

## Vector Addition

**Goal:** To understand the principles of adding vectors by the graphical method and of adding vectors by component addition.

**Background:** Two or more vectors can be added together to determine a vector sum or resultant. Two methods of adding vectors are the graphical or head-to-tail method and the trigonometric or component addition method. This interactive provides practice with each method.

**Getting Ready:** Navigate to the Vector Addition interactive in the Physics Interactives section of The Physics Classroom website:

[http://www.physicsclassroom.com/Physics-Interactives/Vectors-and-Projectiles/Vector Addition](http://www.physicsclassroom.com/Physics-Interactives/Vectors-and-Projectiles/Vector%20Addition)

Path:

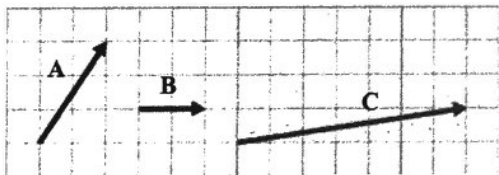
physicsclassroom.com => Physics Interactives => Vectors and Projectiles => Vector Addition

Once the Interactive opens, get acquainted with how it functions. Know how to drag vectors onto the grid, reposition them, change their size, and delete them. Observe what the two buttons do.

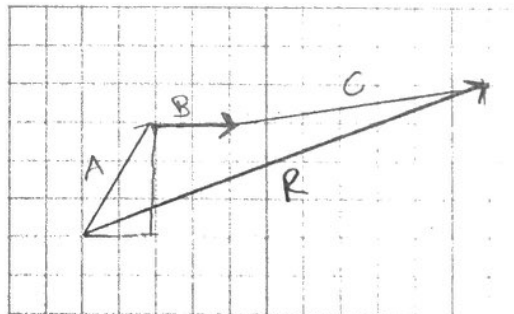
### Directions:

For each problem, vectors **A**, **B** and **C** are shown. Sketch the head-to-tail addition of  $A + B + C$  on the empty grid; label each vector. Draw and label the resultant (**R**). Record the magnitude and direction of each component; use a + to indicate East or North; use a - to indicate a West or South. Sum the components to determine the components of the resultant. Use the Pythagorean theorem and SOH CAH TOA to determine the magnitude and direction of **R**.

### Problem 1:



Vector	E-W Components	N-S Components
A	2	3
B	2	0
C	7	1
R	11.7	4



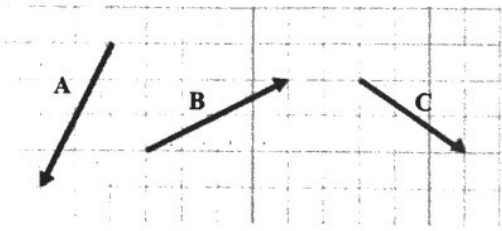
Magnitude of **R** (Pythagorean theorem):

$$11^2 + 4^2 = \boxed{11.7}$$

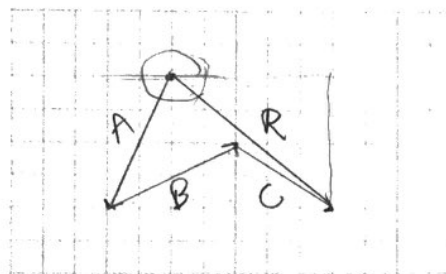
Direction of **R** (SOH CAH TOA):

$$\tan^{-1}\left(\frac{4}{11}\right) = 20^\circ$$

**Problem 2:**



Vector	E-W Components	N-S Components
A	-2	-4
B	4	2
C	3	-2
R	-5	-4



Magnitude of R (Pythagorean theorem):

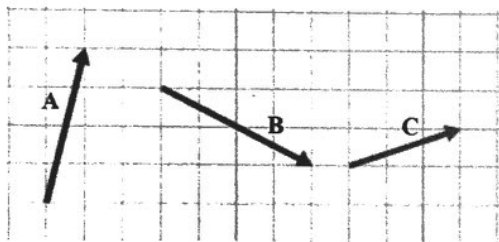
$$-5^2 + -4^2 = C^2$$

$$C = 6.4$$

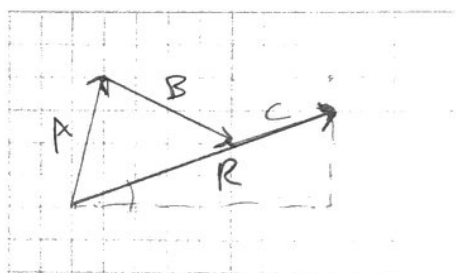
Direction of R (SOH CAH TOA):

$$\tan^{-1}\left(\frac{-4}{-5}\right) = -38.7^\circ \text{ or } 321.3^\circ$$

**Problem 3:**



Vector	E-W Components	N-S Components
A	1	4
B	4	-2
C	3	1
R	8	3



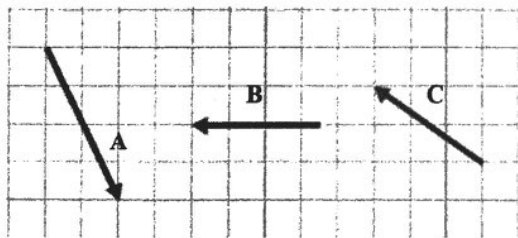
Magnitude of R (Pythagorean theorem):

$$8^2 + 3^2 = \boxed{8.5}$$

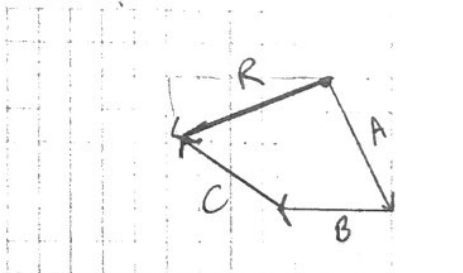
Direction of R (SOH CAH TOA):

$$\tan^{-1}\left(\frac{3}{8}\right) = 21^\circ$$

**Problem 4:**



Vector	E-W Components	N-S Components
A	2	-4
B	-3.5	0
C	-3	2
R	-4.5	-2



Magnitude of R (Pythagorean theorem):

$$(-4.5)^2 + (-2)^2$$

$$C = 4.9$$

Direction of R (SOH CAH TOA):

$$\tan^{-1}\left(\frac{-2}{-4.5}\right) = 24^\circ = 156^\circ$$