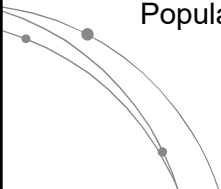


3 Applications of Exponential Functions

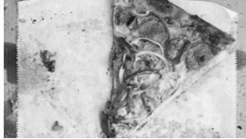
Population, Radioactive Decay



1

Why you shouldn't eat food that's been left out too long

- ❖ A few minutes ago, an invasion took place.
- ❖ 100 cells of Staphylococcus Aureus landed on your left-over pizza
- ❖ Staph bacteria thrives between 50 and 120 degrees Fahrenheit.

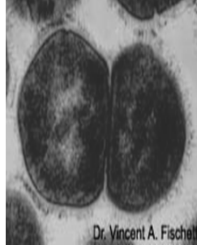


Staphylococcus Aureus
Infested pizza

2

Now you're in trouble

- Average Generation time for Staphylococcus Aureus is about 30 minutes, meaning the population of bacteria on the pizza doubles every 30 minutes!!!



Dr. Vincent A. Fischetti

http://coris.noaa.gov/glossary/binaryfission_186.jpg

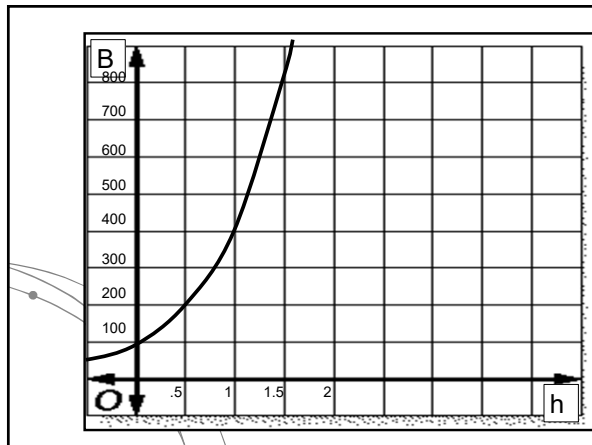
3

How long will it take for you to get sick?

Hours (h)	Bacteria (B)	Function of h
0	100	$100(2^0)$
0.5	200	$100(2^1)$
1	400	$100(2^2)$
2	1600	$100(2^4)$
h	Bacteria (B)	$100(2^{2h})$

$B(h) = 100(2^{2h})$ is called an exponential function because the variable is in the exponent.

4



5

DON'T EAT THE PIZZA!

- How many bacteria are partying on the pizza after 24 hours?

$$\begin{aligned}
 f(24) &= 100(2^{2 \cdot 24}) \\
 &= 100(2^{48}) \\
 &= 100(2.815 \times 10^{14}) \\
 &= 2.815 \times 10^{16}
 \end{aligned}$$

That's over 28 sextillion inside you!!!

6

Radioactive Decay

- Carbon-14 is a radioactive isotope found in all living organisms, and hence, in all organic material.
- It has a half-life of 5730 years, which mean it takes 5730 years for the amount of Carbon-14 in a living organism to reduce to half its original amount.

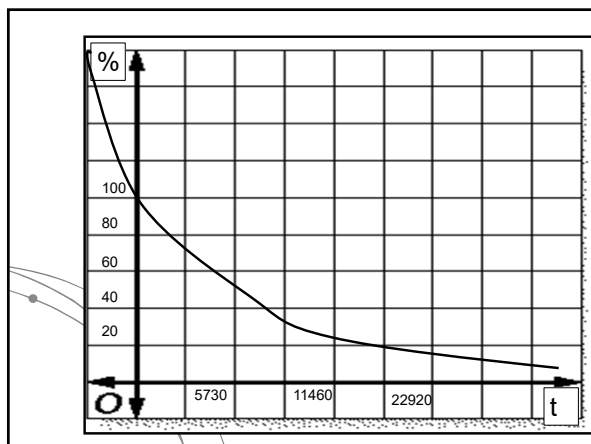
7

How would we model radioactive decay?

Years (t)	% C-14	Function of t
0	100%	$100(\frac{1}{2}^0)$
5730	50%	$100(\frac{1}{2}^1)$
11460	25%	$100(\frac{1}{2}^2)$
57300	Not much	$100(\frac{1}{2}^{10})$
t	C(t)	$100(\frac{1}{2}^{t/5730})$

Every half-life (5730) years, the amount is cut in half, therefore, we must divide the number of years by 5730 to compute the number of half-lives that have passed. $C(t) = 100(\frac{1}{2}^{t/5730})$

8



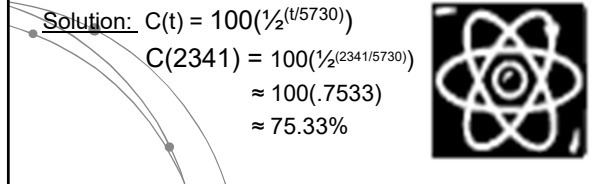
9

Dead Sea Scrolls

Problem: The Dead Sea Scrolls are believed to have been written between 335 BCE to 122 BCE. What percent of C-14 remains?

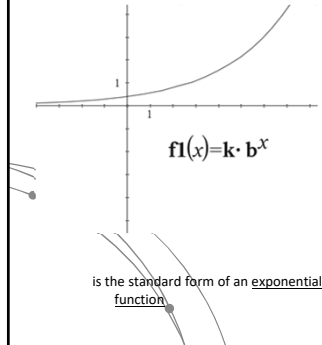
Source: <http://www.physics.arizona.edu/physics/public/dead-sea.html>

Solution: $C(t) = 100(\frac{1}{2}^{(t/5730)})$
 $C(2341) = 100(\frac{1}{2}^{(2341/5730)})$
 $\approx 100(.7533)$
 $\approx 75.33\%$



10

Exponential Functions



$f(x) = k \cdot b^x$

b is called the base of the exponential function

k is the y-intercept of the function because at $x = 0$ implies $b^0 = 1$ which implies $f(0) = k$.

If $a < 1$ then the graph is decreasing

If $a > 1$, then the function increases.

is the standard form of an exponential function

11
