47. So that we don't get confused about $\pm$ signs, we write the angular *speed* of the lazy Susan as $|\omega|$ and reserve the ω symbol for the angular velocity (which, using a common convention, is negative-valued when the rotation is clockwise). When the roach "stops" we recognize that it comes to rest relative to the lazy Susan (not relative to the ground).

(a) Angular momentum conservation leads to

$$mvR + I\omega_0 = \left(mR^2 + I\right)\omega_f$$

which we can write (recalling our discussion about angular speed versus angular velocity) as

$$mvR - I\,|\omega_0| = -\left(mR^2 + I\right)|\omega_f| \quad .$$

We solve for the final angular speed of the system:

$$|\omega_f| = \frac{mvR - I\,|\omega_0|}{mR^2 + I} \quad .$$

(b) No, $K_f \neq K_i$ and – if desired – we can solve for the difference:

$$K_i - K_f = \frac{m\,I}{2}\,\frac{v^2 + \omega_0^2 R^2 + 2Rv\,|\omega_0|}{mR^2 + I}$$

which is clearly positive. Thus, some of the initial kinetic energy is "lost" – that is, transferred to another form. And the culprit is the roach, who must find it difficult to stop (and "internalize" that energy).