6. [12 points] A shipment of fruit is delivered to a warehouse. The boxes containing the fruit were not properly sealed and contained fruit flies. The population of fruit flies (in thousands) in the warehouse is given by the function

$$F(t) = 12 - 10\,e^{-0.17t}$$

where t is the number of days after the fruit was delivered to the warehouse. Assume that there were no fruit flies in the warehouse before the fruit was delivered.

a. [2 points] How many fruit flies entered the warehouse when the fruit was delivered? Include units.

Solution: $F(0) = 12 - 10 = 2$. Two thousand fruit flies.

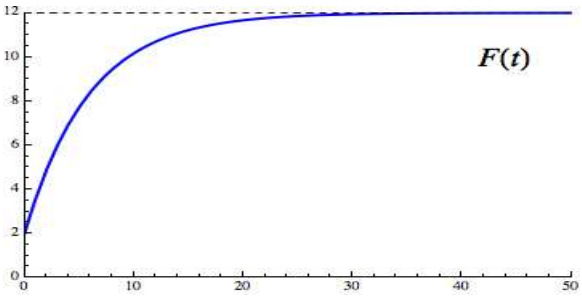
b. [4 points] How long did it take for the population of fruit flies to double after the fruit was delivered into the warehouse? Show all your work and include units.

Solution:

$$\begin{aligned} 4 &= 12 - 10\,e^{-0.17t} \\ 8 &= 10\,e^{-0.17t} \\ 0.8 &= e^{-0.17t} \\ -0.17t &= \ln(0.8) \\ t &= \frac{\ln(0.8)}{-0.17} \approx 1.312 \text{ days.} \end{aligned}$$

c. [2 points] Use your graphing calculator to find $\lim_{t\to\infty} F(t)$. Include a sketch of the graph to support your answer.

Solution:



$$\lim_{t\to\infty} F(t) = 12$$

Problem continues on next page

The statement of the problem has been rewritten for your convenience:

A shipment of fruit is delivered to a warehouse. The boxes containing the fruit were not properly sealed and contained fruit flies. The population of fruit flies (in thousands) in the warehouse is given by the function

$$F(t) = 12 - 10\, e^{-0.17t}$$

where t is the number of days after the fruit was delivered to the warehouse. Assume that there were no fruit flies in the warehouse before the fruit was delivered.

d. [4 points] Five days after the fruit was delivered to the warehouse, a powerful pesticide is applied to control the population of fruit flies. The pesticide causes the population of fruit flies to decay at a continuous rate of 41% per day. Find a formula for $P(T)$, the number of fruit flies (in thousands) T days after the pesticide was applied.

Solution: After 5 days, there are $F(5) = 12 - 10\, e^{-0.17(5)} = 7.725$ thousand fruit flies. Hence $P(T) = 7.725e^{-.41T}$.