CHOJI ALEXANDER PAM
16/ENG02/011
COMPUTER ENGINEERING

1a For bacteria growth, we use $dy/dt = ky$

let y = quantity of bacteria

t = time (hr)

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

$\int dy/y = \int k\,dt$

$\ln y = kt + C$

$y = e^{kt+C}$

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

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

$y = Ce^{kt}$

at initial time $t = 0$; $y = 20$

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

$20 = C$

at $t = 5$, $y = 2(20)$

$t = 5$, $y = 40$

$40 = Ce^{k \cdot 5}$

$40 = 20 \cdot e^{5k}$

$e^{5k} = 2$

$5k = \ln 2$

$5k = 0.6931$

$k = 0.1386$

$\therefore y = 20e^{0.1386t}$ (The required model)

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b) At $t = 1\frac{1}{2}$ day

$t = 24 + 12$ (1 day = 24hrs, $\frac{1}{2}$ day = 12hrs).

$t = 36$ hrs

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

$y = 20 \times 146.8777$

$y = \underline{\underline{2937.55}}$

d) At $y = 10$, and $t = 0$

$10 = Ce^{k.0}$

$C = 10$

at $t = 5$; $y = 20$

$\therefore 20 = 10e^{5k}$

$e^{5k} = 2$

$5k = \ln 2$

$k = 0.1386$

$\therefore$ For initial value, 10, we have $y = 10e^{0.1386t}$

For initial value, 30, we have $y = 30e^{0.1386t}$

For initial value, 50, we have $y = 50e^{0.1386t}$

e) The initial amount of bacteria affected the exponential growth of bacteria the highest initial amount had the highest final amount.

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