Problem **20-R-WE-DK-3**

In this problem, a couple moment M is applied to a disc that is able to rotate. And this moment depends on the angle theta. And we're asked to find the work by this moment, after four hole rotations, and we're also asked what would the sine of the work be if the moment was applied in the opposite direction. So this is, may seem complicated, but it's not too complicated. So the work for a normal force is just the force times a distance, or the integral force in dx or the displacement. With a moment, it's the integral of moment in d theta. So we have dU, being the infinitesimal amount of work is equal to m dtheta. Okay, and so if we want to add up all of the work, we have u is going to be equal to the integral of m dtheta. Okay, so in our case, we're given m in terms of theta. So that's easy, we just have to integrate between a set of bounds, so we start at theta equals to zero. And we said for rotation, so four rotations is four times two pi, two PI is, one rotation for four rotations, okay, then we plug in M, which is in our case, theta squared, plus two theta plus two, and then d theta, we're integrating this whole thing in terms of d theta. So if we do that, we get the following. So we get 1/3 theta cubed, we just becomes a three and the three comes down in the denominator 1/3 theta cubed, plus theta squared, the two that comes down, it's cancelled by this two over here. And then the last one becomes two theta, plus two theta. This is evaluated from zero, and then four times two is eight, pi. Okay. And then we can go ahead and evaluate this. So the way you would evaluate this is, since this is zero, you just plug in eight pi into each of these data's evaluate, and you get that u is equal to 5973.7 J. And this is our final answer for the work done by this couple. This moment. Okay. Now, the question also asked, What would happen if the moment were applied in the opposite direction. So in this case, in the opposite direction, the moment would still give the same positive work. Because it doesn't, the sign of the work, essentially determines whether you're putting work into the system or taking work out of the system. If you make everything rotate in the opposite direction, you're still adding work to the system, you're not removing work, okay? So that's why it would just spin in the opposite direction, but nothing would change, you're still adding work into the system. So that's why the sign would still be positive if you spin the whole system the opposite direction. Okay. Now, if the system provided work out of the system, spinning backwards, let's say then that would be negative, but in this case, you're just spinning in the opposite direction, the the, the directionality of the work with respect to the system is still the same, so it's still be positive. Okay. So I'll write that down. If moments or slide in opposite direction, we would see still would still be positive. This is our other final answer.