Physics 12 Unit 4 – Momentum Worksheet #2

KEY

2-D Problems including Gov Problems

Name: _____ Date: _____

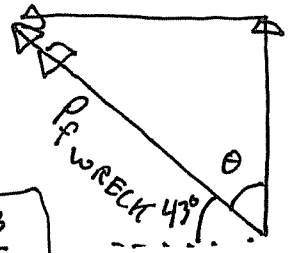
Momentum is a vector quantity

1. A 1200 kg car traveling north at 120 km/r collides with and sticks to a 1600 kg truck travelling west at 100 km/hr. Find the velocity (magnitude and direction) of the wreck.

33.3 m/s

27.7 m/s

$p_{i\,TRUCK} = mv = 44,444\ N\cdot s$



$p_{i\,CAR} = mv = 39,999\ N\cdot s$

use Pythagoras to find p_f

$p_f^2 = p_i^2 + p_i^2$

$p_f = 59,793\ N\cdot s$

$p = mv \rightarrow V = p/m = \frac{59,793}{2800}$

$V = 21.35\ m/s$ of wreck

$\tan\theta = \frac{44,444}{39,999}$

$\theta = 48°$ W of N

OR $43°$ N of W

2. A 1200 kg car traveling north at 120 km/r collides with and sticks to a 1600 kg truck travelling 20 degrees south of west at 100 km/hr. Find the velocity (magnitude only) of the wreck.

use cosine law

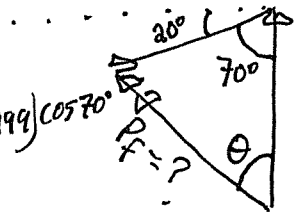
$p_f^2 = a^2 + b^2 - 2ab\cos\theta$

$= (44,444)^2 + (39,999)^2 - 2(44,444)(39,999)\cos 70°$

$p_f = 48571\ N\cdot s$

$V = p/m = \frac{\quad}{2800} = 17.3\ m/s$

$p_{i\,TRUCK} = 44,444\ N\cdot s$



$p_{i\,CAR} = 39,999\ N\cdot s$

$\frac{\sin\theta}{44,444} = \frac{\sin 70°}{48,571}$

$\sin\theta = 0.85985$

$\sin^{-1}$

$\theta = 59.3°$

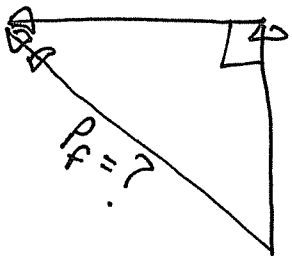
$= 31°$ N of W

3. You can use Pythagoras.

A 1.5 kg physics block is sliding at 8.0 m/s north when it is hit by a 0.40 kg ball of putty going 20 m/s west. The putty sticks to the block. What is the magnitude of their combined momentum after the collision?

A. 4.0 kg m/s
B. 8.9 kg m/s
C. 14 kg m/s
D. 20 kg m/s

$p_i = mv = (.4)(20) = 8\ N \cdot s$



$p_i = mv = (1.5)(8) = 12\ N \cdot s$

$p_f = ?$

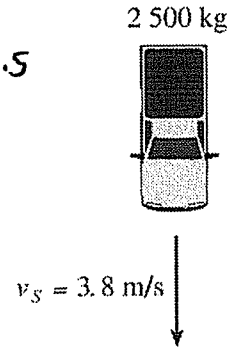
$p_f^2 = p_i^2 + p_i^2$

$p_f^2 = 8^2 + 12^2$

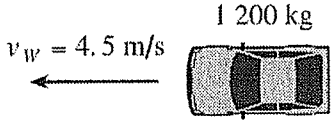
$p_f = 14.4\ N \cdot s$

4. You can use Pythagoras.

Sally is driving south in her 2 500 kg pickup truck at 3.8 m/s when she collides with Willy driving west in his 1 200 kg car at 4.5 m/s.



$p_i = 9500\ N \cdot s$

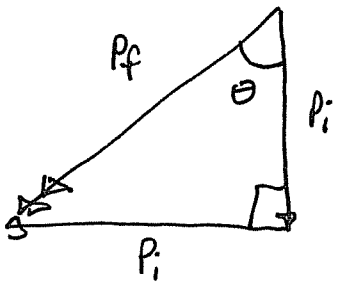


$p_i = 5400\ N \cdot s$

The two vehicles lock together and slide over the wet parking lot. Find the speed and direction of the damaged vehicles immediately after the collision. **(7 marks)**

$p_f^2 = (5400)^2 + (9500)^2$

$p_f = 10{,}927\ N \cdot s$



$\tan\theta = \frac{opp}{adj}$

$\tan\theta = \frac{5400}{9500}$

$\theta = 29.6°$

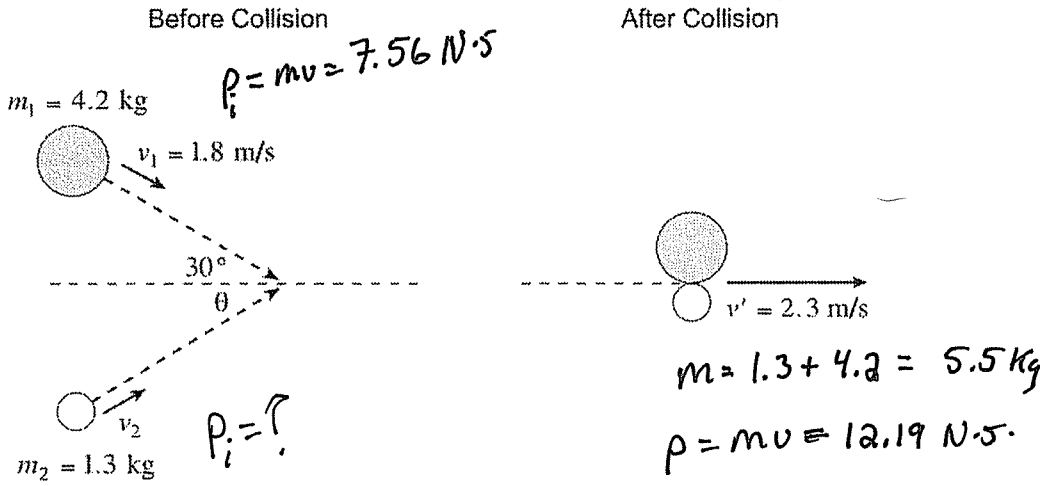
$v = \frac{p}{m} = \frac{}{3700}$

$v = 2.95\ m/s$

29.6° W of S

5. Add the two before vectors tip to tail.

Two steel pucks are moving as shown in the diagram. They collide inelastically.



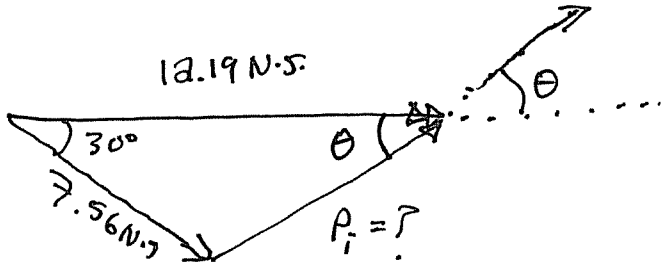
$p_i = mv = 7.56\ N\cdot s$

$p_i = ?$

$m = 1.3 + 4.2 = 5.5\ kg$

$p = mv = 12.19\ N\cdot s$

Determine the speed and direction (angle θ) of the 1.3 kg puck before the collision. **(7 marks)**



use cosine law

$$p_i^2 = (7.56)^2 + (12.19)^2 - 2(7.56)(12.19)\cos 30°$$

$$p_i = 6.7919\ N\cdot s$$

$$\frac{\sin\theta}{7.56} = \frac{\sin 30°}{6.7919}$$

$$\sin\theta = 0.5565$$

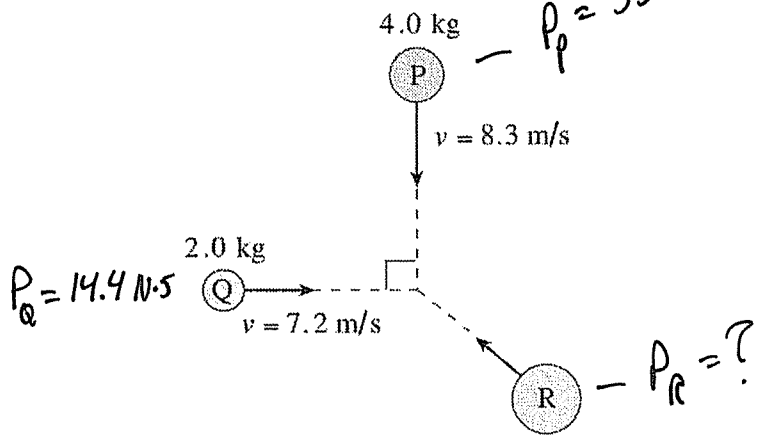
$$\theta = 33.8°$$

$33.8°$ N of E

$$V = p/m = \frac{\quad}{1.3} = 5.2\ m/s$$

6. All three vectors need to add to zero.

Three objects travel as shown.



$p_P = 33.2\ N\cdot s$

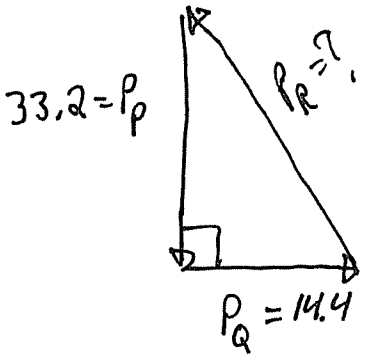
$p_Q = 14.4\ N\cdot s$

$p_R = ?$

What is the magnitude of the momentum of object R so that the combined masses remain stationary after they collide?

$p_f = 0$ so $\vec{p}_P + \vec{p}_Q + \vec{p}_R = 0$

A. 19 kg · m/s
B. 30 kg · m/s
C. 36 kg · m/s
D. 48 kg · m/s



$p_R^2 = 33.2^2 + 14.4^2$

$p_R = 36.2\ N\cdot s$