

Calculation of Bacterial Growth - KEY

Calculate the Generation time G using the following equation: $G = t/n$

't' = time

'n' = the number of generations.

Please express your answer in minutes. Please show your work.

1. A culture of bacteria divides 10 times in 5 hours.

$$t = 5 \text{ hours} \times (60 \text{ min}/1 \text{ hour}) = 300 \text{ min.}$$

$$G = 300 \text{ min}/10 = \mathbf{30 \text{ min.}}$$

2. A culture of bacteria divides 100 times in 4 hours.

$$t = 4 \text{ hours} \times (60 \text{ min}/1 \text{ hour}) = 240 \text{ min.}$$

$$G = 240 \text{ min}/100 = \mathbf{2.40 \text{ min.}}$$

3. A culture of bacteria divides 4 times in 40 minutes.

$$t = 40 \text{ min.}$$

$$G = 40 \text{ min}/4 = \mathbf{10 \text{ min.}}$$

4. A culture of bacteria divides 20 times in 2800 minutes.

$$t = 2800 \text{ min.}$$

$$G = 2800 \text{ min}/20 = \mathbf{140 \text{ min.}}$$

Calculate the answers to the following questions using the following equation:

$$N(t) = N_0 \times 2^n$$

N = Number of bacteria

N(t) = Number of bacteria at time t

N₀ = Number of bacteria at time 0 – ie at the start

2 – refers to the doubling rate

n = the number of generations = Time period/generation time

Please show your work.

Please put numbers of 4 digits or more into scientific notation. (Example: 1,560 = 1.56 x 10³) Include only 2 digits to the right of the decimal place.

1. If you start with a population of 10 bacteria, and the Generation time is 30 min, how many bacteria will you have after 4 hours?

$$N_0 = 10 \text{ bacteria, } G = 30 \text{ min., } G = t/n \quad n = t/G \text{ where } t = 4 \text{ hr.} \cdot (60 \text{ min}/1 \text{ hour}) = 240 \text{ min.}$$

$$n = 240 \text{ min}/30 \text{ min}$$

$$n = 8 \text{ generations or doublings}$$

$$N(t) = N_0 \times 2^n$$

$$N(t) = 10 \times 2^8$$

$$= 10 \times 256$$

$$N(t) = 2.56 \times 10^3 \text{ bacteria}$$

2. If you start with a population of 1 bacterium, how many generations does it take to get 120 bacteria?

$$N_0 = 1 \text{ bacterium, } G = ?, \quad N(t) = 120 \text{ bacteria}$$

$$N(t) = N_0 \times 2^n$$

$$120 = 1 \times 2^n$$

Module 2, Lesson 3: Calculation of Bacterial Growth KEY

$$\ln 120 = \ln 2^n$$

$$\ln 120 = n * \ln 2$$

$$\ln 120 / \ln 2 = n \quad n = 6.91 \text{ or approximately 7 generations or doublings.}$$

3. If you start with a population of 1 bacterium, and the Generation time is 10 min, how many bacteria will you have after 10 hours?

$$N_0 = 1 \text{ bacterium, } G = 10 \text{ min., } G = t/n \quad n = t/G \text{ where } t = 10 \text{ hr.} * (60 \text{ min}/1 \text{ hour}) = 600 \text{ min.}$$

$$n = 600 \text{ min}/10 \text{ min}$$

$$n = 60 \text{ generations or doublings}$$

$$N_{(t)} = N_0 \times 2^n$$

$$N_{(t)} = 1 \times 2^{60}$$

$$= 1 \times (1.15 \times 10^{18})$$

$$N_{(t)} = 1.15 \times 10^{18} \text{ bacteria}$$