

KINEMATICS DAY 8: VECTORS & COMPONENTS

WARMUP Day 7 Lab Review

A cart starts from rest. Its x -versus- t^2 graph is a straight line with slope 0.80 m/s^2 . What is the cart's acceleration?

- ☐ A. 0.40 m/s^2
☐ B. 0.80 m/s^2
☐ C. 1.6 m/s^2
☐ D. 3.2 m/s^2

Check one → convince your neighbor in one sentence.

Physics in the Wild — Planes That Fly Sideways: Watch a crosswind landing video: the plane approaches the runway visibly pointed off to one side. The pilot is "crabbing" — aiming partly into the wind so the *components* of airspeed and wind add up to motion straight down the runway. Components are how physicists split one messy diagonal problem into two easy straight-line problems.

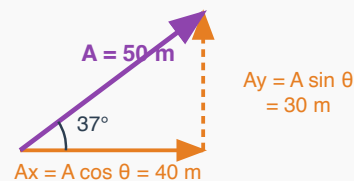
BREAKING & REBUILDING VECTORS

Break apart (θ measured from the $+x$ axis):

$$A_x = A \cos \theta \quad A_y = A \sin \theta$$

Rebuild: $A = \sqrt{A_x^2 + A_y^2}$ $\theta = \tan^{-1}(A_y/A_x)$

θ	30°	37°	45°	53°	60°
$\cos \theta$	0.87	0.80	0.71	0.60	0.50
$\sin \theta$	0.50	0.60	0.71	0.80	0.87



WE DO Exercise 1: Components

A hiker's displacement is 50 m at 37° north of east. Find the east and north components. (Match the diagram on page 1.)

YOU DO Exercise 2: Rebuild

A velocity has components $v_x = 6.0$ m/s and $v_y = 8.0$ m/s. Find the magnitude and the angle above the x-axis.

WE DO Exercise 3: Adding Perpendicular Vectors

A delivery robot drives 12 m east, then 5.0 m north. Find the magnitude and direction of its total displacement.

Only perpendicular things Pythagorize. $A = \sqrt{A_x^2 + A_y^2}$ works because x and y are at 90° . Never apply it to two vectors at some random angle — break them into components first, add the components, *then* rebuild.

THE COMPONENT TABLE METHOD

YOU DO Exercise 4: Perfect Cancellation

In a tug-of-war warmup, one student pulls with 60 N at 0° and another with 60 N at 180° . Find the resultant force. Which single fact about the two x-components lets you write down the resultant without computing anything?

CHALLENGE Exercise 5: Three Vectors, One Table

Add the displacements 10 m at 0° , 10 m at 90° , and 10 m at 180° by completing the table, then rebuild the resultant (magnitude and direction).

Vector	x-component (m)	y-component (m)
10 m at 0°		
10 m at 90°		
10 m at 180°		
Sum		

PAPER PRACTICE

PRACTICE PROBLEMS

P1 Components

Find the x and y components of a 25 m/s velocity at 53° above the horizontal.

P2 Rebuild

A displacement has components (9.0 m, 12 m). Find its magnitude and direction.

P3 Two Legs

A boat travels 8.0 km east, then 6.0 km north. How far from its start is it, and in what direction?

P4 The Round Trip That Wasn't a Trip

A plane flies 40 km at 30° , then 40 km at 150° , then 40 km at 270° . Using a component table (or symmetry), show that the plane ends up exactly where it started.