

SCAVENGER HUNT



PARTITIONING A DIRECTED LINE SEGMENT

Partitioning a Directed Segment

Two points and a ratio on every card · the trip in equal steps · the cards check the answers

FREE

ANSWER

$(-1, 2)$

$A(7, -8)$ and $B(-7, -1)$

P is on the segment from A to B , and $AP : PB = 5 : 2$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

A ratio with the smaller number first puts P nearer the start.

S

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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: *S B D L Q A C F*.
2. **Say this once:** *“The trip starts at the point A. Add the two numbers of the ratio to get the number of equal steps. Find the change from A to B, take your share of it, and add it to A. Then walk to the card with your point 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 shows a segment cut into equal steps.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card gives two points and a ratio, such as $AP : PB = 5 : 2$. On these sheets that means the trip starts at A and is cut into $5 + 2 = 7$ equal steps, and P is 5 steps from A, so P is $5/7$ of the way from A to B. The change from A to B is $B - A$, one coordinate at a time: for $A(7, -8)$ and $B(-7, -1)$ it is $(-7 - 7, -1 - (-8)) = (-14, 7)$. Some textbooks use other definitions, so tell the class which ones this sheet uses. Every answer is a pair of whole numbers. Five cards print B’s point before A’s, but every trip still starts at A.

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. There are two mistakes. In the first, the student swaps the fractions and puts P nearer the wrong end. Starting at B instead of A gives the same wrong point. In the second, the student reads a ratio such as $3 : 2$ as the fraction $3/2$ instead of $3/5$. Each of these 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 simple rule, such as walking to the point nearest A, gets more than eight of the cards. If a group keeps coming back to the same cards, ask: *“How many equal steps? Which end should P be nearer?”*



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ANSWER

(5, 5)

$A(2, 1)$ and $B(-2, 5)$

P is on the segment from A to B , and $AP : PB = 3 : 1$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Count all the steps of the whole trip first. Then take some of them.

A

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ANSWER

(-3, -3)

$B(6, 8)$ and $A(-4, -2)$

P is on the segment from A to B , and $AP : PB = 3 : 2$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Add the two numbers of the ratio. The sum is the number of equal steps.

B

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ANSWER

$(-1, 4)$

$A(2, -4)$ and $B(9, 3)$

P is on the segment from A to B , and $AP : PB = 4 : 3$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Find the midpoint first. Is P on the correct side of it?

C

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ANSWER

$(2, 4)$

$A(7, -3)$ and $B(-7, -10)$

P is on the segment from A to B , and $AP : PB = 2 : 5$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Which end is P nearer? Check it against the ratio.

D

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ANSWER

$(-10, 13)$

$B(-5, -5)$ and $A(9, 9)$

P is on the segment from A to B , and $AP : PB = 2 : 5$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

A ratio is not a fraction. The bottom is the sum of both ratio numbers.

E

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ANSWER

$(6, 0)$

$B(-2, 3)$ and $A(2, -1)$

P is on the segment from A to B , and $AP : PB = 3 : 1$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

P is between the two ends. Does your fraction go past the end?

F

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ANSWER

$(-1, -1)$

$A(1, -2)$ and $B(-3, 2)$

P is on the segment from A to B , and $AP : PB = 3 : 1$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Check the start. $AP : PB$ starts at A . Is P nearer A or nearer B ?

G

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ANSWER

$(-10, 11)$

$A(8, 2)$ and $B(3, -3)$

P is on the segment from A to B , and $AP : PB = 2 : 3$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Two ratio numbers make one whole trip. Add them to find the whole.

H

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ANSWER

$(-11, 10)$

$A(-5, -9)$ and $B(5, -4)$

P is on the segment from A to B , and $AP : PB = 4 : 1$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

The ratio counts the steps on each side of P . How many steps make the whole trip?

J

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ANSWER

$(-3, -8)$

$A(-1, 1)$ and $B(3, 5)$

P is on the segment from A to B , and $AP : PB = 3 : 1$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Which end owns the bigger ratio number? P is nearer the other end.

K

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ANSWER

$(3, -5)$

$A(4, -5)$ and $B(-6, 5)$

P is on the segment from A to B , and $AP : PB = 3 : 2$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

Is the sum of the two ratio numbers at the bottom of your fraction?

L

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ANSWER

$(5, -1)$

$A(5, -2)$ and $B(-5, 8)$

P is on the segment from A to B , and $AP : PB = 3 : 2$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

The start's own ratio number is the top of the fraction. Which side of the midpoint is P ?

M

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ANSWER

(11, 13)

$B(5, -7)$ and $A(-5, -2)$

P is on the segment from A to B , and $AP : PB = 1 : 4$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

The bottom of the fraction is the whole trip, both ratio numbers together.

N

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ANSWER

(-2, 1)

$B(-4, -4)$ and $A(8, 8)$

P is on the segment from A to B , and $AP : PB = 1 : 3$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

A point near the start is made mostly of the start.

Q

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ANSWER

$(3, -6)$

$A(5, -4)$ and $B(-5, 6)$

P is on the segment from A to B , and $AP : PB = 3 : 2$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

The start owns the first ratio number. It goes on top of the fraction.

R

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ANSWER

$(-1, 2)$

$A(7, -8)$ and $B(-7, -1)$

P is on the segment from A to B , and $AP : PB = 5 : 2$. Where is P ?

Start at A . The answer is a point (x, y) with whole numbers.

A ratio with the smaller number first puts P nearer the start.

S

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Scavenger Hunt — where I went

Partitioning a segment

Name _____

Period _____

Date _____

For each card, write the number of equal steps, the change from A to B , and the point P . **Every trip starts at A . Write each answer as a point (x, y) . Every answer here is a pair of whole numbers. No fractions or decimals.** Then find the card with your point 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.**

$AP : PB = 2 : 1$ means: start at A . Cut the trip from A to B into $2 + 1 = 3$ equal steps. P is 2 steps from A , so P is $\frac{2}{3}$ of the way from A to B .

To find P : take $\frac{2}{3}$ of the change from A to B , and add it to A . Do x and y the same way.

The trip starts at the first letter of the ratio, so $BP : PA$ starts at B . From A to B is not the same trip as from B to A .

Card letter	Steps	Change from A to B	The point P
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

How does a point walk along a segment?

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

$(-11, 10) = W$ $(-10, 11) = E$ $(-10, 13) = P$ $(-3, -8) = T$ $(-3, -3) = S$ $(-2, 1) = T$ $(-1, -1) = I$ $(-1, 2) = E$ $(-1, 4) = P$
 $(2, 4) = W$ $(3, -6) = S$ $(3, -5) = I$ $(5, -1) = E$ $(5, 5) = S$ $(6, 0) = E$ $(11, 13) = S$

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$(-11, 10)$ $(-10, 11)$ $(-10, 13)$ $(-3, -8)$ $(-3, -3)$ $(-2, 1)$ $(-1, -1)$ $(-1, 2)$ $(-1, 4)$ $(2, 4)$ $(3, -6)$ $(3, -5)$ $(5, -1)$ $(5, 5)$ $(6, 0)$ $(11, 13)$



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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.

S (-3, -3) → B (2, 4) → D (3, -5) → L (-2, 1) → Q (5, 5) → A (-1, 4) → C (6, 0) → F (-1, 2) → S

How does a point walk along a segment? The answer is *STEPWISE!* It is read along the boxes of the record sheet, which list the points in order of their first number, and of their second number when the first numbers are the same. On every card the trip starts at A.

Card	The question	Answer, and why	The common wrong answer on this card, and why	Letter of its top
1 S	A(7, -8) and B(-7, -1), from A to B, AP : PB = 5 : 2.	(-3, -3) . 5 + 2 = 7 steps. The change from A to B is (-14, 7). 5/7 of it is (-10, 5). A + (-10, 5) = (-3, -3).	(3, -6). The fractions are swapped: 2/7 of the change is added to A, which puts P nearer A. The same point comes from starting at B. P must be nearer B, 5 steps of 7 from A.	E
2 B	B(6, 8) and A(-4, -2), from A to B, AP : PB = 3 : 2.	(2, 4) . 3 + 2 = 5 steps. The change from A to B is (10, 10). 3/5 of it is (6, 6). A + (6, 6) = (2, 4).	(11, 13). The ratio 3 : 2 is read as the fraction 3/2, which goes past B. The trip has 5 steps, so the fraction is 3/5.	S
3 D	A(7, -3) and B(-7, -10), from A to B, AP : PB = 2 : 5.	(3, -5) . 2 + 5 = 7 steps. The change from A to B is (-14, -7). 2/7 of it is (-4, -2). A + (-4, -2) = (3, -5).	(-3, -8). The fractions are swapped: 5/7 of the change is added to A, which puts P nearer B. The same point comes from starting at B. P must be nearer A, 2 steps of 7 from A.	W
4 L	A(4, -5) and B(-6, 5), from A to B, AP : PB = 3 : 2.	(-2, 1) . 3 + 2 = 5 steps. The change from A to B is (-10, 10). 3/5 of it is (-6, 6). A + (-6, 6) = (-2, 1).	(-11, 10). The ratio 3 : 2 is read as the fraction 3/2, which goes past B. The trip has 5 steps, so the fraction is 3/5.	I
5 Q	B(-4, -4) and A(8, 8), from A to B, AP : PB = 1 : 3.	(5, 5) . 1 + 3 = 4 steps. The change from A to B is (-12, -12). 1/4 of it is (-3, -3). A + (-3, -3) = (5, 5).	(-1, -1). The fractions are swapped: 3/4 of the change is added to A, which puts P nearer B. The same point comes from starting at B. P must be nearer A, 1 step of 4 from A.	T
6 A	A(2, 1) and B(-2, 5), from A to B, AP : PB = 3 : 1.	(-1, 4) . 3 + 1 = 4 steps. The change from A to B is (-4, 4). 3/4 of it is (-3, 3). A + (-3, 3) = (-1, 4).	(-10, 13). The ratio 3 : 1 is read as the fraction 3/1, which goes past B. The trip has 4 steps, so the fraction is 3/4.	S
7 C	A(2, -4) and B(9, 3), from A to B, AP : PB = 4 : 3.	(6, 0) . 4 + 3 = 7 steps. The change from A to B is (7, 7). 4/7 of it is (4, 4). A + (4, 4) = (6, 0).	(5, -1). The fractions are swapped: 3/7 of the change is added to A, which puts P nearer A. The same point comes from starting at B. P must be nearer B, 4 steps of 7 from A.	P
8 F	B(-2, 3) and A(2, -1), from A to B, AP : PB = 3 : 1.	(-1, 2) . 3 + 1 = 4 steps. The change from A to B is (-4, 4). 3/4 of it is (-3, 3). A + (-3, 3) = (-1, 2).	(-10, 11). The ratio 3 : 1 is read as the fraction 3/1, which goes past B. The trip has 4 steps, so the fraction is 3/4.	E

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The point at the top of each one is the wrong answer from one ring card. Its right answer is the point 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 kind of mistake here, it goes to another card off the ring. So a second wrong answer never moves a group forward.

Card	The question	Answer, and why	The common wrong answer on this card, and why	Letter of its top
R	A(5, -4) and B(-5, 6), from A to B, AP : PB = 3 : 2.	(-1, 2) . $3 + 2 = 5$ steps. The change from A to B is (-10, 10). $3/5$ of it is (-6, 6). $A + (-6, 6) = (-1, 2)$.	(-10, 11). The ratio 3 : 2 is read as the fraction $3/2$, which goes past B. The trip has 5 steps, so the fraction is $3/5$.	S
N	B(5, -7) and A(-5, -2), from A to B, AP : PB = 1 : 4.	(-3, -3) . $1 + 4 = 5$ steps. The change from A to B is (10, -5). $1/5$ of it is (2, -1). $A + (2, -1) = (-3, -3)$.	(3, -6). The fractions are swapped: $4/5$ of the change is added to A, which puts P nearer B. The same point comes from starting at B. P must be nearer A, 1 step of 5 from A.	S
K	A(-1, 1) and B(3, 5), from A to B, AP : PB = 3 : 1.	(2, 4) . $3 + 1 = 4$ steps. The change from A to B is (4, 4). $3/4$ of it is (3, 3). $A + (3, 3) = (2, 4)$.	(11, 13). The ratio 3 : 1 is read as the fraction $3/1$, which goes past B. The trip has 4 steps, so the fraction is $3/4$.	T
J	A(-5, -9) and B(5, -4), from A to B, AP : PB = 4 : 1.	(3, -5) . $4 + 1 = 5$ steps. The change from A to B is (10, 5). $4/5$ of it is (8, 4). $A + (8, 4) = (3, -5)$.	(-3, -8). The fractions are swapped: $1/5$ of the change is added to A, which puts P nearer A. The same point comes from starting at B. P must be nearer B, 4 steps of 5 from A.	W
G	A(1, -2) and B(-3, 2), from A to B, AP : PB = 3 : 1.	(-2, 1) . $3 + 1 = 4$ steps. The change from A to B is (-4, 4). $3/4$ of it is (-3, 3). $A + (-3, 3) = (-2, 1)$.	(-11, 10). The ratio 3 : 1 is read as the fraction $3/1$, which goes past B. The trip has 4 steps, so the fraction is $3/4$.	I
E	B(-5, -5) and A(9, 9), from A to B, AP : PB = 2 : 5.	(5, 5) . $2 + 5 = 7$ steps. The change from A to B is (-14, -14). $2/7$ of it is (-4, -4). $A + (-4, -4) = (5, 5)$.	(-1, -1). The fractions are swapped: $5/7$ of the change is added to A, which puts P nearer B. The same point comes from starting at B. P must be nearer A, 2 steps of 7 from A.	P
M	A(5, -2) and B(-5, 8), from A to B, AP : PB = 3 : 2.	(-1, 4) . $3 + 2 = 5$ steps. The change from A to B is (-10, 10). $3/5$ of it is (-6, 6). $A + (-6, 6) = (-1, 4)$.	(-10, 13). The ratio 3 : 2 is read as the fraction $3/2$, which goes past B. The trip has 5 steps, so the fraction is $3/5$.	E
H	A(8, 2) and B(3, -3), from A to B, AP : PB = 2 : 3.	(6, 0) . $2 + 3 = 5$ steps. The change from A to B is (-5, -5). $2/5$ of it is (-2, -2). $A + (-2, -2) = (6, 0)$.	(5, -1). The fractions are swapped: $3/5$ of the change is added to A, which puts P nearer B. The same point comes from starting at B. P must be nearer A, 2 steps of 5 from A.	E

Other mistakes lead to no card. A group might read 3 : 2 as $2/3$, take the fraction of B's coordinates instead of the change, lose the minus sign of a negative coordinate of A, or give the midpoint. Its answer is then not the point at the top of any card.