For today, use the logistic model for the spread of an infection:

$$N(t) = \frac{N_0\, T}{(T - N_0)e^{-ct} + N_0} \quad \text{where } N_0 = N(0) = \#\text{ cases at time } t = 0$$

$$\frac{dN}{dt} = \frac{c\, N_0\, T(T - N_0)e^{-ct}}{\left((T - N_0)e^{-ct} + N_0\right)^2}$$

And use values

$T = 6,900,000$, the approximate population of Massachusetts

$N_0 = 164$, the number of COVID-19 cases in Massachusetts on March 15, 2020

1. Use $c = 0.05$ for the parameter related to the rate of spread.
   (a) Find the formula for $N(t)$.
   (b) What does the model predict that the total number of cases in Massachusetts on June 30, 2020 would be? on December 30, 2020?
   (c) Compare your answers with actual number of cases on the dates. You can find this data at: https://www.mass.gov/info-details/archive-of-covid-19-cases-in-massachusetts
   (d) Find the formula for $\frac{dN}{dt}$.
   (e) What does the model predict that the number of new cases in Massachusetts on June 30, 2020 would be? on December 30, 2020?
   (f) Compare your answers with actual number of cases on the dates.
   (g) Find the value of t at the inflection point of $N(t)$.
   (h) What is the value of $\frac{dN}{dt}$ at the inflection point? What is the practical meaning of this value?
   (i) Do you think the value of c is too big, too small, or just right?

2. Let $c = 0.03$ and repeat #1.

3. (a) Graph your $N(t)$ functions from #1 and #2 on the same set of axes.
   (b) Graph your $\frac{dN}{dt}$ functions from #1 and #2 on the same set of axes.
   (c) Explain how your graphs and answers to #1 and #2 show why we were hearing the phrase "flatten the curve" so much in 2020.