# 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.

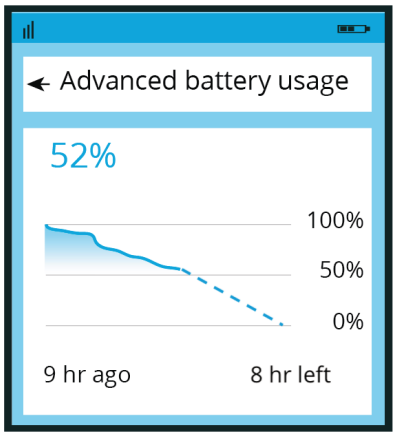
| time | percent charged |
|---|---|
| 11:00 a.m. | 6% |
| 11:10 a.m. | 15% |
| 11:30 a.m. | 35% |
| 11:40 a.m. | 43% |

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.

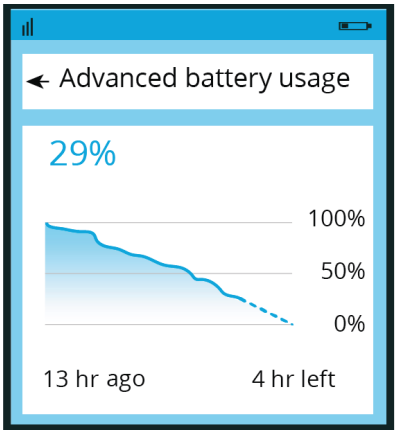


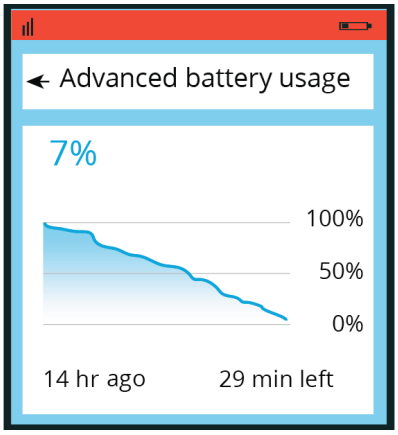

   a. Write an equation for a model that fits the data in the image and gives the percentage of battery power, $p$, as a function of time since the phone was fully charged, $t$. Show your reasoning.

      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?