60. (a) Since the motorcycle is going leftward across our field of view, then when its wheels are rolling they must be going counterclockwise (which we take as the positive sense of rotation, which is the usual convention).

(b) Just before the rear wheel spins up to ω_{wf} it has the angular velocity necessary for rolling $\omega_{wR} = v/R$ where $v = 32$ m/s and $R = 0.30$ m. Since $\omega_{wf} > \omega_{wR}$ the system would seem to have suddenly acquired an increase in (positive) angular momentum – without the action of external torques! Since this is not possible, then the other constituents of the system (the man and the motorcycle body, which the problem just refers to as "the motorcycle") must have acquired some (negative) angular momentum. Thus, the motorcycle rotated clockwise.

(c) Assuming the system's (translational) projectile motion is symmetrical (as in Fig. 4-34 in the textbook) then (with $+y$ upward) it starts with $v_{0y} = v \sin 15°$ and returns with $v_y = -v \sin 15°$. Substituting these into Eq. 2-11 (with $a = -g$) leads to

$$-v \sin 15° = v \sin 15° - gt \implies t = \frac{2v \sin 15°}{g} = 1.7 \text{ s} .$$

(d) As noted in our solution of part (b), $\omega_{wR} = v/R$ which yields the value $\omega_{wR} = 32/0.30 = 106.7$ rad/s. In keeping with the significant figures rules, we round this to 1.1×10^2 rad/s.

(e) We have $L_w = I_w \omega_{wR} = (0.40)(106.7) = 43$ kg·m^2/s.

(f) Recalling our discussion in part (b), we apply angular momentum conservation:

$$I_w \omega_{wR} = I_w \omega_{wf} + I_c \omega_c \implies \omega_c = -\frac{I_w \left(\omega_{wf} - \omega_{wR}\right)}{I_c}$$

which yields $\omega_c = -1.067$ rad/s or $|\omega_c| \approx 1.1$ rad/s.

(g) The problem states that the spin up occurs immediately – the moment this becomes a projectile motion problem (for the center of mass). We assume the motorcycle turns at the (constant) rate $|\omega_c|$ for the duration of the motion. Using the more precise values from our previous results, we are led to

$$\theta = \omega_c t = -1.80 \text{ rad}$$

which we convert (multiplying by $180/\pi$) to $-103°$. Rounding off, we find $|\theta| \approx 100°$.