



# Using Functions to Model Battery Power

Let's use functions to model data and make predictions.

## 20.1 Devices

Think about an electronic device with a battery that you have to charge on a regular basis.

1. What device is it?
2. When you are using the device, about how long does it take the battery to go from 100% charged to the percentage it has when you plug it in again to recharge?
3. About how long does it take to charge to 100% starting from 0% or nearly 0%?
4. Suppose you plugged in your device when the battery was 50% charged.

How long do you think it would take to recharge the device to 100% compared to the time it would take if the device was at 0%? Would it be exactly half the time, more than half the time, or less than half the time it would take if starting from 0%?

## 20.2 Charging a Phone

A cell phone is plugged in to be charged. The table shows the percentage of battery power at some times after the phone was plugged in.

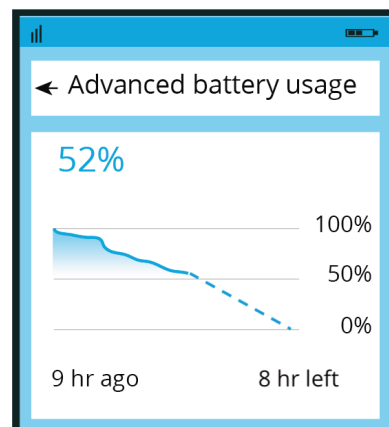
| time       | percent charged |
|------------|-----------------|
| 11:00 a.m. | 6%              |
| 11:10 a.m. | 15%             |
| 11:30 a.m. | 35%             |
| 11:40 a.m. | 43%             |

At what time will the battery be 100% charged?  
Use the data to find out and explain or show your reasoning.

## 20.3 How Long Will It Last?

1. The image shows the battery usage of a cell phone for 9 hours after it was fully charged.

It also shows a prediction that the battery would last 8 more hours.

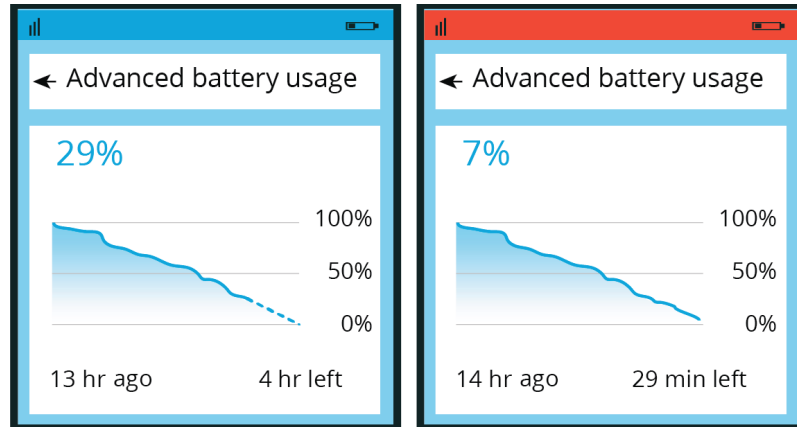


- a. Write an equation for a model that fits the data in the image and gives the percentage of battery power,  $p$ , as a function of time since the phone was fully charged,  $t$ . Show your reasoning.

If you get stuck, consider creating a table of values or a scatter plot of the data.

- b. Based on your function, what percentage of power would the battery have 4 hours after this image was taken? What about 5 hours after the image was taken? Show your reasoning.

2. Here are two more images showing the battery usage at two later times, before the battery was charged again.



- a. How well did the function you wrote predict the battery power 4 and 5 hours after the first image was taken (that is, 13 and 14 hours after the battery was fully charged)? Explain or show your reasoning.
- b. What do you notice about the change in the prediction at  $t = 13$  and at  $t = 14$ ?
- c. Write a new equation for a function that would better fit the data shown in the last image.

 **Are you ready for more?**

Would a piecewise function be a better model for capturing the data shown in all three images? If so, what might the rules of that function be?