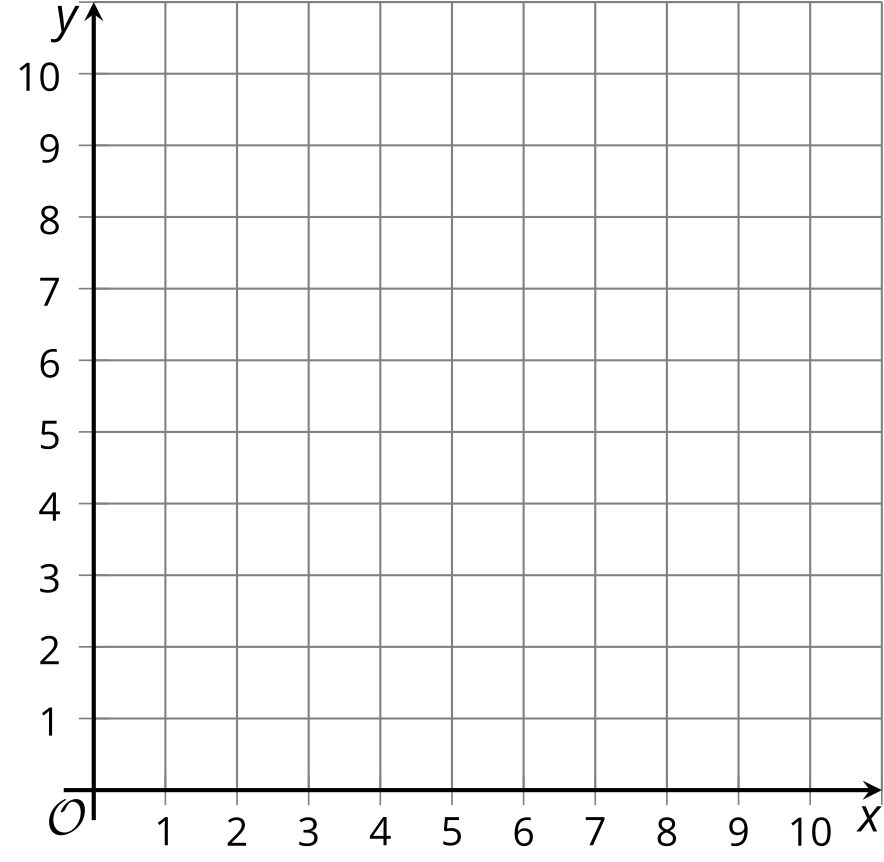
## Lesson 15: Weighted Averages

* Let’s split segments using averages and ratios.

### 15.1: Part Way: Points

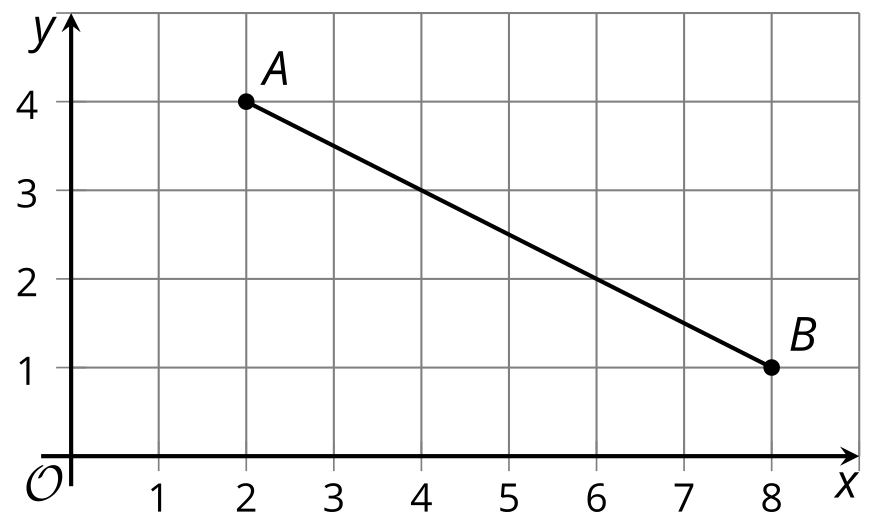
For the questions in this activity, use the coordinate grid if it is helpful to you.



1. What is the midpoint of the segment connecting and ?
2. What is the midpoint of the segment connecting and ?
3. What is the midpoint of the segment connecting and ?

### 15.2: Part Way: Segment

Point has coordinates . Point has coordinates .



1. Find the point that partitions segment in a ratio.
2. Calculate .
3. What do you notice about your answers to the first 2 questions?
4. For 2 new points and , write an expression for the point that partitions segment in a ratio.

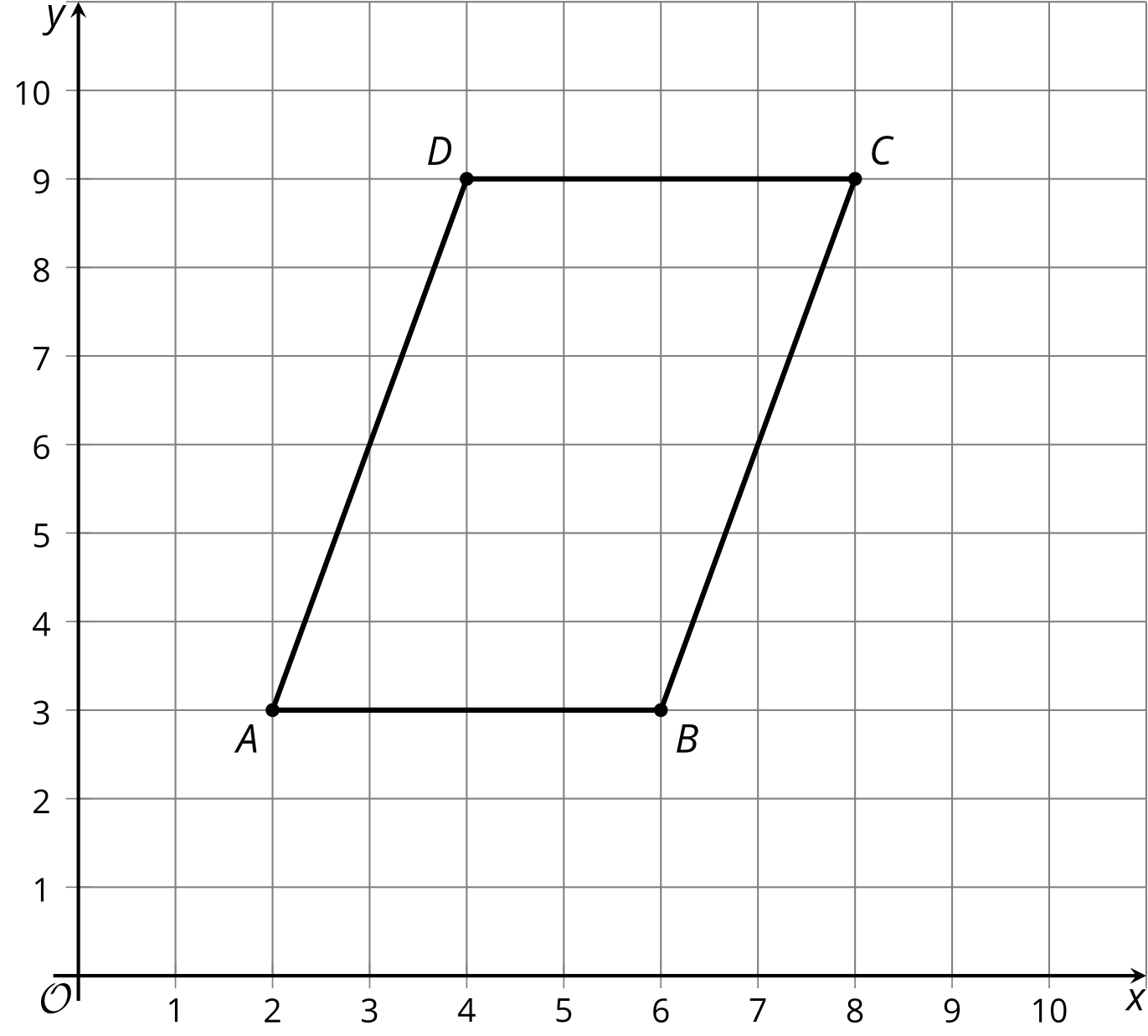
#### Are you ready for more?

Consider the general quadrilateral with and .

1. Find the midpoints of each side of this quadrilateral.
2. Show that if these midpoints are connected consecutively, the new quadrilateral formed is a parallelogram.

### 15.3: Part Way: Quadrilateral

Here is quadrilateral .



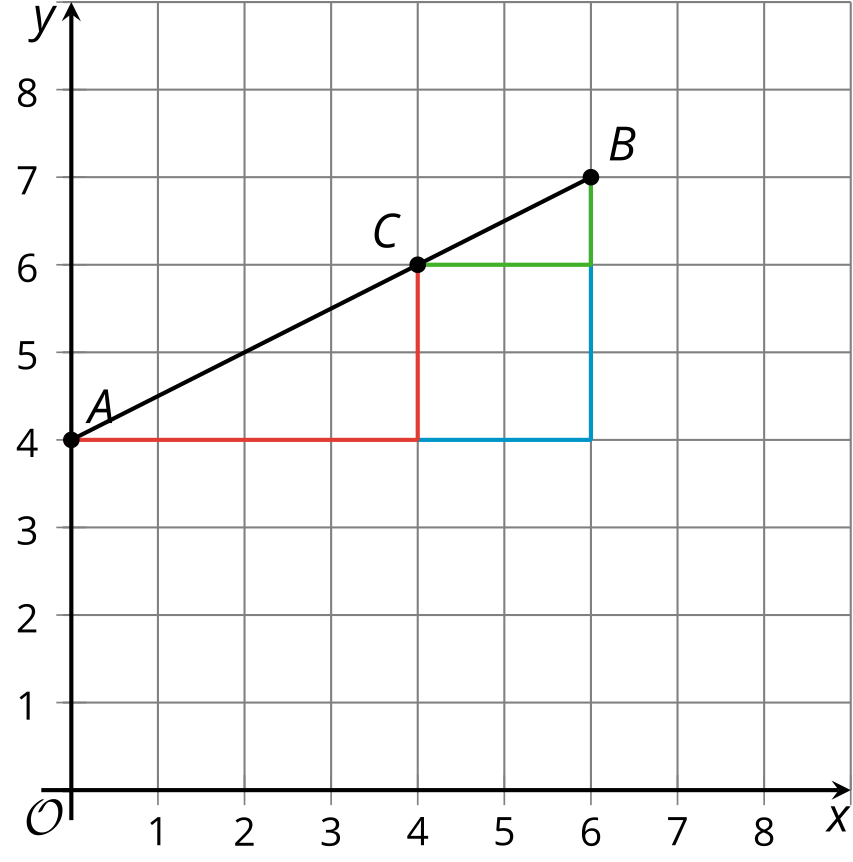
1. Find the point that partitions segment in a ratio. Label it .
2. Find the point that partitions segment in a ratio. Label it .
3. Find the point that partitions segment in a ratio. Label it .
4. Is a dilation of ? Justify your answer.

### Lesson 15 Summary

To find the midpoint of a line segment, we can average the coordinates of the endpoints. For example, to find the midpoint of the segment from to , average the coordinates of and : . Another way to write what we just did is or .

Now, let’s find the point that is of the way from to . In other words, we’ll find point so that segments and are in a ratio.

In the horizontal direction, segment stretches from to . The distance from 0 to 6 is 6 units, so we calculate of 6 to get 4. Point will be 4 horizontal units away from , which means an -coordinate of 4.



In the vertical direction, segment stretches from to . The distance from 4 to 7 is 3 units, so we can calculate of 3 to get 2. Point must be 2 vertical units away from , which means a -coordinate of 6.

It is possible to do this all at once by saying . This is called a weighted average. Instead of finding the point in the middle, we want to find a point closer to than to . So we give point more weight—it has a coefficient of rather than as in the midpoint calculation. To calculate , substitute and evaluate.

Either way, we found that the coordinates of are .



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