ENG 282 ASSIGNMENT

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DEPARTMENT: MECHANICAL

Q1 The ODE of Exponential growth is $y = ky$ 1

$\frac{dy}{dt} \propto y$

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

$\frac{dy}{y} = k\,dt$; $\ln y = kt + C$

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

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

$\therefore y = Ce^{kt}$ is the solution to the ODE

The experiment commenced with 20 bacteria

$y(0) = 20$

$20 = Ce^{k \times 0}$

$20 = C$

$y = 20e^{kt}$

Since, it doubles every 5hours then the model is now

$40 = 20e^{5k}$

$e^{5k} = \frac{40}{20}$, $e^{5k} = 2$

$\ln(e^{5k}) = \ln 2$

$5k = \ln 2$

$k = \frac{\ln 2}{5} = 0.1386$

$y = 20e^{0.1386t}$

b) Estimating the population of the bacteria in $1\frac{1}{2}$ days

1 day = 24hr

$1\frac{1}{2}$ day = 36hr

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

y=2937.55

The number of bacteria varies but not constantly with time for the three different initial number of bacteria.

When the initial nurber of bacteria is 10, the final number of bacteria is 639.435.

When ~~the~~ initial number of bacteria is 30, the final number of bacteria is 1918.305.

When the initial number of bacteria is 50, the final number of bacteria is 3197.175.