

161ENG 061063 MECHANICAL ENG.
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ENG 282 ASSIGNMENT

1. An experiment is carried out by a biomedical Engineer using a certain type of bacteria that double in population every 5hrs in a growth if the experiment is commenced with 20 bacteria.

Solution

- (a) Develop a model for the system

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

$$\frac{dy}{y} = k dt$$

$$\ln y = kt + C$$

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

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

$$e^C = y_0$$

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

but $y =$ Recall that

$$y = 2y_0 \text{ (doubling)}$$

$$\textcircled{a} \quad t = 5 \text{ hrs}$$

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

$$\ln 2 = 5k$$

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

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

b-) Use the model to estimate the population of the bacteria in $1\frac{1}{2}$ day

Solution

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

$$1\frac{1}{2} \text{ days} \Rightarrow 1.5 \text{ day}$$

$$x = 24 \times 1.5 \\ = 36 \text{ hrs}$$

$$\therefore \text{ where } y_0 = 20, t = 36 \text{ hrs}$$

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

$$y = 2980.2$$

$$= 2980 \text{ bacteria}$$

It can be concluded that from the results that the population of bacteria increases with time respectively of the initial bacteria.