1.

a. $a = \frac{F}{m} = \frac{4N}{0.2kg}$ = 20m/s^2

b. $\Delta s = \frac{1}{2}(a)(t^2)$

$12 = \frac{1}{2}(20)(t^2)$

t = 1.095s

c. $W = F \cdot \Delta s$ = (4N)(12m) = 48N·m

d. $W = \Delta K$

$\Delta K = K_f - K_i$

$48J = \frac{1}{2}(0.2)(v_f^2) - 0$

v_f = 21.9m/s

e. W = area = 64N·m

d. $W = \Delta K$

$\Delta K = K_f - K_i$

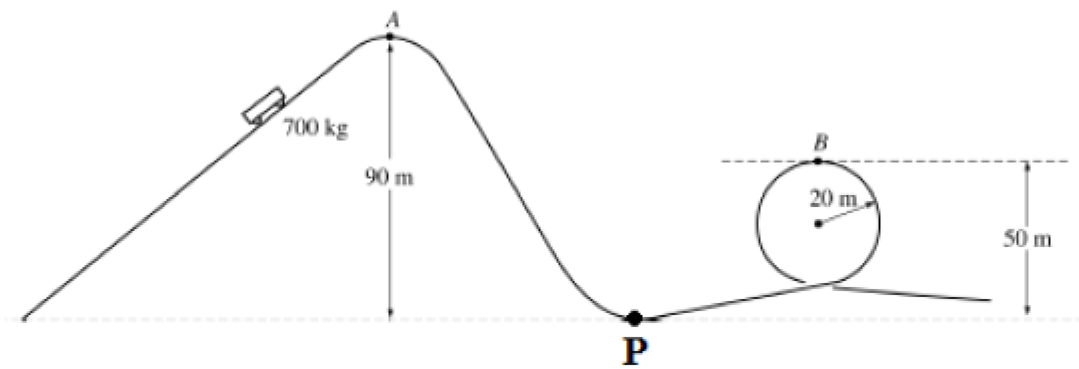
$64J = \frac{1}{2}(0.2)(v_f^2) - 0$

v_f = 25.3m/s

2.

a.

i.



ii.

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

$(700)(10)(90) = \frac{1}{2}(700)(v^2)$

$v = 42.43$m/s

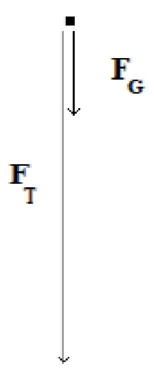
b.

$mgh = mgh + \frac{1}{2}mv^2$

$(700)(10)(90) = (700)(10)(50) + \frac{1}{2}(700)(v^2)$

$v = 28.28$m/s

c.



ii. $F_G = (700)(-10) = -7000$N

$\Sigma F = -m\cdot\frac{v^2}{R} = -28000$N so $F_T = -21000$N

d. The entire loop could be lowered. Therefore, any loss of mechanical energy due to friction could be compensated for by a lesser decrease in gravitational potential energy from P to the top of the loop.

3.

a.

i. A meterstick and a set of masses from 100g to 1000g.
ii. Measure the length of the spring from its top rung to its bottom rung as masses of various magnitudes are attached to the bottom loop of the spring.
iii. Make a graph with gravitational force, mass (in kg) multiplied by $9.8 m/s^2$, on the y-axis and spring length on the x-axis. The slope of this graph would be the spring constant of the spring.

b. Because it begins and ends at rest, $\Delta U_G + \Delta U_{sp} = 0$

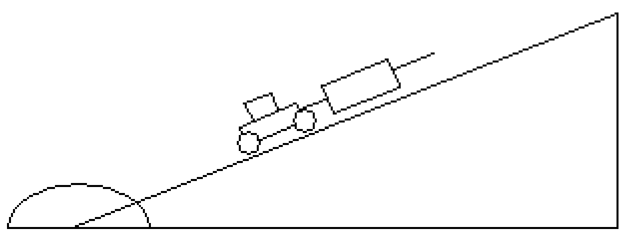
$-mg\Delta y + \frac{1}{2}k\Delta y^2 = 0$

$\frac{2mg}{k} = \Delta y$

$\frac{2 \cdot 2 \cdot 10}{500} = 0.08m$

c.

i.



ii. Place a the object in a cart with a known weight and place the cart on an incline tipped at 30º. Measure the force applied by the spring required to hold the cart stationary on the incline. Divide this force by sin 30º and subtract the weight of the cart. This is the weight of the object.

4.

a. $\Delta t = \sqrt{\frac{2h}{g}}$

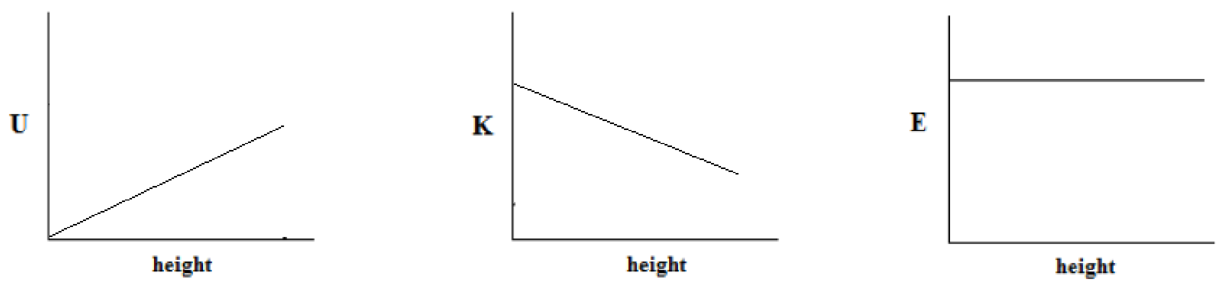
b. $v_x = \frac{D}{\Delta t} = \frac{D}{\sqrt{\frac{2h}{g}}} = D \cdot \sqrt{\frac{g}{2h}}$

c. $W = \Delta K = \frac{1}{2}Mv_x^2 = \frac{1}{2}M \cdot D^2 \cdot \frac{g}{2h} = \frac{mgD^2}{4h}$

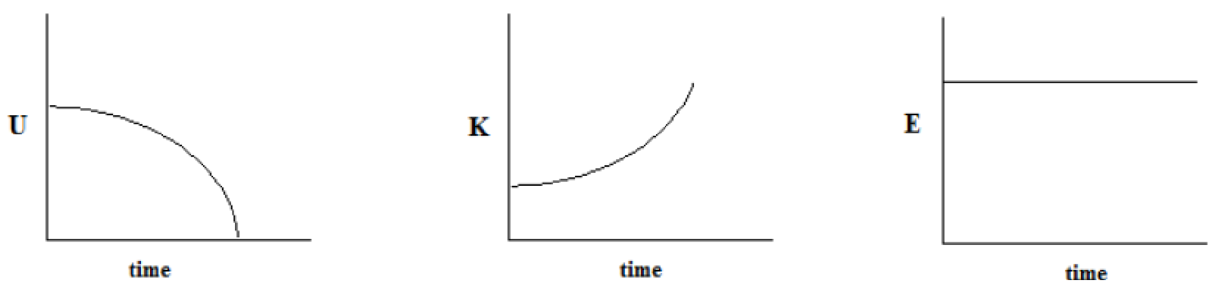
d. $\frac{1}{2}k \cdot x^2 = \frac{1}{2}Mv_x^2 = \frac{mgD^2}{4h}$

$k = \frac{mgD^2}{2h \cdot x^2}$

e.



f.



g. increase h, increase x, increase k

5.

a. $\frac{1}{2}k \cdot x^2 = mgh$

b.

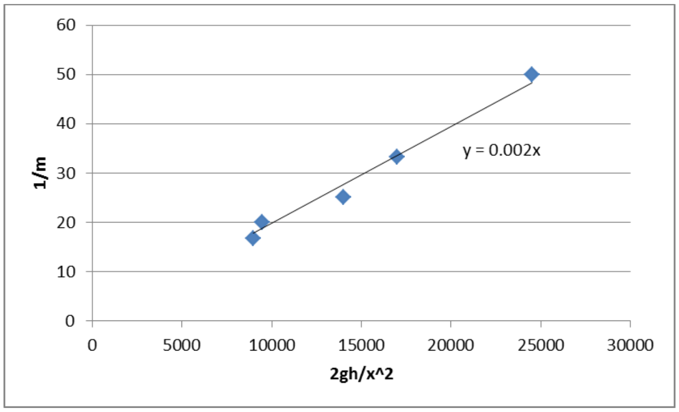
i. Graph $\frac{1}{m}$ on the y-axis and $\frac{2gh}{x^2}$ on the x-axis. Rearranging the equation above produces

$\frac{1}{m} = \frac{1}{k} \cdot \frac{2gh}{x^2}$ so the slope of this graph equals $\frac{1}{k}$.

ii.

1/m (1/kg)	m (kg)	h (m)	$2gh / x^2$ ($1/s^2$)
50.00	0.02	0.49	24500
33.33	0.03	0.34	17000
25.00	0.04	0.28	14000
20.00	0.05	0.19	9500
16.67	0.06	0.18	9000

c. and d.

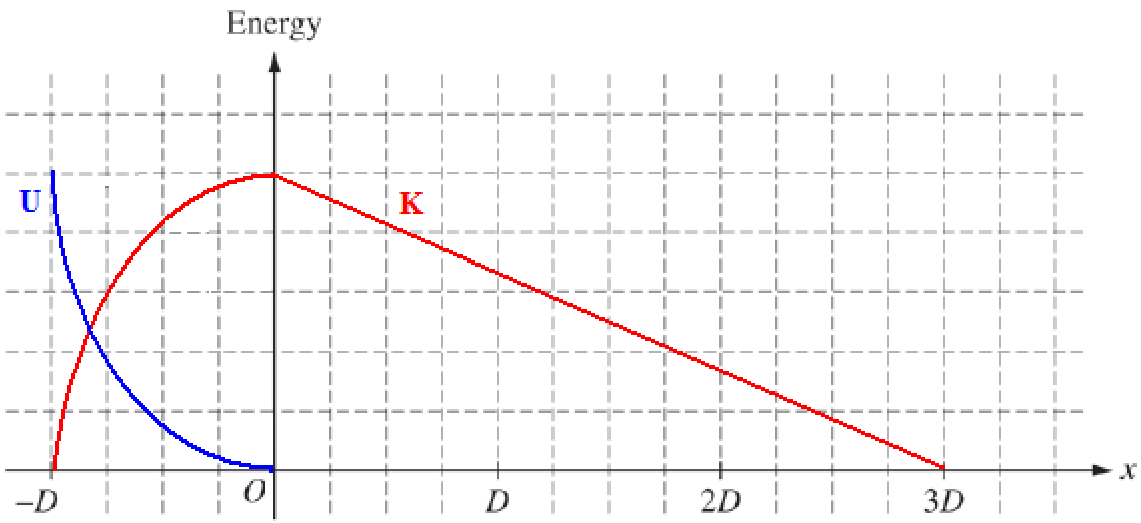


If the slope is 0.002, then the spring constant is 500N/m.

e. Use a high-speed camera to film the ascent and then advance the film frame-by-frame until the toy reaches the maximum height.

6

a.



b. The block will reach position zero with twice as much velocity as before. The potential energy stored at –2D will be four times greater, so the kinetic energy at 0 will be four times greater, which implies the velocity is twice as great if $K = \frac{1}{2}mv^2$. But twice the initial velocity means the block will slide four times farther under a constant acceleration according to the equation $v_f^2 = v_i^2 + 2(a)(\Delta x)$.

c. $\frac{1}{2}kD^2 = \frac{1}{2}mv_0^2$ and $0^2 = v_0^2 + 2(-\mu g)(3D)$ because $ma = -\mu(mg)$

$k = \frac{6\mu mg}{D}$

$\frac{1}{2}k(2D)^2 = \frac{1}{2}mv_0^2$ and $0^2 = v_0^2 + 2(-\mu g)(x)$

$\frac{1}{2}\left(\frac{6\mu mg}{D}\right)(2D)^2 = \frac{1}{2}m(2(\mu g)(x))$

$x = 12D$

d. In the first part of the first line, a linear relationship is shown between D and v_0, suggesting that the block might slide twice the distance. However, the second part of the third line shows a quadratic relationship between v_0 and x, indicating the block will side four times farther.