2-4 Step Functions (16.2 in book)

pgs. 1146-1150 in student book

Objectives:

I can write and graph step function problem situations.
I can analyze the graphs of step functions.
I can use a calculator to graph a step function.

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Problem 2: Taxi Fares

In 2006, the rate for a taxi ride in Macon, Georgia, was $1.20 for the first mile or part of a mile, and $1.20 for each additional mile or part of a mile.

x = miles y = cost

1. Define a piecewise function, g(x), for the cost of a taxi ride up to 5 miles.

$$f(x) = \begin{cases} 1.20 & 0 < x \leq 1 \\ 2.40 & 1 < x \leq 2 \\ 3.60 & 2 < x \leq 3 \\ 4.80 & 3 < x \leq 4 \\ 6.00 & 4 < x \leq 5 \end{cases}$$

2. What is the slope of each interval? Explain your reasoning.

$\frac{\text{rise}}{\text{run}} = \frac{0}{1} = 0$

$m = 0$
constant

Piece	(x, y)
1.20	0, 1.20
	1, 1.20
2.40	1, 2.40
	2, 2.40
3.60	2, 3.60
	3, 3.60
4.80	3, 4.80
	4, 4.80
6	4, 6
	5, 6

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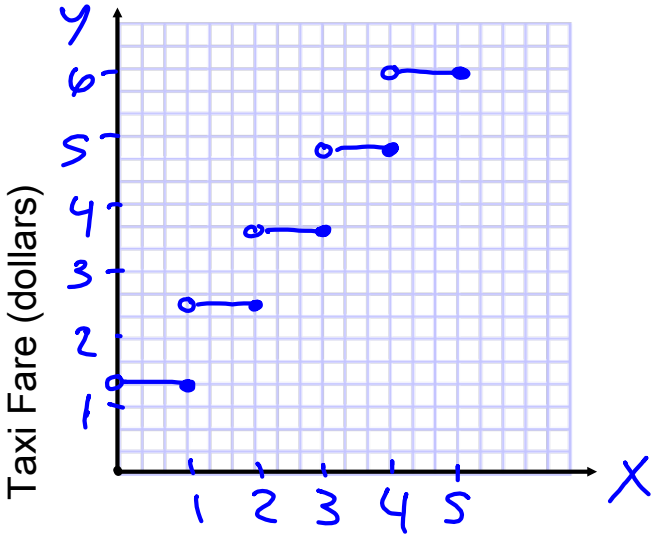
3. Graph g(x) for x < 5 miles.



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You have just graphed a *step function.*

*A **step function*** is a piecewise function whose pieces are disjoint constant functions. *

5. Why do you think this function is called a step function?

that's what it looks like!

*Calculator steps in book.

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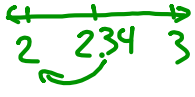
Problem 3 Special Step Functions

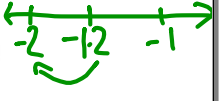
The *greatest integer function* is a special kind of step function. The **greatest integer function**, also known as the **floor function**, $G(x) = \lfloor x \rfloor$ is defined as the greatest integer less than or equal to x.

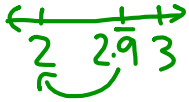
1. Evaluate each using the greatest integer function.

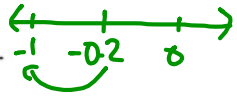
a. $\lfloor 2 \rfloor = 2$

b. $\lfloor 0.17 \rfloor = 0$ 

c. $\lfloor 2.34 \rfloor = 2$ 

d. $\lfloor -1.2 \rfloor = -2$ 

e. $\lfloor 2.99999 \rfloor = 2$ 

f. $\lfloor -0.2 \rfloor = -1$ 

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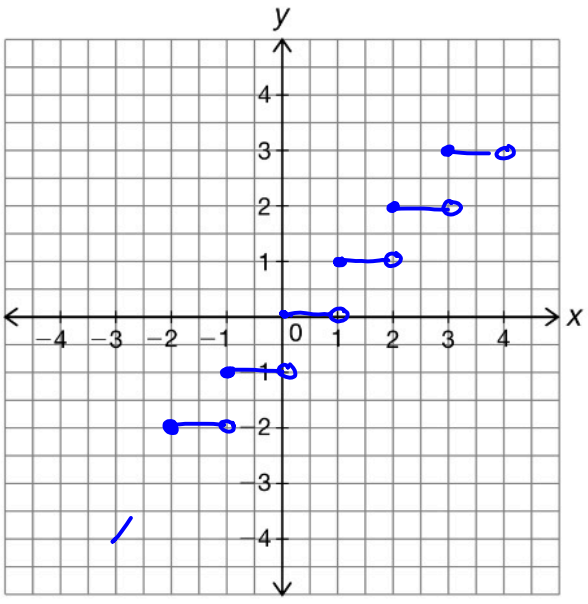
2. Graph $G(x) = \lfloor x \rfloor$.



Points
(0,0)
(0.1,0)
(0.9,0)
(1,1)
(1.1,1)
(1.9,1)
(2,2)

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The *least integer function* is another special kind of step function. The **least integer function** $L(x) = \lceil x \rceil$ also known as the **ceiling function,** is defined as the least integer greater than or equal to x.

3. Calculate each:

a. $\lceil 2 \rceil = 2$

b. $\lceil 0.17 \rceil = 1$

c. $\lceil 2.34 \rceil = 3$

d. $\lceil -1.2 \rceil = -1$

-2 -1.2 -1

e. $\lceil 2.99999 \rceil = 3$

f. $\lceil -0.2 \rceil = 0$

-1 -0.2 0

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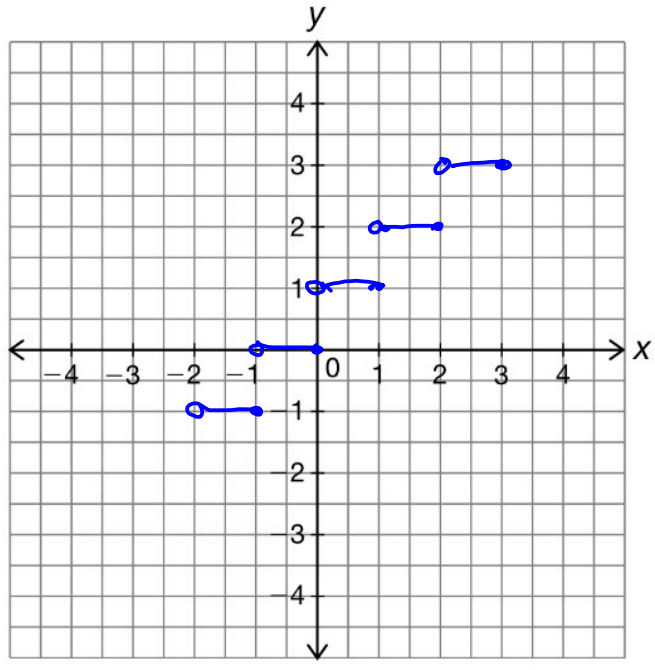
4. Graph $L(x) = \lceil x \rceil$.



(0,0)
(0.1, 1)
(0.9, 1)
(1, 1)
(1.1, 2)
(1.9, 2)
(2, 2)

6. X = \$ spent
y = value of coupons

interval
equation/piece

$$f(x) = \begin{cases} 0, & 0 \le x < 20 \\ 2 & 20 \le x < 40 \\ 4 & 40 \le x < 60 \\ 6 & 60 \le x < 80 \\ 8 & 80 \le x < 100 \end{cases}$$

7. x = sales → interval
y = \$ returned → piece

$$f(x) = \begin{cases} 100, & 0 < x \leq 250 \\ 225, & 250 < x \leq 500 \\ 350, & 500 < x \leq 750 \\ 475, & 750 < x \leq 1000 \end{cases}$$

14. x = weight
y = cost

$$f(x) = \begin{cases} 5, & 0 < x \leq 10 \\ 10, & 10 < x \leq 20 \\ 15, & 20 < x \leq 30 \\ 20, & 30 < x \leq 40 \\ 25, & 40 < x \leq 50 \end{cases}$$