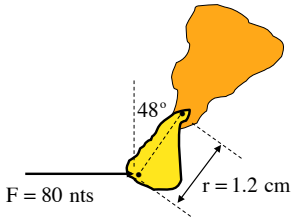
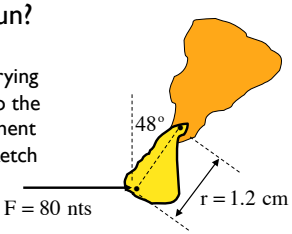
Problem 8.4

An 80 newton force is applied as shown. What is the torque applied about the tooth contact with the gum?

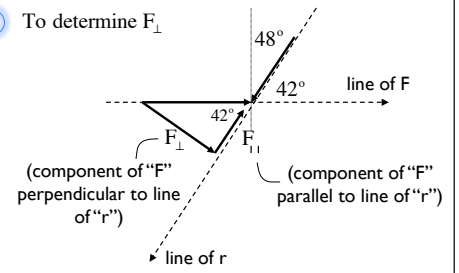


An 80 newton force is applied as shown. What is the torque applied about the tooth contact with the gum?

Using the F-perpendicular approach: In this case, you are trying to determine the component of "F" that is perpendicular to the line of "r." (Note: It is easier to identify the parallel component first, then determine the perpendicular one). Looking at sketch we can write:



1 To determine $F_\perp$



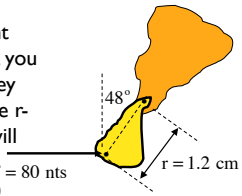
3 $\Gamma_A = F_\perp |r|$
$= \left[(80\text{ nt})\sin 42^\circ\right](.012\text{ m})$
$= .64\text{ nt}\bullet\text{m}$

4 Again, the torque is in the +k direction.

2 So $F_\perp = F\sin 42^\circ$

An 80 newton force is applied as shown. What is the torque applied about the tooth contact with the gum?

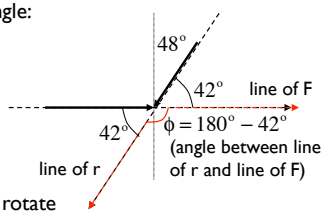
After you identify "r" (this is a vector that GOES FROM the point about which you are taking the torque TO where the force acts), you have three approaches you can use to determine the torque. They are the F-perpendicular approach, the definition approach and the r-perpendicular approach. I will show all three. (In all cases, you will either have to use the right-hand rule or the clockwise/ counterclockwise approach to determine the torque's direction.)



Using the definition approach:

$\Gamma_A = |r||F|\sin\phi$
$= (.012\text{ m})(80\text{ nt})\sin 138^\circ$
$= .64\text{ nt}\bullet\text{m}$

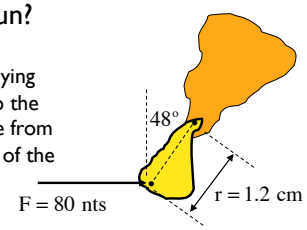
for the angle:



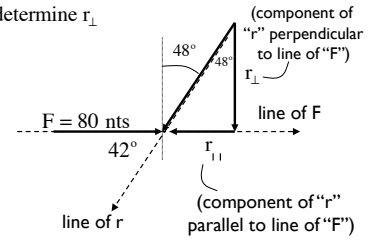
Direction using right-hand rule is *out of page* in the +k direction . . . OR . . . The force is trying to make the tooth rotate about the gun in a counterclockwise direction, so the torque must be positive. This will be true for all of the approaches.

An 80 newton force is applied as shown. What is the torque applied about the tooth contact with the gum?

Using the r-perpendicular approach: In this case, you are trying to determine the component of "r" that is perpendicular to the line of "F." The key question: "What is the shortest distance from the point about which the torque is being taken to the line of the force. That distance is r-perpendicular.



1 To determine $r_\perp$



3 $\Gamma_A = r_\perp |F|$
$= \left[(.012\text{ m})\cos 48^\circ\right](80\text{ nt})$
$= .64\text{ nt}\bullet\text{m}$

4 Again, the torque is in the +k direction.

2 So $r_\perp = r\cos 48^\circ$