2 Dimensional conservation of momentum

Wednesday, March 27, 2013 10:22 AM

$= p$

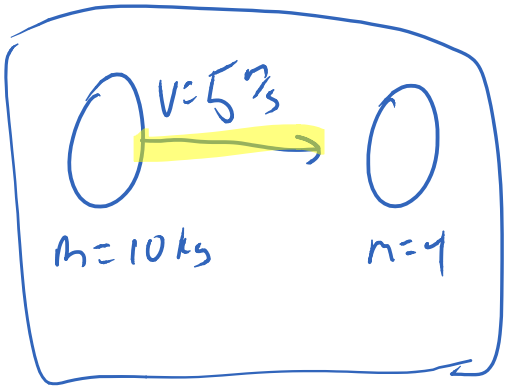
$\downarrow$

mv

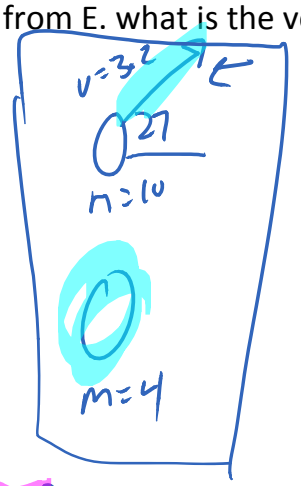
$\Delta p = F \cdot t =$ impulse

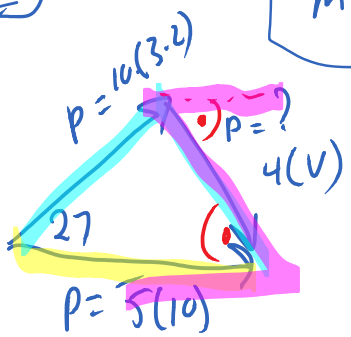
The key to your success is a good vector diagram.

A cat of mass 10 kg moving east at 5.0 m/s collides with a 4.0 kg cat at rest. The 10.0 kg Cat travels away with a velocity of 3.2 m/s at 27° N from E. what is the velocity of the other cat?



THEN





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

$= 32^2 + 50^2 - 2(32)(50)\cos 27$

$p = 25.9$ Ns

$\theta \Rightarrow \frac{\sin\theta}{32} = \frac{\sin 27}{25.9}$

$\theta = \sin^{-1}\left[\frac{\sin 27 (32)}{25.9}\right]$

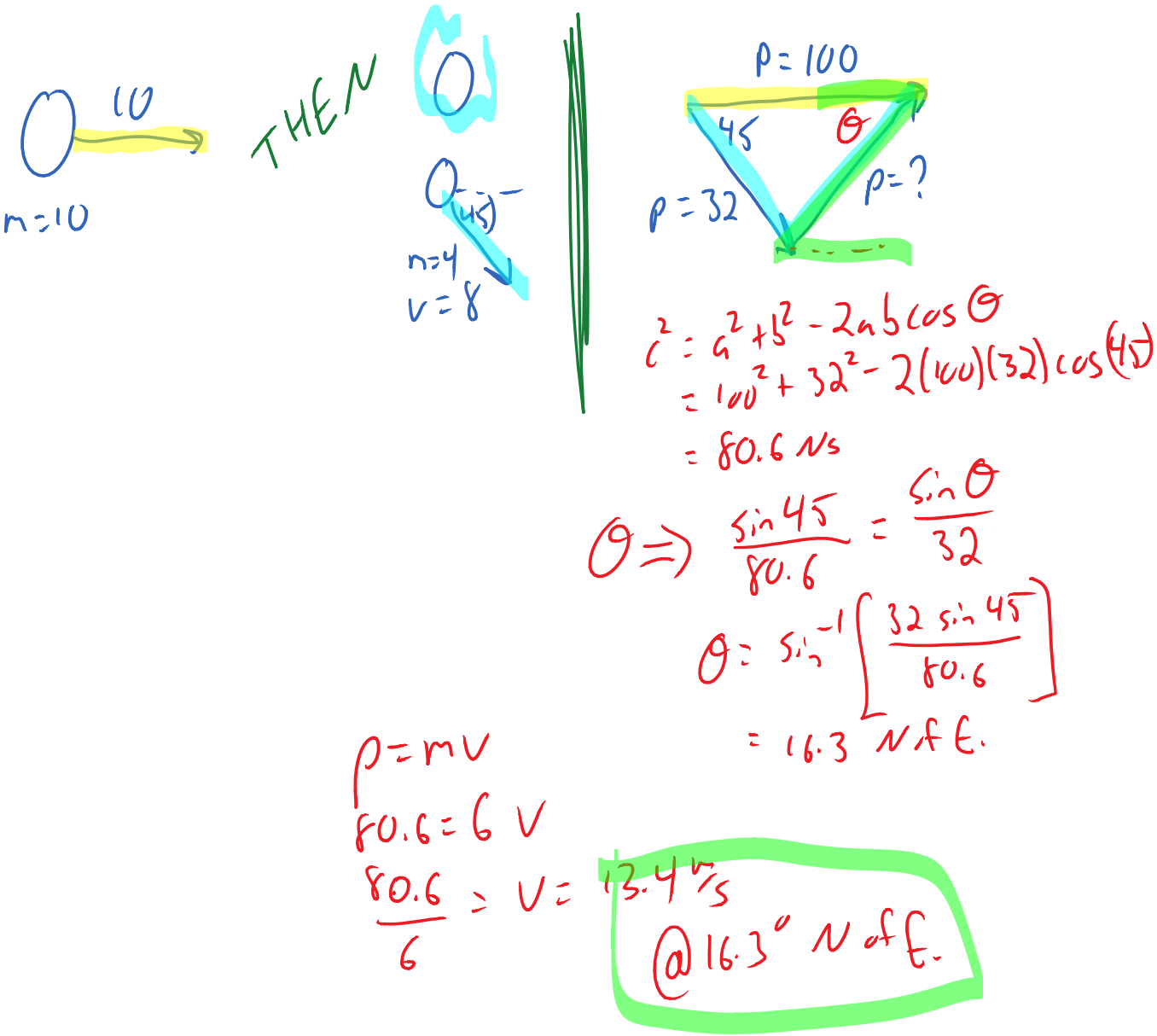
$= 34.1°$ of E.

$p = mv = 25.9$

$v = \frac{25.9}{4}$

$= 6.48$ m/s

A 10 kg cat runs at 10 m/s [E] toward a spike, it splits into 2 parts, a 4.0 kg mass travels at 8.0 m/s at 45° S of E what is the velocity of the other piece?



A cat of mass 10 kg at rest is exploded into 3 pieces. A 2.5 kg piece travels off at 20 m/s at 30° N from W, a 3.0 kg mass travels due south at 12 m/s find the velocity of the 3rd piece

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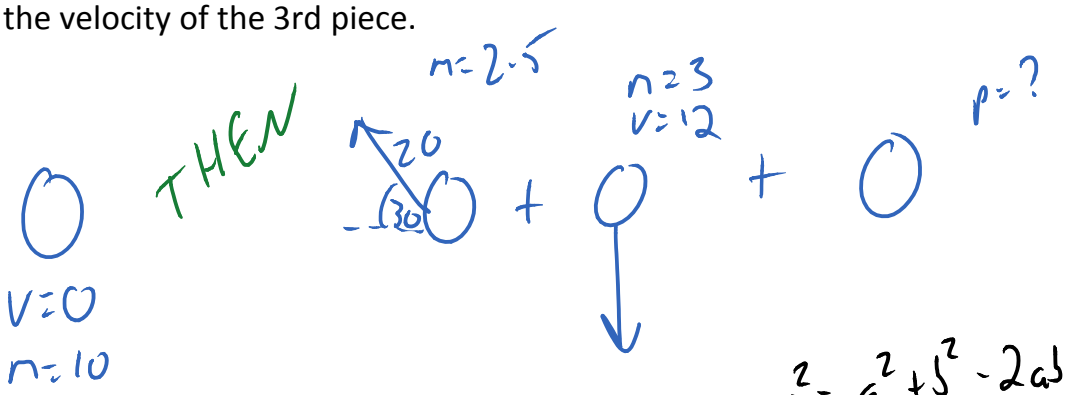
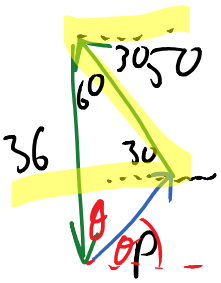




$c^2 = a^2 + b^2 - 2ab\cos\theta$

$= 50^2 + 36^2 - 2(50)36\cos 60$

$= 44.7\ Ns$

$\theta \Rightarrow \frac{\sin 60}{44.7} = \frac{\sin\theta}{50}$

$\theta = \sin^{-1}\left[\frac{50\sin 60}{44.7}\right]$

$= 75.6^\circ$

$\in$ from N

$= 16.3$ N of E

$p = mv$

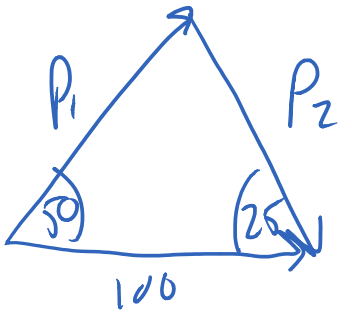
$44.7 = 4.5\ v$

$\frac{44.7}{4.5} = v = 9.9\ m/s$

You had better draw momentum vectors!
Re-draw in tip to tail fashion:

COSINE LAW saves the day

A mass of a 5.0 kg is travelling due East at 20 m/s when an explosion separates it into exactly 2 pieces, a 1.5 kg mass travels at 50° N of E and the other mass travels off at 25° from the original path. Determine the speed of each piece.



$P_1 \Rightarrow 29.2$ m/s

$P_2 \Rightarrow 22.7$ m/s

$P_2 \Rightarrow \frac{\sin 50 (100)}{\sin 105} = 79.3$

$P_1 \Rightarrow \frac{\sin 25}{P_1} = \frac{\sin 105}{100}$

$P_1 = \frac{\sin 25 (100)}{\sin 105} = 43.8$

$P_2 = 79.3 = mv$

$= 3.5v$

$v = 22.7$

$P_1 = 43.8 = mv$

$= 1.5v$

$v = 29.2$