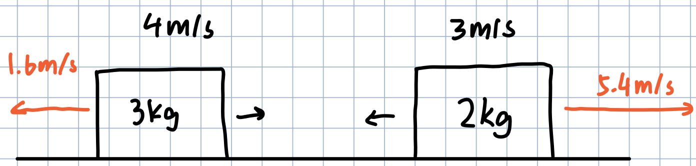
We only want to consider kinetic energy and discard all the other energies



Find Final Velocities

√ $\vec{P}_T = \vec{P}_T{}'$

x $\vec{P}_3 + \vec{P}_2 = \vec{P}_3{}' + \vec{P}_2{}'$

?x $m_3\vec{v}_3 + m_2\vec{v}_2 = m_3\vec{v}_3{}' + m_2\vec{v}_2{}'$

√ $3(4) + 2(-3) = 3\vec{v}_3{}' + 2\vec{v}_2{}'$

$$6 = 3\vec{v}_3{}' + 2\vec{v}_2{}'$$

$$\vec{v}_3{}' = \frac{6 - 2\vec{v}_2{}'}{3}$$

↓ sub

$$\vec{v}_3{}' = \frac{6 - 2(5.4)}{3}$$

$$\vec{v}_3{}' = -1.6\,m/s\ [R]$$

$$= \boxed{1.6\,m/s\ [L]}$$

√ $E_K = E_K{}'$

x $E_{K3} + E_{K2} = E_{K3}{}' + E_{K2}{}'$

?x $\cancel{\tfrac{1}{2}}m_3v_3^2 + \cancel{\tfrac{1}{2}}m_2v_2^2 = \cancel{\tfrac{1}{2}}m_3v_3'^2 + \cancel{\tfrac{1}{2}}m_2v_2'^2$

√ $3(4)^2 + 2(-3)^2 = 3v_3'^2 + 2v_2'^2$

$$66 = 3v_3'^2 + 2v_2'^2$$

$$66 = 3\frac{(6 - 2\vec{v}_2{}')^2}{3^2} + 2v_2'^2$$

$$66 = \cancel{3}\frac{36 - 24\vec{v}_2{}' + 4\vec{v}_2{}'^2}{3^{\cancel{2}}} + 2v_2'^2$$

$$198 = 36 - 24\vec{v}_2{}' + 4\vec{v}_2{}'^2 + 6v_2'^2$$

$$10v_2'^2 - 24v_2' - 162 = 0$$

-3	10	-24	-162
	↓	-30	162
	10	-54	0

$$10v_2' - 54 = 0$$

$$v_2' = \boxed{5.4\,m/s\ [R]}$$

Newton's Second Law

$F = ma$

$F = m\frac{\Delta v}{\Delta t}$

$F\Delta t = m\Delta v \quad = \quad \text{Impulse } (\vec{I}) \text{ units} = kgm/s = N\cdot s$

$F\Delta t = m(v'-v)$

$F\Delta t = mv' - mv$

$\vec{F}\Delta t = p' - p$

$\vec{F}\Delta t = \Delta\vec{P}$

Find force if lasted 100ms

3kg	2kg
$\vec{F}_3 \Delta t_3 = m_3 \Delta V_3$	$\vec{F}_2 \Delta t_2 = m_2 \Delta V_2$
$\vec{F}_3(0.1) = 3(1.6[L] - 4[R])$	$\vec{F}_2(0.1) = 2(5.4[R] - 3[L])$
$\vec{F}_3(0.1) = 3(5.6[L])$	$\vec{F}_2(0.1) = 2(8.4[R])$
$\vec{F}_3 = 168N[L]$	$\vec{F}_2 = 168N[R]$

How many energy is stored in the spring at minimum separation

$\vec{P}_T = \cancel{\vec{P}_T}' = \vec{P}_{T\,min}$

$\vec{P}_3 + \vec{P}_2 = \vec{P}_{3\,min} + \vec{P}_{2\,min}$

$m_3\vec{v}_3 + m_2\vec{v}_2 = m_3\vec{v}_3\,min + m_2\vec{v}_2\,min$

but at minimu sep

move at same speed

$\vec{v}_{3min} = \vec{v}_{2min} = \vec{v}_{min}$

$3(4) + 2(-3) = 3\vec{v}_{min} + 2\vec{v}_{min}$

$6 = 5\vec{v}_{min}$

$1.2 = \vec{v}_{min}$

$E_T = \cancel{E_T}' = E_T\ min$

$E_{k3} + E_{k2} = E_{k3min} + E_{k2min} + E_s$

$\cancel{\tfrac{1}{2}}m_3v_3^2 + \cancel{\tfrac{1}{2}}m_2v_2^2 = \cancel{\tfrac{1}{2}}m_3v_{min}^2 + \cancel{\tfrac{1}{2}}m_2v_{min}^2 + 2E_s$

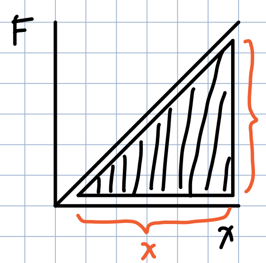
$3(4)^2 + 2(-3)^2 = 3(1.2)^2 + 2(1.2)^2 + 2E_s$

$66 = 5(1.2)^2 + 2E_s$

$E_s = 29.4\,J$

Springs:

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



Area = Energy

$= \frac{1}{2}xF$

$= \frac{1}{2}x(kx)$

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

If the spring 30cm and gets within 10cm, what's the spring constant

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

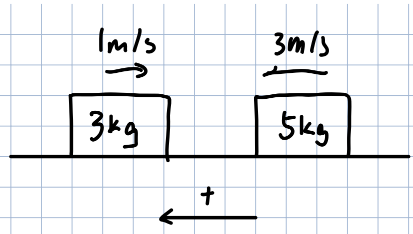
$29.4 = \frac{1}{2}k(0.2)^2$

$k = 1470$ N/m

If total inelastic collision, How much energy is lost? What's the velocity of cars?

29.4 J
is lost

1.2 m/s is the velocity



$$3(-1) + 5(3) = 3V_3' + 5V_5'$$

$$V_3' = \frac{12 - 5V_5'}{3}$$

$$V_3' = \frac{12 - 5(0)}{3}$$

$$V_3' = 4\,m/s$$

$$3(-1)^2 + 5(3)^2 = 3V_3'^2 + 5V_5'^2$$

$$48 = \cancel{3}\frac{(12 - 5V_5')^2}{3} + 5V_5'^2$$

$$\cancel{144} = \cancel{144} - 120V_5' + 25V_5'^2 + 15V_5'^2$$

$$40V_5'^2 - 120V_5' = 0$$

$$0 = 40V_5'(V_5' - 3)$$

$V_5 = 0, \cancel{5}$ → initial

$= 0\,m/s$

$$P_T = P_T\,min$$

$$12 = 3V_{min} + 5V_{min}$$

$$12 = 8V_{min}$$

$$V_{min} = 1.5\,m/s$$

$$E_T = E_T\,min$$

$$3(-1)^2 + 5(3)^2 = 3V_{min}^2 + 5V_{min}^2 + 2E_s$$

$$48 = 5(1.5)^2 + 3(1.5)^2 + 2E_s$$

$$E_s = 15\,J$$