5-1 Identify Linear Functions and Their Graphs

Name _____ Date _____

Determine if $f(x) = x^3 - 1$ represents a linear function.

Make a function table. Look at the rate of change.

	+1	+1	+1	+1
x	−2	−1	0	1	2
y	−9	−2	−1	0	7
	+7	+1	+1	+7

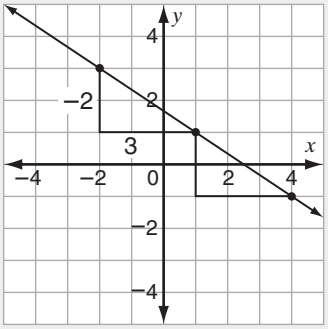
The constant change of +1 in x does not correspond to a constant change in y.

Because the $\frac{\text{change in } y}{\text{change in } x}$ is not constant,

$f(x) = x^3 - 1$ is not a linear function.

Remember: You can also use a graph to determine if a function is linear. If the graph of a function is a nonvertical line, it is a linear function.

Find the slope of the line.



$$\text{Slope } (m) = \frac{\text{vertical change}}{\text{horizontal change}} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{1 - 3}{1 - (-2)} \leftarrow \text{Substitute } (-2, 3) \text{ and } (1, 1) \text{ into the formula, and simplify.}$$

$$= \frac{-2}{3} = -\frac{2}{3}$$

The slope is $-\frac{2}{3}$; because the slope is negative, the line slants down from left to right.

Tell whether the relation represents a linear function. Explain *why* or *why not*. Find the slope of the line if it represents a linear function.

1.

x	y
−2	−6
−1	1
0	0
1	1
2	16

change in x constant: +1
change in y varies
16 − 1 = 15; 1 − 0 = 0
0 − 1 = −1; 1 − (−6) = 7
not a linear function

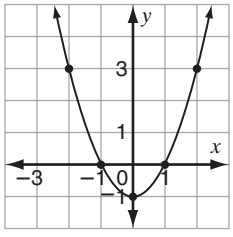
2.

x	y
−2	−32
−1	−1
0	0
1	−1
2	−32

3.

x	y
−2	−3
−1	−1
0	1
1	3
2	5

4.



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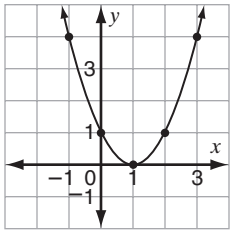

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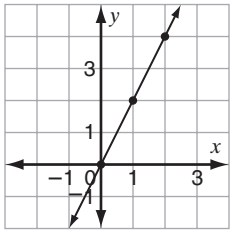

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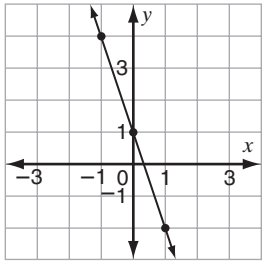


Tell whether the relation represents a linear function. Explain *why* or *why not*. Find the slope of the line if it represents a linear function.

8. $y = -4x + 8$

x	y
−2	16
−1	12
0	8
1	4
2	0

linear function
constant rate: $\frac{-4}{1}$
slope (m) = −4

9. $y = -3x - 6$

10. $y = -2x^2 + 5$

11. $y = 3x^2 - 2$

12. $y = x - 2.5$

13. $y = -x - 3.9$

14. $y = \frac{2}{3}x - 1$

15. $y = \frac{1}{4}x + 1$

16. $y = -\frac{2}{5}x - 1$

17. $y = -\frac{1}{6}x + 1$

18. $y = 8$

19. $x = -4$

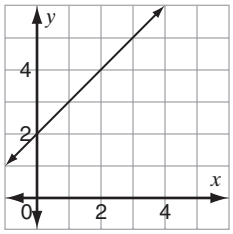
20. $y = -0.25x + 2$

21. $y = 0.125x - 2$

22. $y = -4x^3$

23. $y = \frac{x}{3} + 1$

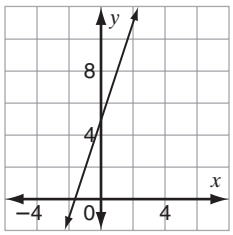
Find the slope of the line for each graph.

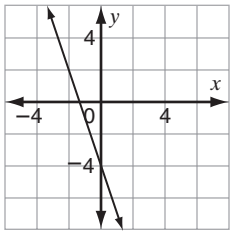
24. 

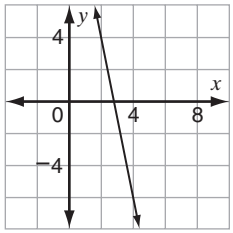
$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 2}{3 - 0}$

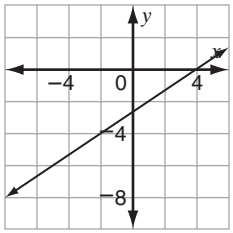
$= \frac{3}{3} = 1$

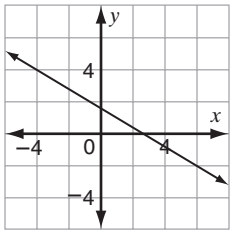
The slope is 1.

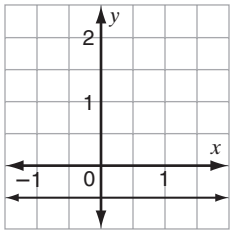
25. 

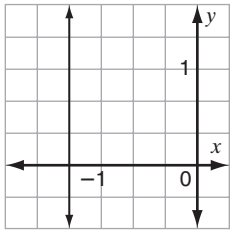
26. 

27. 

28. 

29. 

30. 

31. 

Find the slope of the line that contains the given points. Describe the line.

32. (3, 8) and (9, 6)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 8}{9 - 3} = \frac{-2}{6} = -\frac{1}{3}$

slope $= -\frac{1}{3}$; The line slants down from left to right.

33. (2, 7) and (11, 4)

34. (−8, −9) and (−6, −7)

35. (−11, −7) and (−8, −10)

36. (6.3, 8) and (6.3, 12)

37. $\left(-2, \frac{2}{5}\right)$ and $\left(4, \frac{2}{5}\right)$

38. (3.4, −2.5) and (5.4, −7.5)

39. (1.8, −3.9) and (5.8, −6.9)

40. $\left(2\frac{1}{5}, 3\frac{2}{3}\right)$ and (4, 6)

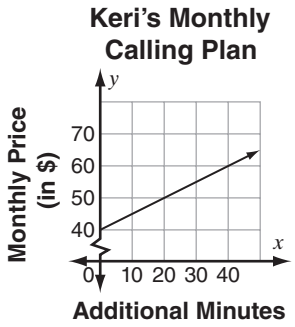
41. $\left(\frac{7}{3}, \frac{4}{3}\right)$ and $\left(-\frac{1}{3}, \frac{2}{3}\right)$

42. (2.7, 6.3) and (1, 8)

43. (−4.1, 7.1) and (9, −6)

Solve. Show your work.

44. The graph shows the cost of Keri's monthly calling plan on her cell phone.



a. What is the slope of this line? What does it mean?

b. This month, Keri used 28 additional minutes. How much was this month's bill?

45. Environment According to data provided by the Permanent Service for Mean Sea Level (PSMSL), the global sea level has been rising since 1870. According to their data, the global sea level had risen about 1 cm by 1920 and about 12 cm by 1980.

a. Using the rate for 1920 to 1980, at about what rate is the sea level rising?

b. At this rate, by how much will the global sea level have risen from 1870 to 2101?

Problem Solving

46. One side of a roof has a slope of $\frac{1}{4}$. The horizontal length of the roof is 48 ft. What is the height of the roof if the highest point is above the center of the horizontal length?

47. A hill rises 80 ft vertically over a 15-ft horizontal distance. A nearby hill rises at the same rate but is 300 ft tall. If the hills' highest points are above the center of the horizontal length of each hill, what is the horizontal length of the nearby hill?

CHALLENGE

48. A line with a slope of $\frac{7}{8}$ passes through the point $(-15, -13)$.
A different line with a slope of -1 passes through the point $(4, -2)$.
At what point do the two lines cross?