First Name: _____

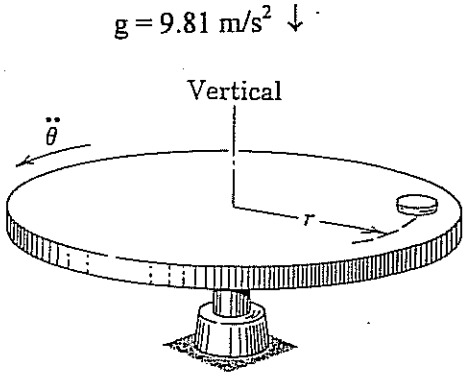
Student Number: _____

MIE 200F - Quiz number 3b - October 5/99
quiz duration = 25 minutes

A turntable consists of a disk of radius 18 cm, oriented in the horizontal plane, turning about a vertical axis. It starts to rotate from rest at time t = 0, accelerating in a counterclockwise direction with an angular acceleration equal to $\alpha = 0.3\ s^{-2}$. A coin of mass 10 grams is lying on the surface of the disk, adjacent to the rim.

(a) What is the magnitude of the total acceleration of the coin at t = 2 seconds?

(b) How much work is done on the coin by the disk in the first 2 seconds?



(a) $\ddot{\theta} = 0.3\ s^{-2}$

$\dot{\theta} = \int \ddot{\theta}\, dt = (.3)(2) = .6\ s^{-1}$

$r = .18$, $\dot{r} = \ddot{r} = 0$

$a_r = \ddot{r} - r\dot{\theta}^2 = -(.18)(.6)^2 = 0.065$

$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} = (.18)(.3) = 0.054$

$|\vec{a}| = \sqrt{a_n^2 + a_t^2} = \sqrt{.065^2 + .054^2} = 0.0844\ m/s^2$

(b) $\dot{\theta} = 0.3t$

$\theta = \int \dot{\theta} = \frac{.3}{2} t^2 = \frac{.3}{2}(2^2) = 0.6$ radians.

$\Rightarrow$ distance travelled in θ direction $= \theta r$

$= (.6)(.18\ m) = 0.108\ m.$

Frictional force in θ direction

$= (m)(a_\theta) = (10^{-2} kg)(0.054) = 5.4\ E{-}4$ Newtons.

$\text{work} = \int \vec{F} \cdot d\vec{s} = (5.4\ E{-}4)(0.108)$

$= 5.83\ E{-}5$ Joules.

Note: no displacement in r direction.

OR // $T_{final} = \frac{1}{2} m v^2 = \cancel{T_1^{\,0}} + U_{1\to 2}$

$(\frac{1}{2})(0.01)(v^2) = (\frac{1}{2})(.01)(r\dot{\theta})^2 = (\frac{1}{2})(.01)(.18)^2(.6)^2 = 5.83E{-}5$