See the HiHW grading rubric posted on Carmen

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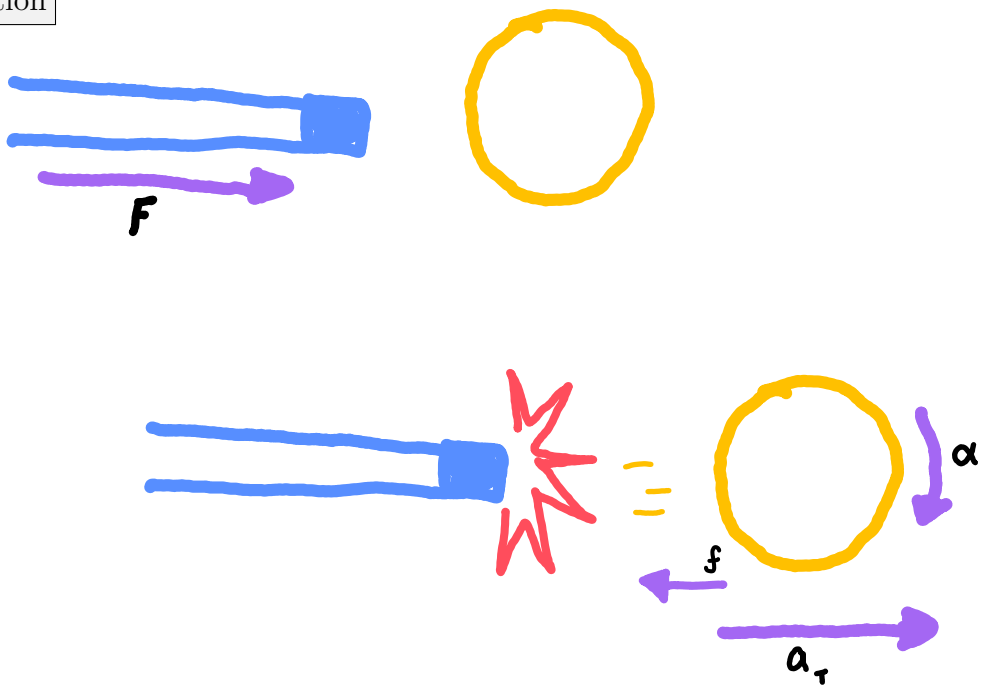
A billiard ball is a solid sphere with diameter $d = 57\,\text{mm}$. Suppose that a billiard ball is placed on the table and hit perfectly horizontally with the cue stick, so that is has no spin initially. If the coefficient of friction between the ball and the table is $\mu_k = 0.20$, then what is the angular acceleration α of the ball just after it is hit? For the limit check, investigate what happens to α if the table becomes very slippery ($\mu_k \to 0$).

Representation:	0	1	2
Physics Concept(s):	0	1	2
Initial Equation(s):	0	0.5	1
Symbolic Answer:	0		1
Units Check:	0	0.5	1
Limits Check:	0	0.5	1
Neatness:	-2	-1	0
Total:			
Correct Answer:	Y	N	

Representation



Physics Concept(s) (Refer to the list posted on Carmen)

(1) Collisions

(2) Impulse

(3) Conservation of Momentum

Initial Equations

$$\tau = I\alpha$$

$$I = \frac{2}{5}mR^2$$

$$f = \mu_k mg$$

$$\tau = fR\sin\theta$$

↓ Show Your Equation Work On Next Page ↓

Algebra Work (Symbols only. Don't plug in any numbers yet.)

$fR\sin\theta = I\alpha$

$\sin 90 = 1$

$fR = \frac{2}{5}mR^2\alpha$

$\mu_k mgR = \frac{2}{5}mR^2\alpha$

$\mu_k g = \frac{2}{5}R\alpha$

$\alpha = \frac{5\mu_k g}{2R}$

$\tau = I\alpha$

$I = \frac{2}{5}mR^2$

$f = \mu_k mg$

$\tau = fR\sin\theta$

Symbolic Answer: $\alpha = \frac{5\mu_k g}{2R}$

Units Check

$\frac{m/s^2}{m} = \frac{1}{s^2}$

$\frac{1}{s^2} = \frac{rad}{s^2}$

yeah, it checks out

Limits Check

a) As $\mu_k \to 0$, what limit does α approach?

$\lim_{\mu_k \to 0}(\alpha) = 0$

b) Why does the result make physical sense?

Because there would be no change in angular velocity without an exterior force, in this case being friction.

Numerical Answer: (Obtain this by plugging numbers into your symbolic answer.)

171.93 rad/s^2.

$r = 0.0285\,m$

$\mu_k = 0.2$

$g = 9.8\,m/s^2$