

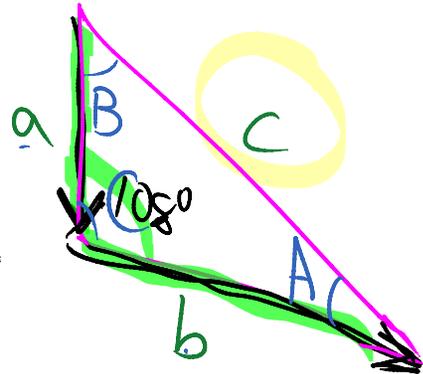
# Cosine Law /Sine Law Vector Addition

Friday, September 09, 2011  
9:21 AM

The advantage of this method is speed. It is significantly faster than component method. But it is significantly more mathematically more tricky.

cosine law

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



\* Cosine Law is used to find an unknown side when a triangle has 2 known sides and a known angle trapped by the two known sides.

A cat is kicked 15m at 45° S from E, then punched 4.62 m at 30° S from W. find the resultant displacement!

$$c^2 = 15^2 + 4.62^2 - 2(15)(4.62) \cos 75^\circ$$

$$c^2 = 225 + 21.3 - 138.6 \cos 75$$

$$c^2 = 246.3 - 35.9$$

$$c^2 = 210.4$$

$$c = 14.5 \text{ m}$$

$$\frac{\sin \theta}{4.62} = \frac{\sin 75}{14.5}$$

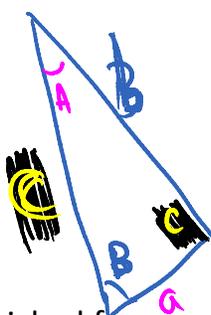
$$\sin \theta = \frac{4.62 \sin 75}{14.5}$$

$$\sin \theta = .308 \quad \theta = 18^\circ$$

+ 45° / 63° S from E

- ① Draw vectors tip to tail
- ② Geometry to get angle in  $\Delta$
- ③ Cos law magnitude of resultant
- ④ Sine law find angle in  $\Delta$
- ⑤ +/- to get an angle from N, E, S, W

Sine Law is used when all angles in a triangle are known and the length of one side is known, usually used to find the direction of a resultant

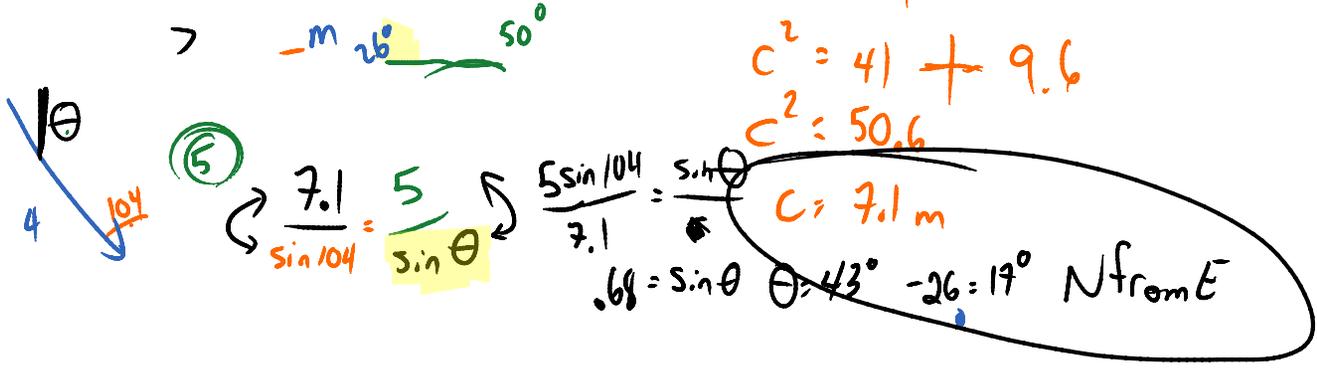


$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

A cat is kicked from a point and is displaced 4.0 m at 26° S from E, then it is dragged a displacement of 5.0 m at 50° N from E find the final displacement from the original place.

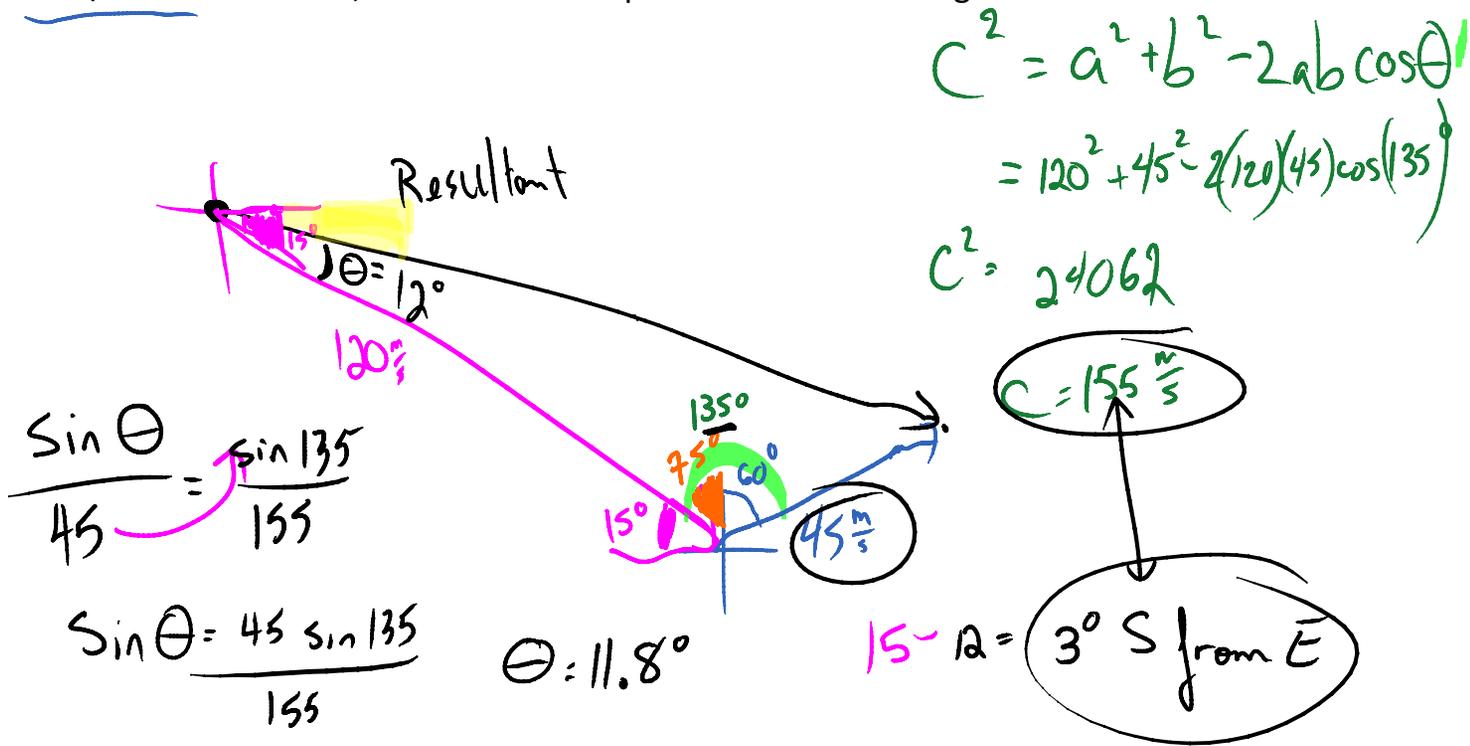
$4^2 + 5^2 - 2(4)(5) \cos 104$

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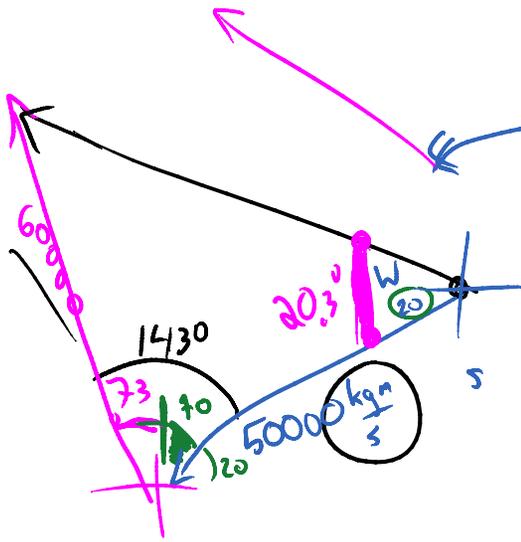


1. Draw vectors
2. Redraw in tip to tail fashion
3. Find angle between your known vectors
4. Cos Law for magnitude
5. Sine law for an angle
6. Might have to do a subtraction or addition to get an angle from N, E, S, W

An airplane has an engine speed of 120 m/s 15° S from E, if a wind blows at 45 m/s at 60° E from N, what combined speed is seen from the ground?



A car has a momentum vector of  $5.0 \times 10^4 \text{ kg}\cdot\text{m/s}$  at  $20^\circ \text{ S from W}$ , it hits a minivan with momentum of  $6.0 \times 10^4 \text{ kg}\cdot\text{m/s}$  at  $73^\circ \text{ W from N}$ , what is the combined momentum?



$$C^2 = 60000^2 + 50000^2 - 2(50000)(60000) \cos 143$$

$$= 104364$$

$$= 1.04 \times 10^5 \frac{\text{kg}\cdot\text{m}}{\text{s}}$$

$$\frac{\sin \theta}{60000} \rightarrow \frac{\sin 143}{1.04 \times 10^5}$$

$$\sin \theta = .347$$

$$\theta = 20.3^\circ$$

$20.3^\circ \text{ N from W}$   
(West)