1. Why is there no friction between the playing card and the wall, even if the wall is not smooth, when there is no friction between the card and the table?

\[ F_{f_{w1}} = 0 \Rightarrow N_2 = 0 \Rightarrow F_{f_{w2}} = 0 \]

\[ \leq \mu_s N_2 \]

2. Recall three equivalent formulas you can use for the magnitude of a torque due to some force applied at some point on a body about an axis \( P \)? Draw pictures to explain all three versions.

\[ \tau = RF \sin \theta = R \perp F = RF \perp \]

\[ R \sin \theta \]

\[ F \sin \theta \]

3. What is the moment of inertia of the falling hoop around point \( P \) (an axis parallel to the hoop's symmetry axis) and what is the torque due to gravity around that point, on p. 3, if CW is +?

\[ I_p = I_{cm} + Mh^2 = 2MR^2 \]

\[ L = MR^2 \]

\[ \tau_{p, mg} = + MR mg \sin 90^o = MRg \]

4. What is \( r_{cm} \) on p. 4? (Hint: Thus the translational \( L_{cm} \) depends on the reference point – the axis – while the \( L_{int} \) does not.)

\[ r_{cm} = \text{distance of closest approach of CM to P} \]

5. Although you might guess wrong about the resulting rotational direction for \( L_{int} \), why does it not matter?

Calculation \( \omega \) will be \(< 0\) and it tells you the opposite direction is correct.

6. What is the initial angular momentum for the putty ball if the reference point (axis) for the angular momentum is the point where the putty ball hits the rod? How will this change our answers for \( v_{cm} \) and \( \omega \)?

Then \( L_{ball, init} = 0 \) No change \( v_{cm} \) obviously not

\[ v_{cm, new P} \]

\[ (m + M) \]

\[ v_{cm, new P} \]

7. Draw a picture that helps us understand what the projectile and stick are doing after the collision in HW 32-4, indicating the direction of \( \omega \).

8. Once and for all, if \( \mu_s \) is the static coefficient of friction for a block of mass \( m \) on a table, what is the direction and magnitude of the friction force if an external horizontal force \( F \) is applied (but block does not move)?

\[ f = F \text{ opposite to F} \]

\[ NOT \mu_s mg \]