TP A.12
The relationship between cue ball spin and cue tip offset

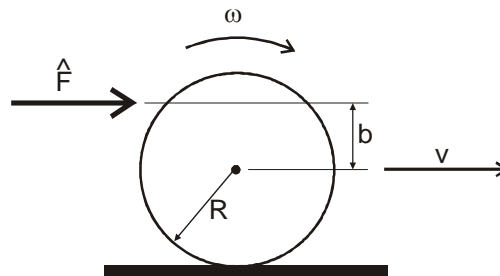supporting:
"The Illustrated Principles of Pool and Billiards"
http://billiards.colostate.edu
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Linear impulse results in linear momentum:

$$\hat{F} = mV \tag{1}$$

The offset (b) of the impulse about the ball center results in angular momentum:

$$b\hat{F} = I\omega = \frac{2}{5}mR^2\omega \tag{2}$$

Solving for and equating the impulse from Equations 1 and 2 yields:

$$\left(\frac{\omega}{v/R}\right) = \frac{5}{2}\left(\frac{b}{R}\right) \tag{3}$$

The term on the left side of Equation 3 is the spin rate factor (SRF), expressed as a percentage of the natural roll rate of the ball (v/R). The b/R term is the offset factor, expressed as a percentage of the ball radius.

The typical maximum recommended offset to not risk miscues is approximately:

$$b_{max} := \frac{9}{16}\cdot in \qquad \text{with} \qquad R := 1.125\cdot in$$

which corresponds to an offset factor of:

$$\frac{b_{max}}{R} = 0.5$$

The spin rate factors for various offsets are:

$$SRF(b) := \frac{5}{2} \cdot \frac{b}{R} \qquad SRF(0 \cdot in) = 0 \qquad SRF\left(\frac{b_{max}}{2}\right) = 0.625 \qquad SRF\left(\frac{2}{5} \cdot R\right) = 1 \qquad SRF\left(b_{max}\right) = 1.25$$

<table>
<tr><td></td><td>stun shot</td><td>62.5% of
natural roll</td><td>natural roll</td><td>25% more than
natural roll</td></tr>
</table>

The maximum spin rate factor observed in HSV A.98-A.109 (in A.106) was:

$$SPR_{max} := 1.37$$

which, from Equation 3, corresponds to an offset factor (b/R) of:

$$\frac{2}{5} \cdot SPR_{max} = 0.55$$