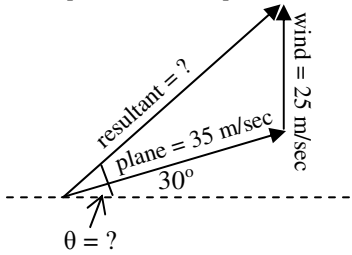


Adding Vectors Examples

Example 1: A plane flies 35 m/sec at 30° north of east. A wind is blowing north at 25 m/sec. Find the speed and direction of the plane's resulting flight.

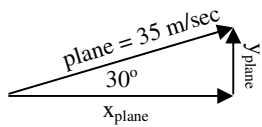
Step 1: Draw the problem



Step 2: Resolve all vectors into their components

Wind is already all y-component so:
 $y_{wind} = 25 \text{ m/sec}$

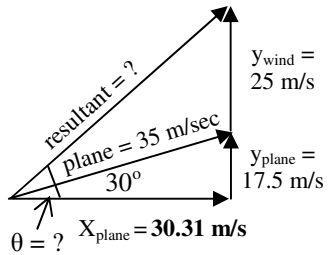
But must find x and y components of the plane.



adj. = hyp.(cos θ)
 $x_{plane} = 35 \text{ m/s}(\cos 30)$
 $x_{plane} = 35 \text{ m/s}(.866) =$
 $x_{plane} = 30.31 \text{ m/s}$

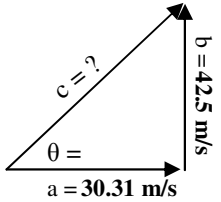
$y_{plane} = 35 \text{ m/s}(\sin 30) = 35 \text{ m/s}(.5)$
 $y_{plane} = 17.5 \text{ m/s}$

Step 3: Add together all components



$y_{total} =$
 $(25 + 17.5) \text{ m/s}$
 $= 42.5 \text{ m/s}$

Step 4: Find the resultant's magnitude using the Pythagorean theorem



Step 4: Find the resultant's angle using trigonometry

$\tan \theta = \text{opp./adj.}$
 $\tan \theta = 42.5/30.31$
 $\tan \theta = 1.402$
 $\theta = \tan^{-1}(1.402)$
 $\theta = 54.5^\circ$

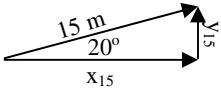
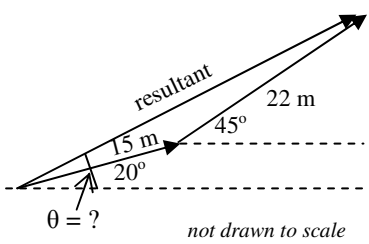
Adding the components together makes a large right-triangle.

$c^2 = a^2 + b^2 = (30.31)^2 + (42.5)^2$
 $c^2 = (918.7) + (1806.25) = 2724.95$
 $c = 52.2 \text{ m/sec}$

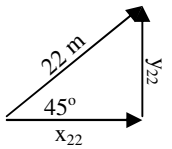
Answer: The plane will be flying 52.2 m/sec at 54.5° to the horizontal.

Example 2: A person walks 15 m at 20° to the horizontal, then 22 m at 45° to the horizontal. Find the magnitude and direction of their final displacement.

Step 1: Draw the problem



Step 2: Resolve all vectors into components



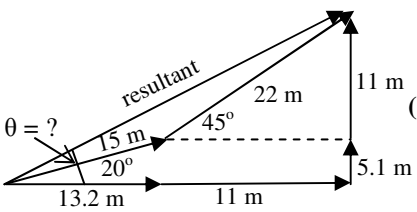
adj. = hyp.(cos θ)
 $x_{15} = (15\text{m})(\cos 20) = 14.1 \text{ m}$

opp. = hyp.(sin θ)
 $y_{15} = (15\text{m})(\sin 20) = 5.1 \text{ m}$

adj. = hyp.(cos θ)
 $x_{22} = (22\text{m})(\cos 45) = 15.6 \text{ m}$

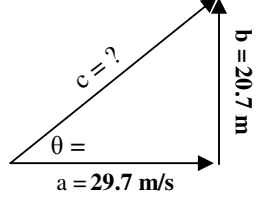
opp. = hyp.(sin θ)
 $y_{22} = (22\text{m})(\sin 45) = 15.6 \text{ m}$

Step 3: Add together all components



$x_{total} =$
 $(5.1 + 15.6) \text{ m}$
 $= 20.7 \text{ m}$

Step 4: Find the resultant's magnitude using the Pythagorean theorem



Step 4: Find the resultant's angle using trigonometry

$\tan \theta = \text{opp./adj.}$
 $\tan \theta = 20.7/29.7$
 $\tan \theta = 0.6970$
 $\theta = \tan^{-1}(0.6970)$
 $\theta = 34.9^\circ$

$x_{total} = (14.1 + 15.6) \text{ m} = 29.7 \text{ m}$

Adding the components together makes a large right-triangle.

$c^2 = a^2 + b^2 = (29.7)^2 + (20.7)^2$
 $c^2 = (882.09) + (428.49) = 1310.58$
 $c = 36.2 \text{ m}$

Answer: The person's displacement is 36.2 m at 34.9° to the horizontal.