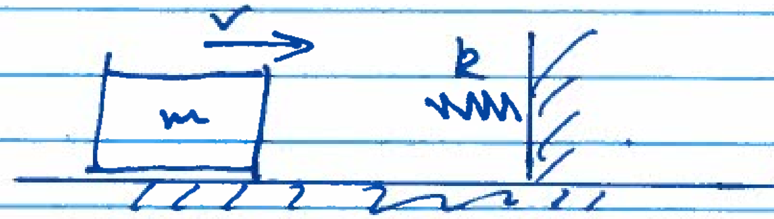
Given:



linear spring, $k = 13\,kN/m$
vel at impact, $v = 4.4\,m/s$
mass, $m = 100\,kg$
No friction

Find: δ_{max}

Soln: $KE = SprEn$

$$\frac{1}{2} m v^2 = \frac{1}{2} k \delta^2$$

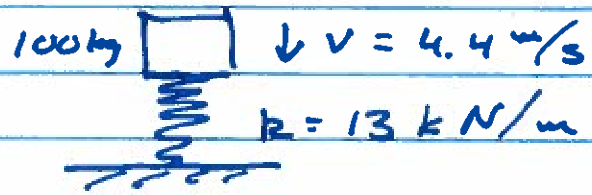
$$(100\,kg)(4.4\,m/s)^2 = (13{,}000\,N/m)\,\delta^2$$

$$\delta = 0.386\,m$$

$$\underline{\delta_{max} = 0.39\,m}$$

Assumptions: spring remains linear
spring is massless
object is rigid

Given:



100 kg object is moving vertically at 4.4 m/s when it contacts the spring.

Find δ_{max}

Assume: spring is elastic, mass is rigid.
" " massless.

Soln:

$$\delta_{max} = \delta_{ST}\left(1 + \sqrt{1 + \frac{v^2}{g\,\delta_{ST}}}\right)$$

$$\delta_{ST} = \frac{W}{k} \qquad W = mg = (100\,kg)\left(10\,\frac{m}{s^2}\right) = 1000\,N$$

$$\delta_{ST} = \frac{1\,kN}{13\,kN/m} = 0.077\,m$$

$$\delta_{max} = 0.077\,m\left(1 + \sqrt{1 + \frac{(4.4\,m/s)^2}{\left(10\,\frac{m}{s^2}\right)(0.077\,m)}}\right)$$

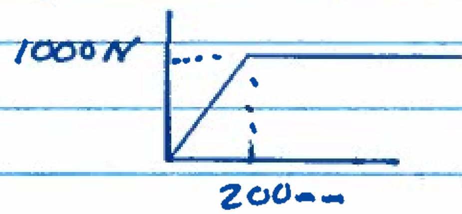
$$= 0.077\,m\,(6.11)$$

$$\delta_{max} = \underline{\underline{0.47\,m}}$$

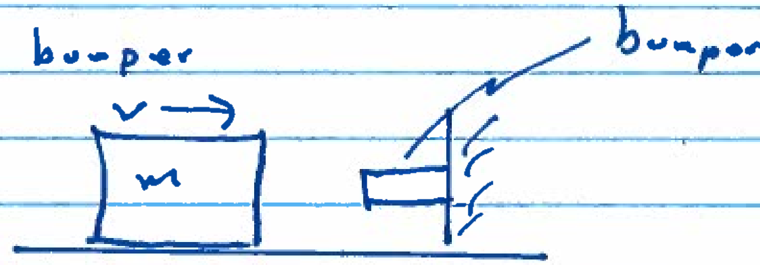
- When dropped vertically compared to horizontally, if velocity and mass are the same, kinetic energy is the same. However, the vertical dropped object has potential energy at the moment of impact; therefore more energy absorbtion is required to bring it to rest

0.39m - horizontal
0.47m - vertical

Given: 5kg object moving horizontally at 10 m/s strikes a safety-bumper with:



Find: δ of bumper



Assume: no friction, mass-less bumper, rigid mass

$$KE = \int F \, d\delta$$

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (5 kg)(10 m/s)^2$$

$$KE = 250 N \cdot m$$

If $\delta \leq 200 mm$

$$\int F \, d\delta = \frac{1}{2} F \delta$$

If $\delta = 200 mm = 0.2 m$

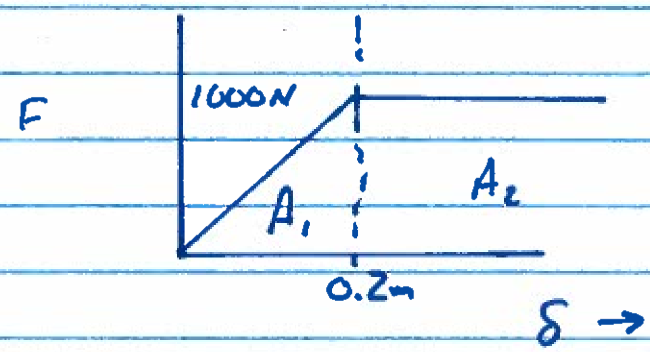
$$\text{Energy} = \frac{1}{2} (1000 N)(0.2 m) = 100 N\text{-}m$$

Since KE (250 N-m) > 100 N-m

the bumper deflection will be greater than 200 mm

For $\delta > 200$ mm

$$\int F\,d\delta = 100\,N\text{-}m + 1000\,N(\delta - 0.2\,m)$$



$$A_1 = \tfrac{1}{2} F \delta = \tfrac{1}{2}(1000\,N)(0.2\,m)$$

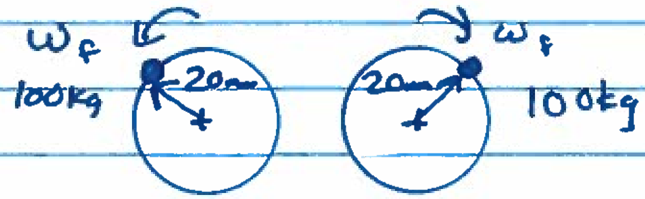
$$A_2 = F(\delta - 0.2\,m)$$
$$= 1000\,N(\delta - 0.2)$$

$$KE = \int F\,d\delta$$

$$250\,N\text{-}m = 100\,N\text{-}m + 1000\,N(\delta - 0.2\,m)$$

$$\delta = 0.35\,m = 350\,mm$$

Given! eccentric spinning masses



100kg @ 20 mm each (eccentricity)

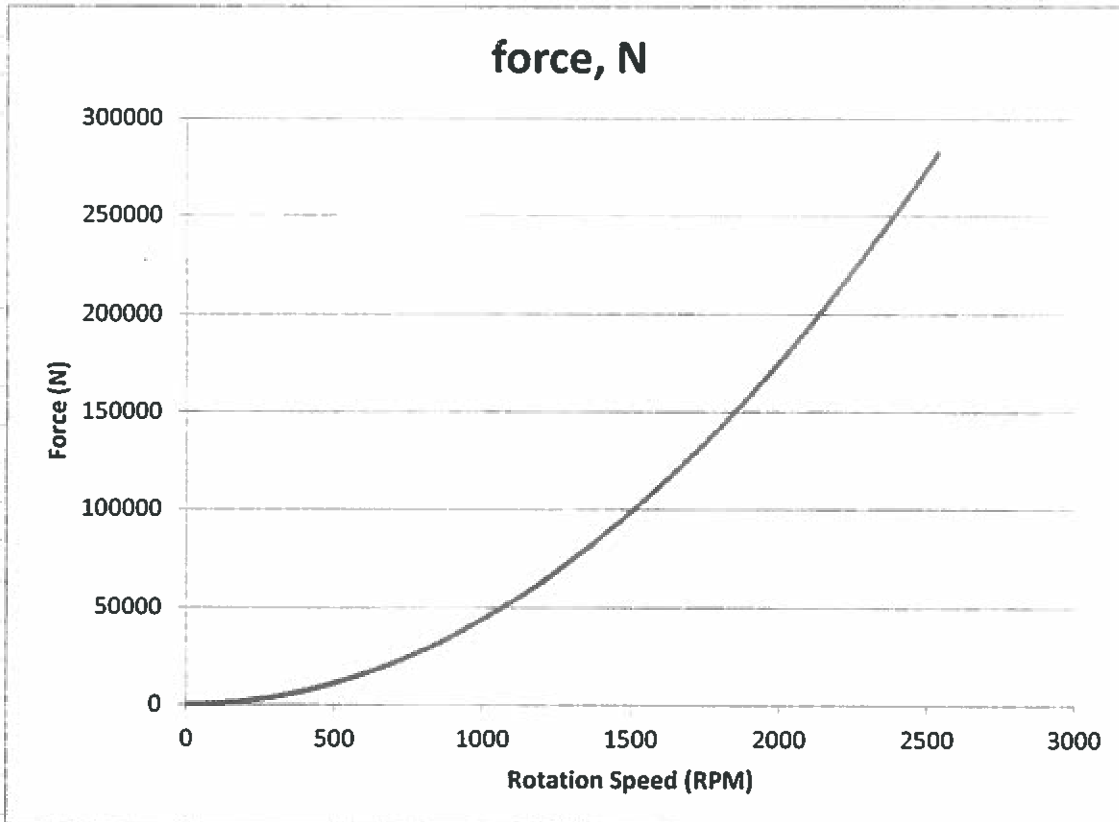
Each disk: $F_{circ} = m \cdot e\,\omega^2$

$m = 100\ kg$
$e = 0.02m$ (20mm)
$\omega \Rightarrow rad/sec$ $0 \rightarrow 3000\ RPM$

$$1\ rad/sec = \frac{rad}{sec} \cdot \frac{60 sec}{min} \cdot \frac{1\ rev}{2\pi\ rad} = 9.549\ RPM$$

See spread sheet

	A	B	C	D	E	F	G	
1	GIVEN:			Spinning frqcy, rad/sec	Hz	RPM	force, N	force, N
2	mass of disk	100	kg	0.0	0.00	0	0	
3	eccentricity	0.02	m	0.5	0.08	5	1	equation in cell G4:
4	number of disks	2		1.0	0.16	10	4	B$4*B$2*B$3*D4^2
5				1.5	0.24	14	9	



12.5	1.99	119	625
13.0	2.07	124	676
13.5	2.15	129	729
14.0	2.23	134	784
14.5	2.31	138	841
15.0	2.39	143	900

This problem asks to plot the force produced by two eccentric mass spinning disks. They are rototing in oposite directions so the net force is limited to a single direction.