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

let y = quantity of bacteria

t = time (hr)

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

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

$$\ln y = kt + c$$

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

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

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

$$y = Ce^{kt}$$

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)

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

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

$t = 36$ hrs

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

$y = 20 \times 146.8777$

$y = 2937.55$,,

ii) 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 $y = 50e^{0.1386t}$

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