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161ENG041043 - Electrical Electronics,
ENG 282

1. An experiment is called out by a biomedical engineer using a certain type of bacteria that doubles in population every 5 hours in a growth medium. If the experiment is commenced with 20 bacteria.

a. develop a model for the system.

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

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

$$\ln y = kt + c$$

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

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

$$e^c = y_0$$

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

but

$$y = y_0 \text{ when } t = 5 \text{ hrs}$$

~~$$y_0 = y_0 \cdot e^{kt}$$~~

$$dy_0 = y_0 \cdot e^{kt}$$

$$\ln 2 = 5k$$

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

$$y = y_0 e^{0.1395t}$$

b. Use the model to estimate the population of the bacteria in 1 1/2 day

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

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

$$x = 24 \times 1.5$$

$$= 36 \text{ hrs}$$

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

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

$$y = 2980.2$$

$$y = 2980 \text{ bacteria.}$$

Based on the answer obtained in d) the population of the bacteria has an increase with time irrespective of the initial bacteria.

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