Velocity is the rate of change of displacement.

- **If the displacement, $s$, is expressed as a function of $t$, then the velocity, $v$, can be expressed as $v = \frac{ds}{dt}$**

In the same way, acceleration is the rate of change of velocity.

- **If the velocity, $v$, is expressed as a function of $t$, then the acceleration, $a$, can be expressed as $a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$**

A particle $P$ is moving on the $x$-axis. At time $t$ seconds, the displacement $x$ metres from $O$ is given by $x = t^4 - 32t + 12$. Find:

**a** the velocity of $P$ when $t = 3$

**b** the value of $t$ for which $P$ is instantaneously at rest

**c** the acceleration of $P$ when $t = 1.5$.