Coordinate Systems

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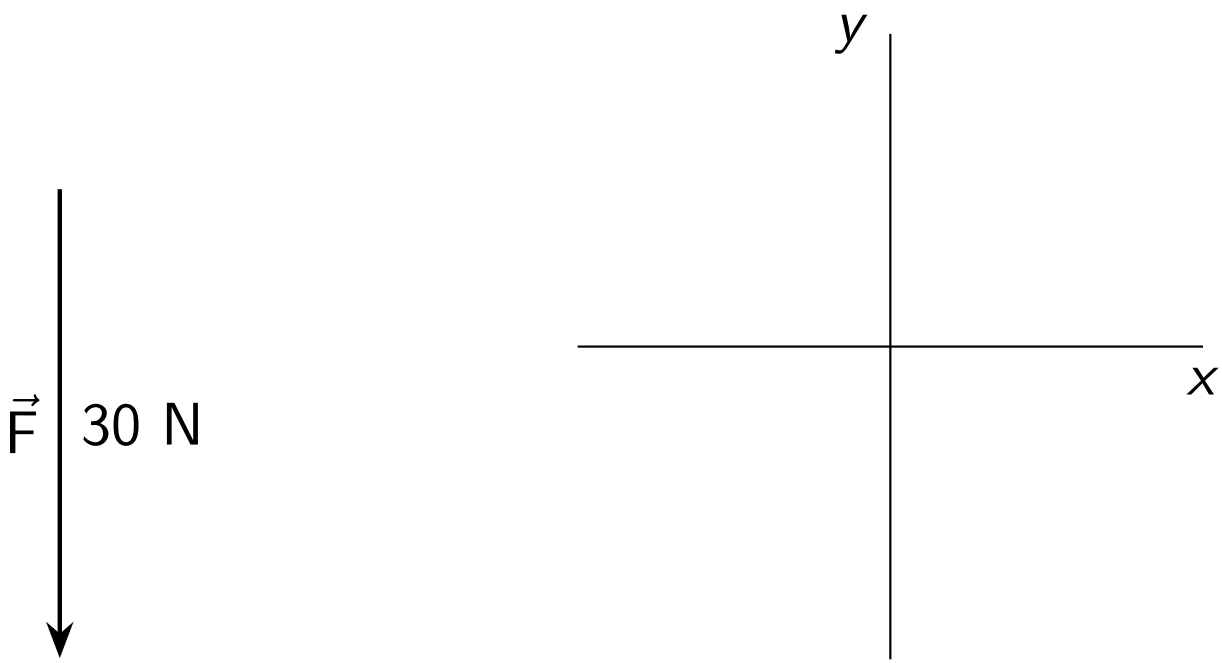
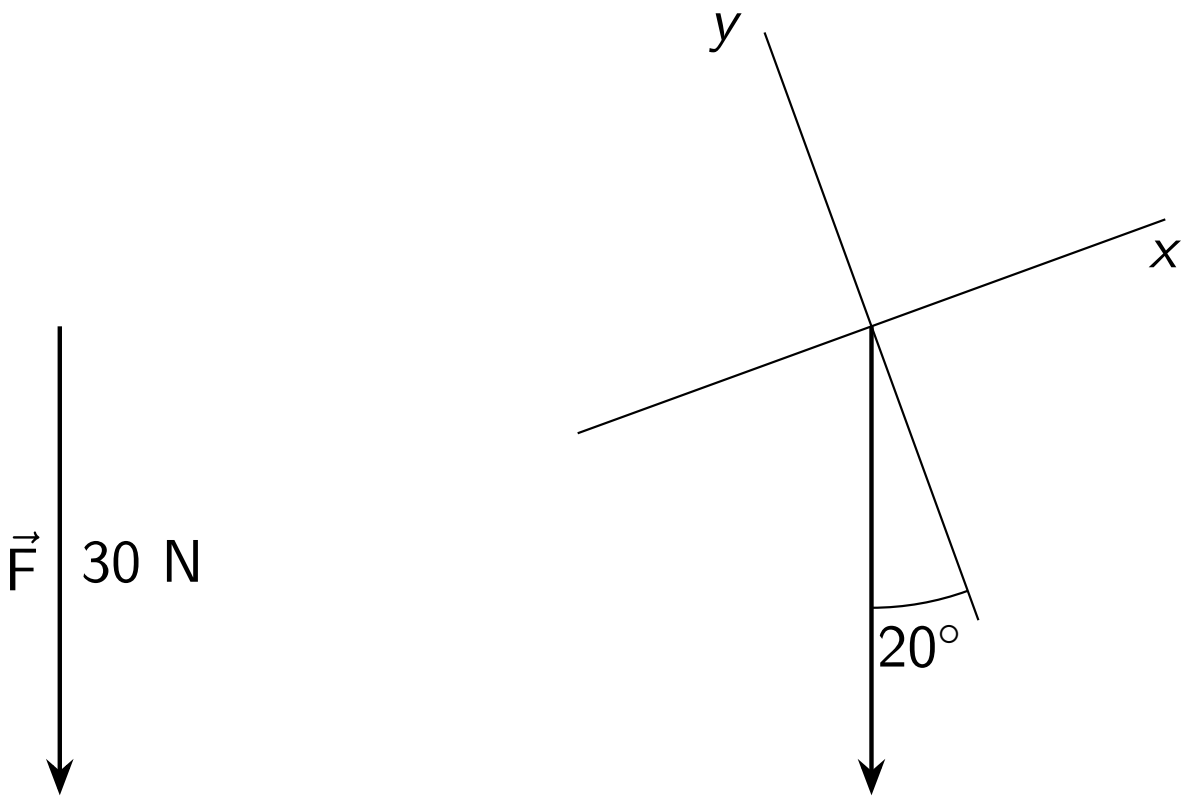
A coordinate system turns a vector into numbers.



$F_x = 0$ $F_y = -30$ N

- A vector is never negative.
- Components of a vector can be positive, zero, or negative.

A different coordinate system turns the same vector into different numbers.

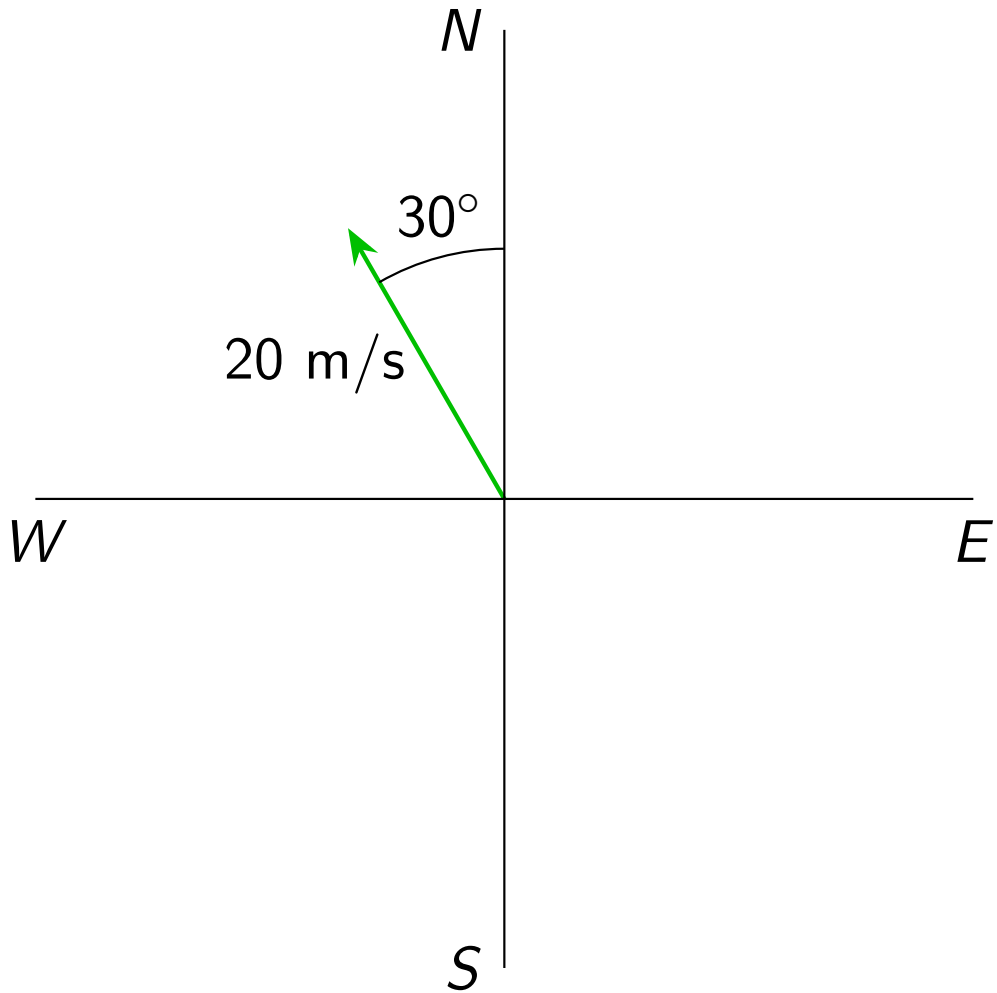


$$F_x = -(30\ \text{N}) \sin 20^\circ \qquad F_y = -(30\ \text{N}) \cos 20^\circ$$

- Components depend on coordinate system.

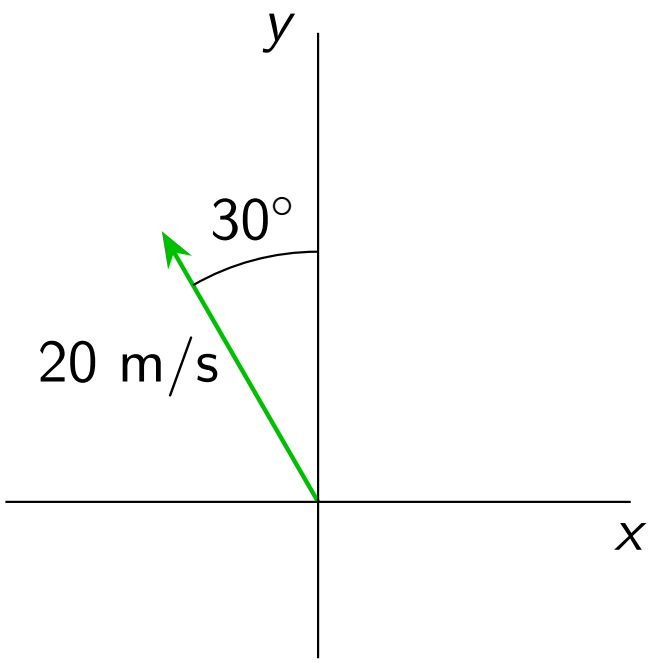
What are the components of this velocity vector?

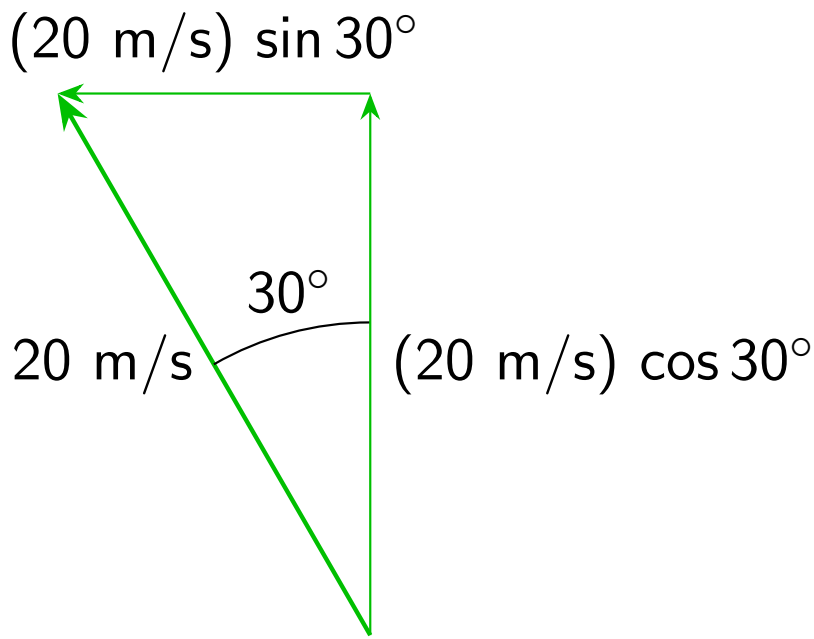
$\vec{v} = 20$ m/s @ 30° west of north



To find components, we need a coordinate system.

- Let's use the standard coordinate system.





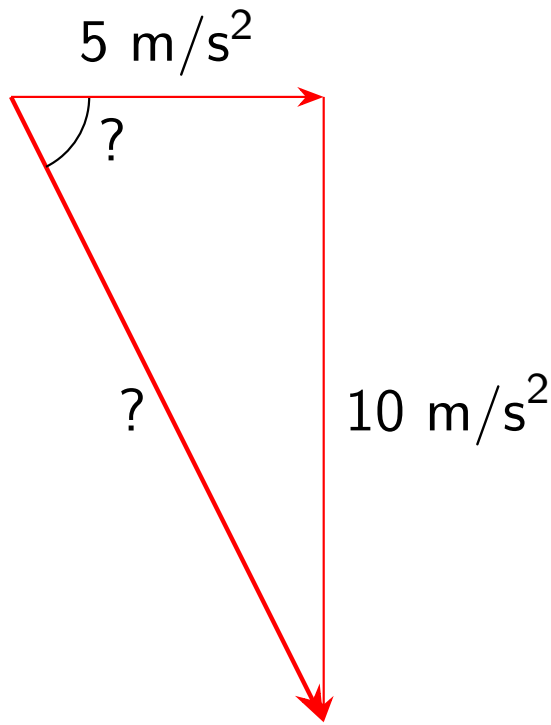
$$v_x = -(20\ \text{m/s}) \sin 30^\circ = -10\ \text{m/s}$$
$$v_y = (20\ \text{m/s}) \cos 30^\circ = 17.32\ \text{m/s}$$

- Vector itself is not negative.
- One component is positive; one component is negative.

Find the acceleration in magnitude-angle form.

$$a_x = 5 \text{ m/s}^2$$

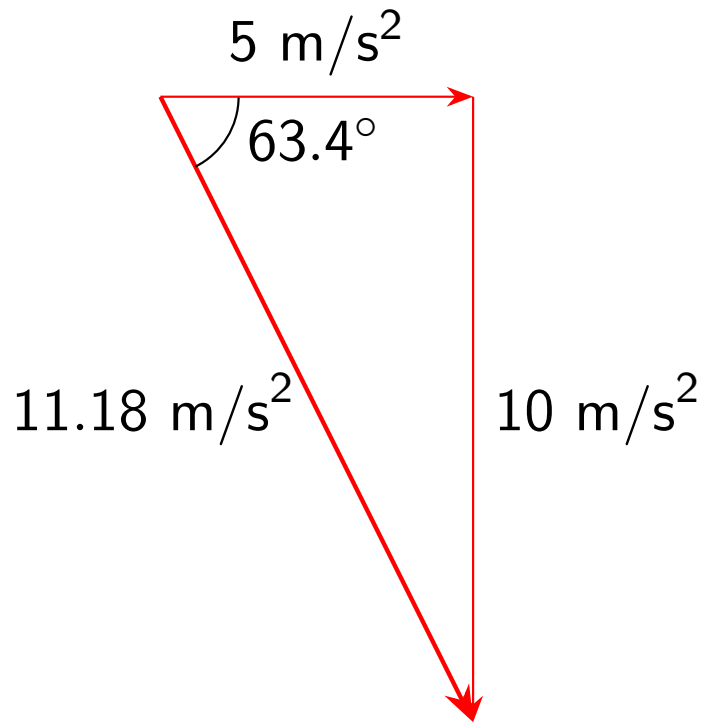
$$a_y = -10 \text{ m/s}^2$$



Use Pythagorean Theorem and some trig

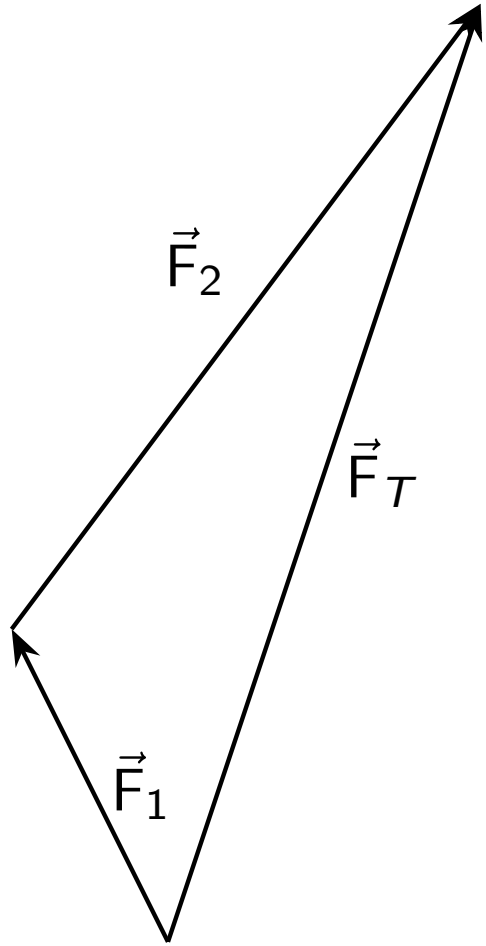
$$a = \sqrt{a_x^2 + a_y^2} = \sqrt{(5\ \text{m/s}^2)^2 + (-10\ \text{m/s}^2)^2} = 11.18\ \text{m/s}^2$$

$$\tan\theta = \frac{10\ \text{m/s}^2}{5\ \text{m/s}^2} = 2$$



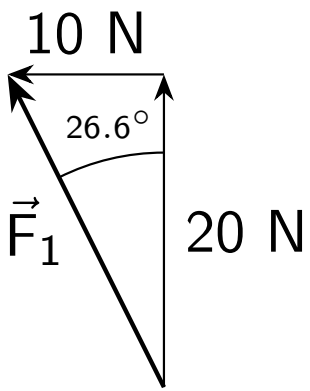
Add these two vectors

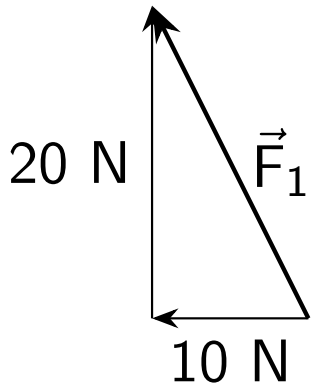
Force	Magnitude	Angle
$\vec{F}_1$	22.36 N	26.6° W of N
$\vec{F}_2$	50.00 N	53.1° N of E
$\vec{F}_T$	?	?



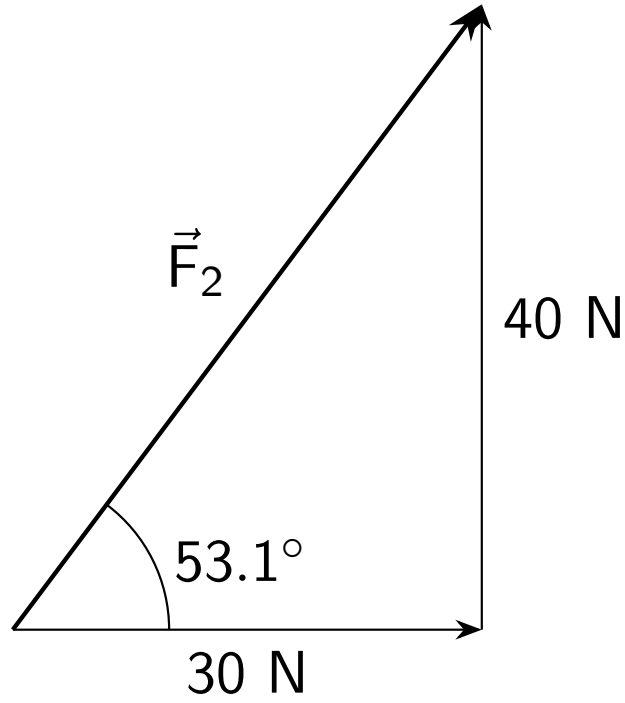
- To add vectors, you can add the components.

Find components of each vector.



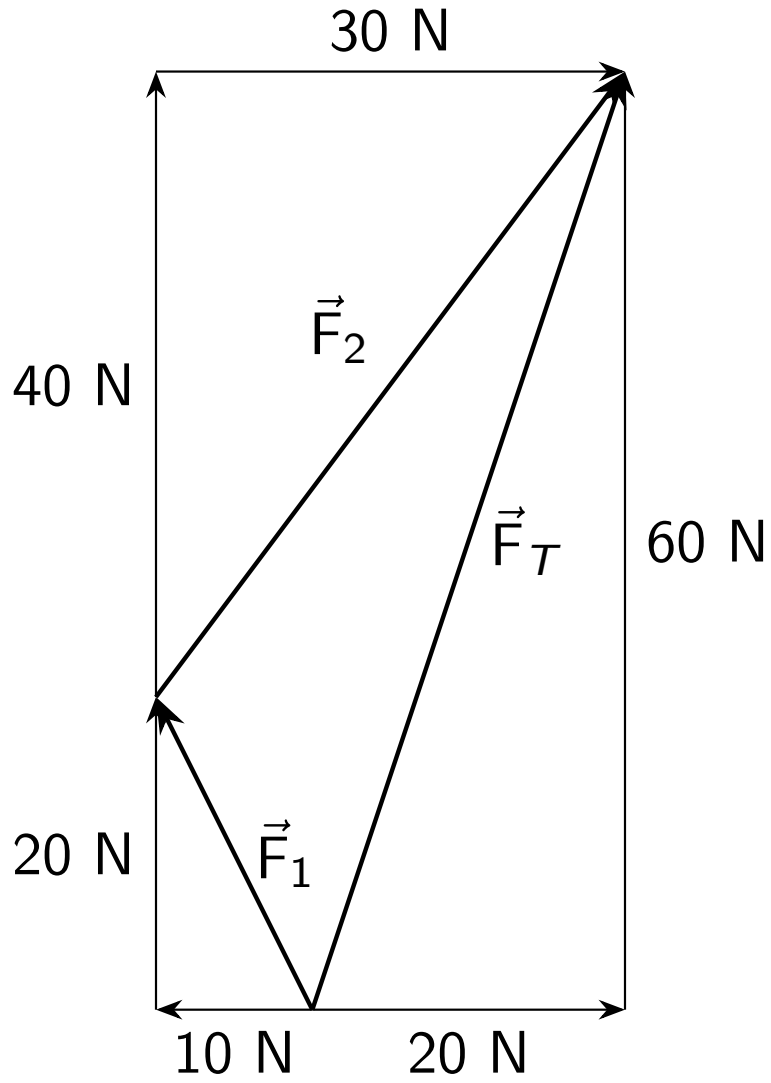


$$F_{1x} = -(22.36\ \text{N}) \sin 26.6^\circ$$
$$= -10\ \text{N}$$
$$F_{1y} = (22.36\ \text{N}) \cos 26.6^\circ$$
$$= 20\ \text{N}$$



$$F_{2x} = (50.00\ \text{N}) \cos 53.1^\circ$$
$$= 30\ \text{N}$$
$$F_{2y} = (50.00\ \text{N}) \sin 53.1^\circ$$
$$= 40\ \text{N}$$

Why does adding the components work?



To add vectors, you can add the components.

- Add the x components to get the total x component.
- Add the y components to get the total y component.
- Never add an x to a y.
- Convert back to magnitude/angle form if you need/want to.

Force	Magnitude	Angle	F_x (N)	F_y (N)
$\vec{F}_1$	22.36 N	26.6° W of N	−10	20
$\vec{F}_2$	50.00 N	53.1° N of E	30	40
$\vec{F}_T$	63.25 N	71.6° N of E	20	60