

SCAVENGER HUNT



SLOPES OF PARALLEL AND PERPENDICULAR LINES

Perpendicular Slopes: Opposite Reciprocals

Change the sign, turn the fraction over · slopes and equations · the cards check the answers

FREE

ANSWER

$$\frac{4}{7}$$

Line n has slope -3 .

Find the slope of a line perpendicular to line n .

Two steps make a perpendicular slope. Change the sign, then turn the fraction over.

P

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1. **Tape the 16 cards around the room**, in any order. Each card has a large letter in its bottom left corner. Start each group at a *different* one of these eight cards: *P A C G K N J E*.
2. **Say this once:** “Each card gives a line n . Find the slope of a line perpendicular to n . Do two steps: change the sign, then turn the fraction over. Write the answer as a fraction in lowest terms or a whole number, like $-3/8$. Then walk to the card with that answer at the top.”
3. **Each group writes one line per card.** Eight right answers bring the group back to its first card.

16 cards	pages 3–10, one copy. There are two cards on each sheet. Cut the whole stack once.
Record sheet	page 11, one per student. It has a column for each of the two steps.
Answers	pages 12–13, for you only. Do not put them up in the room.

Two lines are perpendicular when their slopes are opposite reciprocals. To find a perpendicular slope, change the sign and turn the fraction over: $-\frac{2}{5}$ becomes $\frac{5}{2}$, and 3 becomes $-\frac{1}{3}$. A whole number is a fraction over 1. The two slopes multiply to -1 , which is a quick check. Eight of the cards give the line as an equation $y = mx + b$, already solved for y , so the slope is the number in front of x . The others give the slope itself.

Eight of the sixteen cards make the ring. A group reaches the other eight only by a wrong answer, but all the cards look the same. Students make two different mistakes here, about equally often. Some change the sign and forget to turn the fraction over. Others turn the fraction over and keep the sign. The two mistakes take turns around the ring, and each lands on a card off the ring. That card sends the group back to the card it got wrong.

The check is the length of the group’s list. A clean run is **eight lines**. Each wrong answer adds two. Every card has a line in italics under its question. It tells a group that arrived by a wrong answer what to check. A group that arrived by a right answer skips it. Guessing does not work: no single rule, such as only changing the sign, gets more than two of the cards. The record sheet has one column for each step, so you can see which step a student leaves out.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.

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ANSWER

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

Line n : $y = \frac{2}{5}x + 1$

Find the slope of a line perpendicular to line n .

In a perpendicular pair, one line goes up and the other goes down. Check the signs.

A

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ANSWER

$$-\frac{3}{5}$$

Line n : $y = 6x - 2$

Find the slope of a line perpendicular to line n .

A steep line meets a flat line at a right angle. Is one slope big and one small?

B

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ANSWER

$$-\frac{5}{2}$$

Line n : $y = \frac{4}{3}x - 2$

Find the slope of a line perpendicular to line n .

Is your answer the fraction of line n upside down?

C

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ANSWER

$$\frac{2}{7}$$

Line n : $y = -5x - 1$

Find the slope of a line perpendicular to line n .

Turn the fraction over as well. The top and the bottom swap with each other.

D

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ANSWER

$$-\frac{5}{3}$$

Line n : $y = -\frac{7}{4}x + 2$

Find the slope of a line perpendicular to line n .

Does one slope have a minus sign and the other no minus sign?

E

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ANSWER

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

Line n has slope $\frac{2}{5}$.

Find the slope of a line perpendicular to line n .

Turn the fraction over: the top goes to the bottom. Is that step in the work?

F

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ANSWER

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

Line n has slope -5 .

Find the slope of a line perpendicular to line n .

A perpendicular slope always has the other sign. Look at the minus sign.

G

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ANSWER

$$3$$

Line n has slope $-\frac{7}{4}$.

Find the slope of a line perpendicular to line n .

Write the whole number over 1. Then turn the fraction over, so the 1 goes on top.

H

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ANSWER

$$-\frac{1}{6}$$

Line n has slope $\frac{3}{5}$.

Find the slope of a line perpendicular to line n .

Write a whole number over 1 first. Then do each step on the fraction.

J

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ANSWER

$$\frac{1}{5}$$

Line n : $y = -\frac{2}{7}x + 3$

Find the slope of a line perpendicular to line n .

A steep line meets a flat line at a right angle. Is one slope big and one small?

K

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ANSWER

$$\frac{5}{2}$$

Line n : $y = -3x + 4$

Find the slope of a line perpendicular to line n .

Uphill and downhill lines meet at right angles. Which sign does each slope have?

L

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ANSWER

$$\frac{1}{6}$$

Line n has slope $-\frac{2}{7}$.

Find the slope of a line perpendicular to line n .

Change the sign as well. A positive slope gives a negative perpendicular slope.

M

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ANSWER

$$\frac{7}{2}$$

Line n has slope 6.

Find the slope of a line perpendicular to line n .

Multiply the two slopes. A perpendicular pair always gives -1 .

N

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ANSWER

$$\frac{4}{7}$$

Line n has slope -3 .

Find the slope of a line perpendicular to line n .

Two steps make a perpendicular slope. Change the sign, then turn the fraction over.

P

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ANSWER

$$-\frac{4}{7}$$

Line n : $y = \frac{3}{5}x - 4$

Find the slope of a line perpendicular to line n .

Say the two steps out loud. Which step changes the sign?

Q

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ANSWER

$$-\frac{1}{5}$$

Line n has slope $\frac{4}{3}$.

Find the slope of a line perpendicular to line n .

Check the sign step. A negative slope gives a positive perpendicular slope.

R

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Scavenger Hunt — where I went

Perpendicular slopes

Name _____

Period _____

Date _____

For each card, write the slope of line n . Then change the sign. Then turn the fraction over. That is the answer. Find the card with your answer at the top. A clean run is eight lines. Each card has a line in italics under its question. **If you are on a card because you went wrong, its line says what to check. If you were right, skip it.**

Perpendicular slope, in two steps: change the sign, then turn the fraction over. $-\frac{2}{3} \rightarrow \frac{2}{3} \rightarrow \frac{3}{2}$.

Write a slope as a whole number or a fraction in lowest terms, with its sign: $-\frac{3}{4}$, 5, $-\frac{1}{2}$. A whole number is a fraction over 1: $5 = \frac{5}{1}$.

Card letter	Slope of line n	Change the sign	Turn it over	Answer: the perpendicular slope
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

What kind of reciprocal do two perpendicular slopes need?

Every number stands for a letter. Write the letter for each answer in the box above its number. Read the boxes you filled, left to right. **If they do not spell the answer, one of your answers is wrong.**

$-\frac{5}{2} = O$ $-\frac{5}{3} = P$ $-\frac{4}{3} = O$ $-\frac{3}{4} = P$ $-\frac{3}{5} = S$ $-\frac{4}{7} = I$ $-\frac{1}{5} = E$ $-\frac{1}{6} = O$ $\frac{1}{6} = T$ $\frac{1}{5} = S$ $\frac{2}{7} = P$ $\frac{1}{3} = I$ $\frac{4}{7} = T$

$\frac{5}{2} = P$ $3 = O$ $\frac{7}{2} = E$

$-\frac{5}{2}$	$-\frac{5}{3}$	$-\frac{4}{3}$	$-\frac{3}{4}$	$-\frac{3}{5}$	$-\frac{4}{7}$	$-\frac{1}{5}$	$-\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{2}{7}$	$\frac{1}{3}$	$\frac{4}{7}$	$\frac{5}{2}$	3	$\frac{7}{2}$	



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Scavenger Hunt — answers

For the teacher

The ring in order, with the answer found on each card. A group may begin anywhere on it. Wherever it begins, eight right answers bring it back to that card.

P (1/3) → A (-5/2) → C (-3/4) → G (1/5) → K (7/2) → N (-1/6) → J (-5/3) → E (4/7) → P

What kind of reciprocal do two perpendicular slopes need? The answer is *OPPOSITE!* It is read along the boxes of the record sheet, which run from the smallest number to the largest. This sheet writes every slope as a whole number or a fraction in lowest terms, with its sign in front. Some textbooks use other definitions, so tell the class which ones this sheet uses.

Card	What the card shows	Answer, and why	The common wrong answer on this card, and why	Letter of its top
1 P	Line n: slope -3. Find the slope of a line perpendicular to n.	1/3. Change the sign: 3. Turn it over: 1/3. Check: $-3 \times 1/3 = -1$.	3. The sign is changed and the fraction is not turned over: -3 becomes 3. Then -3×3 is not -1.	T
2 A	Line n: $y = (2/5)x + 1$. Find the slope of a line perpendicular to n.	-5/2. The equation is solved for y, so the slope of n is the number in front of x, 2/5. Change the sign: -2/5. Turn it over: -5/2. Check: $2/5 \times -5/2 = -1$.	5/2. The fraction is turned over and the sign is kept: 2/5 becomes 5/2. The product of the two slopes is 1, not -1.	I
3 C	Line n: $y = (4/3)x - 2$. Find the slope of a line perpendicular to n.	-3/4. The equation is solved for y, so the slope of n is the number in front of x, 4/3. Change the sign: -4/3. Turn it over: -3/4. Check: $4/3 \times -3/4 = -1$.	-4/3. The sign is changed and the fraction is not turned over: 4/3 becomes -4/3. Then $4/3 \times -4/3$ is not -1.	O
4 G	Line n: slope -5. Find the slope of a line perpendicular to n.	1/5. Change the sign: 5. Turn it over: 1/5. Check: $-5 \times 1/5 = -1$.	-1/5. The fraction is turned over and the sign is kept: -5 becomes -1/5. The product of the two slopes is 1, not -1.	P
5 K	Line n: $y = -(2/7)x + 3$. Find the slope of a line perpendicular to n.	7/2. The equation is solved for y, so the slope of n is the number in front of x, -2/7. Change the sign: 2/7. Turn it over: 7/2. Check: $-2/7 \times 7/2 = -1$.	2/7. The sign is changed and the fraction is not turned over: -2/7 becomes 2/7. Then $-2/7 \times 2/7$ is not -1.	S
6 N	Line n: slope 6. Find the slope of a line perpendicular to n.	-1/6. Change the sign: -6. Turn it over: -1/6. Check: $6 \times -1/6 = -1$.	1/6. The fraction is turned over and the sign is kept: 6 becomes 1/6. The product of the two slopes is 1, not -1.	E
7 J	Line n: slope 3/5. Find the slope of a line perpendicular to n.	-5/3. Change the sign: -3/5. Turn it over: -5/3. Check: $3/5 \times -5/3 = -1$.	-3/5. The sign is changed and the fraction is not turned over: 3/5 becomes -3/5. Then $3/5 \times -3/5$ is not -1.	O
8 E	Line n: $y = -(7/4)x + 2$. Find the slope of a line perpendicular to n.	4/7. The equation is solved for y, so the slope of n is the number in front of x, -7/4. Change the sign: 7/4. Turn it over: 4/7. Check: $-7/4 \times 4/7 = -1$.	-4/7. The fraction is turned over and the sign is kept: -7/4 becomes -4/7. The product of the two slopes is 1, not -1.	P

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The number at the top of each one is the wrong answer from one ring card. Its right answer is the number at the top of that ring card, so the group goes to the card it got wrong and tries it again. If the group makes the same mistake here, it goes to another card off the ring. So a second wrong answer never moves a group forward.

Card	What the card shows	Answer, and why	The common wrong answer on this card, and why	Letter of its top
H	Line n: slope $-7/4$. Find the slope of a line perpendicular to n.	4/7 . Change the sign: $7/4$. Turn it over: $4/7$. Check: $-7/4 \times 4/7 = -1$.	$-4/7$. The fraction is turned over and the sign is kept: $-7/4$ becomes $-4/7$. The product of the two slopes is 1, not -1 .	O
L	Line n: $y = -3x + 4$. Find the slope of a line perpendicular to n.	1/3 . The equation is solved for y, so the slope of n is the number in front of x, -3 . Change the sign: 3. Turn it over: $1/3$. Check: $-3 \times 1/3 = -1$.	3. The sign is changed and the fraction is not turned over: -3 becomes 3. Then -3×3 is not -1 .	P
F	Line n: slope $2/5$. Find the slope of a line perpendicular to n.	$-5/2$. Change the sign: $-2/5$. Turn it over: $-5/2$. Check: $2/5 \times -5/2 = -1$.	$5/2$. The fraction is turned over and the sign is kept: $2/5$ becomes $5/2$. The product of the two slopes is 1, not -1 .	O
R	Line n: slope $4/3$. Find the slope of a line perpendicular to n.	$-3/4$. Change the sign: $-4/3$. Turn it over: $-3/4$. Check: $4/3 \times -3/4 = -1$.	$-4/3$. The sign is changed and the fraction is not turned over: $4/3$ becomes $-4/3$. Then $4/3 \times -4/3$ is not -1 .	E
D	Line n: $y = -5x - 1$. Find the slope of a line perpendicular to n.	1/5 . The equation is solved for y, so the slope of n is the number in front of x, -5 . Change the sign: 5. Turn it over: $1/5$. Check: $-5 \times 1/5 = -1$.	$-1/5$. The fraction is turned over and the sign is kept: -5 becomes $-1/5$. The product of the two slopes is 1, not -1 .	P
M	Line n: slope $-2/7$. Find the slope of a line perpendicular to n.	7/2 . Change the sign: $2/7$. Turn it over: $7/2$. Check: $-2/7 \times 7/2 = -1$.	$2/7$. The sign is changed and the fraction is not turned over: $-2/7$ becomes $2/7$. Then $-2/7 \times 2/7$ is not -1 .	T
B	Line n: $y = 6x - 2$. Find the slope of a line perpendicular to n.	$-1/6$. The equation is solved for y, so the slope of n is the number in front of x, 6. Change the sign: -6 . Turn it over: $-1/6$. Check: $6 \times -1/6 = -1$.	$1/6$. The fraction is turned over and the sign is kept: 6 becomes $1/6$. The product of the two slopes is 1, not -1 .	S
Q	Line n: $y = (3/5)x - 4$. Find the slope of a line perpendicular to n.	$-5/3$. The equation is solved for y, so the slope of n is the number in front of x, $3/5$. Change the sign: $-3/5$. Turn it over: $-5/3$. Check: $3/5 \times -5/3 = -1$.	$-3/5$. The sign is changed and the fraction is not turned over: $3/5$ becomes $-3/5$. Then $3/5 \times -3/5$ is not -1 .	I

Other mistakes lead to no card. A group might copy the slope of n without changing it, which gives the slope of a parallel line. On a card with an equation, it might take the number b at the end as the slope. Its answer is then not the number at the top of any card, and the group knows to check its work.