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16/ENG061004  
MECHANICAL ENGR

An experiment is carried out by a Biomedical Engineer using a certain type of bacteria that doubles in population every 5 hr in a growth medium if the experiment is commenced with 20 bacteria.

a. Develop a model for the system

$$\frac{dy}{dt} = ky$$

$$\ln y = kt + c$$

$$y = e^{kt} + c$$

$$y = e^c \cdot e^{kt}$$

$$e^c = y_0$$

$$y = y_0 e^{kt}$$

but

$$y = 2y_0 \text{ when } t = 5 \text{ hr}$$

$$2y_0 = y_0 e^{kt}$$

$$\ln 2 = 5k$$

$$k = \frac{\ln 2}{5} = 0.139$$

$$y = y_0 e^{0.139t}$$

b. Use the model to estimate the population of the bacteria in  $1\frac{1}{2}$  days

Solution

$$24 \text{ hrs} = 1 \text{ day}$$

$$x = 1.5 \text{ day}$$

$$x = 24 \times 1.5$$

$$x = 36 \text{ hrs}$$

Where  $y_0 = 20$  ,  $t = 36$

$$y = 20 e^{0.139 \times 36}$$

$$y = 2980.2$$

$\approx 2980$  bacteria

Based on the results gotten in d. The population of the bacteria increases with time irrespective of the initial bacteria.