Key

Unit 6 Day 10 Notes: Exponential Decay

$y = a \cdot b^x$

Here's a data table, write an exponential equation to fit this data:

x	-1	0	1	2	3	4
y	1215	405	135	45	15	5

$\times\frac{1}{3}$ $\times\frac{1}{3}$ $\times\frac{1}{3}$ $\times\frac{1}{3}$ $\times\frac{1}{3}$ ← b

a

$y = 405 \cdot \left(\frac{1}{3}\right)^x$

Let's try an application:

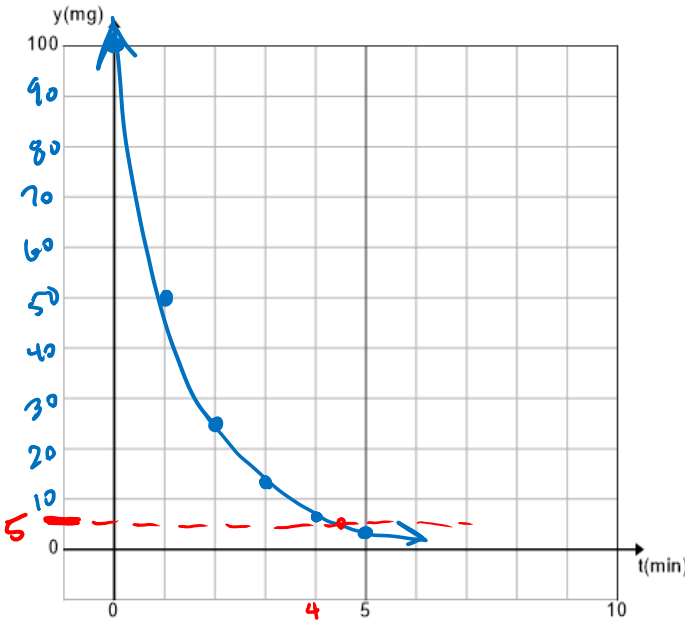
$a = 100$

You have a bad cough so you take cough drops. The cough drops contain 100 mg of menthol per drop to soothe your sore throat. Every minute, the amount of menthol in your body is cut in half.

a) Make a table and sketch a graph of the scenario.

Time, t (minutes)	0	1	2	3	4	5
Menthol, y (mg)	100	50	25	12.5	6.25	3.125

$\times\frac{1}{2}$ $\times\frac{1}{2}$ $\times\frac{1}{2}$ $\times\frac{1}{2}$ 5 mg



b) Write a function that models the amount of menthol in your body over time.

$y = 100 \cdot \left(\frac{1}{2}\right)^x$

c) How much menthol is left in your body after 8 minutes?

$x = 8$

$y = 100\left(\frac{1}{2}\right)^8$

$= .39$ mg

d) If it is safe to take another cough drop after the level of menthol in your body is less than 5mg, how long will it be before it is safe to take another cough drop?

somewhere between 4 and 5 minutes

Recap the comparison from yesterday

$y = a(b)^x$ → decay

$0 < b < 1$

$y = a(1-r)^t$ → decay uses subtraction

Name the **rate of decay** (or decay rate) and **starting amount.**

$y = 5(1-.02)^t$ ← same → $y = 5(.98)^t$

$y = 5(1-.02)^t$

$a = 5$

$r = .02$ (2%)

$y = 10(.95)^t = 10(1-.05)^t$

$a = 10$

$r = .05$ (5%)

$y = 10(.6)^t = 10(1-.4)^t$

$a = 10$

$r = .4$ (40%)

Another application:

If you start with 100 mg of menthol in your system and the percent **decrease** is 40% every minute… ($r = .4$)

a) Write an equation to model this situation

$y = 100(1-.4)^t$

b) Predict how much menthol will be in your system after 5 minutes. ($t = 5$)

$y = 100(1-.4)^5 = 100(.6)^5$

$y = 7.776$ mg