

ENG 282

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16/ENG03/039

Civil Engineering

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

SOLN

a Develop a model for the system

$$\frac{dy}{dx} = k$$

Using Separation of the Variable method

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

~~y dt~~

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

$$\ln y = kt + C$$

$$e^{\ln y} = e^{(kt + C)}$$

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

$$\text{If } e^c \approx 40$$

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

but

$$y = dy_0 \text{ when time } (t) = 5 \text{ hrs}$$

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

$$\ln d = 5k$$

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

$$k = 0.1386$$

$$y = y_0 \cdot e^{0.1386t}$$

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

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

$$12 \text{ hours} = \frac{1}{2} \text{ day}$$

$$1\frac{1}{2} \text{ days} = 36 \text{ hours}$$

$$\text{When } y_0 = 20 \quad k = 0.1386 \quad t = 36 \text{ hours}$$

$$y = 20 e^{0.1386 \times 36}$$

$$y = 2938.6 \text{ bacteria}$$

Observing the value obtained in (d)
the population of the bacteria has
an increase with time irrespective
of the initial bacteria