

7. At the start of the year 2000, a survey began of the number of foxes and rabbits on an island.

At time t years after the survey began, the number of foxes, f , and the number of rabbits, r , on the island are modelled by the differential equations

$$\frac{df}{dt} = 0.2f + 0.1r$$

$$\frac{dr}{dt} = -0.2f + 0.4r$$

(a) Show that $\frac{d^2f}{dt^2} - 0.6 \frac{df}{dt} + 0.1f = 0$ (3)

(b) Find a general solution for the number of foxes on the island at time t years. (4)

(c) Hence find a general solution for the number of rabbits on the island at time t years. (3)

At the start of the year 2000 there were 6 foxes and 20 rabbits on the island.

- (d) (i) According to this model, in which year are the rabbits predicted to die out?
(ii) According to this model, how many foxes will be on the island when the rabbits die out?
(iii) Use your answers to parts (i) and (ii) to comment on the model.