**Feeding the Birds**

**Background**

Your neighbor is an ornithologist. She has to leave for a weekend. She has asked you to make sure her birdfeeder always has food in it. Refilling too seldom will cause the birds to look elsewhere for food. Refilling too much will scare off the birds.

**Leading Question**

How often should you feed the birds so they keep coming back?

The birdfeeder has 4 holes - one pair near the bottom and one pair about halfway up, as shown in the diagram above.

1. When you go to the bird feeder early in the morning, the birdfeeder is nearly full. You check back in 40 minutes and it is about half full. You come back 40 minutes later and it’s still not empty. The birds are still coming by consistently to eat, so they are still hungry. Why isn’t it empty?
2. Answer the next two questions to help determine the amount of time it will take for the birds to eat the final half of the food in the birdfeeder.

For 40 minutes, birds ate nonstop off 4 perches. How many total minutes were birds on a perch?

How long would it take the birds to eat the same amount of food off of 2 perches?

1. If the birdfeeder is initially filled to the top, how many total minutes will it take to get empty?
2. Complete the table below.

|  |  |
| --- | --- |
| Total time(minutes), *x* | Fraction of the birdfeeder that is full, *y* |
|  | 1 |
|  | ½  |
|  | 0 |

1. Find a piecewise function for the amount of food in the birdfeeder after any number of minutes.

a. Write an equation for a line through the first two points in the table.

b. Write an equation for the line through the 2nd and 3rd points in the table.

c. Now write the piecewise function.

$$y=f\left(x\right)=\left\{\begin{array}{c}\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_when\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_when\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\end{array}\right.$$

You did so well taking care of your neighbor’s birdfeeder that she recommended you for a weekend job watching her coworker’s birdfeeder. This birdfeeder has 6 feeding holes – 2 at the bottom, 2 about one-third of the way up, and two holes about two-thirds of the way up.

1. The first morning you get there you notice that the feeder is about 2/3 full. You wait a while and notice that it takes about 30 minutes before the feeder is about 1/3 full. How many more minutes do you think it will take before you need to refill the feeder?
2. Answer the next three questions to help determine the amount of time it will take for the birds to eat the first third of food in the birdfeeder and the final third of food in the birdfeeder.

For 30 minutes, birds ate nonstop off 4 perches. How many total minutes were birds on a perch?

How long would it take the birds to eat off 6 perches? (Remember the time should be faster!)

How long would it take the birds to eat off 2 perches? (Remember the time should be slower!)

1. If the birdfeeder starts off full, how many total minutes will it take for the feeder to become empty? How did you get your answer? Show your work. State your answer in a sentence.
2. This table that shows the birdfeeder started full. Complete the table by showing the total amount of time it will take to get each fraction of the birdfeeder to be full.

|  |  |
| --- | --- |
| Total time(minutes), *x* | Fraction of the birdfeeder that is full, *y* |
| 0 | 1 |
|  | 2/3  |
|  | 1/3  |
|  | 0 |

1. Write a piecewise function that can be used to find the amount of feed in the birdfeeder after any number of minutes. Show all steps in the space below.
2. Graph your piecewise function on the coordinate plane below.



1. If it has been 30 minutes since you refilled the bird feeder, approximately how much of the birdfeeder still has food?
2. If there is ¼ of the bird food remaining in the birdfeeder, approximately how many minutes has it been since you last refilled?

**EXTENSION**

1. Build a mock birdfeeder like the one pictured on page 2. Use a clear cylindrical container as the birdfeeder. Use rice as the bird food. Make holes in the container to allow the rice to spill out. How well did you mathematical model agree with your physical model?
2. Write a mathematical description of how to determine how quickly the birdfeeder will empty.
3. Can you generalize the description above for any number of feedholes?