LAST Name: ANSWER.

First Name: _____

Student Number: _____

# MIE 200F - Quiz number 3b – October 3, 2002
## quiz duration = 20 minutes

A force P is applied to the stationary block of mass 10 kg as shown. Coefficients of friction are $\mu_s = 0.65$, and $\mu_k = 0.45$. The force P is then slowly increased until the block moves.

3 (a) Draw a free-body diagram of the block

7 (b) At what value of P will the block start to move? (Assume that the block does not rotate.)

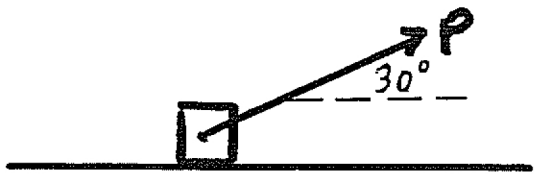
$\vec{a} = \dot{v}\,\hat{e}_t + v\dot{\theta}\,\hat{e}_n = \dot{v}\,\hat{e}_t + v^2/\rho\,\hat{e}_n$ $\quad T_2 = T_1 + U_{1\to 2}$ $\quad U_{gravity} = -mg\Delta h$ $\quad g = 9.81\ m/s^2 \downarrow$

$\vec{v} = \dot{r}\,\hat{e}_r + r\dot{\theta}\,\hat{e}_\theta$ $\quad \vec{a} = (\ddot{r} - r\dot{\theta}^2)\,\hat{e}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\,\hat{e}_\theta$ $\quad P = \vec{F}\cdot\vec{v}$

Static friction $\le \mu_s F_N$

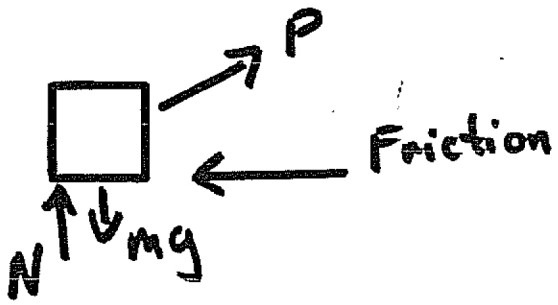
Kinetic friction $= \mu_k F_N$

$g = 9.81\ m/s^2 \downarrow$





(a)




(b) when block is on verge of moving, friction = $\mu_s N$

$\Sigma F_x = 0 = P\cos 30 - \mu_s N$

$\Sigma F_y = 0 = P\sin 30 + N - mg$

2 equations, unknowns are P & N. Rewrite as

(1) $P\sin 30 = mg - N$

(2) $P\cos 30 = \mu_s N$

Divide (1) by (2): $\tan 30 = \dfrac{mg - N}{\mu_s N} \Rightarrow N = 71.3$

2 $\quad P = 53.54$ Newtons.