Vector Components

Unit Vectors

A unit vector is a vector with magnitude equal to one.

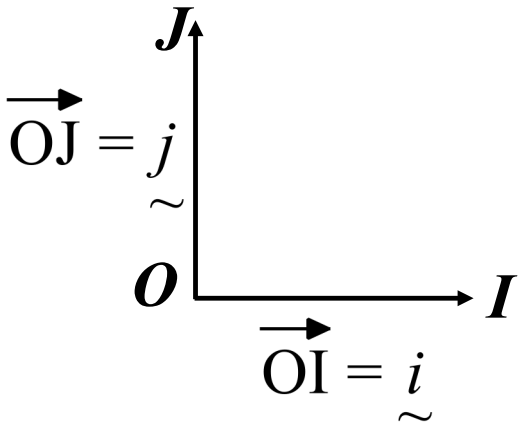
Every non-zero vector has a corresponding unit vector with the same direction

$$\hat{\underset{\sim}{a}} = \frac{\underset{\sim}{a}}{|\underset{\sim}{a}|} \quad \text{and} \quad \left|\hat{\underset{\sim}{a}}\right| = 1$$

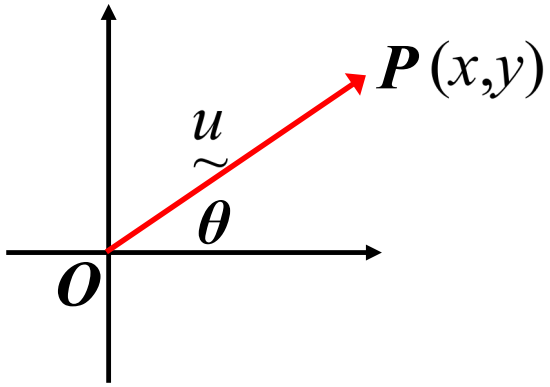
Two Special Unit Vectors

All vectors can be rewritten in terms of components, two special unit vectors that are perpendicular.

For convenience we will define them to be horizontal and vertical



Component Form of a Position Vector



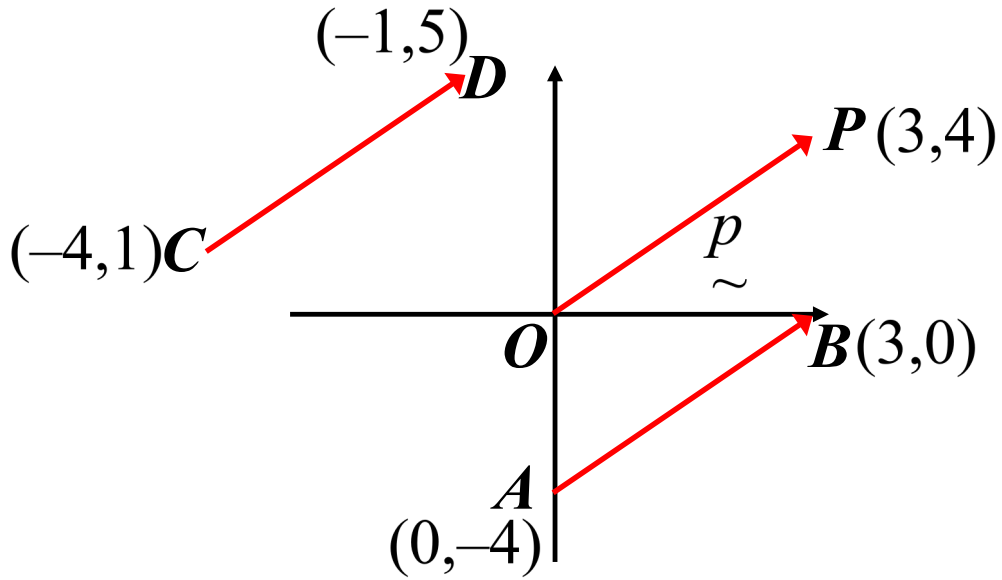
$$\underset{\sim}{u} = \overrightarrow{OP} = (x,y) = \begin{pmatrix} x \\ y \end{pmatrix} = x\,\underset{\sim}{i} + y\,\underset{\sim}{j}$$

position vector ***ordered pair*** ***column vector*** ***component form***

$$|\underset{\sim}{u}| = \sqrt{x^2 + y^2} \qquad \text{direction} = \theta = \tan^{-1}\frac{y}{x}$$

Equal Vectors

Equal vectors have the same magnitude and direction



To calculate the equivalent position vector of any displacement vector

head minus tail

$$\overrightarrow{AB} = \begin{pmatrix} 3 \\ 0 \end{pmatrix} - \begin{pmatrix} 0 \\ -4 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \qquad \therefore \overrightarrow{OP} = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \qquad \hat{\underset{\sim}{p}} = \frac{1}{5}\underset{\sim}{p}$$

$$\overrightarrow{CD} = \begin{pmatrix} -1 \\ 5 \end{pmatrix} - \begin{pmatrix} -4 \\ 1 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \qquad \underset{\sim}{p} = 3\underset{\sim}{i} + 4\underset{\sim}{j} \qquad = \frac{3}{5}\underset{\sim}{i} + \left(\frac{4}{5}\right)\underset{\sim}{j}$$

Exercise 8B; 1 to 4, 5ac, 6cd, 7a, 8 to 10, 11ab, 12ac, 13 to 18