Let's think about calculating torque.

I have a force, F, being applied to an object.

And that object is pivoted at a point, Q. I'll define R as the vector from the pivot point, Q, to the point of the application of the force.

Torque is defined as the cross product, R cross F, which we can also write as R times F times the sine of theta.

But what does that mean?

I'll introduce two different intuitive ways of understanding this mathematical expression.

First, we can think about this as the magnitude of F times the quantity, R sine theta.

If we look at the direction of the force, then it is easy to see there R sine theta is just the part of R that is perpendicular to the force.

So here the torque is equal to the magnitude of the force, times the magnitude of this perpendicular part of the vector R.

This perpendicular portion of the distance vector R is often referred to as the moment arm.

We can instead group F with sine theta.

So this means that we're thinking of the cross-product as the distance R multiplied by F sine theta.

The component of the force F, that's perpendicular to the position vector R.

Here I'm calculating torque as the distance between the pivot point, and where the force is applied, times the perpendicular part of the force.

Be very careful about the sine theta term.

In many cases the angle theta that is given in the problem is not the angle that is used in the expression.

In this example, F times the sine of theta, will actually give the parallel component of the force.

Therefore it is much better to remember to take the perpendicular component, rather than just memorizing sine of theta.