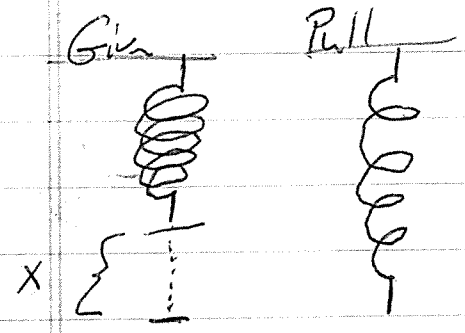
Elastic Potential Energy

Part I When force is applied to a spring, the spring extends (or compresses) a specific amount

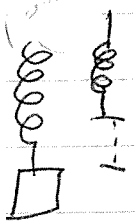


x is the amount of deformation (Extension or compression) measured in meters.

F force acting on the spring

Hookes Law $F_s = kx$ k Spring constant (Each spring has a different spring constant)

Ex 1 A block is suspended from a spring. The spring is stretched .5 m. If the spring constant is 100 N/m, what is the weight of the block?



$F = kx$ $F = 50N$

$F = 100 N.m (.5m)$

(Do Graphs on Back before part II)

Pt II When work is done on the spring in compressing or stretching it, potential energy is stored in the spring

$$PE_s = \frac{1}{2} k x^2$$

Ex 2 Determine the potential energy stored in a spring with a spring constant of 25.0 N/m, when a force of 2.50 newtons is applied

$PE_s = \frac{1}{2} k x^2$

$\frac{1}{2} \ 25.0 \frac{N}{m} \ (x^2)$ $(.1m)$

$= .125 J$

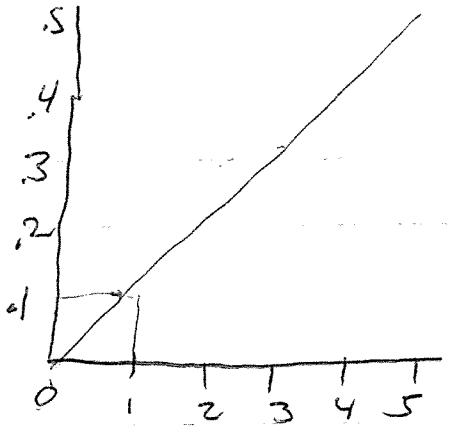
$F = kx$

$25N = 25\frac{N}{m} \ x \qquad x = .1 m$

Part III Graphs

Elongation (m)

Find me "K"

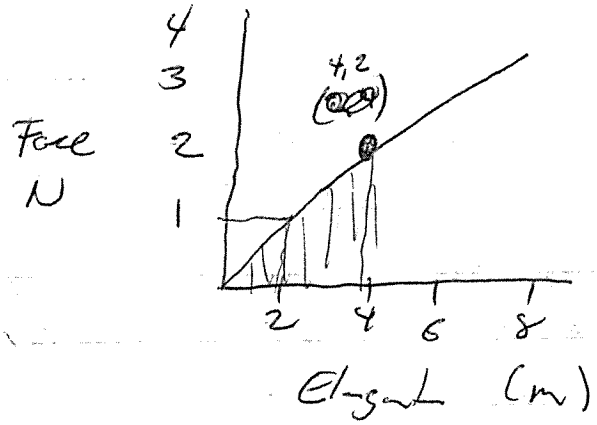


What is the value of the spring constant

$\frac{F}{x} = \frac{kx}{x}$ $\frac{F}{x} = k$

$\frac{1N}{.1m} = k$

$k = 10 \frac{N}{m}$



Spring Constant

$\frac{F}{x} = \frac{kx}{x}$

$\frac{2N}{4m} = k$

$k = .5 \frac{N}{m}$

How much work is done to stretch the spring 4m.

$W = \Delta E$ $W = PES$

IB Springs

43 A spring ($K = 900 N/m$) is attached to a table & is compressed .150 m. a) What is the speed given to a .3 kg ball?
b) How high above the original position (spring compressed) will the ball fly?

Given

a) $K = 900 N/m$
$x = .15 m$
$m_{ball} = .3 kg$

Use Cons. of Energy

$PE_s \rightarrow KE_{Ball}$

$E_{T\,Before} = PE_s + KE^0$

$= \frac{1}{2} K x^2$

$= \frac{1}{2} (900 \frac{N}{m}) (.15 m)^2$

$= 10.125 J$

$E_{T\,After} = PE_s^0 + KE$

$10.125 J = \frac{1}{2} (.3 kg) v^2$

$\sqrt{67.5} = \sqrt{v^2}$

$8.2 m/s = v$

b) As the ball rises $KE \rightarrow PE_g$ gravitational

$E_T = PE + KE^0$

$10.125 J = mgh$

$10.125 J = .3 kg (9.8 m/s^2) h$

$3.44 m = h$

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42. A 60 kg bungee Jumper jumps from a bridge. She is tied to a 12 m long cord & falls a total of 31 m.
a) Find K b) Calc. the max accel.

a) x = Elongation $31 - 12 = 19 m$

$F = mg = (60 kg)(9.8 m/s^2) = 588 N$

$F = Kx$

$588 N = K (19 m)$

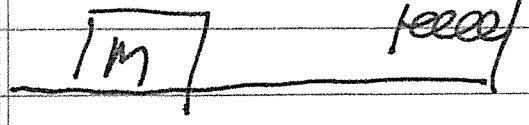
$K = 31 N/m$

b)

11/21 IIB

Conservative Forces + Springs

- A 30 kg mass is sliding on a horiz. frictionless surface w/ a speed of 2.5 m/s & hits a spring. ($k = 3000 \frac{N}{m}$).



a) Find the total Mech Energy of the system.

b) What is the KE when the spring is compressed a distance of 1 cm?

c) How far will the spring compress when the mass comes to a stop!

Given $m = .3$ kg
$v_i = 2.5$ m/s
$k = 3000$ N/m
$x = .01$ m

Find E_T
KE
x_{max}

a) $E_T = PE_s + KE$ (KE = 0)
$\frac{1}{2}(.3)(2.5 \text{ m/s})^2$
$= .94$ J

b) $E_T = PE_s + KE$
$.94 = \frac{1}{2}(3000 \frac{N}{m})(.01)^2 + KE$
$KE = .79$ J

c) $E = \frac{1}{2}kx^2$
$.94 = \frac{1}{2}(3000 \frac{N}{m})x^2$ $\quad x = .025$ m