

6.1

Slope

Try These

i) $-3 - (-6) = \underline{3}$

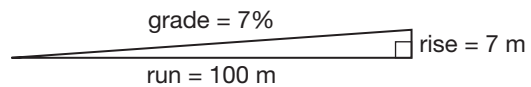
iii) $1 - 7 = \underline{-6}$

ii) $5 - (-4) = \underline{9}$

iv) $-2 - 10 = \underline{-12}$



Louise is travelling in British Columbia. She knows that 7% on this sign refers to the **slope** or **grade** of the hill.



For every 100 m of horizontal distance, the elevation increases by 7 m. How are grade and slope related?

slope (m)

a measure of the steepness of a line; the ratio of the vertical change to the horizontal change between two points

$$m = \frac{\text{rise}}{\text{run}} = \frac{\text{change in } y}{\text{change in } x}$$

grade

slope expressed as a percent

pitch

a term for slope

constant

not changing

1 Write the grade as a fraction in lowest terms. $7\% = \frac{7}{100}$

2 Write the slope as a ratio and as a decimal.

$$m = \frac{\text{rise}}{\text{run}}, \text{ which is } \frac{7}{100}, \text{ or } \underline{0.07} \text{ as a decimal}$$

3 Suppose the road had a rise of 8 m and a run of 100 m. What would the slope be? What would the grade be?

$$\text{Slope} = \frac{\text{rise}}{\text{run}}$$

$$= \frac{8}{100}$$

$$= \frac{2}{25}, \text{ or } \underline{0.08}$$

$$\text{Grade} = \text{slope} \times 100\%$$

$$= \frac{8}{100} \times 100\%$$

$$= \underline{8}\%$$

Slope as a decimal: 0.08 Grade of the road: 8%

Example 1

Zenaida is a contract developer. She is building a set of five steps. Each step must have a 6 in. rise height and a 10 in. tread depth.

- What is the **pitch** of each step?
- How does this compare to the pitch of the staircase?
- Is the pitch of the staircase **constant**?

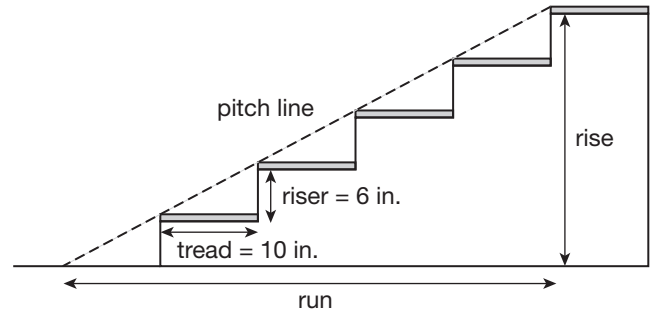
Solution

- A. What is the pitch of each step?

$$\frac{\text{rise}}{\text{run}} = \frac{\boxed{6}}{\boxed{10}}, \text{ or } \frac{\boxed{3}}{\boxed{5}}$$

- B. What is the pitch of the staircase?

$$\frac{\text{rise}}{\text{run}} = \frac{5 \times \boxed{6}}{5 \times \boxed{10}}, \text{ or } \frac{\boxed{30}}{\boxed{50}}, \text{ or } \frac{\boxed{3}}{\boxed{5}}$$

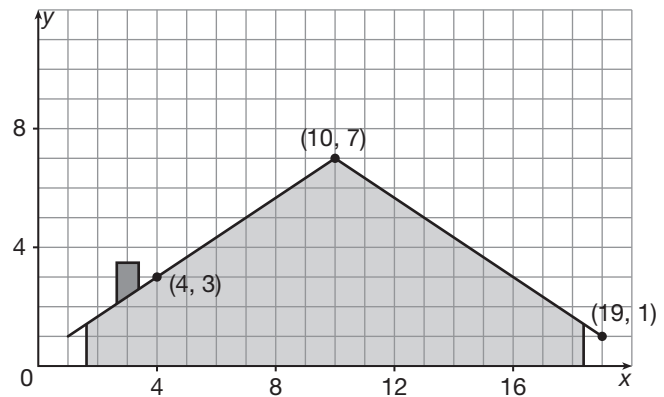


- C. The pitch of each step and the pitch of the staircase are

the same. The pitch of the staircase is constant.

Example 2

Marsha is a carpenter. She drew a plan for the roof of a house on grid paper. What is the slope of each side of the roof? How do the slopes compare?



Solution

- A. What is the slope of the left side?

Count the squares. Rise from (4, 3) to (10, 7): 4

Count the squares. Run from (4, 3) to (10, 7): 6

$$\frac{\text{rise}}{\text{run}} = \frac{\boxed{4}}{\boxed{6}}, \text{ or } \frac{\boxed{2}}{\boxed{3}}$$

- B. Use the coordinates. What is the slope of the left side?

Difference between y-coordinates: $7 - \underline{3} = \underline{4}$

Difference between x-coordinates: $\underline{10} - 4 = \underline{6}$

$$\frac{\text{rise}}{\text{run}} = \frac{\text{difference between } \boxed{y} \text{-coordinates}}{\text{difference between } \boxed{x} \text{-coordinates}}, \text{ or } \frac{\boxed{4}}{\boxed{6}}, \text{ or } \frac{\boxed{2}}{\boxed{3}}$$

- C. What is the slope of the right side? Use the slope formula.

$$m = \frac{y_2 - y_1}{x_2 - x_1}, \text{ or } \frac{7 - \boxed{1}}{\boxed{10} - 19}, \text{ or } \underline{\underline{-\frac{2}{3}}}$$

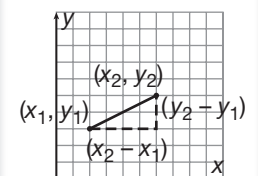
- D. How are the slopes the same? What does this show?

e.g., Both slopes have a ratio of 2 to 3. Both slopes represent the same steepness, or roof pitch.

Hint

Slope Formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



Slopes rising from left to right are positive. Slopes falling from left to right are negative.

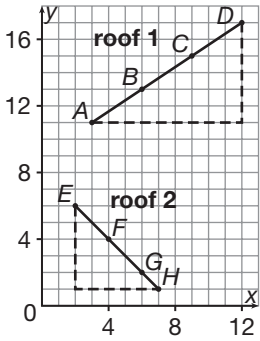
REFLECTING

Do the two sides of the roof have the same steepness? How do you know?

E. How are the slopes different? What does this show?

e.g., One is positive. One is negative. This shows that the parts of the roof are slanted in opposite directions.

Practice



1. a) Xavier is making plans for a building project. He drew the roof sections on the left. He needs to check that the pitch of each roof section is constant. Complete the chart. Are any changes needed? Explain.

Line segment	Rise	Run	Slope
AD	6	9	$\frac{6}{9} = \frac{2}{3}$
BC	2	3	$\frac{2}{3}$
EH	-5	5	-1
FG	-2	2	-1

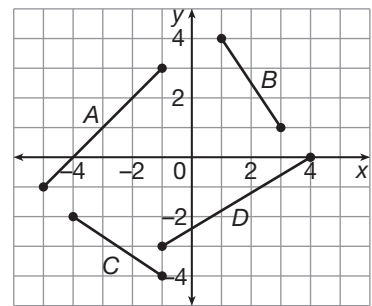
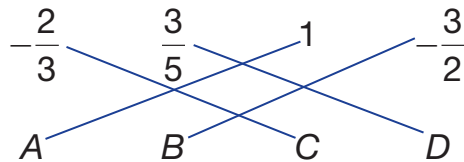
No. e.g., All slopes for roof 1 are the same. All slopes for roof 2 are the same.



b) The pitch of the roof on the left is not constant. What might happen to debris on the roof?

e.g., The debris might become stuck.

2. Match each slope with a line segment.



3. What is the slope of the line segment that joins each pair of points?

a) (4, 1) and (-6, -2)

$$\frac{-2 - 1}{-6 - 4} = \frac{-3}{-10}, \text{ or } \frac{3}{10}$$

c) (-3, 3) and (7, -1)

$$\frac{-1 - 3}{7 - (-3)} = \frac{-4}{10}, \text{ or } -\frac{2}{5}$$

b) (-10, -25) and (-16, -55)

$$\frac{-55 - (-25)}{-16 - (-10)} = \frac{-30}{-6}, \text{ or } 5$$

d) (12, 8) and (2, 10)

$$\frac{10 - 8}{2 - 12} = \frac{2}{-10}, \text{ or } -\frac{1}{5}$$

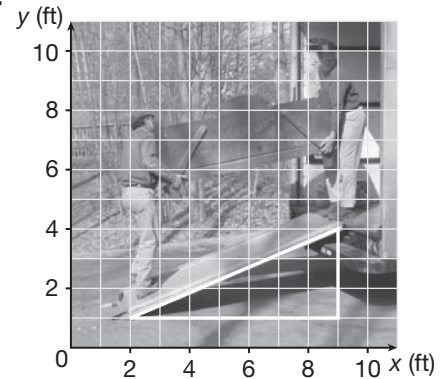
4. a) What is the slope of this ramp? What is the grade?

Rise: 3 ft Run: 7 ft

Slope: $\frac{3 \text{ ft}}{7 \text{ ft}} = \frac{3}{7}$, or 0.428... as a decimal

Grade: 0.428... $\times 100\% \doteq$ 43 %

The slope of the ramp is $\frac{3}{7}$, or 0.428.... The grade is about 43%.

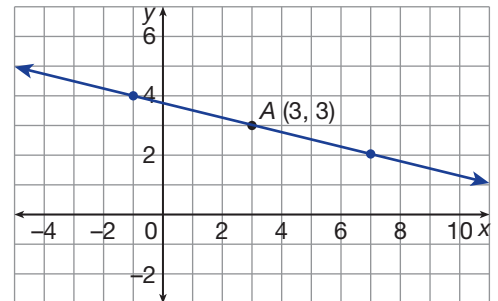


- b) Verify the slope of the ramp for Part a). Use

the slope formula: $m = \frac{y_2 - y_1}{x_2 - x_1}$

e.g., $m = \frac{4 - 1}{9 - 2} = \frac{3}{7}$, or about 0.43. This verifies the slope for Part a).

5. Draw a straight line through point A(3, 3) with slope $-\frac{1}{4}$. Mark another point on this line. Repeat these steps using the slope $\frac{1}{-4}$.



- a) Do all three points lie on the same straight line? yes

- b) What is the slope of the line joining the two points you plotted?

$$\begin{aligned} \text{e.g., } m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{2 - 4}{7 - (-1)} \\ &= \frac{-2}{8}, \text{ or } -\frac{1}{4} \quad \text{The slope is } \frac{-1}{4} = \frac{1}{-4}. \end{aligned}$$

REFLECTING

When might someone use a slope formula at work?

6. Ray is installing an eavestrough. He needs the eavestrough to drop 1 in. for every 60 in. length so the water will drain properly.

- a) What is the slope of the eavestrough?

Slope: $\frac{\text{rise}}{\text{run}} = \frac{-1 \text{ in.}}{60 \text{ in.}}$, or $-\frac{1}{60}$

The slope of the eavestrough is $-\frac{1}{60}$.



- b) Ray found standing water in the eavestrough. How can he fix this?

e.g., He can make the eavestrough slope more steeply by increasing the drop.