 10

••5 ILW A diver makes 2.5 revolutions on the way from a 10-m-high platform to the water. Assuming zero initial vertical velocity, find the average angular velocity during the dive.

First, we find the time of the jump.

$$\Delta y = -\frac{1}{2}gt^2$$

$$t = \sqrt{\frac{-2\Delta y}{g}} = \sqrt{\frac{-2(-10\text{ m})}{9.8\text{ m/s}^2}} = 1.43\text{ s}.$$

$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{2.5\text{ rev}}{1.43\text{ s}} = 1.75\,\frac{\text{rev}}{\text{s}} = 11\text{ rad/s}.$$

••15 SSM A wheel has a constant angular acceleration of 3.0 rad/s^2. During a certain 4.0 s interval, it turns through an angle of 120 rad. Assuming that the wheel started from rest, how long has it been in motion at the start of this 4.0 s interval?

$$\Delta\theta = \omega_1(t_2 - t_1) + \frac{1}{2}\alpha(t_2 - t_1)^2$$

$$120 \text{ rad} = \omega_1(4.0 \text{ s}) + \frac{1}{2}(3.0 \text{ rad/s}^2)(4.0 \text{ s})^2$$

Solving for ω_1 gives that $\omega_1 = 24$ rad/s.

$$\omega_1 = \omega_0 + \alpha\, t_1.$$

Using that $\omega_0 = 0$ and solving for t_1 gives that $t_1 = 8$ s.

••25 SSM (a) What is the angular speed ω about the polar axis of a point on Earth's surface at latitude 40° N? (Earth rotates about that axis.) (b) What is the linear speed v of the point? What are (c) ω and (d) v for a point at the equator?

a)

$$\omega = \frac{1\text{ rev}}{24\text{ h}} \times \frac{2\pi\text{ rad}}{1\text{ rev}} \times \frac{1\text{ h}}{3600\text{ s}} = 7.27 \times 10^{-5}\text{ rad/s}.$$

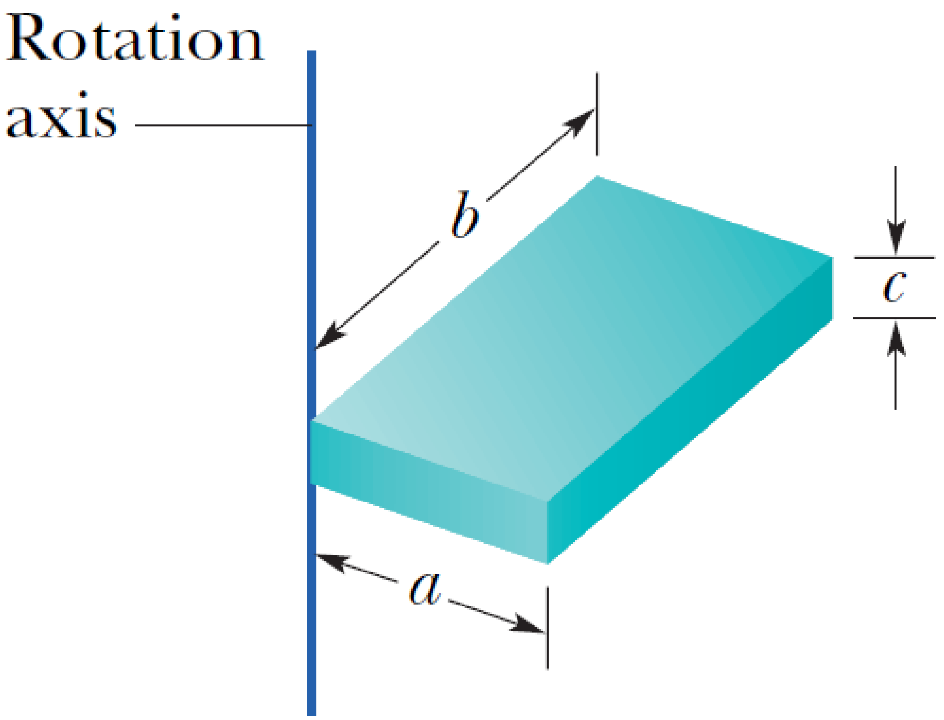
b)

$$\begin{aligned} v = r\omega &= (r_E \cos 40°)\omega \\ &= (6.37 \times 10^{6}\text{ m})(\cos 40°)(7.27 \times 10^{-5}\text{ rad/s}) \\ &= 355\text{ m/s}. \end{aligned}$$

c)

$$v = r\omega = (6.37 \times 10^{6}\text{ m})(7.27 \times 10^{-5}\text{ rad/s}) = 463\text{ m/s}.$$

••43 SSM WWW The uniform solid block in Fig. 10-35 has mass 0.172 kg and edge lengths a = 3.5 cm, b = 8.4 cm, and c = 1.4 cm. Calculate its rotational inertia about an axis through one corner and perpendicular to the large faces.



$$I = I_{com} + Mh^2 = \frac{M}{12}(a^2 + b^2) + M\left(\frac{\sqrt{a^2 + b^2}}{2}\right)^2 = \frac{M}{3}(a^2 + b^2)$$

$$I = \frac{0.172\text{ kg}}{3}[(0.035)^2 + (0.084)^2] = 4.7 \times 10^{-4}\text{ kg}\cdot\text{m}^2.$$