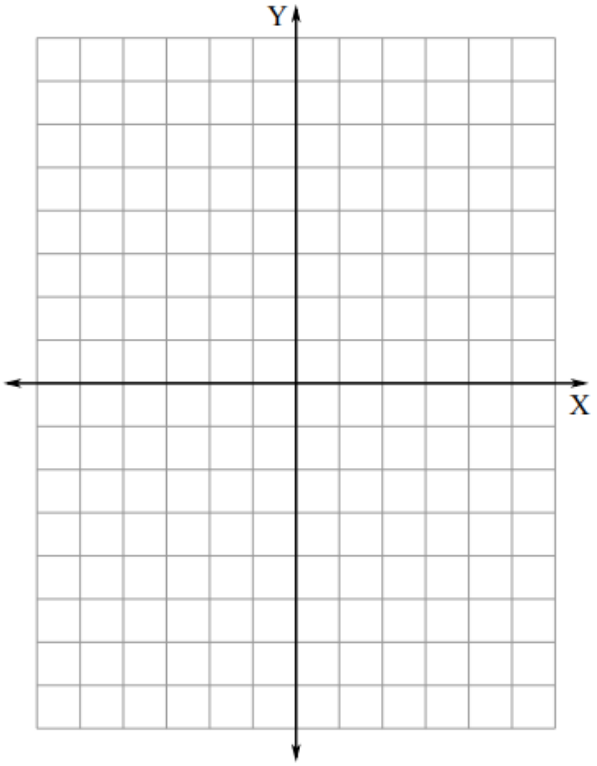
Bellringer

Graph the following equation:

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



4.4 Proportional and Nonproportional Situations

8.F.2
Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal expression)

8.F.3
Interpret the equation $y=mx+b$ as defining a linear function, whose graph is straight line; give examples of functions that are not linear

8.F.4
Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

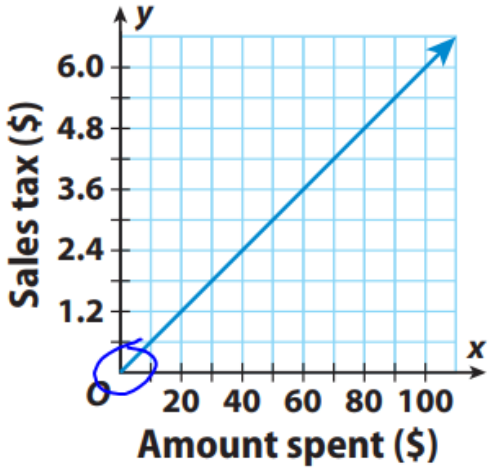
Distinguish Between Proportional and Nonproportional Situations Using a Graph

- Is it linear?
  - yes: proportional or nonproportional
  - no: nonproportional

- Does it cross the origin?
  - yes: proportional
  - no: nonproportional

EXAMPLE 1 Real World

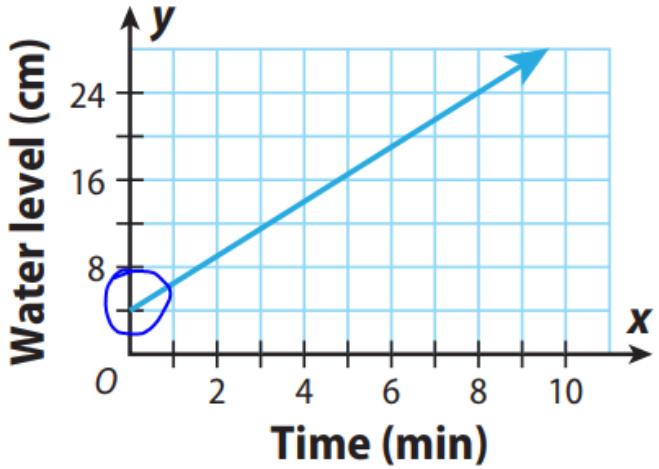
The graph shows the sales tax charged based on the amount spent at a video game store in a particular city. Does the graph show a linear relationship? Is the relationship proportional or nonproportional?



The graph shows a linear proportional relationship

ADDITIONAL EXAMPLE 1

The graph shows the water level as a bathtub fills. Does the graph show a linear relationship? Is the relationship proportional or nonproportional?

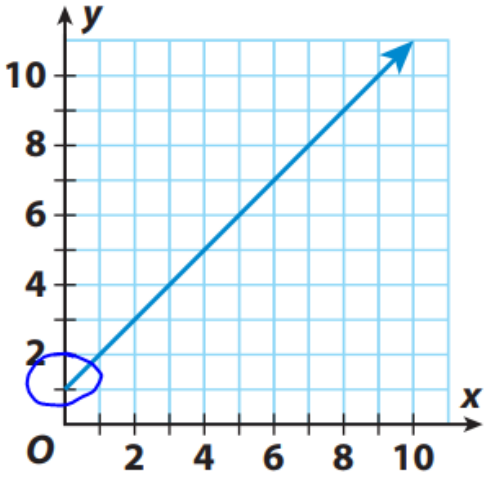


This graph represents a linear nonproportional relationship

YOUR TURN

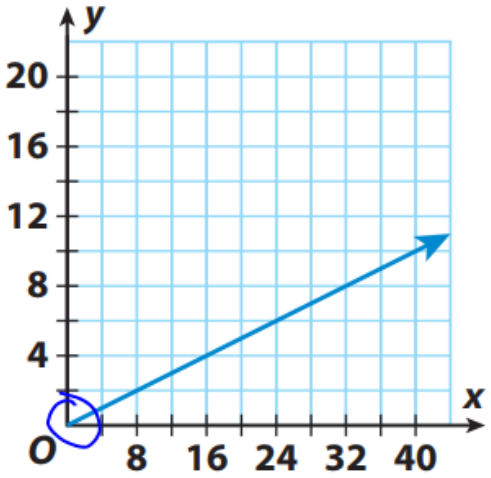
Determine if each of the following graphs represents a proportional or nonproportional relationship.

1.



Linear
N.P.

2.



Linear
Proportional

Distinguish Between Proportional and Nonproportional Situations Using an Equation

- Does it have a "b"

$$y = mx + b$$

b = y-intercept

$b = 0 \rightarrow$ proportional

$b \neq 0 \rightarrow$ nonproportional

EXAMPLE 2

The number of years since Keith graduated from middle school can be represented by the equation $y = a - 14$, where y is the number of years and a is his age. Is the relationship between the number of years since Keith graduated and his age proportional or nonproportional?

Linear nonproportional relationship with a y-intercept of -14

ADDITIONAL EXAMPLE 2

The change in a test score for each incorrect answer is represented by the equation $y = -\frac{x}{2}$, where x is the number of incorrect answers. Is the relationship between the number of incorrect answers and the change in score proportional or nonproportional?

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

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

Proportional

YOUR TURN

$y = mx + b$

Determine if each of the following equations represents a proportional or nonproportional relationship.

5. $d = 65t$

Proportional

6. $p = 0.1s + 2000$

Nonproportional

7. $n = 450 - 3p$

Nonproportional

8. $36 = 12d$

Nonproportional

Distinguish Between Proportional and Nonproportional Situations Using a Table

- Does it have a constant $\left(k = \frac{y}{x}\right)$?
  - ↳ yes: proportional & linear
  - ↳ no: nonproportional, could be linear or nonlinear
- If it is nonproportional
  - ↳ Check for constant rate of change
    - ↳ yes: linear, nonproportional
    - ↳ no: nonlinear, nonproportional

EXAMPLE 3 Real World

The values in the table represent the numbers of U.S. dollars three tourists traded for Mexican pesos. The relationship is linear. Is the relationship proportional or nonproportional?

U.S. Dollars Traded	Mexican Pesos Received
130	1,690
255	3,315
505	6,565

$K = \frac{y}{x}$

$K = \frac{1690}{130} = \frac{13}{1}$

$K = \frac{3315}{255} = \frac{13}{1}$

$K = \frac{6565}{505} = \frac{13}{1}$

Proportional Relationship

ADDITIONAL EXAMPLE 3

The table shows the distance of a train from a station and the time it will take to arrive. The relationship is linear. Is it proportional or nonproportional?

x	**Time (min)**	25	45	65
y	**Distance (mi)**	15	30	45

$K = \frac{y}{x}$

no constant

Nonproportional

$k = \frac{15}{25}$ $K = \frac{30}{45}$ $K = \frac{45}{65}$

$\frac{3}{5}$ $\frac{6}{9} = \frac{2}{3}$ $\frac{9}{13}$

YOUR TURN

Determine if the linear relationship represented by each table is a proportional or nonproportional relationship.

$k = \frac{y}{x}$

9.

x	y
2	30
8	90
14	150

$\frac{30}{2} = \frac{15}{1}$

$\frac{90}{6} = \frac{45}{4}$

$\frac{150}{14} = \frac{75}{7}$

Nonproportional

no constant

10.

x	y
5	1
40	8
65	13

$\frac{1}{5}$

$\frac{8}{40} = \frac{1}{5}$

$\frac{13}{65} = \frac{1}{5}$

Proportional

Comparing Proportional and Nonproportional Situations

EXAMPLE 4 Real World

A **A laser tag league has the choice of two arenas for a tournament. In both cases, x is the number of hours and y is the total charge. Compare and contrast these two situations.**

Arena A

$y = 225x$

Arena A:

$225/hr

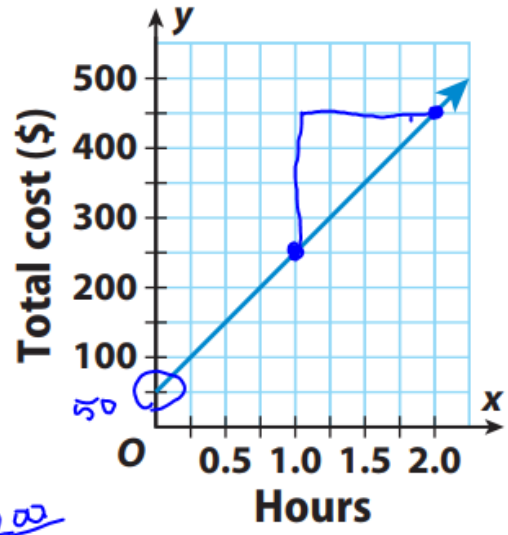
Arena B:

$200/hr

$50 fee

$y = 200x + 50$

Arena B



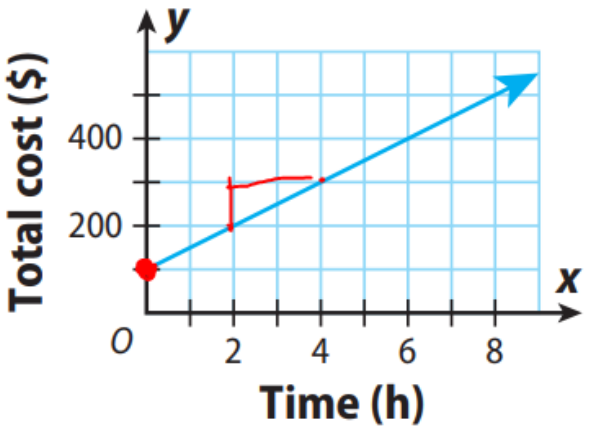
$\frac{200}{1}$

ADDITIONAL EXAMPLE 4

A John has a choice of hiring two plumbers. In both cases, x is the number of hours and y is the total charge in dollars. Compare and contrast these two situations.

Plumber A: $y = 75x$

Plumber B:



$\frac{\uparrow 100}{\rightarrow 2} = \frac{50}{1}$

Plumber A:

$y = 75x$

\$75/hr

Plumber B:

$y = 50x + 100$

- \$50/hr plus a \$100 one time fee

YOUR TURN

11. Compare and contrast the following two situations.

Test-Prep Center A	Test-Prep Center B
The cost for Test-Prep Center A is given by $c = 20h$, where c is the cost in dollars and h is the number of hours you attend.	Test-Prep Center B charges $25 per hour to attend, but you have a $100 coupon that you can use to reduce the cost.

1. Finish Graph Activity

2. GP/IP p 117-120 (1-13)