Math-3A

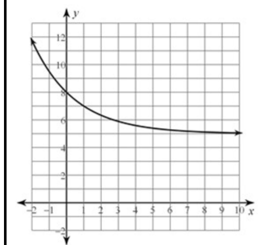
Lesson 7-6

More

Exponential Modeling

1. Money
2. Radioactive Decay
3. Carbon-14 Dating

Find the equation of the graph.



$y = AB^x + k$ →

1. Horizontal asymptote:

$y = AB^x + 5$

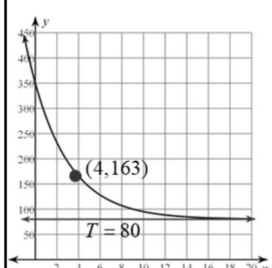
2. Passes through: (x, y) =

$y = 3B^x + 5$

3. Passes through: (x, y) =

---

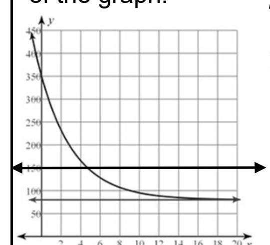
1. Find the equation of the graph.



$T(t) = AB^t + m$

2. What will be the temperature in 10 minutes?

Find the equation of the graph.



1. Find 't' to reach 150 F

$T(t) = 270(0.7446)^t + 80$

$150 = 270(0.7446)^t + 80$

$\frac{150 - 80}{270} = (0.7446)^t$

→ $0.2593 = (0.7446)^t$

How do we solve for 't'?

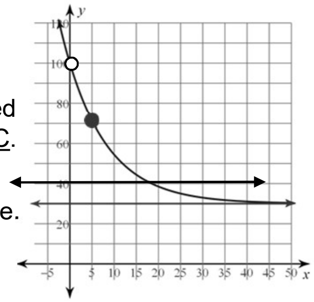
1. "Guess and check" → build a table and try some values for 't'

t	4	4.2	4.4	4.5	4.6
T	0.307	0.290	0.273	0.265	0.258

2. Solve by graphing: $y_1 = 270(0.7446)^t + 80$

$y_2 = 150$

A cup of hot water is taken out of the microwave oven. Its initial temperature is 100 C.
It is placed on the counter in a room whose temperature is 30 C. In 5 minutes it has cooled to 72 C. When will it reach 40 C.



1. Draw a graph that shows temperature as a function of time.

2. What is the equation of the graph? (use the following equation). $T(t) = AB^t + k$

3. Draw a horizontal line for T = 40

4. Solve by graphing

$y_1 =$ ____________________

$y_2 = 40$

A cake taken out of the oven at temperature of 450° F. It is placed on in a room with an ambient temperature of 75°F to cool. 10 minutes later the temperature of the cake is 180°F. When will the cake be cool enough to put the frosting on (90°F)? (t=?, 90°F)

Start with either:

$T(t) = AB^t + k$

$T(t) =$ ____________________

$T(t) = 90$

Solve by graphing

You deposit $100 money into an account that pays 3.5% interest per year. The interest is "compounded" monthly. How much money will be in the account at the end of the 5th year?

$$A(t) = A_0(1 + r/k)^{kt}$$

What is the doubling time for this account?

$y_1 =$ ____________________

$y_2 = 2$ Solve by graphing

You deposit $200 money into an account that pays 5.5% interest per year. The interest is "compounded" quarterly. How long will it take for your money to triple?

$A(t) = A_0(1 + r/k)^{kt}$ $\quad 600 = 200(1 + 0.055/4)^{4(t)}$

$3 = (1.0138)^{4t}$

$y_1 = (1.0138)^t$

$y_2 = 3$

Solve by graphing

Radioactive decay (also known as **nuclear decay** or **radioactivity**) is the process by which the nucleus of an unstable atom loses energy by emitting radiation, including alpha particles, beta particles, gamma rays, and conversion electrons. A material that spontaneously emits such radiation is considered **radioactive**.

The process of radioactive decay results in the nucleus of the atom becoming smaller → it turns into a new element.

We measure the time it takes to turn into another element using "half-life" (the time it takes to reach half of its original amount).

- Uranium-238 decays with a half-life of 4.5 billion years to thorium-234
- which decays with a half-life of 24 days to protactinium-234
- which decays with a half-life of 1.2 minutes to uranium-234
- which decays with a half-life of 240 thousand years to thorium-230
- which decays with a half-life of 77 thousand years to radium-226
- which decays with a half-life of 1.6 thousand years to radon-222
- which decays with a half-life of 3.8 days to polonium-218
- which decays with a half-life of 3.1 minutes to lead-214
- which decays with a half-life of 27 minutes to bismuth-214
- which decays with a half-life of 20 minutes to polonium-214
- which decays with a half-life of 160 microseconds to lead-210
- which decays with a half-life of 22 years to bismuth-210
- which decays with a half-life of 5 days to polonium-210
- which decays with a half-life of 140 days *to lead-206, which is a stable n*uclide.

The "half life" of Carbon-14 (a radioactive isotope of carbon), is 5730 years.
1. What is the base of the exponential?

$$t_{\frac{1}{2}} = 5730$$

2. What is the exponential equation?

$$A(t) = A_0(b)^t$$

$$0.5A_0 = A_0(b)^{5730}$$

3. If there was originally 10 gm of C-14, how many graphs would be left after 2000 years?