

# KEY FEATURES OF LINEAR FUNCTIONS



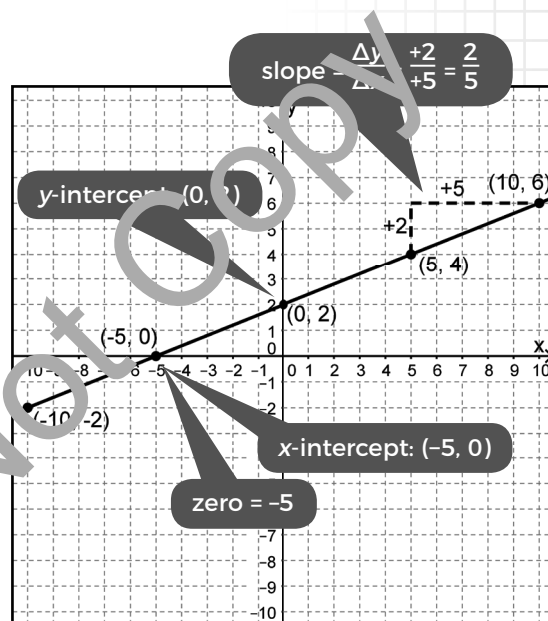
The student is expected to graph linear functions on the coordinate plane and identify key features, including **x-intercept**, **y-intercept**, **zeros**, and **slope**, in mathematical and real-world problems.



## TELL ME MORE...

The graph of a linear function reveals certain attributes that are important to the function, especially when you are using a function to model real-world data or real-world situations. For example, the graph of  $y = \frac{2}{5}x + 2$  (or,  $-2x + 5y = 10$ ) is shown. Key features of the graph include the **x-intercept**, **y-intercept**, **zero**, and **slope**.

- The **x-intercept** is the point where the graph of the line crosses the  $x$ -axis. Here, the  $y$ -value is 0.
- The **y-intercept** is the point where the graph of the line crosses the  $y$ -axis. Here, the  $x$ -value is 0.
- The **zero** of a linear function is the input value that generates an output value of 0. It is equivalent to the  $x$ -coordinate of the  $x$ -intercept.
- The **slope** of a linear function is the steepness of the graph of the line. Slope is measured as the ratio of the change in the vertical direction to the change in the horizontal direction.



## EXAMPLES

**EXAMPLE 1:** The graph of a linear function is shown. What ordered pairs best represent the  $x$ -intercept and  $y$ -intercept of the line?

**STEP 1** Use the coordinates of the two points provided to determine the slope of the line.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-3)}{7 - (-5)} = \frac{4}{12} = \frac{1}{3}$$

$$m = \frac{1}{3}$$

**STEP 2** Determine the  $y$ -intercept,  $(0, y)$ . Substitute  $x = 0$  into the equation and solve for  $y$ .

$$y = \frac{1}{3}x - \frac{4}{3}$$

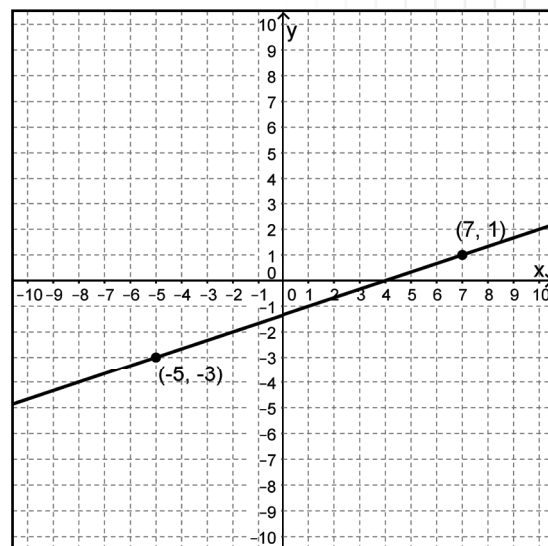
$$y - y_1 = m(x - x_1)$$

$$y - 1 = \frac{1}{3}(x - 7)$$

$$y - 1 = \frac{1}{3}x - \frac{7}{3}$$

$$y - 1 + 1 = \frac{1}{3}x - \frac{7}{3} + \frac{3}{3}$$

$$y = \frac{1}{3}x - \frac{4}{3}$$



**STEP 3** Determine the coordinates of the  $x$ -intercept,  $(x, 0)$ , by substituting  $y = 0$  and solving for  $x$ .

**(4, 0)**

$$y = \frac{1}{3}x - \frac{4}{3}$$

$$0 = \frac{1}{3}x - \frac{4}{3}$$

$$0 = x - 4$$

$$4 = x$$

**STEP 4** Determine the coordinates of the  $y$ -intercept,  $(0, y)$ , by substituting  $x = 0$  and solving for  $y$ .

**$(0, -\frac{4}{3})$**

$$y = \frac{1}{3}x - \frac{4}{3}$$

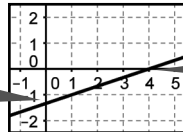
$$y = \frac{1}{3}(0) - \frac{4}{3}$$

$$y = (0) - \frac{4}{3}$$

$$y = -\frac{4}{3}$$

**STEP 5** Check the reasonableness of your calculated intercepts by making sure the given graph crosses the line at these points.

$y$ -intercept:  $(0, -\frac{4}{3})$   
or  $(0, -1\frac{1}{3})$



$x$ -intercept: (4, 0)

**EXAMPLE 2:** The graph of  $r(x)$  is shown. What is the zero of  $r$ ? Record your answer and fill in the bubbles on your answer document.

**STEP 1** Use the coordinates of the two points provided to determine the slope of the line.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - (-5)}{6 - 3} = \frac{12}{3} = 4$$

**$m = 4$**

**STEP 2** Use the point-slope formula to determine the equation of the line shown.

$$y - y_1 = m(x - x_1)$$

$$y - 7 = 4(x - 6)$$

$$y - 7 = 4x - 24$$

$$y = 4x - 17$$

**$r(x) = 4x - 17$**

**STEP 3** The zero of  $r$  is the  $x$ -value that makes  $r(x) = 0$ . Substitute 0 for  $r(x)$  and solve for  $x$ .

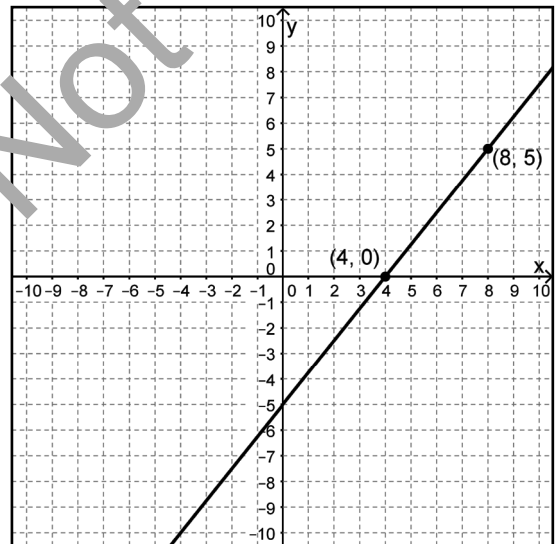
$$r(x) = 4x - 17$$

$$0 = 4x - 17$$

$$17 = 4x$$

$$\frac{17}{4} = x$$

**The zero is  $\frac{17}{4}$ .**



	4	.	2	5					
+	-		-	-	-	-	-	-	-
-	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1
	2	2		2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4
	5	5	5		5	5	5	5	5
	6	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9	9

- 
- A number line is shown with tick marks at 18, 19, 20, 21, and 22. A point is plotted at 20, and a line segment is drawn from the point to the left, ending at 18.

**Propane Consumption**

Time (months)	Volume (cubic feet)
0	500
20	0

A coordinate plane showing a line passing through the points  $(2, 450)$  and  $(3, 425)$ . A right triangle is drawn between these points to find the slope. The vertical change (rise) is labeled as  $-25$  (from 450 to 425), and the horizontal change (run) is labeled as  $+1$  (from 2 to 3).

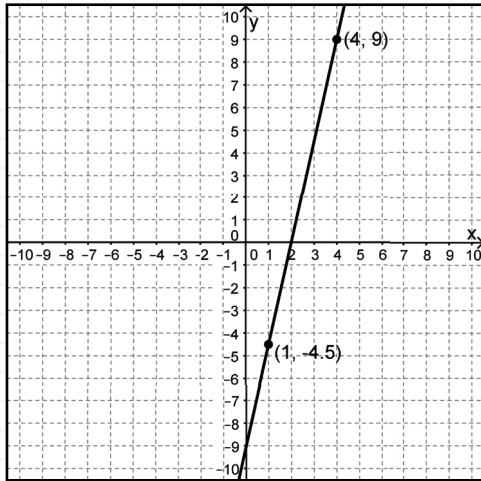
63



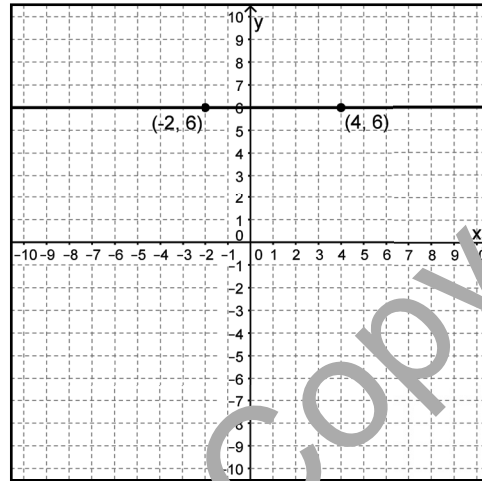
## PRACTICE

For each graph shown, identify the slope,  $x$ -intercept,  $y$ -intercept, and zero (if they exist).

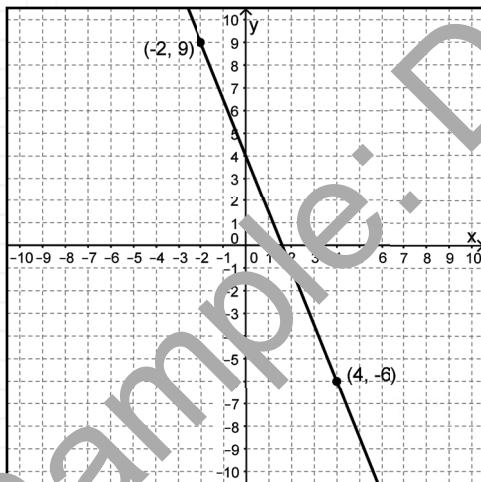
1.



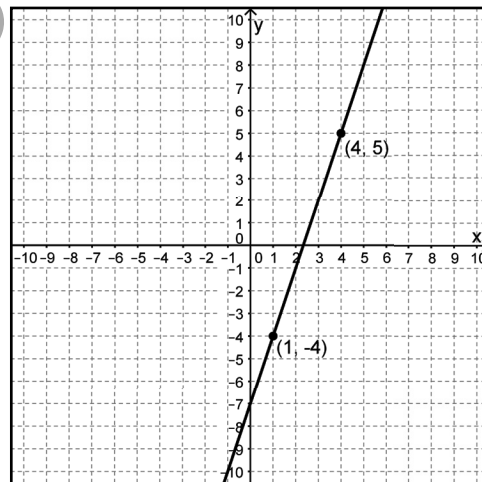
3.



2.

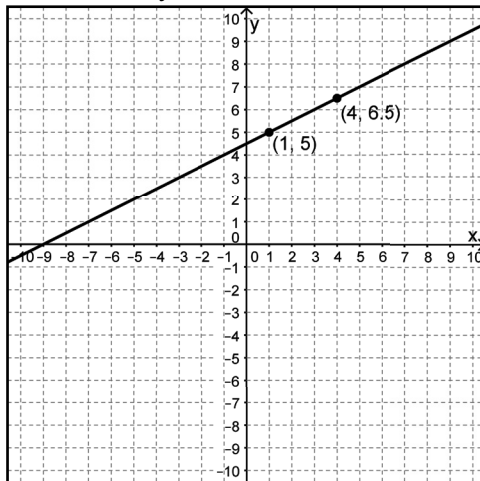


4.



5. Petra runs a snow cone stand in town. She sells snow cones in two sizes. Small cones sell for \$3 each and large cones sell for \$5 each. On Thursday evenings Petra sells an average of \$60 in snow cones. When the relationship of number of large cones sold,  $x$ , and the number of small cones sold,  $y$ , is plotted, what do the  $x$ - and  $y$ -intercepts represent?

6. The graph of linear function  $h(x)$  is shown. What is the zero of  $h(x)$ ? Record your answer and fill in the bubbles on your answer document.



+	-	-	-	-	-	-	-
-	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

7. Maya's Coffee Club gift card balance information is shown in the table below.

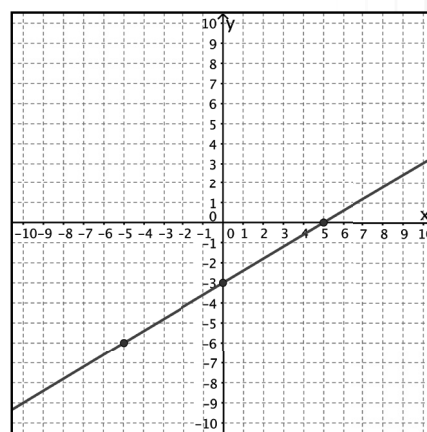
Days used, $x$	Balance (\$), $y$
13	71
14	68
20	50
26	32

If Maya writes a function to model the data on her gift card and graphs the function, where will the  $x$ - and  $y$ -intercepts be located?

8. Carolina often calls her mother who lives in Canada. A 6-minute international call to her mother costs \$7 and a 15-minute international call costs \$10. On the graph of the function  $f(m)$  that represents the situation, what do the slope and  $y$ -intercept represent?

- A** The slope is the connection fee of \$5 and the  $y$ -intercept is the cost per minute.  
**B** The slope is the cost per minute and the  $y$ -intercept is the cost of a 5-minute call.  
**C** The slope is the cost per minute and the  $y$ -intercept is the connection fee of \$5.  
**D** The slope is the cost to connect the call each minute and the  $y$ -intercept is the cost after talking 15-minutes.

9. The graph of a linear function is shown below.



How will the graph change if the slope remains the same and the zero is changed to 7?

- F** The graph will shift up 10 units.  
**G** The graph will shift down 2 units.  
**H** The graph will get steeper.  
**J** The graph will be less steep.