Momentum as a Vector (Year 2 content)

Mass and time are scalar quantities.
Momentum, Force, Velocity and Impulse are all vector quantities.

For one dimensional questions all direction is simply + or -.
For two dimensional questions, all the equations from this chapter can be used with vectors.
You can work separately with **i, j** (and **k**) components.

> A particle of mass 0.2kg is moving with velocity $(10\mathbf{i} - 5\mathbf{j})$ ms^{-1} when it receives an impulse $(3\mathbf{i} - 2\mathbf{j})$Ns. Find the new velocity of the particle.

$$I = m(v - u)$$

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

To find the **magnitude** of a vector (e.g. Impulse Momentum) use Pythagoras
To find the **direction** of a vector use trigonometry

> **Tip**: Remember if the question asks for speed, this is the magnitude of velocity, if it asks for distance this is the magnitude of displacement.

> An ice hockey puck of mass 0.17 kg receives an impulse **Q** Ns . Immediately before the impulse the velocity of the puck is $(10\mathbf{i} + 5\mathbf{j})$ ms^{-1} and immediately afterwards its velocity is $(15\mathbf{i} - 7\mathbf{j})$ ms^{-1}. Find the magnitude of **Q** and the angle between **Q** and **i**.

A particle of mass 0.15kg is moving with velocity $(20\mathbf{i} - 10\mathbf{j})\ ms^{-1}$ when it collides with a particle of mass 0.25kg moving with velocity $(16\mathbf{i} - 8\mathbf{j})\ ms^{-1}$. The two particles coalesce and form one particle of mass 0.4kg. Find the velocity of the combined particle.

Your Turn

A tennis ball of mass 0.1 kg is hit by a racquet. Immediately before being hit, the ball has velocity $30\mathbf{i}$ m s^{-1}. The racquet exerts an impulse of $(-2\mathbf{i} - 4\mathbf{j})$ N s on the ball. By modelling the ball as a particle, find the velocity of the ball immediately after being hit.

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