7.2b Modelling Real-World Data with Logarithms

Below are some measurements taken with a phone dB app (that measures the loudness of sound) while a constant tone was playing from a speaker.

Distance From Speaker (m)	Loudness (dB)
4	84.89
8	79.51
15	74.58
19	71.51
25	69.60
33	67.9
40	65.50
52	63.27
64	60.24
75	60.04
91	57.14
103	56.75

Investigation

As a group, consider how you might model the above data using an equation/graph. Use Desmos to vary parameters to figure out the best approximation you can.

1. Plot the data in Desmos.
2. Determine a model for a function that fits the data well (you won't be able to do it perfectly).

3. How loud will the tone be (in dB) at the following distances?
   a) 300 m b) 4 km

4. Determine the distance at which the loudness of the sound would be:
   a) 50 dB b) 0 dB

5. Click on “Graph Settings” (the wrench at the top-right corner of the screen). Then “more options”, and change the *x*-axis to “logarithmic”. What do you notice about your modelling equation?

6. a) What happens to the loudness as you approach the speaker? Is this reasonable?

   b) What happens to the loudness as you go very far away? Is this reasonable?

7. Write an equation to model the loudness, as a function of distance from the speaker, using:
   a) $\log_{10}$ b) $\log_{2}$

   c) $\log_{4}$ d) $\log_{32}$

8. For these data, is it possible to have a logarithmic model with a horizontal translation? Why or why not?

9. For these data, is it possible to have a logarithmic model without a vertical translation? Why or why not?

10. Assume the level of ambient noise is 45 dB. What is a reasonable domain for your modelling function?