A particle $P$ of mass $m\,\mathrm{kg}$ is held at rest at a point $O$ and released so that it moves vertically under gravity against a resistive force of magnitude $0.1mv^2\,\mathrm{N}$, where $v\,\mathrm{m\,s}^{-1}$ is the velocity of $P$ at time $t\,\mathrm{s}$.

**(a)** Find an expression for $v$ in terms of $t$. [6]

The displacement of $P$ from $O$ at time $t\,\mathrm{s}$ is $x\,\mathrm{m}$.

**(b)** Find an expression for $v^2$ in terms of $x$. [5]