15 A model for the motion of a small object falling through a thick fluid can be expressed using the differential equation

$$\frac{dv}{dt} = 9.8 - kv,$$

where $v\,\mathrm{m\,s}^{-1}$ is the velocity after t s and k is a positive constant.

(a) Given that $v = 0$ when $t = 0$, solve the differential equation to find v in terms of t and k. **[7]**

(b) Sketch the graph of v against t. **[2]**

Experiments show that for large values of t, the velocity tends to $7\,\mathrm{m\,s}^{-1}$.

(c) Find the value of k. **[2]**

(d) Find the value of t for which $v = 3.5$. **[1]**