Continuing Diff. Eq

Bacteria in a culture are observed to grow at a rate proportional to the number of cells present. At the beginning of an experiment, there are 10,000 cells present. After 3 hours, there are 500,000. How many will there be after 24 hours? What is the doubling time for this system?

B : # of Bacteria cells

$B'(t)$: rate of Bact. Cells' growth

$$B'(t) = k \cdot B$$

$$dt\left(\frac{dB}{dt}\right) = (kB)\,dt$$

Sep. of variables

$$\frac{dB}{B} = \frac{kB \cdot dt}{B}$$

* get B with dB, get t with dt.

$$\int \frac{1}{B}\,dB = \int k\,dt$$

Integrate!

$$\ln|B| + \cancel{C} = kt + C$$
$$-C \qquad\qquad -C$$

$\int 3\,dx$

$3x + C$

$$\log_e |B| = kt + C$$

Exponentiate

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

* $\log_b a = c \Longleftrightarrow b^c = a$

prop. of exp.

$$e^{kt} \cdot \cancel{e^{C}} = B$$

another Constant

$$C e^{kt} = B$$

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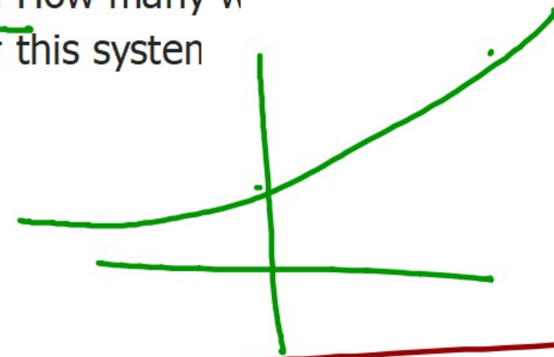
$$B = Ce^{kt}$$

$(0, 10000)$

$$B(t) = 10000e^{kt}$$



$$\boxed{10{,}000e^{1.304t}}$$

$(3, 500{,}000)$

$$500{,}000 = 10000e^{k\cdot 3}$$

$$\ln 50 = \cancel{\ln e}^{3k}$$

$$\frac{\ln 50}{3} = \frac{\cancel{3}k}{\cancel{3}}$$

$$1.304 = k$$

Good shortcut to know:

growth factor

$$\frac{dY}{dt} = kY \longrightarrow Y = Ce^{kt}$$

initial Value

HW

watch tonight's video
before tomorrow's class

(it doesn't get any easier than that)