

14 John wants to encourage more birds to come into the park near his house.

Each day, starting on day 1, he puts bird food out and then observes the birds for one hour. He records the maximum number of birds that he observes at any given moment in the park each day.

He believes that his observations may be modelled by the following differential equation, where n is the maximum number of birds that he observed at any given moment on day t .

$$\frac{dn}{dt} = 0.1n \left(1 - \frac{n}{50} \right)$$

(a) Show that the general solution to the differential equation can be written in the form

$$n = \frac{50A}{e^{-0.1t} + A}, \text{ where } A \text{ is an arbitrary positive constant.} \quad \mathbf{[9]}$$

(b) Using his model, determine the maximum number of birds that John would expect to observe at any given moment in the long term. **[1]**

(c) Write down one possible refinement of this model. **[1]**

(d) Write down one way in which John's model is not appropriate. **[1]**