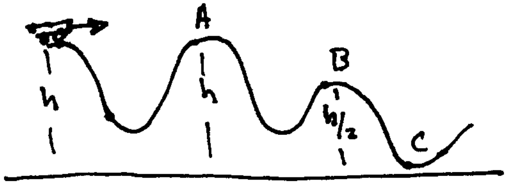
8.2



$m = 825$ kg

$V_0 = 17$ m/s

$h = 42$ m

a) Work by grav force $0 \to A$

Zero

b) Work by grav force $0 \to B$

- can be calculated as difference in potential energy

$$mgy_0 - mgy_B$$

$$mg\,\Delta y$$

$$825\,(9.8)\,(42-21) =$$

$$1.70 \times 10^5 \text{ Joules}$$

c) Work by grav force $0 \to C$

$$mgy_0 - mgy_C$$

$$mg\,\Delta y$$

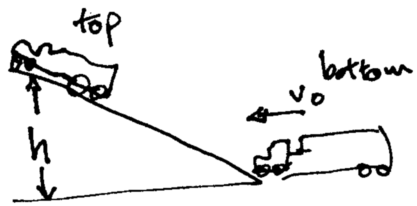
$$825\,(9.8)\,(42-0) = 3.40 \times 10^5 \text{ Joules}$$

d) $U_B = mgy_B = 825\,(9.8)(21) = 1.70 \times 10^5$ Joules

e) $U_A = mgy_A = 825\,(9.8)(42) = 3.40 \times 10^5$ Joules

f) If mass doubled, grav pot'l energy change would double

8.15



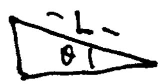
$V_0 = 130\ \frac{km}{h}$

$= 36.1$ m/s

Total Energy at bottom of ramp = Total Energy at top of ramp

$$\tfrac{1}{2}mv^2 = mgh$$

Notice how the mass will cancel out.



$h = L\sin\theta$

$$\tfrac{1}{2}\cancel{m}v^2 = \cancel{m}gL\sin\theta$$

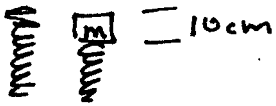
$$\tfrac{1}{2}(31.6)^2 = 9.8\,L\,\sin 15^\circ$$

$$L = 197\text{ m}$$

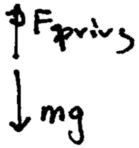
The length L goes up with the square of the speed.

8.19 $m = 8\ kg$

a)



At equilibrium



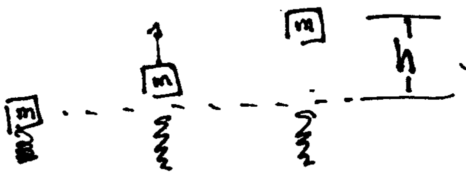
$m\cancel{a_y}^{0} = F_{spr} - mg$

$0 = kx - mg$

$0 = k(0.1) - 8(9.8)$

$k = 784\ N/m$

part d)



measure from compressed position to maximum height.

$$\text{Total Init Energy} = \text{Total Final Energy}$$

$$\frac{1}{2}kx^2 = mgh$$

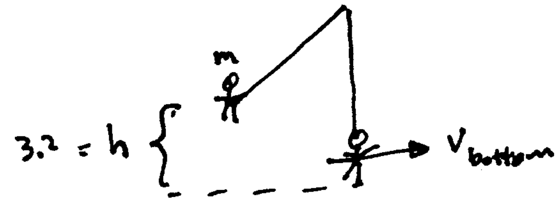
$$\frac{1}{2}784(0.40)^2 = 8(9.8)h$$

$$h = 0.80\ m$$

part b) $\frac{1}{2}kx^2 = \frac{1}{2}784(0.4)^2 = 62.7$ Joules

c) Same as part b)

8.27 The largest force in the vine will occur when the vine is vertical – at the bottom of the swing. So check out the situation there first.



$mg = 688$

$m = 70.2\ kg$

$R = 18\ m$

$$\text{Tot Init Energy} = \text{Total Final Energy}$$

$$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$$

$$9.8(3.2) = \frac{1}{2}v^2$$

$$\rightarrow v = 7.92\ m/s$$

Now use a fbd to get information on the forces radial

$$ma_{rad} = T - mg$$

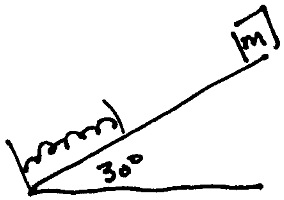
$$m\frac{v^2}{R} = T - mg$$

$$70.2\frac{(7.92)^2}{18} = T - 688$$

$$T = 933\ \text{Newtons}$$

So the vine does not break.

8.29



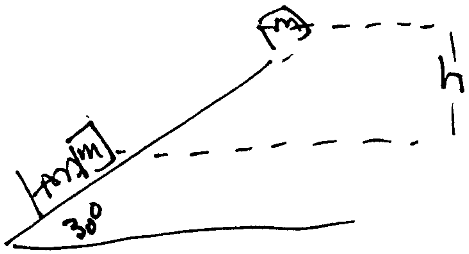
$m = 12$ kg

Spring constant given as

$$k = \frac{270 \text{ Newtons}}{0.02 \text{ m}}$$

$$k = 1.35\times10^{4} \text{ N/m}$$

a) The block stops when spring is compressed by 5.5cm



measure the height above the stopped position.

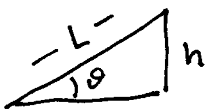
Total Energy at bottom = Total Energy at top

$$\tfrac{1}{2}kx^2 = mgh$$

$$\tfrac{1}{2}(1.35\times10^4)(0.055)^2 = 12\ 9.8\ h$$

$$h = 0.17 \text{ m}$$

If we are supposed to measure along the incline, then



$$h = L\sin\theta$$

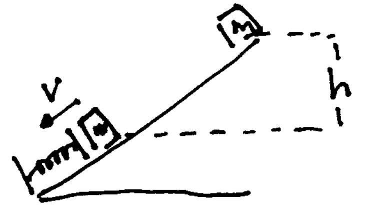
$$0.17 = L\sin30^\circ$$

$$L = 0.34 \text{ m}$$

b) This part wants to know about just as the ~~spring~~ block touches the spring.

The distance the block would have slid down the incline is then

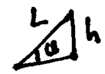
$$0.340 - 0.055 = 0.285 \text{ m}$$



measure the height now above the spring relaxed position

Tot Energy at bottom = Tot Energy at top

$$\tfrac{1}{2}\cancel{m}v^2 = \cancel{m}gh$$

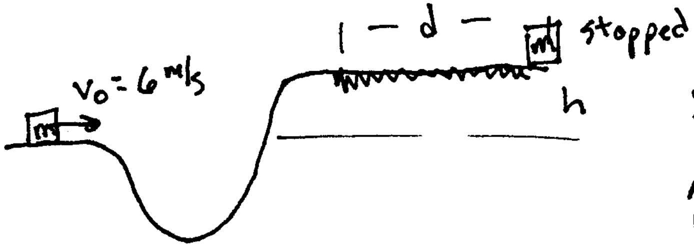


$$h = L\sin\theta$$
$$= 0.285 \sin 30^\circ$$
$$= 0.1425 \text{ m}$$

$$\tfrac{1}{2}v^2 = 9.8(0.1425)$$

$$v = 1.67 \text{ m/s}$$

8.57



$d = ?$

$m = ?$

$\mu = 0.6$

$h = 1.1$

(Tot Init Energy) − (Energy Lost to Friction) = (Total Final Energy)

$$\frac{1}{2} m v_0^2 - fd = mgh$$

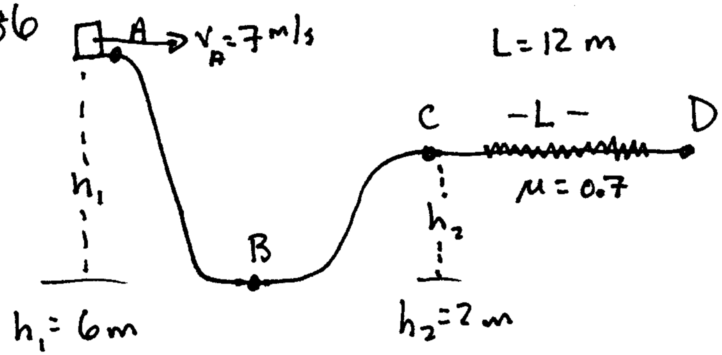
In this situation from a fbd $f = \mu N = \mu m g$

$$\frac{1}{2} \cancel{m} v_0^2 - \mu \cancel{m} g d = \cancel{m} g h$$

$$\frac{1}{2} (6)^2 - 0.6(9.8) d = 9.8 (1.1)$$

$$d = 1.23 \text{ m}$$

8.86



a) Energy at A = Energy at B

$$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh = \frac{1}{2}\cancel{m}v_B^2$$

$$\frac{1}{2}7^2 + 9.8(6) = \frac{1}{2}v_B^2$$

$$v_B = 12.9 \text{ m/s}$$

b) Energy at A = Energy at C

$$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh_1 = \frac{1}{2}\cancel{m}v_c^2 + \cancel{m}gh_2$$

$$\frac{1}{2}7^2 + 9.8(6) = \frac{1}{2}v_c^2 + 9.8(2)$$

$$v_c = 11.29 \text{ m/s}$$

c) Let's first suppose it does make it to location D.

$$(\text{Energy at A}) - \left(\begin{matrix}\text{Lost to}\\ \text{friction}\end{matrix}\right) = \text{Energy at D}$$

$$\frac{1}{2}mv_A^2 + mgh_1 - fL = \frac{1}{2}mv_D^2 + mgh_2$$

If the mass doesn't make it, then we will get a stupid value for v_D.

In this situation $f = \mu N = \mu mg$

$$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh_1 - \mu\cancel{m}gL = \frac{1}{2}\cancel{m}v_D^2 + \cancel{m}gh_2$$

$$\frac{1}{2}7^2 + 9.8(6) - 0.7(9.8)12 = \frac{1}{2}v_D^2 + 9.8(2)$$

$$v_D^2 = -18.62$$

Which would give us an Imaginary value for v_D

Therefore, the ~~da~~block will stop somewhere along the rough surface. Let this distance be L again

$$(\text{Energy at A}) - \left(\begin{matrix}\text{Lost to}\\ \text{friction}\end{matrix}\right) = \begin{matrix}\text{Energy at final}\\ \text{location}\end{matrix}$$

$$\frac{1}{2}mv_A^2 + mgh_1 - fL = mgh_2$$

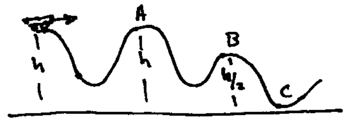
$$\vdots$$

$$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh_1 - \mu\cancel{m}gL = \cancel{m}gh_2$$

$$\frac{1}{2}7^2 + 9.8(6) - 0.7(9.8)L = 9.8(2)$$

$$L = 9.29 \text{ m}$$

8.2



$m = 825$ kg
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Zero

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- can be calculated as difference in potential energy
$mgy_0 - mgy_B$
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1.70×10^5 Joules

c) Work by grav force $0 \to C$
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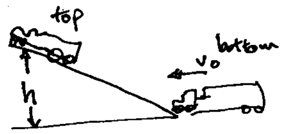

$V_0 = 130 \frac{km}{h}$
$= 36.1$ m/s

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Notice how the mass will cancel out.

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$\frac{1}{2}(31.6)^2 = 9.8\,L\,\sin 15°$

$L = 197$ m

The length L goes up with the square of the speed.

8.19

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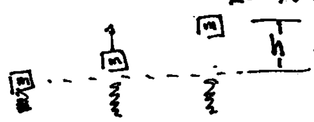
a)

At equilibrium
F_{spring}
mg

$m\cancel{a_y}^{\,0} = F_{spr} - mg$
$0 = kx - mg$
$0 = k(0.1) - 8(9.8)$
$k = 784$ N/m

part d)



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$\frac{1}{2}kx^2 = mgh$

$\frac{1}{2}\,784\,(0.40)^2 = 8\,(9.8)\,h$

$h = 0.80$ m

part b) $\frac{1}{2}kx^2 = \frac{1}{2}\,784\,(0.4)^2 = 62.7$ Joules

c) Same as part b)

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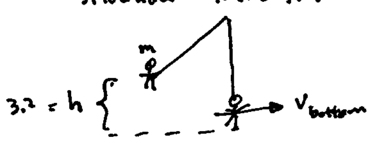
$mg = 688$
$m = 70.2$ kg
$R = 18$ m



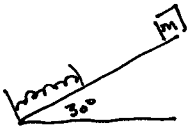
Tot Init Energy = Total Final Energy
$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$
$9.8\,(3.2) = \frac{1}{2}\,v^2$
$\longrightarrow v = 7.92$ m/s

Now use a fbd to get information on the forces

$ma_{rad} = T - mg$
$m\frac{v^2}{R} = T - mg$
$70.2\,\frac{(7.92)^2}{18} = T - 688$
$T = 933$ Newtons

So the vine does not break.

8.29



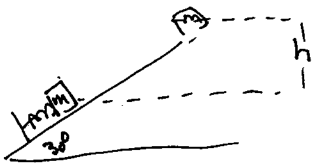
$m = 12\ kg$

Spring constant given as

$$k = \frac{270 \text{ Newtons}}{0.02\ m}$$

$$k = 1.35 \times 10^4\ N/m$$

a) The block stops when spring is compressed by 5.5 cm

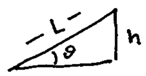


Measure the height above the stopped position.

Total Energy at bottom	=	Total Energy at top
$\frac{1}{2}kx^2$	=	mgh
$\frac{1}{2}(1.35\times10^4)(0.055)^2$	=	$12\ 9.8\ h$

$h = 0.17\ m$

If we are supposed to measure along the incline, then



$h = L\sin\theta$

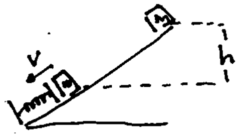
$0.17 = L\sin 30°$

$L = 0.34\ m$

b) This part wants to know about just as the ~~spring~~ block touches the spring.

The distance the block would have slid down the incline is then

$0.340 - 0.055 = 0.285\ m$



measure the height now above the spring relaxed position

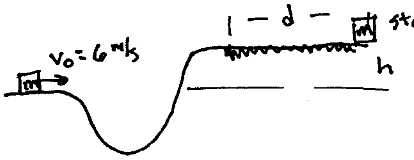
Tot Energy at bottom	=	Tot Energy at top
$\frac{1}{2}\cancel{m}v^2$	=	$\cancel{m}gh$

$h = L\sin\theta$
$= 0.285 \sin 30°$
$= 0.1425\ m$

$\frac{1}{2}v^2 = 9.8\ (0.1425)$

$v = 1.67\ m/s$

8.57



$d = ?$
$m = ?$
$\mu = 0.6$
$h = 1.1$

$$\left(\text{Tot Init Energy}\right) - \left(\text{Energy Lost to Friction}\right) = \left(\text{Total Final Energy}\right)$$

$$\frac{1}{2}mv_0^2 - fd = mgh$$

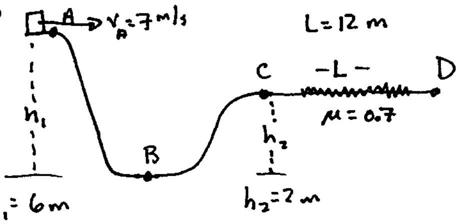
In this situation $f = \mu N = \mu mg$ from a sled

$$\frac{1}{2}\cancel{m}v_0^2 - \mu\cancel{m}gd = \cancel{m}gh$$

$$\frac{1}{2}(6)^2 - 0.6(9.8)\,d = 9.8\,(1.1)$$

$$d = 1.23\,m$$

8.86



a) Energy at A = Energy at B

$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh_1 = \frac{1}{2}\cancel{m}v_B^2$

$\frac{1}{2}7^2 + 9.8(6) = \frac{1}{2}v_B^2$

$v_B = 12.9$ m/s

b) Energy at A = Energy at C

$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh_1 = \frac{1}{2}\cancel{m}v_c^2 + \cancel{m}gh_2$

$\frac{1}{2}7^2 + 9.8(6) = \frac{1}{2}v_c^2 + 9.8(2)$

$v_c = 11.29$ m/s

c) Let's first suppose it does make it to location D.

(Energy at A) − (Lost to friction) = Energy at D

$\frac{1}{2}mv_A^2 + mgh_1 - fL = \frac{1}{2}mv_D^2 + mgh_2$

If the mass doesn't make it, then we will get a stupid value for v_D.

In this situation $f = \mu N = \mu mg$

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$\frac{1}{2}7^2 + 9.8(6) - 0.7(9.8)12 = \frac{1}{2}v_D^2 + 9.8(2)$

$v_D^2 = -18.62$

Which would give us an imaginary value for v_D

Therefore, the ~~b~~block will stop somewhere along the rough surface. Let this distance be L again

(Energy at A) − (Lost to friction) = Energy at final location

$\frac{1}{2}mv_A^2 + mgh_1 - fL = mgh_2$

⋮

$\frac{1}{2}\cancel{m}v_A^2 + \cancel{m}gh_1 - \mu\cancel{m}gL = \cancel{m}gh_2$

$\frac{1}{2}7^2 + 9.8(6) - 0.7(9.8)L = 9.8(2)$

$L = 9.29$ m