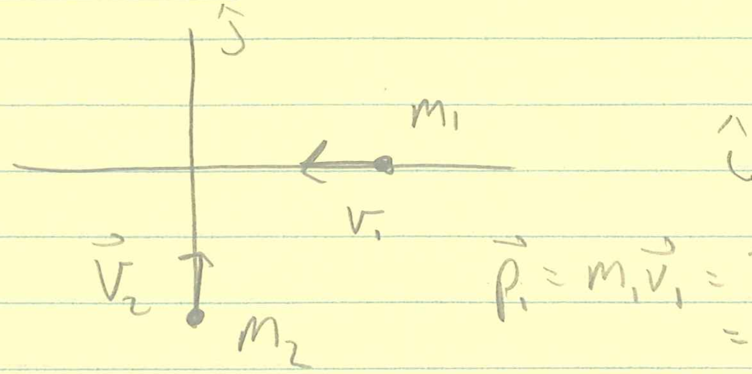
HW due 3/6

8.4)

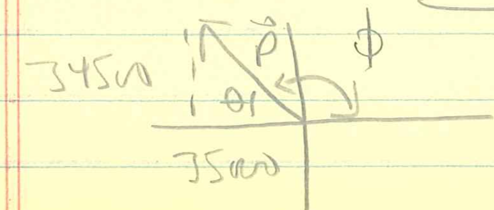


$\vec{p}_1 = m_1\vec{v}_1 = 2500(-14\hat{i})$
$= -35000\,\hat{i}$

$\vec{p}_2 = m_2\vec{v}_2 = 1500(+23\hat{j})$
$= 34500\,\hat{j}$

$\vec{P}_{system} = \vec{p}_1 + \vec{p}_2 = -35000\hat{i} + 34500\hat{j}$

$|\vec{P}_{system}| = \underline{\underline{49145}}$ kgm/s "@ 135.4°"



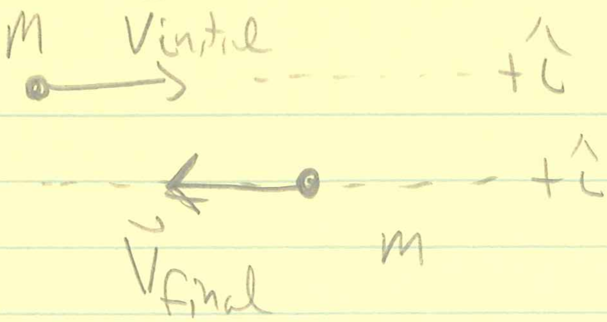
$\theta = \tan^{-1}\left(\frac{34500}{35000}\right) = 44.6°$

8.6) $\boxed{\begin{aligned}\Delta t &= 30 \times 10^{-3}\,s \\ m &= 0.057\,kg\end{aligned}}$

a.) $\vec{v}_{initial} = 0$
$\vec{v}_{final} = +73\,\hat{i}$
$\Delta\vec{p} = m\vec{v}_{final} - m\vec{v}_{initial} = 4.161\hat{i}$

$\underbrace{\vec{F}_{AVG}\Delta t}_{\text{Impulse}} = \Delta\vec{p} = \underline{\underline{+4.161\hat{i}}}$ Impulse

Also, $\vec{F}_{AVG} = \frac{\Delta\vec{p}}{\Delta t} = \underline{\underline{138.7\hat{i}}}$ newtons b)



$$\Delta\vec{P} = \vec{P}_{final} - \vec{P}_{initial} = m\vec{V}_{final} - m\vec{V}_{initial}$$

$$= 0.057(-55\hat{i}) - 0.057(73\hat{i})$$

$$= \underbrace{-7.296\hat{i}}_{\text{Impulse delivered}}$$

$$= \overbrace{\vec{F}_{AVG}\,\Delta t} = \Delta\vec{P}$$

$$\vec{F}_{AVG} = \frac{\Delta\vec{P}}{\Delta t} = -\frac{7.296\hat{i}}{30\times10^{-3}} = -243.2\,\hat{i} \text{ Newtons}$$

8.8) $m = 0.145$ kg

$\longrightarrow \vec{v}_i = +45\hat{i}$

$\longleftarrow \vec{v}_f = -55\hat{i}$

$$\overrightarrow{\text{Impulse}} = \Delta\vec{P} = 0.145(-55\hat{i}) - 0.145(45\hat{i})$$

$$= \underline{-14.5\hat{i}} \text{ kgm/s} \quad \text{Answer (A)}$$

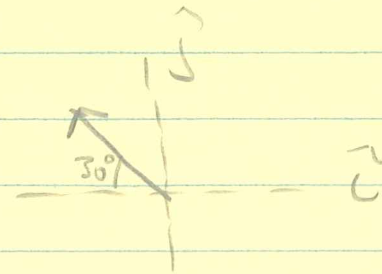
$$= \vec{F}_{AVG} = \frac{\Delta\vec{P}}{\Delta t} = \frac{-14.5\hat{i}}{2\times10^{-3}} = \underline{-7250\,\hat{i}} \text{ Newtons} \quad \text{Ans (B)}$$

8.10)

$M = 0.145$

$\vec{V}_i = 40\hat{i}$

$\vec{V}_f = -52\cos(30)\hat{i} + 52\sin(30)\hat{j}$



$\Delta\vec{P} = M\vec{V}_f - M\vec{V}_i = -12.330\hat{i} + 3.77\hat{j}$

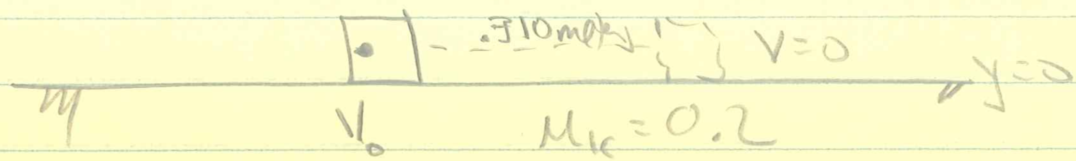
$\vec{F}_{AVG} = \frac{\Delta\vec{P}}{\Delta t} = \frac{\Delta\vec{P}}{1.75 \times 10^{-3}} = -7046\hat{i} + 2154\hat{j}$

Answer.

8.24) Worked in class ☺

8.42)

$M = (M_{block} + M_{bullet})$



$\mu_k = 0.2$

$M_{bullet} = 0.005$

$M_{block} = 1.2$

From 2nd law we get

$f_k = \mu_k M g$

So $W_{f_k} = \int \vec{f}_k \cdot d\vec{s} = -\mu_k M g (0.310)$

$= -0.732158$ joules

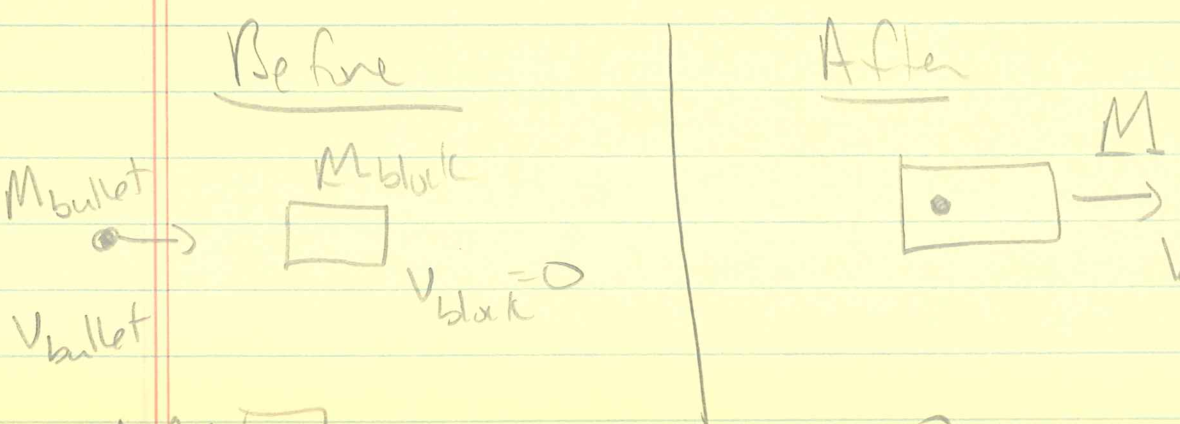
Conservation of energy demands that this be ΔKE (Newton and Conservation of Energy $\Rightarrow$ YOU work the process!!)

I am sketching a solution for which you should be able to fill in the details ☺

$$\Delta KE = \tfrac{1}{2}M(0)^2 - \tfrac{1}{2}M V_0^2 = -0.732158$$

$$\therefore V_0 = 1.10236102 \text{ m/s}$$

Conservation of Momentum



All $\boxed{\hat{i}}$

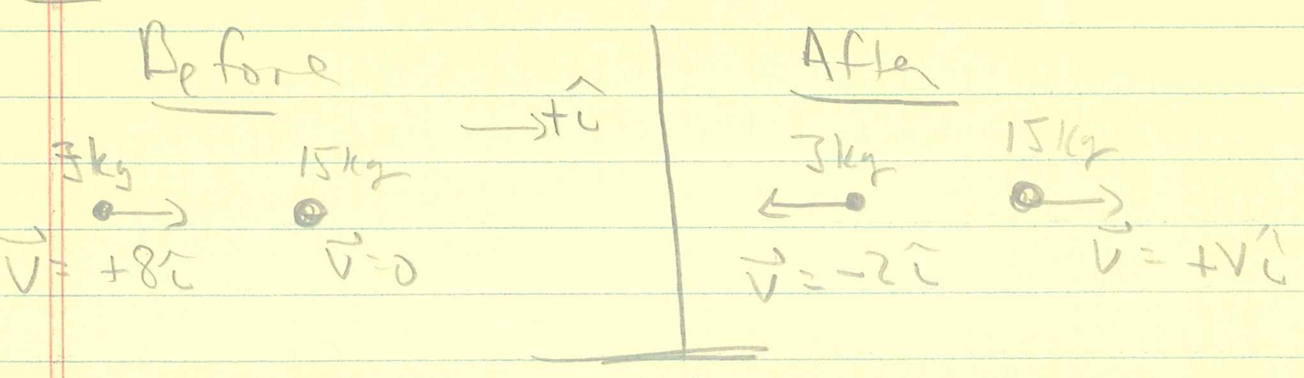
$$\vec{P}_{before} = \vec{P}_{After}$$

$$M_{bullet} V_{bullet} = 1.205(1.10236102)$$

$$\therefore V_{bullet} = 265.7 \text{ m/s}$$

Answer.

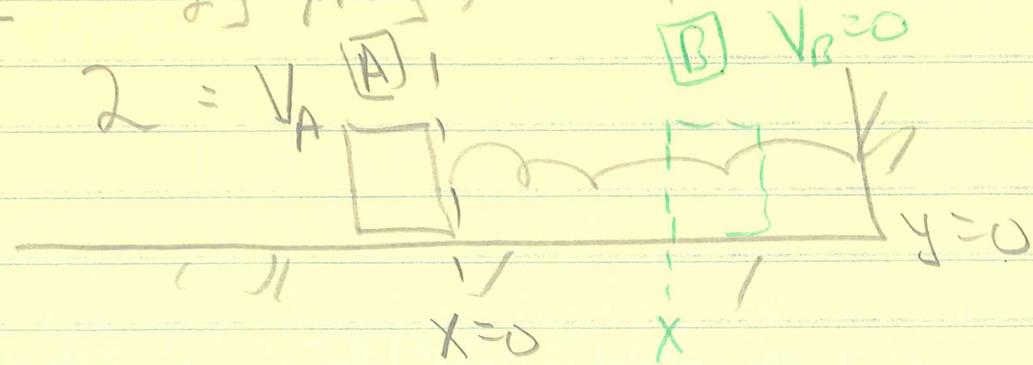
8.44) The temptation here is to use **only** Conservation of Energy. The problem with that is that during the collision it is possible that some K.E. was converted into another kind of energy **that we are not tracking** w/ a P.E.. Assuming that is the case, we start w/ conservation of momentum.



$\boxed{\hat{i}}$

$$P_{before} = P_{after}$$
$$3(8) = 3(-2) + 15(v)$$
$$v = 2\ m/s$$

System: 15kg, spring, Earth



$$TE_{\boxed{A}} = KE_{\boxed{A}} + \underbrace{PE_{g\boxed{A}}}_{\to 0} + \underbrace{PE_{s\boxed{A}}}_{\to 0} = \frac{1}{2}(15)(2)^2$$

$$TE_{\boxed{B}} = \underbrace{KE_{\boxed{B}}}_{\to 0} + \underbrace{PE_{g\boxed{B}}}_{\to 0} + PE_{s\boxed{B}} = \frac{1}{2}(500)x^2$$

Cons Energy : $TE_{\boxed{A}} = TE_{\boxed{B}}$

$$\frac{1}{2}(15)(4) = \frac{1}{2}(500)x^2$$

$$x = 0.346 \text{ meters}$$

Answer,

Let's check KE, in that collission :

$$KE_{before} = \frac{1}{2}(3)(8)^2 = 96 \text{ J}$$

$$KE_{after} = \frac{1}{2}(3)(2)^2 + \frac{1}{2}(15)(2)^2 = 36 \text{ J}$$

YES INDEED ! Some of that original energy was "lost" to our counting.

HAD IT NOT BEEN, as in an "elastic collission", all we would have needed to do was apply conservation of Energy. ☺

8.64)

$m = 0.04$

$\vec{V}_i = -6.26\ \hat{j}$

$\vec{V}_f = +5.6\ \hat{j}$

You can get this using eqtns of motion or cons. of energy.

$\overrightarrow{\text{Impulse}} = \Delta\vec{P} = 0.04(5.6\hat{j}) - 0.04(-6.26\hat{j})$

$= \underline{\underline{0.4744\ \hat{j}}}$

$\vec{F}_{AVG} = \frac{\Delta\vec{P}}{\Delta t} = \frac{0.4744\hat{j}}{2\times10^{-3}} = \underline{\underline{237.2\ \hat{j}}}$ newtons