5 A scientist is monitoring the decline in the population of a certain endangered species of animal in an area where their natural habitat has been damaged.

As a model, the scientist proposes that the rate of decline per year of the population is given by $\frac{1}{80}P^2$, where P is the size of the population t years after the start of the modelling.

(a) Explain how this model gives rise to the differential equation

$$\frac{\mathrm{d}P}{\mathrm{d}t} = -\frac{1}{80}P^2.$$

[1]

The scientist notes that at the start of the monitoring the population is 120.

(b) Use the model to determine an expression for P in terms of t. **[4]**

(c) Use the model to determine the time it takes for the population to reach 10. **[2]**

The model predicts that the population will never reach zero.

(d) By considering the case when $t \geqslant 160$, or otherwise, comment on the validity of the model for large values of t. **[1]**