

Vectors

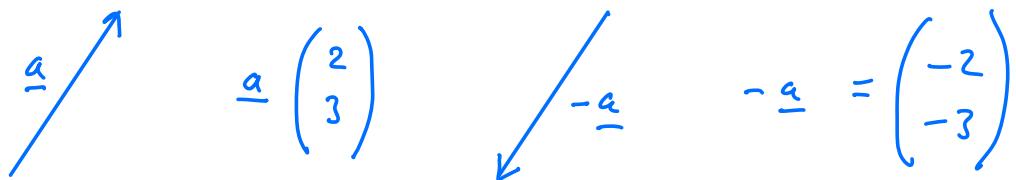
A vector quantity has both magnitude and direction

A scalar quantity has only magnitude


Vectors Force, velocity, acceleration
 displacement

Scalars Mass, speed, distance

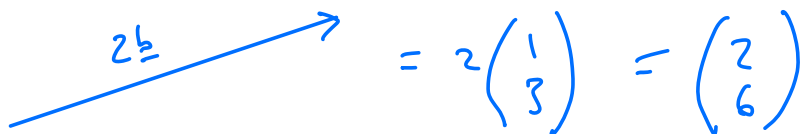
Vectors do have position except that we often have position vectors relative to an origin



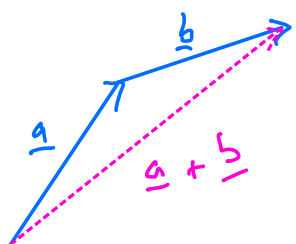
A diagram showing two vectors originating from the same point. Vector \underline{a} points up and to the right. Vector $-\underline{a}$ points down and to the left. Next to \underline{a} is the column vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$. Next to $-\underline{a}$ is the equation $-\underline{a} = \begin{pmatrix} -2 \\ -3 \end{pmatrix}$.



A diagram showing a single vector \underline{b} pointing to the right. Next to it is the column vector $\begin{pmatrix} 1 \\ 3 \end{pmatrix}$.

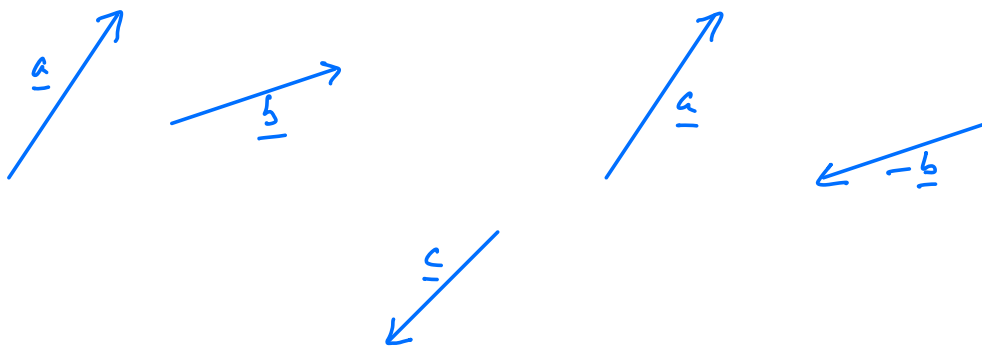


A diagram showing a longer vector $2\underline{b}$ pointing to the right. Next to it is the equation $2\underline{b} = 2\begin{pmatrix} 1 \\ 3 \end{pmatrix} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$.



$$\underline{a} + \underline{b} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} + \begin{pmatrix} 1 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ 6 \end{pmatrix}$$

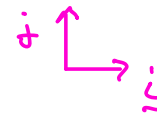
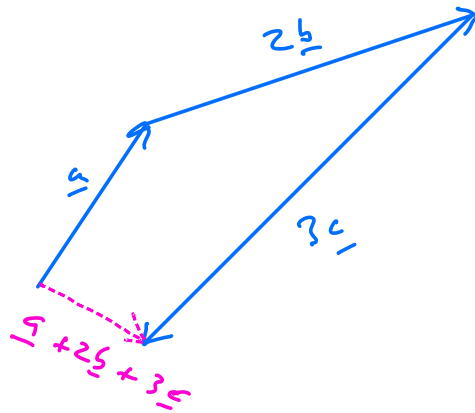
Triangle rule, parallelogram rule, nose to tail rule



Find $\underline{a} + 2\underline{b} + 3\underline{c}$

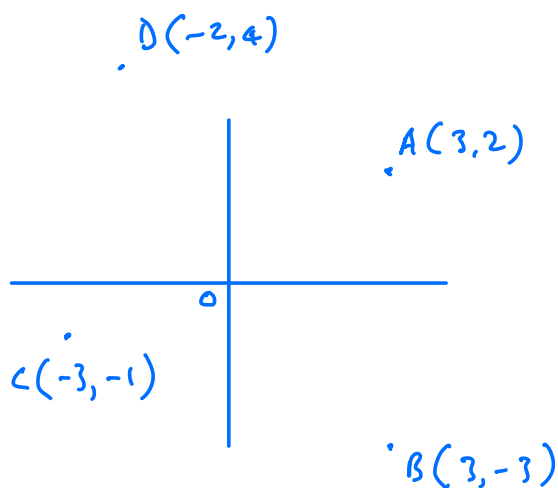
$$\begin{pmatrix} 2 \\ 3 \end{pmatrix} + 2 \begin{pmatrix} 3 \\ 1 \end{pmatrix} + 3 \begin{pmatrix} -2 \\ -2 \end{pmatrix}$$

$$= \begin{pmatrix} 2 + 6 - 6 \\ 3 + 2 - 6 \end{pmatrix} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$$



A unit vector in the x -direction is normally called \underline{i}

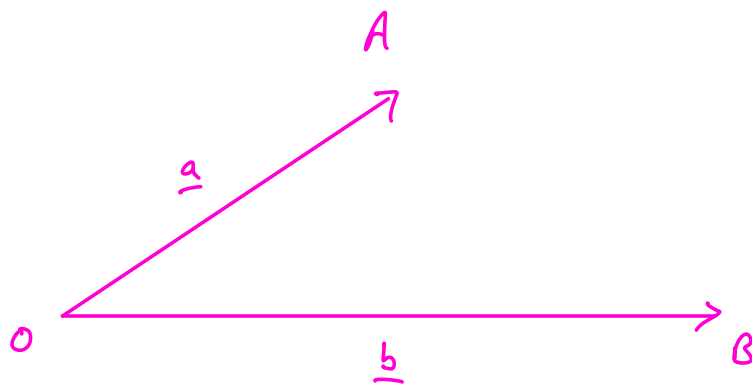
A unit vector in the y -direction is normally called \underline{j}



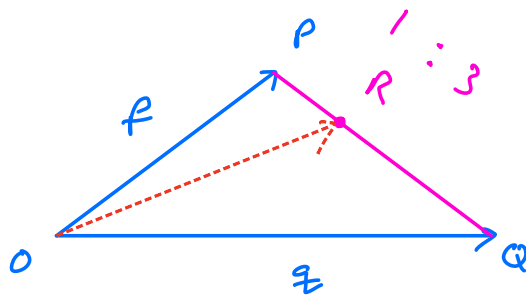
$$\vec{OA} = \begin{pmatrix} 3 \\ 2 \end{pmatrix} \quad \vec{OB} = \begin{pmatrix} 3 \\ -3 \end{pmatrix} \quad \vec{OC} = \begin{pmatrix} -3 \\ -1 \end{pmatrix} \quad \vec{OD} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$$

We say A has position vector $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$

We say the point (x, y) has position vector $\begin{pmatrix} x \\ y \end{pmatrix}$



$$\begin{aligned} \vec{AB} &= \vec{AO} + \vec{OB} \\ &= -\underline{a} + \underline{b} \quad \text{or} \quad \underline{b} - \underline{a} \end{aligned}$$



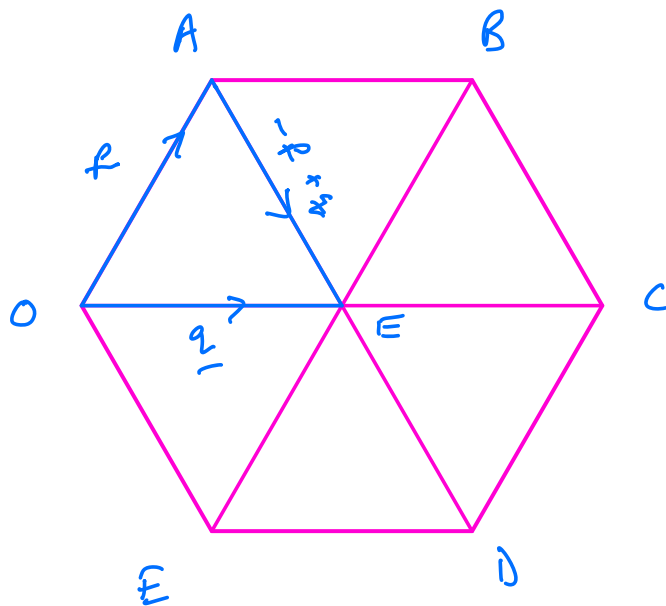
Suppose R splits PQ in ratio 1:3

Find \vec{OR}

$$\begin{aligned}\vec{PQ} &= \vec{PO} + \vec{OQ} \\ &= -f + g\end{aligned}$$

$$\vec{PR} = \frac{1}{4}\vec{PQ} = \frac{1}{4}(-f + g) = -\frac{1}{4}f + \frac{1}{4}g$$

$$\begin{aligned}\vec{OR} &= \vec{OP} + \vec{PR} \\ &= f - \frac{1}{4}f + \frac{1}{4}g \\ &= \underline{\underline{\frac{3}{4}f + \frac{1}{4}g}}\end{aligned}$$



$$\begin{aligned}\vec{AE} &= \vec{AO} + \vec{OE} \\ &= -f + g\end{aligned}$$

$$\begin{aligned}\vec{OD} &= \vec{OA} + \vec{AB} + \vec{BC} + \vec{CD} \\ &= f + g - f + g - f = 2g - f\end{aligned}$$

$$\vec{OD} = \vec{OE} + \vec{ED}$$

$$= -p + q + q = 2q - p$$

\vec{OD} is independent of the actual route taken from O to D

Homework Read Chapter 11 Pages 230 - 240
without actually doing any exercises
