

Checklist

What you should know

By the end of this subtopic you should be able to:

- describe the motion of an object moving in a straight line with constant velocity by the vector equation $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t$, where $\mathbf{r}_0 = \begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix}$ is the initial position vector relative to a fixed origin, $\mathbf{v} = \begin{pmatrix} v_x \\ v_y \\ v_z \end{pmatrix}$ is the velocity and t is the time
- recall that speed is the magnitude of the velocity vector $\mathbf{v} = \begin{pmatrix} v_x \\ v_y \\ v_z \end{pmatrix}$ and use Pythagoras' theorem to find it: $|\mathbf{v}| = \sqrt{(v_x)^2 + (v_y)^2 + (v_z)^2}$
- recall that if an object is moving with constant acceleration given by acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$, then the formula for the velocity of an object at a given time is $\mathbf{v} = \mathbf{u} + \mathbf{a}t$, where \mathbf{a} is the acceleration, \mathbf{u} is the initial velocity, \mathbf{v} is the final velocity and t is time.
- recall that if an object is moving in two dimensions, its velocity can be separated into two perpendicular components which may vary with time, i.e. $\mathbf{v} = \begin{pmatrix} v_x \\ v_y \end{pmatrix}$, where v_x and v_y depend on t according to the relationship $\mathbf{v} = \mathbf{u} + \mathbf{a}t$
- recall that for a projectile moving freely under gravity, the horizontal component of the acceleration is constant and the vertical component will be given by $-g$ where g is the acceleration due to gravity, i.e. $\mathbf{a} = \begin{pmatrix} 0 \\ -g \end{pmatrix}$.

