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1a For bacteria growth we use  $\frac{dy}{dt} = ky$   
 $y =$  quantity of bacteria  
 $t =$  time

$$dy = Kdt$$

$$\int \frac{dy}{y} = \int Kdt$$

$$\ln y = Kt + c$$

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

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

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

$$y = ce^{Kt}$$

At initial time  $t = 0$  hr,  $y = 20$

$$\therefore 20 = ce^{K \cdot 0}$$

$$c = 20$$

At  $t = 5$ ,  $y = 2y$

$t = 5$ ,  $y = 40$

$$40 = ce^{K \cdot 5}$$

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

$$e^{5K} = 2$$

$$5K = \ln 2$$

$$5K = 0.6931$$

$$K = 0.1386$$

$y = 20e^{0.1386t}$  is the required model

1b At  $t = 1\frac{1}{2}$  day  
 $t = (24 + 12)$  hours  
 $t = 36$  hours  
 $y = 20e^{36 \times 0.1386}$   
 $y = 20 \times 146.8777$   
 $y = 2937.55$

1d At  $y = 10$  and  $t = 0$   
 $10 = ce^{k \cdot 0}$   
 $c = 10$   
 At  $t = 5$ ,  $y = 20$   
 $\therefore 20 = 10e^{5k}$   
 $e^{5k} = 2$   
 $5k = \ln 2$   
 $k = 0.1386$

~~For initial value = 10, we have  $y = 10e^{0.1386t}$~~   
~~For initial value = 30, we have  $y = 30e^{0.1386t}$~~   
 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  $y = 50e^{0.1386t}$

1e The initial amount of bacteria affected the exponential growth of the bacteria. The highest initial amount had the highest final amount.