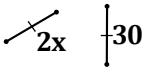
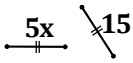
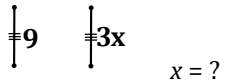
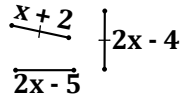
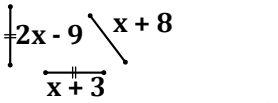
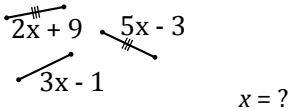
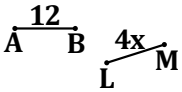
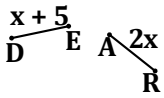
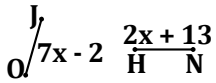
Name: _____ Per: _____

Measuring Segments Using Midpoints and Congruence

Often, the only way to determine a segment's length is by comparing it to its parts or to another segment that is congruent (≅) to it. Congruent means that it has the same size (equal distance) and is the same shape (a segment). There are 4 ways that you can know that a set of segments are congruent: 1) the problem tells you that the two parts are congruent, 2) the segments are marked with matching "tick marks" (slashes through the segment- one slash matches one slash, two matches two, and so on), 3) the given measurements are the same (both 4 cm or both 6*x* in), or 4) the two segments are part of a larger segment & separated by a point identified as a midpoint or bisector. If the segments are congruent, you can determine their measure by setting their values equal.

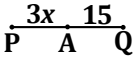
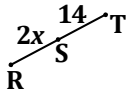
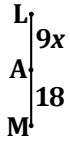
Segments are not always congruent, however. Sometimes, you have to use other information to solve the problem. If you have a midpoint, you can use the fact that they are congruent, or you can use the fact that one part created by the midpoint will equal half of the whole segment. If you have a segment made of two or more smaller segments, you can add the values of the smaller segments and set the sum equal to the value for the whole segment. This is called Segment Addition.

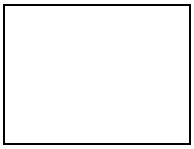
We'll start with segments we know are congruent.

Example	Your Turn	Still Your Turn
 *x* = ? 2*x* = 30 ÷2 ÷2 *x* = 15 *The tick marks mean that the segments are the same. So,* *2x = 30*	1.  *x* = ?	2.  *x* = ?
 *x* = ? *x* + 2 = 2*x* – 4 -x -x 2 = *x* – 4 +4 +4 6 = *x* *x* = 6 *x + 2 & 2x – 4 have matching tick marks. So,* *x + 2 = 2x - 4*	3.  *x* = ?	4.  *x* = ?
$\overline{AB} \cong \overline{LM}$  *x* = ? 12 = 4*x* ÷4 ÷4 3 = *x* *x* = 3 *The problem tells me the segments are congruent* (≅). So, 12 = 4*x*.	5. $\overline{DE} \cong \overline{AR}$ *x* = ? 	6. $\overline{JO} \cong \overline{HN}$ *x* = ? 

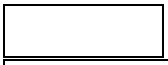
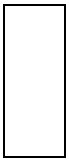
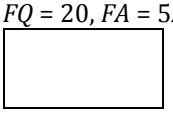
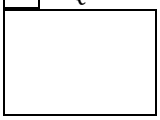
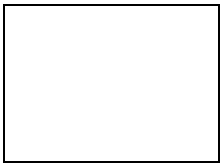
Now we'll work with midpoints. A midpoint does two things: 1) it creates two congruent parts, so you can set them equal, and 2) it splits a segment in half (which means that one part is half as big as the whole segment).

First, let's use the fact that a midpoint creates equal parts. So, part$_1$=part$_2$.

A is the midpoint of $\overline{PQ}$.  *x* = ? *PA = AQ* 3*x* = 15 ÷3 ÷3 *x* = 5 *Since the problem tells me that A is the **midpoint**, I know that **part$_1$=part$_2$**.* *So, **PA = AQ*** *Plug in the values* *PA = 3x, AQ = 15*	7. *S* is the midpoint of $\overline{RT}$. *x* = ? 	8. *A* is the midpoint of $\overline{LM}$. *x* = ? 

M is the midpoint of ☐. *DM* = ?  *DM* = *MC* 2*x* = 4*x* – 6 -4*x* -4*x* -2*x* = -6 ÷-2 ÷-2 *x* = 3 *DM* = 2*x* = 2(3) = 6 *DM* = 6	*Since the problem tells me that M is the* ***midpoint****, I know that* ***part₁=part₂.*** *So,* ***DM = MC*** *2x = 4x – 6* *Be careful! The problem did not ask for x! It asked for DM.* *Plug in x = 3 to find it.*	9. *L* is the midpoint of ☐. *EL* = ? 	10. *O* is the midpoint of ☐. *DO* = ? 

Now, we'll use the fact that a midpoint divides a segment in half.
Tip: *Saying that part of the segment is half of the whole is the same as saying the whole is 2 times as big as the part. I prefer to multiply by two instead of dealing with halves. So, if you have a midpoint, then* ***whole = 2(part)****.*

M is the midpoint of ☐. *AB* = 18, *MB* = 9*x*. *x* = ?   whole = 2(part) *AB* = 2(*MB*) 18 = 2(9*x*) 18 = 18*x* ÷18 ÷18 1 = *x*	*We know that M is the midpoint. Use the formula* ***whole = 2(part)*** *(Draw it out)* *The whole is AB.* *The part that we know is MB.* *AB = 18,* *MB = 9x.* *Plug it in.*	11. *E* is the midpoint of ☐. *DE* = 7, *DF* = 2*x*. *x* = ? 	12. *A* is the midpoint of ☐. *FQ* = 20, *FA* = 5*x*. *x* = ? 
A is the midpoint of ☐. *FQ* = ?   whole = 2(part) *FQ* = 2(*AQ*) 4*x* = 2(*x* + 7) 4*x* = 2*x* + 14 -2*x* -2*x* 2*x* = 14 ÷2 ÷2 *x* = 7 *FQ* = 4*x* = 4(7) = 28 *FQ = 28*	*A is the midpoint. Use the formula* ***whole = 2(part)*** *(Draw it out)* *The whole is FQ.* *The part that we know is AQ.* *FQ = 4x,* *AQ = x + 7.* *Plug it in.* *Careful! The problem is not asking for x! It is asking for FQ. Plug x into FQ to find it.*	13. *M* is the midpoint of ☐. *MB* = ? 	14. *E* is the midpoint of ☐. *DF* = ? 

Worksheet Answer Key

Title

1. x =
2. x =
3. x =
4. x =
5. x =
6. x =
7. x =
8. x =
9. x =
10. x =
11. x =
12. x =
13. x =
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