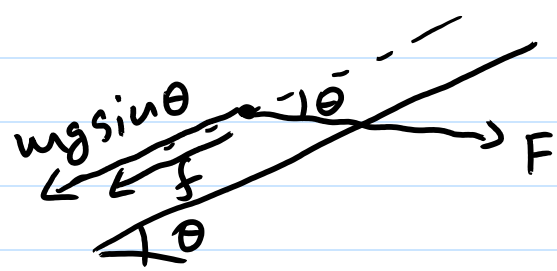
Physics Midterm

(1) 50 J potential → 50 J kinetic
additional 10 m
final $y = 10 + 10 = 20$ m

(2)
$$0.9a = 0.9g - T$$
$$0.6a = T - 0.6g$$
$$1.5a = 0.9g - 0.6g$$
$$a = \frac{0.3}{1.5}g = \frac{g}{5} = \frac{9.8}{5} = 1.96 = 2\ m/s^2$$

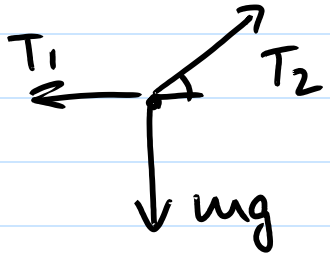
(3)



$$F\cos\theta - f - mg\sin\theta = ma$$

(4)
$$P = \frac{\Delta W}{\Delta t} = \frac{100\ J}{50s} = 2\ W$$

(5)



$$T_2\cos\theta - T_1 = 0$$
$$T_2\sin\theta - mg = 0$$
$$T_2 = mg/\sin\theta$$

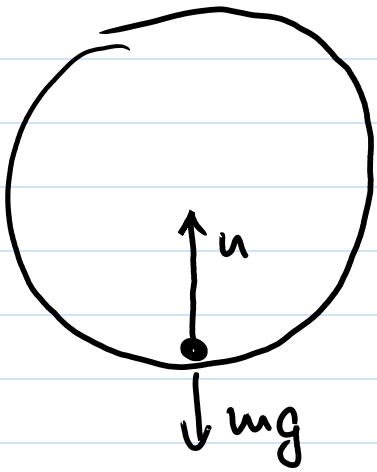
$$T_1 = T_2\cos\theta = mg\cot\theta = (2)(9.8)\cot(30^\circ) = 34\ N$$

(6) max: $6 + 3 = 9\ N$
min: $6 - 3 = 3\ N$

It is NOT $2\ N$.

(7) $W = F s \cos\theta = (15)(6)\cos(28°) = 79.47 =$
$= 79\ N$

(8)

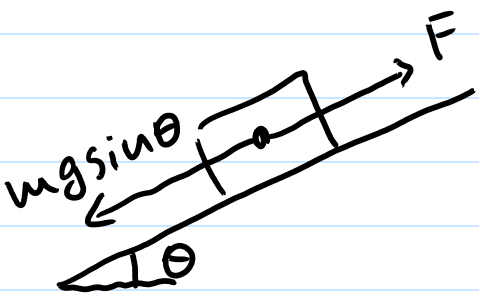


$$n - mg = \frac{mV^2}{R}$$

$$V = \frac{2\pi R}{T} = \frac{2\pi(10)}{10} = 2\pi$$

$$n = m\left(g + \frac{V^2}{R}\right) = 50\left(9.8 + \frac{(2\pi)^2}{10}\right) = 690\ N$$

(9)

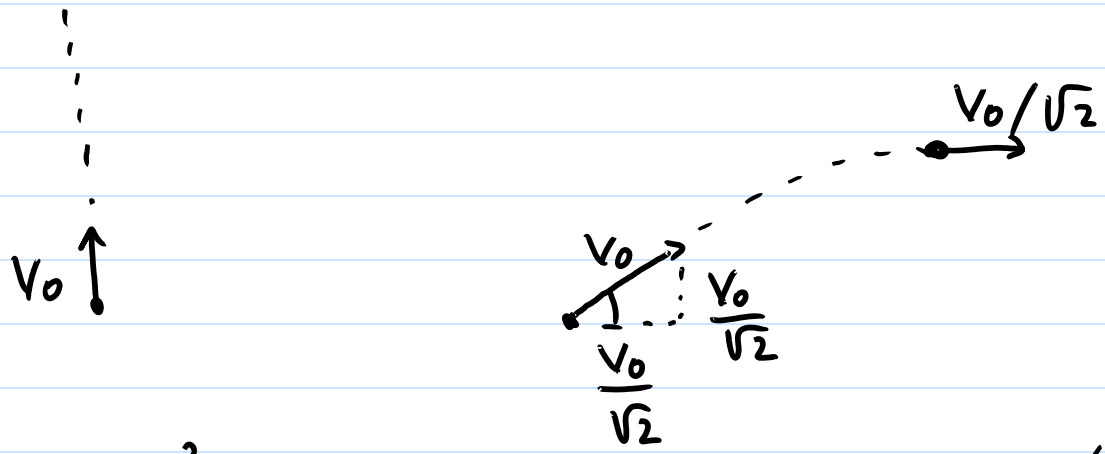


$$F - mg\sin\theta = ma$$

$$a = \frac{F}{m} - g\sin\theta =$$

$$= \frac{25}{3} - 9.8\sin(30°) = 3.4\ \frac{m}{s^2}$$

(10)



$KE = \frac{mV_0^2}{2}$

vertical $KE = \frac{m}{2}\left(\frac{V_0}{\sqrt{2}}\right)^2 =$

$= \frac{m}{2} \cdot \frac{V_0^2}{2} = \frac{1}{2}\left(\frac{mV_0^2}{2}\right)$

$\Rightarrow h \longrightarrow \frac{h}{2}$

(11)

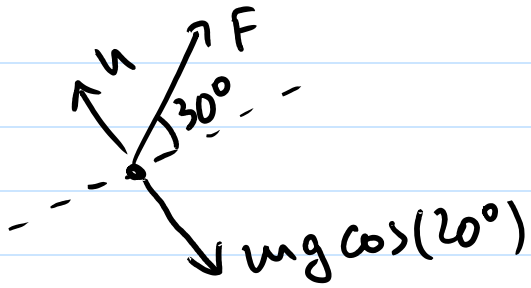
$K_1 + U_{g1} + U_{el1} = K_2 + U_{g2} + U_{el2}$

$\frac{mV_1^2}{2} + mgh + 0 = 0 + 0 + U_{el2}$

$U_{el2} = \frac{mV_1^2}{2} + mgh = \frac{2(1.7)^2}{2} + 2(9.8)(0.6) =$

$= 14.65 = 15\,J$

(12)



$n + F\sin 30 - mg\cos(20°) = 0$

$n = mg\cos(20°) - F\sin(30°) =$

$= 50.4(9.8)\cos 20° -$

$- 195 \sin 30° = 367\,N$

(13) No contact $\rightarrow$ $F = 0$

(14) a) $mg = 30\,N$

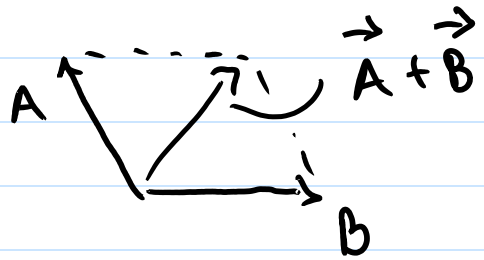
$$m = \frac{30\,N}{9.8} = 3.1\ kg$$

b) $n = mg\cos\theta = (30)\cos(37^\circ) = 24\,N$

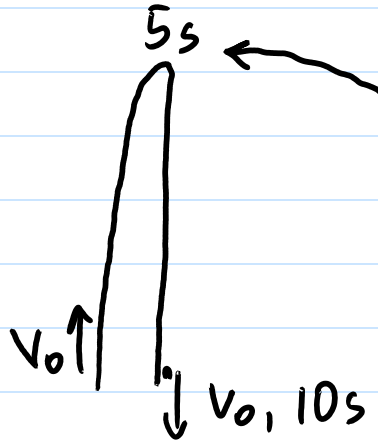
c) $W = -mg\Delta y = -30(-5) = 150\ J$

(15) Friction does negative work and decreases KE.

(16)



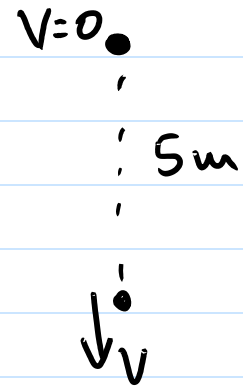
(17)



$V_y = 0 = V_0 - gt$

$V_0 = gt = (9.8)(5) = 50\ m/s$

(18)

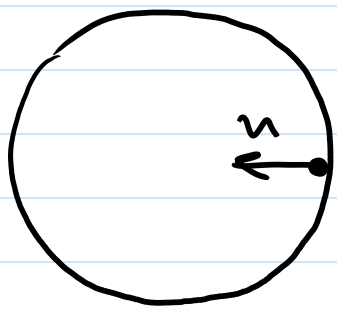


$$K_1 + U_1 = K_2 + U_2$$

$$0 + mgh = \frac{mV^2}{2} + 0$$

$$V = \sqrt{2gh} = \sqrt{2(9.8)(5)} = 10 \text{ m/s}$$

(19)

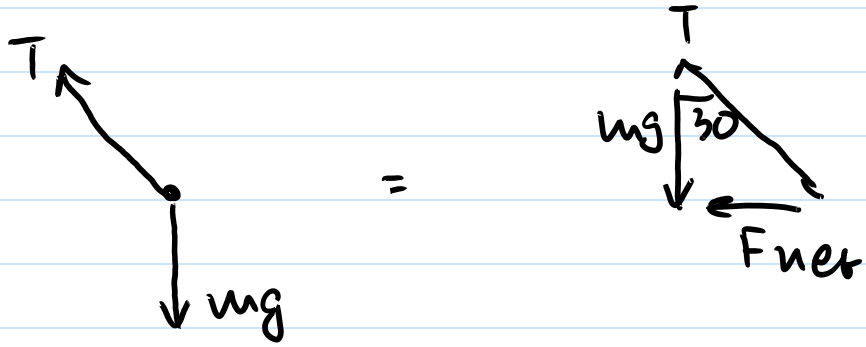


$$n = \frac{mV^2}{R} = \frac{m\left(\frac{2\pi R}{T}\right)^2}{R} =$$

$$= \frac{(0.110)\left(\frac{2\pi\, 0.275}{0.650}\right)^2}{0.275} = 2.83\,N$$

(20) Speed increases not "velocity" but anyways.

(21)



$$T > mg = (65)(9.8) = 637\,N$$

(22)

$F - mg = ma$ $\qquad m = 1.5\,kg$ total

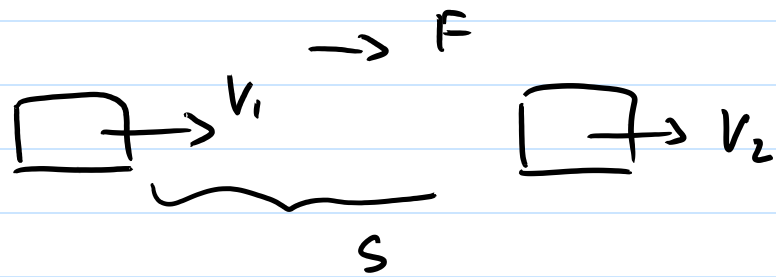
$$a = \frac{F}{m} - g = \frac{18}{1.5} - 9.8 = 2.2\,m/s^2$$

(23) Weight = gravitational attraction

(24) mass measures inertia

(25) $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

(26)



$$W = Fs = K_2 - K_1$$

$$Fs = \frac{mv_2^2}{2} - \frac{mv_1^2}{2}$$

$$v_2 = \sqrt{v_1^2 + \frac{2Fs}{m}} = \sqrt{4.11^2 + \frac{2(65)(2.91)}{12.5}}$$

$$v_2 = 6.87 \text{ m/s}$$

(27) $K_1 + U_1 + W = K_2 + U_2$

$$\frac{mv_1^2}{2} + 0 + W = \frac{mv_2^2}{2} + mgh$$

$$W = \frac{m}{2}(v_2^2 - v_1^2) + mgh = \frac{125}{2}(16.9^2 - 22.5^2) + 125(9.8)(11)$$

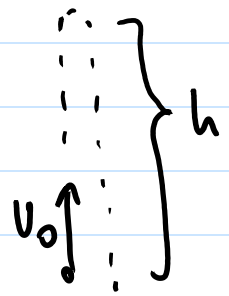
$= -315$ J dissipated

(28) Friction is non-conservative.

(29) $a = \frac{\Delta V}{\Delta t} = \frac{30}{6} = 5 \text{ m/s}^2$

$\Delta X = V_0 t + \frac{a t^2}{2} = 0 + \frac{5(4.9)^2}{2} = 60 \text{ m}$

(30)



$K_1 + U_1 = K_2 + U_2$

$\frac{m v_0^2}{2} + 0 = 0 + mgh$

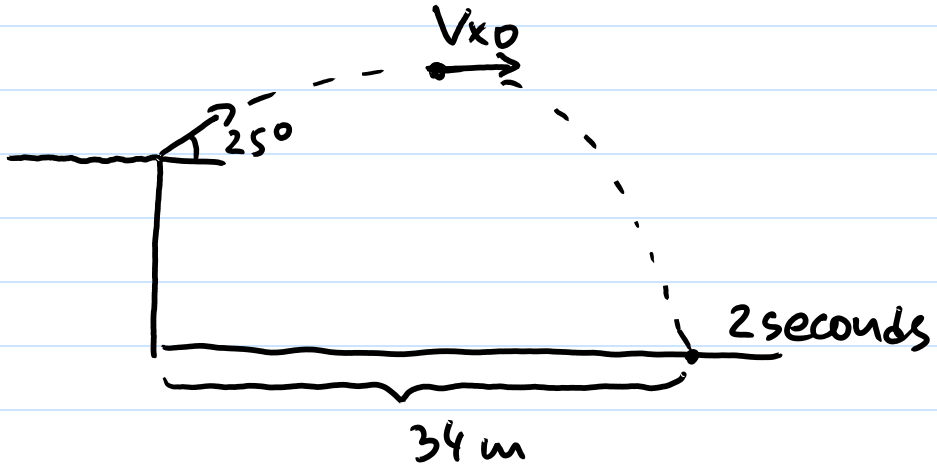
$h = \frac{V_0^2}{2g} = \frac{24.5^2}{2(9.8)} = 30.6 \text{ m}$

(31) $W = \int F(x)\,dx =$

$= \int_0^{4.7} 0.4 x^2 \,dx = 0.4 \frac{x^3}{3}\Big|_0^{4.7} = \frac{0.4}{3}(4.7)^3 = 13.8 \text{ J}$

(32) No answer is correct.

33



At highest point: $V = V_{xo} = \frac{34}{2} = 17\ m/s$