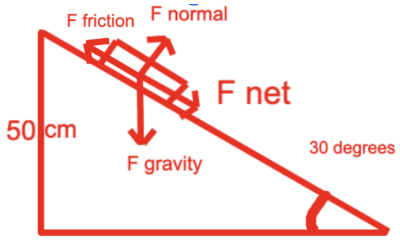
Physics Practice Homework # 4

1.1)



d = 0.5/sin(30°) = 1 m
t = 1 second

$d = v_i t + \frac{1}{2} a t^2 = \frac{1}{2} a t^2$
$\Rightarrow a = 2d/t^2 = 2\ m/s^2$

$F_{normal} = F_{gravity} \cos(30°)$
$F_{static\ friction} = \mu_k F_{normal} = \mu_k F_{gravity} \cos(30°)$
$F_{net} = F_{gravity} \sin(30°) - F_{static\ friction} = F_{gravity} \sin(30°) - \mu_k F_{gravity} \cos(30°)$

$\mu_k = (F_{gravity} \sin(30°) - F_{net})/(F_{gravity} \cos(30°)) = (\frac{1}{2} mg - ma)/(\sqrt{3}/2\ mg) = (\frac{1}{2} g - a)/(\sqrt{3}/2\ g)$
$= (\frac{1}{2} * 9.81 - 2)/(\sqrt{3}/2 * 9.81) \cong 0.34$ (2 d.p.)

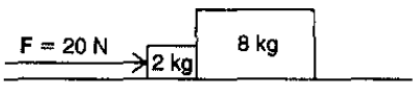
1.2)

$\mu_s = 0.5$
r = 0.3 m

$F_{static\ friction} = F_{centripetal}$
$\Leftrightarrow \mu_s mg = ma_c$
$\Leftrightarrow \mu_s g = r\omega^2$
$\Leftrightarrow \mu_s g = 4r\pi^2 f^2$
$\Leftrightarrow f = \sqrt{((\mu_s g)/(4r\pi^2))} = \sqrt{((0.5*9.81)/(4*0.3*\pi^2))} \cong 0.64$ Hz (2d.p.)
RPM = f*60 ≅ 38.61 RPM (2d.p.)

1.3)

A 20-newton force is pushing two blocks horizontally along a frictionless floor as shown below.



What is the force that the 8-kilogram mass exerts on the 2-kilogram mass?

$\mu_k = 0.1$

$F_{\text{friction total}} = \mu_k F_{\text{normal total}} = 0.1*10*9.81 = 9.81$ N

$F_{\text{net total}} = F_{\text{push}} - F_{\text{friction total}} = 20 - 9.81 = 10.19$ N

$a = F_{\text{net total}} / m = 10.19 / 10 = 1.019$ m/s^2

$F_{\text{net small}} = m_{\text{small}} * a = 2 * 1.019 = 2.038$ N

$F_{\text{net small}} = F_{\text{push}} - F_{\text{by large}} - F_{\text{friction small}}$

$\Leftrightarrow F_{\text{by large}} = F_{\text{push}} - F_{\text{net total}} - F_{\text{friction small}} = 20 - 2.038 - 0.1*2*9.81 = 16$ N