

FoP  
22. Batman + Robin

13.0m  
12.0m  
5.0m  
 $\theta_1$   
 $\theta_2$

5-12-13 is a Pythag. trible.

Horizontally:  
 $T_{1x} = T_{2x}$   
 $T_1 \cos \theta_1 = T_2 \cos \theta_2$

Vertically:  
 $T_{1y} + T_{2y} = F_g$   
 $T_1 \sin \theta_1 + T_2 \sin \theta_2 = F_g$

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38.

enlarge  
Support  
70°  
30.0m  
A base  
 $F_g = (6.0 \text{ kg})(9.8 \text{ m/s}^2)$   
 $F_g = (2.0 \text{ kg})(9.8 \text{ m/s}^2)$   
 $F_g = (2.0 \text{ kg})(9.8 \text{ m/s}^2)$

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BEFORE

AFTER

same red vector as before.

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Conservation of Momentum in 2D collisions

$\vec{P}_{\text{total}} = \vec{P}_{\text{total}}$

Momentum is conserved in 2D collisions in an isolated system (i.e. no friction)

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

BEFORE

	x	y
Ball 1	0	0.300 kg m/s
Ball 2	0	0
Total	0	0.300 kg m/s

AFTER

	x	y
Ball 1	0.280 kg m/s	0.190 kg m/s
Ball 2	0	0.110 kg m/s
Total	0.280 kg m/s	0.300 kg m/s

$0.28^2 + 0.19^2 = 0.30^2$   
 $0.0784 + 0.0361 = 0.09$   
 $0.1145 = 0.1145$

$\tan \theta = \frac{0.19}{0.28} = 0.6786$   
 $\theta = 34^\circ$

The velocity of the ball is 0.34 m/s at an angle of 34 degrees from the original direction of the ball's path.

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Another way:

$\vec{P}_{\text{total}} = \vec{P}_{\text{total}}$

$\vec{P}_b + \vec{P}_g = \vec{P}_b' + \vec{P}_g'$

$\vec{P}_b = \vec{P}_b' + \vec{P}_g'$  ← Vector Addition

0.5423 kg·m/s

← Momentum Vector Addition Diagram.

$= 0.4805 \text{ kg·m/s}$

① Use Law of Cosines  
② Use Law of Sines.

TWO METHODS

TO DO:

- PP/S09
- PHET Collision Lab
- Video Analysis
- x-y chart BEFORE + AFTER
- Momentum Vector Addition Diagram

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