Motion in Two Dimensions

Force and Acceleration can be represented as both scalars and vectors. Therefore Newton's 2nd law can be used in vector form too.

This naturally means that $\boldsymbol{F} = m\boldsymbol{a}$ works with vectors too.

Example

Forces $\boldsymbol{F}_1\ (4\boldsymbol{i} - 7\boldsymbol{j})$, and $\boldsymbol{F}_2\ (-6\boldsymbol{i} + 2\boldsymbol{j})$ and $\boldsymbol{F}_3\ (4\boldsymbol{j})$ act on a particle of mass 2kg. Find the acceleration of the particle. Find also the magnitude and the bearing of the acceleration.

Example – Using SUVAT Equations

A constant force $\boldsymbol{F}$ N acts on a particle of mass 5kg for 8 seconds. The particle is initially at rest and 8 seconds later it has velocity $(12\boldsymbol{i} - 5\boldsymbol{j})$ ms^{-1}. Find $\boldsymbol{F}$.

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A boat is modelled as a particle of mass 60 kg being acted on by three forces.

$$\boldsymbol{F}_1 = \begin{pmatrix} 80 \\ 50 \end{pmatrix} N, \quad \boldsymbol{F}_2 = \begin{pmatrix} 10p \\ 20q \end{pmatrix} N, \quad \boldsymbol{F}_3 = \begin{pmatrix} -75 \\ 100 \end{pmatrix} N$$

Given that the boat is accelerating at a rate of $\begin{pmatrix} 0.8 \\ -1.5 \end{pmatrix}$ ms^{-2}, find the values of p and q.

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