

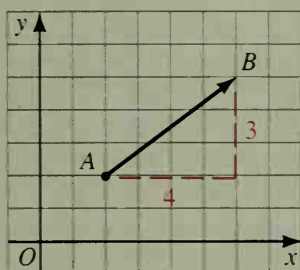
## 13-4 Vectors

The journey of a boat or airplane can be described by giving its speed and direction, such as 50 km/h north-east. Any quantity such as force, velocity, or acceleration, that has both *magnitude* (size) and *direction*, is a **vector**.

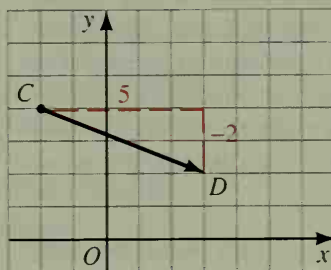
When a boat moves from point  $A$  to point  $B$ , its journey can be represented by drawing an arrow from  $A$  to  $B$ ,  $\overrightarrow{AB}$  (read “vector  $AB$ ”). If  $\overrightarrow{AB}$  is drawn in the coordinate plane, then the journey can also be represented as an ordered pair.



$$\overrightarrow{AB} = (\text{change in } x, \text{change in } y)$$



$$\overrightarrow{AB} = (4, 3)$$



$$\overrightarrow{CD} = (5, -2)$$

The **magnitude** of a vector  $\overrightarrow{AB}$  is the length of the arrow from point  $A$  to point  $B$  and is denoted by the symbol  $|\overrightarrow{AB}|$ . You can use the Pythagorean Theorem or the Distance Formula to find the magnitude of a vector. In the diagrams above,

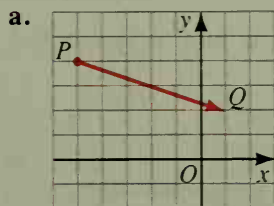
$$|\overrightarrow{AB}| = \sqrt{4^2 + 3^2} = 5$$

and  $|\overrightarrow{CD}| = \sqrt{5^2 + 2^2} = \sqrt{29}.$

**Example 1** Given: Points  $P(-5, 4)$  and  $Q(1, 2)$

- Sketch  $\overrightarrow{PQ}$ .
- Find  $\overrightarrow{PQ}$ .
- Find  $|\overrightarrow{PQ}|$ .

**Solution**



$$\begin{aligned} \text{b. } \overrightarrow{PQ} &= (1 - (-5), 2 - 4) = (6, -2) \\ \text{c. } |\overrightarrow{PQ}| &= \sqrt{6^2 + (-2)^2} = \sqrt{40} = 2\sqrt{10} \end{aligned}$$