Quiz 5

Name: _____ Key _____
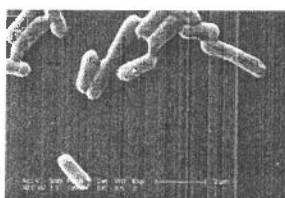
You must show your work to get full credit.

FIGURE 1. Colony of E. coli

Part of the point of this quiz is to show how fast exponential functions grow. Under ideal conditions the bacterium E. coli will double every 1/3 hours. A single E. coli weights 10^{-15}kg.

1. We start with a colony of a single E. coli. Assuming that the weight of the colony doubles every 1/3 hours, give a formula for the weight, $W(t)$, of the colony after t hours.

The growth is exponential so

$W(t) = W(0)\lambda^t = 10^{-15}\lambda^t$ kg.

$W(\frac{1}{3}) = 10^{-15}\lambda^{\frac{1}{3}} = 2 \cdot W(0) = 2 \cdot 10^{-15}$

So $\lambda^{\frac{1}{3}} = 2$

and thus $\lambda = 2^3 = 8$.

i.e $W(t) = 10^{-15}(8)^t$

$$W(t) = \underline{10^{-15}(8)^t} \text{ kg}$$

2. The weight of the Earth is 6.0×10^{24}kg. How long does it take our colony of E. coli to have the same weight as the Earth?

We need to solve   Time to reach mass of Earth is __44.05__ hours.

$W(t) = 10^{-15}(8)^t = 6.0 \times 10^{24}$

mult. by 10^{15} $8^t = 6.0 \times 10^{24} \times 10^{15} = 6.0(10)^{39}$

$t \ln(8) = \ln(6.0 \times 10^{39})$

$t = \ln(6.0 \times 10^{39})/\ln(8)$

$= 44.05$ hours