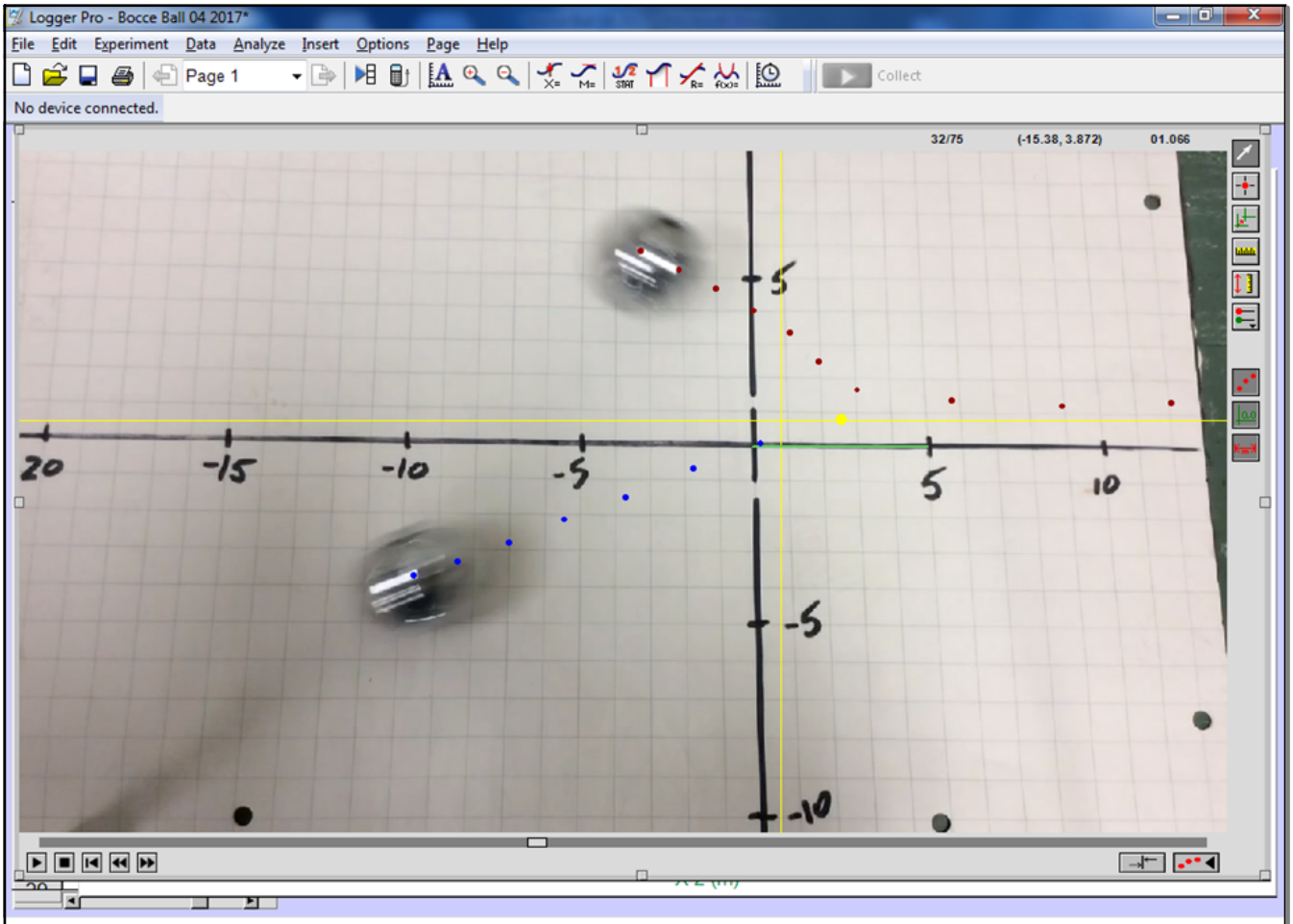
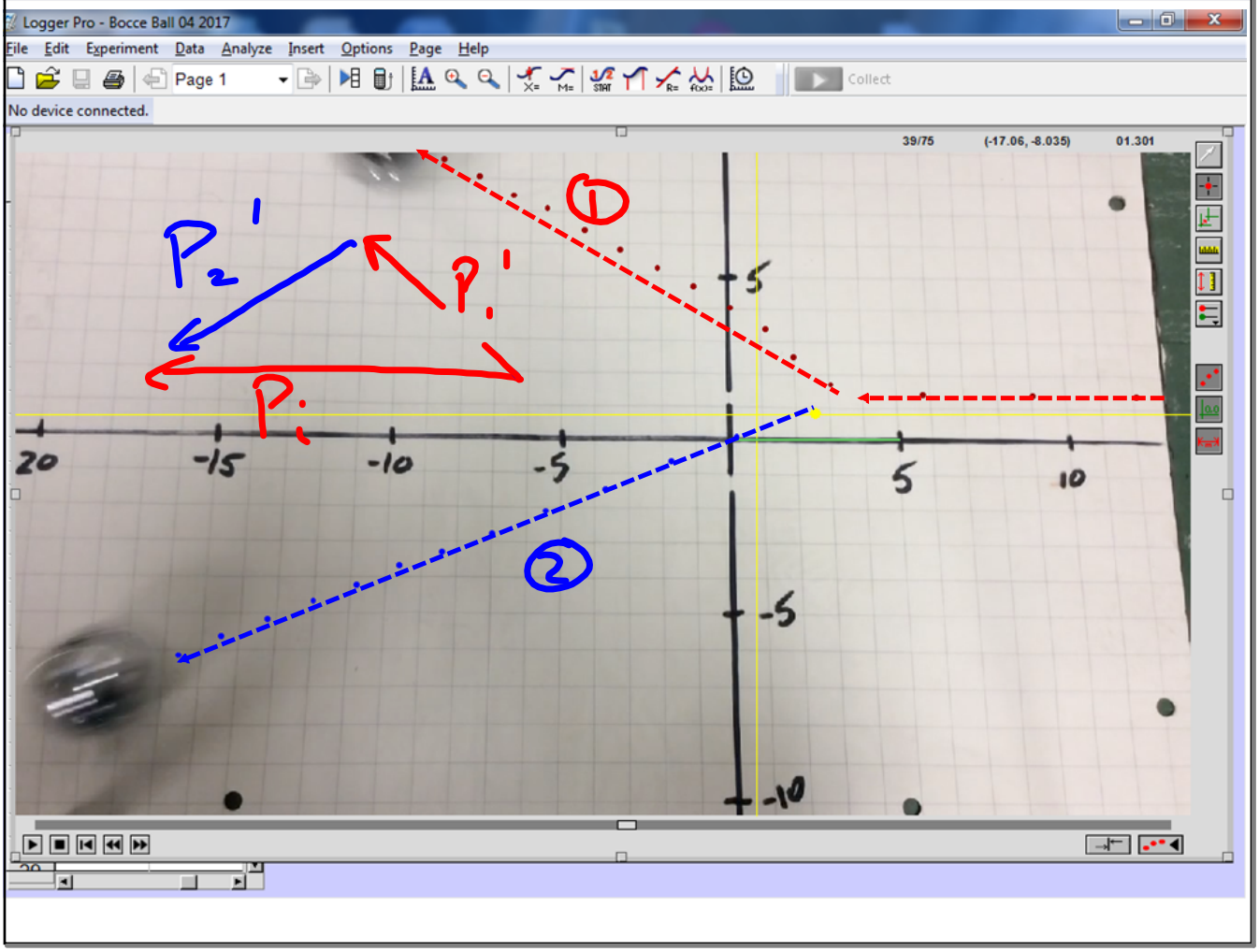
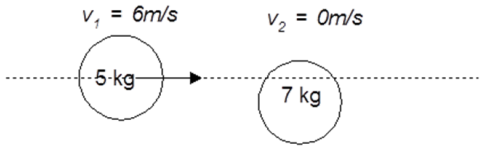




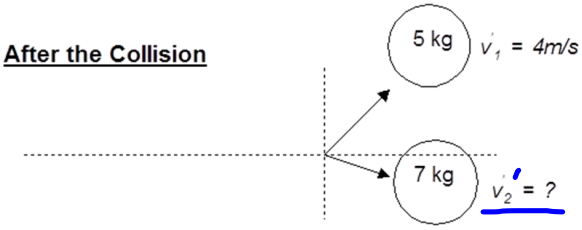
Apr 19-11:59 AM

Conservation of Momentum - 2D (glancing collision)

Before the Collision



After the Collision

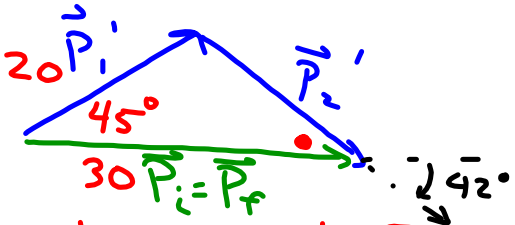


$$\vec{P}_i = \vec{P}_f$$

$$\vec{P}_1 + \vec{P}_2 = \vec{P}_1' + \vec{P}_2'$$

$$m_1\vec{v}_1 + m_2\vec{v}_2 = m_1\vec{v}_1' + m_2\vec{v}_2'$$

$$30[E] = 20[E45N] + \vec{P}_2'$$



Cosine law $|P_2'| = \sqrt{20^2 + 30^2 - 2(20)(30)\cos 45}$

$= 21.25$

Sine law $\frac{\sin\theta}{20} = \frac{\sin 45}{21.25}$

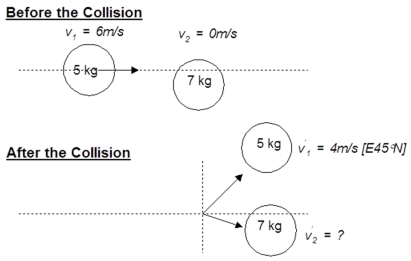
$\theta = 42°$

$\vec{P}_2' = 21.25\ kgm/s\ [E42S]$

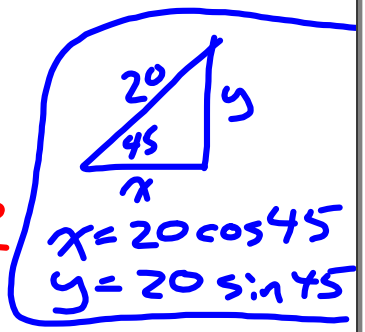
$\vec{V}_2 = \frac{\vec{P}_2'}{m_2} = 3.0\ m/s\ [E42S]$

Mar 10-8:24 PM

Conservation of Momentum - 2D (glancing collision)



Components



$x = 20\cos 45$

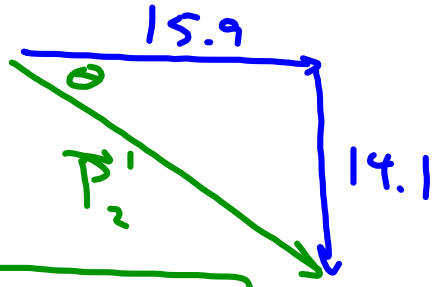
$y = 20\sin 45$

$30[E] = 20[E45N] + \vec{P}_2'$

Component Table

	X (E-W)	Y (N-S)
P_1'	14.1	14.1
P_2'	15.9	-14.1
$P_i = P_f$	30	0

$\vec{P}_2'$



$|P_2'| = \sqrt{15.9^2 + 14.1^2} = 21.25$

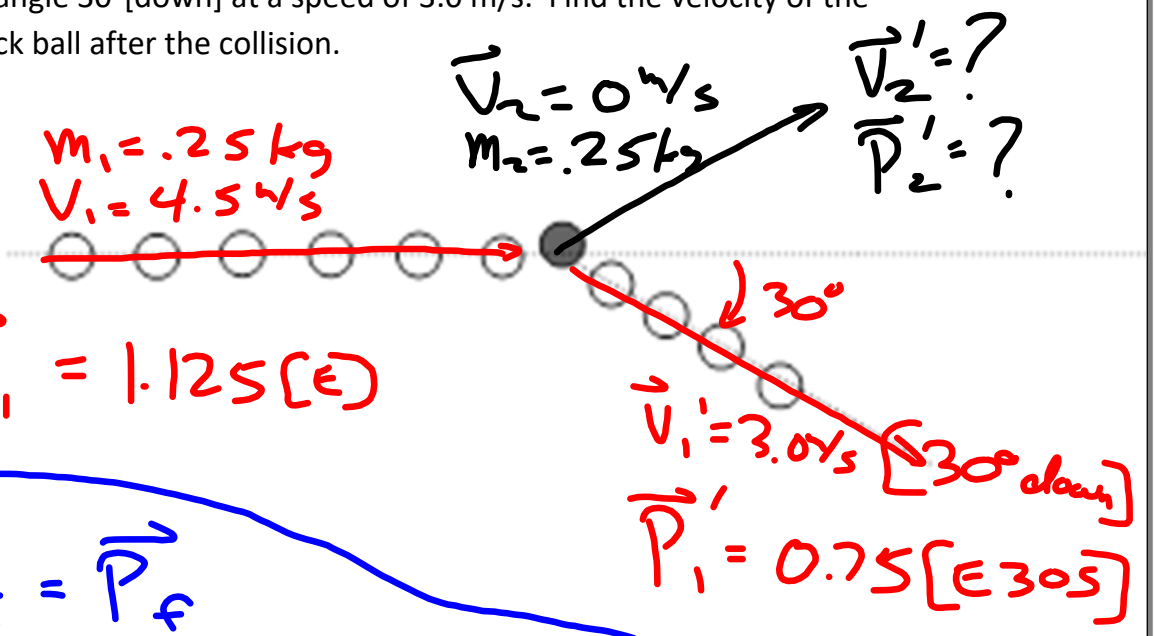
$\theta = \tan^{-1}\left(\frac{14.1}{15.9}\right) = 42°$

$\therefore \vec{P}_2' = 21.25[E42S]$

$\vec{V}_2' = 3.0 m/s[E42S]$

Mar 10-8:24 PM

1. The diagram below shows two balls each with mass 250g. The white ball is moving at 4.5 m/s before it collides with a stationary black ball. After a "glancing collision" the white ball moves off at an angle 30°[down] at a speed of 3.0 m/s. Find the velocity of the black ball after the collision.



$\vec{P}_1 = 1.125\ [E]$

$\vec{P}_1' = 0.75\ [E30S]$

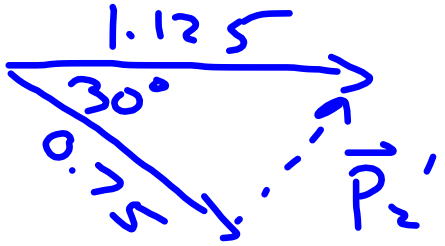
$\vec{P}_i = \vec{P}_f$

$1.125\ [E] = 0.75\ [E30S] + \vec{P}_2'$

Component Table

	X	Y
P_1'	0.650	-0.375
P_2'	+0.475	+0.375
$P_i = P_f$	1.125	0

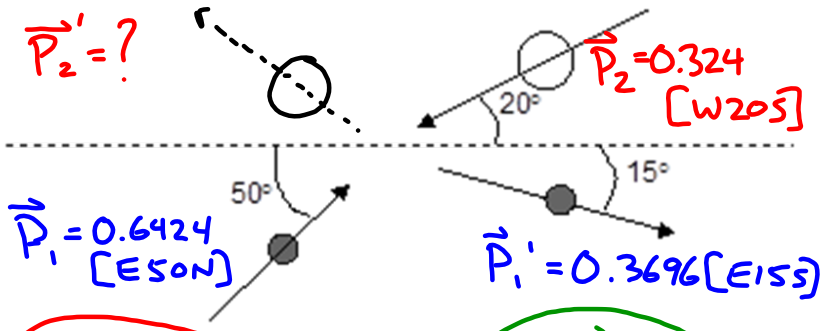
Tip-to-Tail



$\vec{P}_2' = 0.606\ kg\ m/s\ [E38N]$

$\vec{V}_2' = 2.4\ m/s\ [E38N]$

2. The small black ball in the diagram below has a mass of 88 grams and is moving at 7.3 m/s [E50°N] and it strikes the 180 gram large white ball moving at 1.80 m/s [W20°S]. The small black ball moves off at 4.2 m/s [E15°S]. Determine the resulting velocity of the white ball after the collision.



$\vec{P}_i = \vec{P}_f$

$\vec{P}_1 + \vec{P}_2 = \vec{P}_1' + \vec{P}_2'$

$\vec{P}_1$

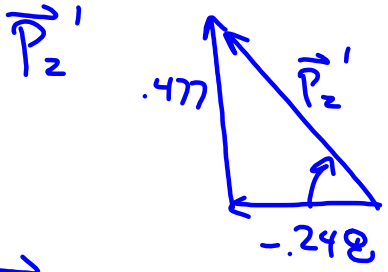
$P_{1x} = P_1 \cos\theta = +.413$

$P_{1y} = P_1 \sin\alpha$

Components

	X(E-W)	Y(N-S)
P_1	0.413	0.492
P_2	-0.304	-0.111
P_i	0.109	0.381
$\vec{P}_1'$	.357	-0.096
$\vec{P}_2'$	-.248	0.477
P_f	0.109	0.381

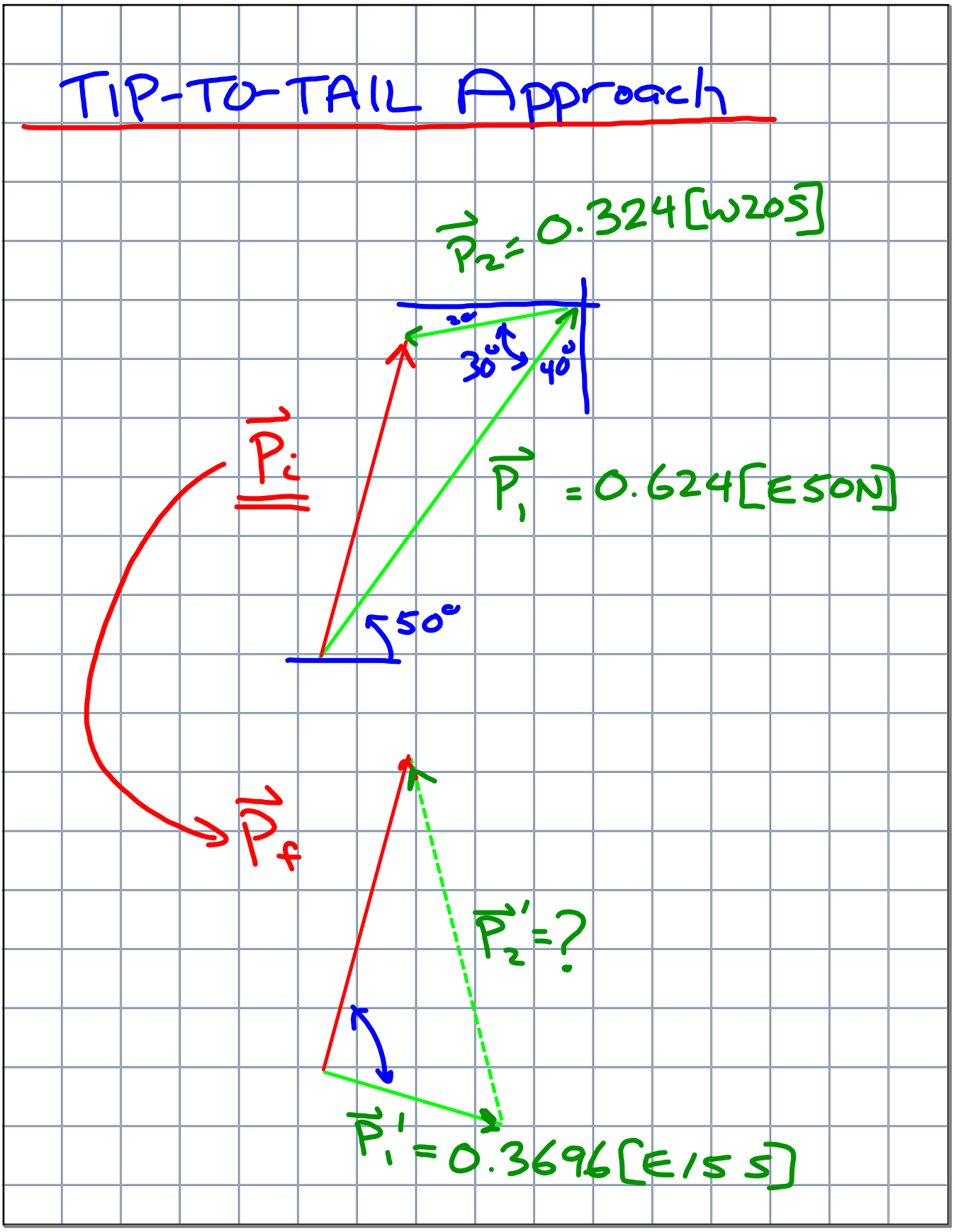
* unknown



$\vec{P}_2' = 0.537$ kg m/s [W63°N]

$\vec{V}_2' = \vec{P}_2' / m_2 = 3.0$ m/s [W63N]

Mar 23-11:14 AM


TIP-TO-TAIL Approach
$\vec{P}_2 = 0.324[W20S]$
30°
40°
$\vec{P}_i$
$\vec{P}_1 = 0.624[ESON]$
50°
$\vec{P}_f$
$\vec{P}_2' = ?$
$\vec{P}_1' = 0.396[E15S]$

Pool Hall Physics

In analyzing problems like the game of pool when the masses of the objects are equal, it is often convenient to ignore the mass of the objects and deal with velocity vectors instead of momentum vectors.

Conservation of momentum

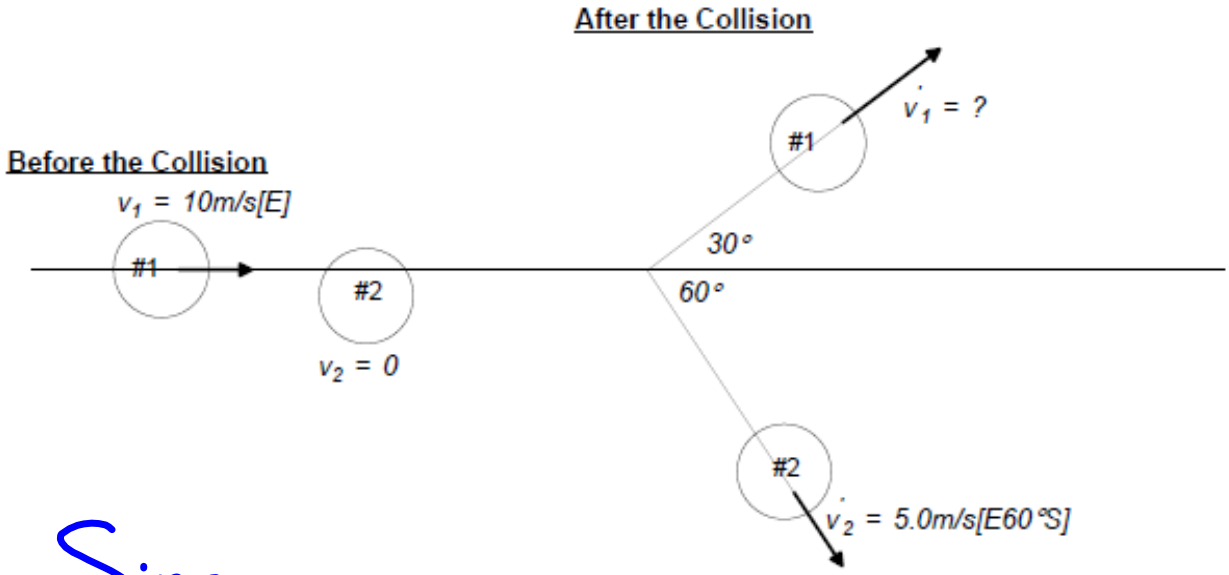
$$\vec{P}_i = \vec{P}_f$$

$$m_1\vec{v}_1 + m_2\vec{v}_2 = m_1\vec{v}_1' + m_2\vec{v}_2'$$

if $m_1 = m_2$

$$\vec{v}_1 + \vec{v}_2 = \vec{v}_1' + \vec{v}_2'$$

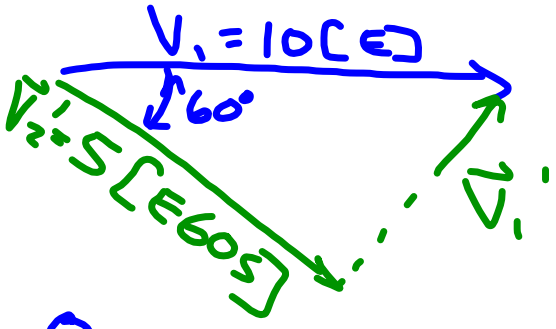
1. The diagram below shows two identical billiard balls before and after a glancing collision. Find the resultant velocity of ball 1 (v_1').



Since $m_1 = m_2$

$$\vec{v}_1 + \vec{v}_2 = \vec{v}_1' + \vec{v}_2'$$

$$\vec{v}_1 = \vec{v}_1' + \vec{v}_2'$$



$$\vec{v}_1' = 8.7\,m/s[E30°N]$$

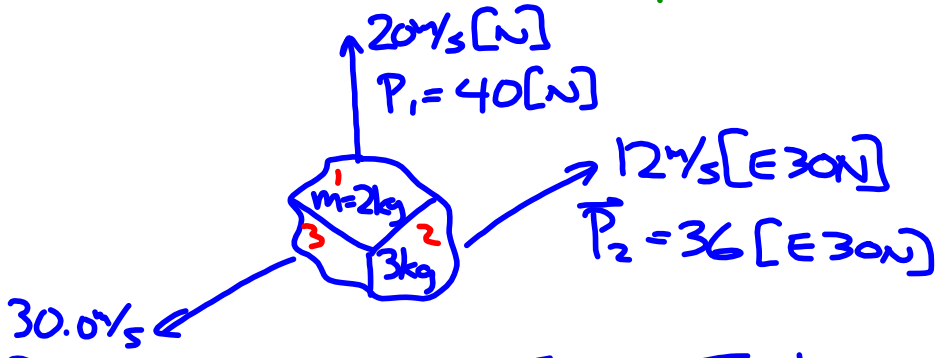
Explosions

A device that "pops" apart into three separate pieces is initially at rest on a horizontal surface. It pops into three pieces and all of them fly off horizontally. The first piece is 2.0kg and flies off at 20.0m/s[N], the second piece is 3.0kg and flies off at 12m/s [E30°N]. The third piece flies off at 30.0m/s.

a. Find the direction the third piece flies off at.

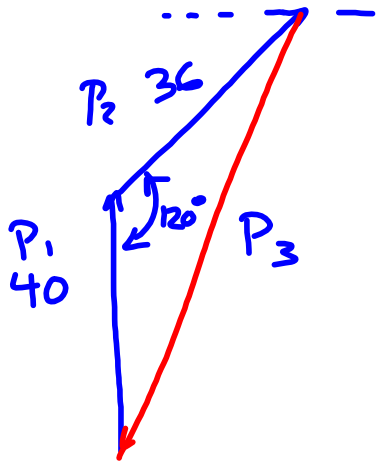
b. What is the mass of the third piece?

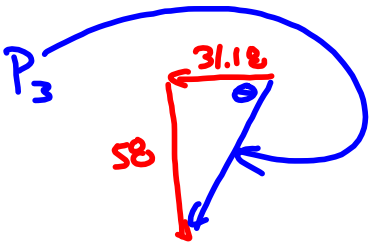
$\vec{P}_i = \phi$



	E-W	N-S
P_1	0	40
P_2	31.18	18
P_3	-31.18	-58
P_f	0	0

Tip-to-Tail





$\theta = \tan^{-1}\left(\frac{58}{31.18}\right)$

$= 62°$

dir'n [W62°S]

$|P_3| = 66$

$\vec{P}_3 = 66$ kgm/s [E62 S]

$m_3 = \vec{P}_3 / v_3 = 2.2$kg

Mar 30-10:01 AM