**13** A scientist is attempting to model the number of insects, $N$, present in a colony at time $t$ weeks. When $t = 0$ there are 400 insects and when $t = 1$ there are 440 insects.

**(i)** A scientist assumes that the rate of increase of the number of insects is inversely proportional to the number of insects present at time $t$.

**(a)** Write down a differential equation to model this situation. **[1]**

**(b)** Solve this differential equation to find $N$ in terms of $t$. **[4]**

**(ii)** In a revised model it is assumed that $\frac{dN}{dt} = \frac{N^2}{3988e^{0.2t}}$. Solve this differential equation to find $N$ in terms of $t$. **[6]**

**(iii)** Compare the long-term behaviour of the two models. **[2]**