3.1) $r = 7.2\,m$ $\quad 19.3\ rev/min = \omega$

speed of person?

$C = 2\pi r = 2\pi(7.2) = 14.4\pi\ m$ $\quad = 1\ rev$

$\omega = 19.3\ rev/min \cdot 1\ min/60\ s = 0.3216\ rev/s$

speed $= C/\omega = \boxed{14.55165\ m/s}$

3.2) $m = 46\ kg$ $\quad N = ?$ $\quad a_c = v^2/r$

$a_c = \frac{(14.55)^2}{7.2} = 29.41063\ m/s^2$ $\quad F = ma$

$29.41063 \cdot 46 = \boxed{1352.889051\ N}$

3.3) Minimum μ_s needed? To keep from sliding

$1352\mu_s \geq mg$

$852\mu_s = 46 \cdot 9.8$

$\mu_s \geq \boxed{0.3332}$

3.4) $m_2 = 92\ kg$

$f_{s_1} \leq \mu_s m_2 \frac{v^2}{r}$ $\quad 9.8 \cdot 92 = \mu_s (92)(29.41063)$

$\mu_s = 0.3332$

3.5) Normal force $= 2mg$ $\quad mg \leq \mu_s (2mg)$

$\frac{1}{2} \leq \mu_s$

4.3)

x component: $-mg\cos\theta$

y component: $-mg\sin\theta$

5.1) $m_1 = 8.6\ kg$ $\quad \theta = 35°$ $\quad$ Magnitude of $\vec{a}$? $\quad \boxed{a = 5.62\ m/s^2}$

$F = mg\sin 35 = 48.34$

$48.34 = 8.6a$

5.2) $\sum F = mg\sin(35) - \mu_k N$ $\quad \mu_k = 0.32$

$\sum F = 26.248\ N = 8.6\,a$

$a = 3.052\ m/s^2$

5.3) $k = ?$ $\quad \Delta x = 0.15m$ $\quad \mu_s = 0.352$

$\sum F = -mg\sin(35°) + \mu_s mg\cos(35°) = -24.0395\ N$

$-24.0395 = k(0.15)$ $\quad \boxed{k = 160.26\ N/m}$

5.4) 

$m_2 = 6.9\ kg$ $\quad m_1 = 8.6\ kg$

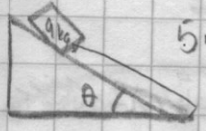
$\Sigma F_1 = -mg\sin(35°) + \mu_s mg\cos(35°) + T$

$\Sigma F_2 = -m_2 g\sin(35°) + \mu_{s_2} mg\cos(35°) - T$

$\Sigma F = \Sigma F_1 + \Sigma F_2 = -mg\sin(35°) - m_2 g\sin(35°) + \mu_s mg\cos(35°) + \mu_{s_2} mg\cos(35°)$

$0 = -143.3361 + 24.301 + \mu_{s_2}(135.667)$

$119.035282 = \mu_{s_2}(135.667)$ $\quad \mu_{s_2} = 0.8774$

6) 

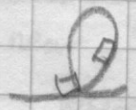
$m = 9\ kg$ $\quad t = 2s,\ \theta = 30°.\ \ f_k = ?$

$x = x_0 + v_0 t + \frac{1}{2}at^2$ $\quad \Sigma F = 9(9.8)\sin(30°) - \mu_k 9(9.8)\cos(30°)$

$5 = 0 + 0 + \frac{1}{2}a(2^2)$ $\quad 5 = 2a$ $\quad a = 5/2 = 2.5\ m/s^2$

$\Sigma F = -f_k + mg\sin 30° = ma$ $\quad f_k = -ma + mg\sin(30°)$

$f_k = 21.6$

7.1) 

$m = 217\ kg$ $\quad R = 10.5m$

$v = 15.73\ m/s$

Normal force? $\quad \Sigma F = N - Mg = ma_c$ $\quad N - 2126.6 = 5113.61$

$N = 7240N$

7.2) Normal force at side?

$\Sigma F = -N = -ma_c$ $\quad -217\left(\frac{15.73^2}{10.5}\right)$

7.3) Normal force @ top $\quad N = 5113.61N$

$\Sigma F = -N - mg = ma_c$

$\Sigma F = -N - 2126.6 = -5113.61$

7.4) Min speed to stay in contact @ top?

$N = 2987.013N$

$\Sigma F = -N + mg = -ma_c$ $\quad g = a_c$ $\quad g = \frac{v^2}{R}$ $\quad 10.5g = v^2$

$v = 10.1439\ m/s$

6.1) $m_s = 2600\,kg$ $R = 1.5\,r_{mars}$

$r_{mars} = 3.397\times10^6\,m$

$m_{mars} = 6.4191\times10^{23}\,kg$ $G = 6.67428\times10^{-11}\,\frac{Nm^2}{kg^2}$

$F = G\frac{m_1 m_2}{r^2}$ $r_{total} = 2.5\,r_{mars}$

$F = G\cdot\frac{(2600)(6.4191\times10^{23})}{7.2122\times10^{13}} = 1663.280464\,N$

6.2) Speed of satellite for perfect orbit

$ma_c = m\frac{v^2}{R}$ $= 1663\,N$ $v = \sqrt{\frac{GM}{r}}$

$\frac{v^2}{R} = 0.594028\,m/s^2$ $v = 2246.06\,m/s$

6.3) Time for 1 rev?

$v = \frac{2\pi r}{T}$ $T = \frac{2\pi r}{v} = \frac{2\pi(2.5\times3.397\times10^6)}{2246}$

$T = 23759.12703\,s$

$= 6.594\,hrs$

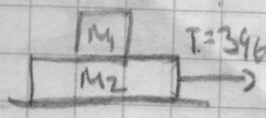
6.5) $\frac{2\pi R}{\sqrt{\frac{GM}{R}}} = 8T$ $\frac{2\pi R}{\sqrt{\frac{GM}{R}}} = 1.050329\cdot8$

$R = 8.402364\sqrt{\frac{GM}{R}}$

$R^2 = \frac{70.599\,GM}{R}$

HW: Friction

$\mu_s = 0.77$ $\mu_k = 0.6$

1.1) 

$m_1 = 16\,kg$ $m_2 = 91\,kg$ $a_1 = ?$

$396 = (16\,kg + 91\,kg)\,a$

$a = 3.7009\ m/s^2$

1.2) Friction of lower on upper?

$f_s \leq \mu_s \cdot N$ $N = (16 + 91)\cdot 9.8 = 1048.6$

$f_{s_{max}} \leq \mu_s \cdot 1048.6$

$f_{s_{max}} \leq 807.4222\,N$

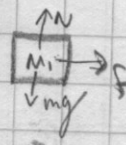
$F = ma$ $F = 16 \cdot 3.7009$

$F = 59.21495326\,N$

1.3) Max Tension before m_1 slides?

$f_s \leq 807.4222\,N$

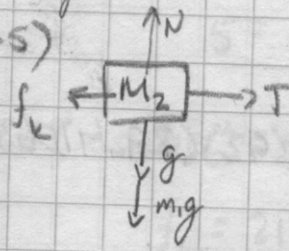
1.4) $T = 1115\,N$



$f_k = \mu_k N$ $f_k = (0.6)(16 \cdot 9.8)$

$f_k = 5.65\,N$

1.5)



$\Sigma F = T - f_k = 1115 - 5.65 = 91a$

$a = 12.16813\ m/s^2$

2.1)

$m = 19\,kg$ $\mu_s = 0.84$ $\mu_k = 0.68$

Truck: $v_0 = 0$ $v = 15\,m/s$ $t = 15\,s$

$a = 15/15 = 1\,m/s^2$

2.2) Frictional force on box?

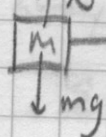
$\Sigma F = ma$ $\Sigma F = f_s \rightarrow f_s = 19\,kg \cdot 1\,m/s^2 = 19\,N$

2.3) Max acceleration before box slides?

$f_s \leq \mu_s N \rightarrow f_s \leq 0.84(19 \cdot 9.8)$ $f_s \leq 156.408\,N$

$156.408\,N = 19\,kg \cdot a$ $a = 8.232\ m/s^2$

2.4) Box slides; car accelerates @ $a_{box} = ?$



$\Sigma F = f_k$ $f_k = \mu_k \cdot N$ $f_k = 0.68(19 \cdot 9.8)$

$f_k = 126.616\,N = 19a$ $a = 6.664\ m/s^2$

2.5) max deceleration w/o sliding?

$8.232\ m/s^2$