

68. (a) The angular speed of the top is  $\omega = 30 \text{ rev/s} = 30(2\pi) \text{ rad/s}$ . The precession rate of the top can be obtained by using Eq. 11-46:

$$\Omega = \frac{Mgr}{I\omega} = \frac{(0.50 \text{ kg})(9.8 \text{ m/s}^2)(0.040 \text{ m})}{(5.0 \times 10^{-4} \text{ kg} \cdot \text{m}^2)(60\pi \text{ rad/s})} = 2.08 \text{ rad/s} \approx 0.33 \text{ rev/s}.$$

(b) The direction of the precession is clockwise as viewed from overhead.

69. The precession rate can be obtained by using Eq. 11-46 with  $r = (11/2) \text{ cm} = 0.055 \text{ m}$ . Noting that  $I_{\text{disk}} = MR^2/2$  and its angular speed is

$$\omega = 1000 \text{ rev/min} = \frac{2\pi(1000)}{60} \text{ rad/s} \approx 1.0 \times 10^2 \text{ rad/s},$$

we have

$$\Omega = \frac{Mgr}{(MR^2/2)\omega} = \frac{2gr}{R^2\omega} = \frac{2(9.8 \text{ m/s}^2)(0.055 \text{ m})}{(0.50 \text{ m})^2(1.0 \times 10^2 \text{ rad/s})} \approx 0.041 \text{ rad/s}.$$