Section 2.2 Linearity

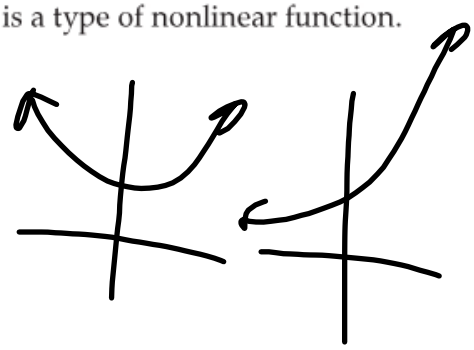
$y = 2$

$y = 3x + 2$

$y = \frac{1}{2}x$

1 Identify Linear Functions In a **linear function**, no variable is raised to a power other than 1. Any linear function can be written in the form $f(x) = mx + b$, where m and b are real numbers. Linear functions can be modeled by linear equations, which can be written in the form $Ax + By = C$. The graph of a linear equation is a straight line.

A function that is not linear is called a **nonlinear function**. The graph of a nonlinear function includes a set of points that cannot all lie on the same line. A nonlinear function cannot be written in the form $f(x) = mx + b$. A parabola is the graph of a quadratic function, which is a type of nonlinear function.



$2x + 3y = 6$

$y - 1 = \frac{2}{3}(x - 2)$

Key Concept Linear Functions

Words A linear function can be written in the form $f(x) = mx + b$ or $y = mx + b$, where m and b are real numbers.

Examples

$f(x) = -\frac{2}{3}x - 1$

$f(x) = \frac{1}{2}x$

$4x - 5y = 16$

Nonexamples

$f(x) = \frac{1}{x}$ $f(x) = x^{-1}$

$2x + 6y^2 = -25$

$x + \sqrt{xy} = \frac{5}{8}$

Example 1 Identify Linear Functions from Equations

State whether each function is a linear function. Write *yes* or *no*. Explain.

a. $3x + 2y = 8$

State whether each function is a linear function. Write yes or no. Explain.

A. $g(x) = 2x - 5$ yes

State whether each function is a linear function. Write yes or no. Explain.

B. $p(x) = x^3 + 2$ NO exp > 1

State whether each function is a linear function. Write yes or no. Explain.

C. $3y - 21x = 12$ yes

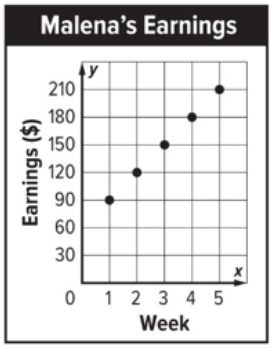
$3x - 21x = 12$

$-18x = 12$

$x = \frac{12}{-18}$

Real-World Example 2 Identify Linear Functions from Graphs

EARNINGS Malena and Helena work part-time at a smoothie store. The number of hours they worked increased for the first 5 weeks on the job.
The graph models Malena's weekly earnings, and the table models Helena's weekly earnings, for these 5 weeks. State whether each relation is a linear function. Explain.



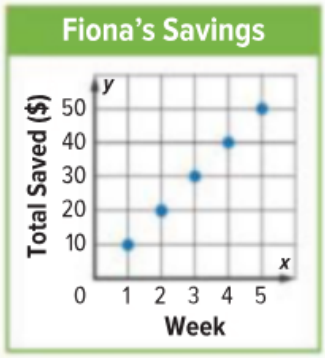
Helena's Earnings					
Week	1	2	3	4	5
Earnings ($)	60	120	180	210	240

State whether each function is a linear function. Write *yes* or *no*. Explain.

1. $f(x) = \frac{x + 12}{5}$ 2. $g(x) = \frac{7 - x}{x}$ 3. $y = 3x^2 - 4$ 4. $12y = 4x + 8$

5 **SAVINGS** Selena and Fiona are each saving money to buy a bicycle. The table shows how the total amount of Selena's savings has changed over time, and the graph shows how the total amount of Fiona's savings has changed over time. State whether each function is a linear function. Explain.

Selena's Savings					
Week	1	2	3	4	5
Total Saved ($)	10	25	40	55	70



State whether each equation or function is a linear function. Write *yes* or *no*. Explain.

10. $3y - 4x = 20$ 11. $y = x^2 - 6$ 12. $h(x) = 6$

13. $j(x) = 2x^2 + 4x + 1$ 14. $g(x) = 5 + \frac{6}{x}$ 15. $f(x) = \sqrt{7 - x}$

16. $4x + \sqrt{y} = 12$ 17. $\frac{1}{x} + \frac{1}{y} = 1$ 18. $f(x) = \frac{4x}{5} + \frac{8}{3}$