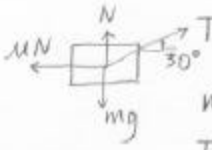
Quiz #2 Solutions

1. Initiation of motion:

$\Sigma F_y = 0 \Rightarrow N = mg - T_{cr}\sin 30^\circ = mg - \frac{T}{2}$

$\Sigma F_x = 0 \Rightarrow T_{cr}\cos 30^\circ - \mu\left(mg - \frac{T_{cr}}{2}\right) = 0$

$T_{cr} = \frac{\mu mg}{\cos 30^\circ + \mu \sin 30^\circ} = \frac{\sqrt{3}/4}{\frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{8}} mg = \frac{2}{5} mg = 3.92\ N$



$m = 1\ kg$

$T = 1.96\ t$

$\mu = \sqrt{3}/4$

$t_2 = 4\ sec$

$1.96 t_1 = T_{cr} \Rightarrow t_1 = \frac{3.92}{1.96}\ s = \boxed{2\ second}$

2. $\Sigma F_x = T\cos 30^\circ - \mu\left(mg - \frac{T}{2}\right) = ma$

$\Rightarrow a_x = \frac{T}{m}\left(\frac{\sqrt{3}}{2} + \frac{\mu}{2}\right) - \mu g = \frac{1.96\,t}{1}\left(\frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{8}\right) - \frac{\sqrt{3}}{4} \cdot 9.8 = 2.12\,(t-2)$

At $t = t_2$: $\boxed{a_x = 4.24\ m/s^2}$

3. $v = \int_{t_1=2}^{t} 2.12(t-2)\,dt = 1.06\,(t-2)^2 \Big|_{t_1=2}^{t} = 1.06\,(t-2)^2$

At $t = t_2$: $\boxed{v = 4.24\ m/s}$

4. $x = \int_{t_1=2}^{t} 1.06\,(t-2)^2\,dt = 0.354\,(t-2)^3 \Big|_{t_1=2}^{t} = 0.354\,(t-2)^3$

At $t = t_2$: $\boxed{x = 2.83\ m}$