

Module 2

Properties of Quadrilaterals



What this module is about

This module is about the properties of the diagonals of special quadrilaterals. The special quadrilaterals are rectangles, square, and rhombus. The conditions sufficient to guarantee that a quadrilateral is a parallelogram are also discussed in this module.



What you are expected to learn

This module is designed for you to

1. apply inductive/deductive skills to derive the properties of the diagonals of special quadrilaterals
 - rectangle
 - square
 - rhombus
2. verify sets of sufficient conditions which guarantee that a quadrilateral is a parallelogram
3. apply the conditions to prove that a quadrilateral is a parallelogram
4. solve routine and non routine problems



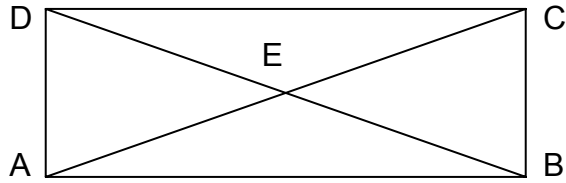
How much do you know

True or False

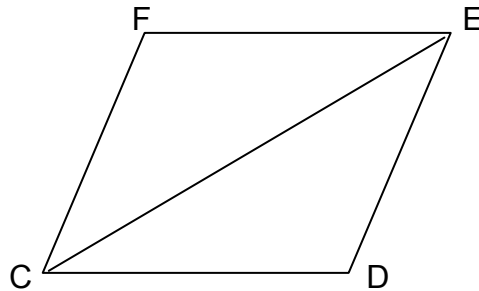
1. The diagonals of a square are congruent.
2. The diagonals of a rectangle are perpendicular.
3. The diagonals of a rhombus bisect each other.
4. A square is a rhombus.
5. If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

6. If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram.

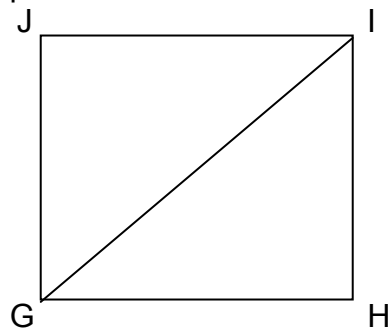
Quadrilateral ABCD is a rectangle. Its diagonals AC and BD intersect at E.



7. If $AC = 2(x + 10)$ and $BD = x + 60$, what is AC?
8. If $AE = 4x - 5$ and $CE = 10 + x$, what is AE?
9. Quadrilateral CDEF is a rhombus. If $m\angle FCE = 3x - 5$ and $m\angle DCE = 2x$, find $m\angle FCD$.



Quadrilateral GHIJ is a square.



10. If $m\angle HGI$ is $3(x + 5)$, what is x ?

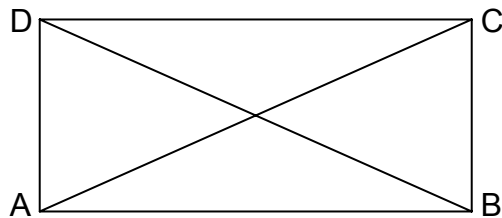


What you will do

Lesson 1

The Properties of the Diagonals of Special Quadrilaterals

A diagonal of a quadrilateral is a segment which connects any two non-consecutive vertices. In the following quadrilateral, \overline{AC} and \overline{BD} are the diagonals.



The following are the properties of the diagonals of special quadrilaterals.

1. The diagonals of a rectangle are congruent.
2. The diagonals of a square are congruent.
3. The diagonals of a square are perpendicular
4. Each diagonal of a square bisects a pair of opposite angles.
5. The diagonals of a rhombus are perpendicular.
6. Each diagonal of a rhombus bisects a pair of opposite angles

You can apply inductive skills to derive these properties of the diagonals of special quadrilaterals. In the following activities you need a ruler, a pencil, a protractor and pieces of graphing paper.

1. Do the following activity:

- a. On a graphing paper, draw a rectangle.
- b. Name your rectangle \overline{ABCD} .
- c. Draw diagonals \overline{AC} and \overline{BD} .
- d. Find the lengths of \overline{AC} and \overline{BD} . Are their lengths equal? Are the diagonals congruent?

Conclusion: The diagonals of a rectangle are congruent

2. Do the following activity:

- a. On a graphing paper, draw a square.
- b. Name your square \overline{ABCD} .
- c. Draw diagonals \overline{AC} and \overline{BD} .

- d. Find the lengths of the diagonals. Are their lengths equal? Are the diagonals of the square congruent?

Conclusion: The diagonals of a square are congruent.

3. Do the following activity:

- a. Construct a square on a graphing paper
- b. Name your square $EFGH$.
- c. Draw its diagonals \overline{EG} and \overline{HF} .
- d. Label the intersection of the diagonals, M .
- e. Using a protractor, find the measures of $\angle HME$, and $\angle HMG$.
- f. What kind of angles are the two angles?
- g. Are the diagonals perpendicular?

Conclusion: The diagonals of a square are perpendicular

4. Do the following activity.

- a. Draw a square on a graphing paper.
- b. Name your square $ABCD$.
- c. Draw diagonal \overline{AC} .
- d. What do you notice? Into how many angles are the two opposite vertex angles divided?
- e. What do you conclude?

Conclusion: Each diagonal of a square bisects a pair of opposite angles.

5. Do the following activity.

- a. Draw a rhombus on a graphing paper.
- b. Name your rhombus $ABCD$.
- c. Draw the diagonals and name the point of intersection, E .
- d. Find the measures of $\angle AED$ and $\angle CED$.
- e. What kind of angles are they?
- f. What can you say about the diagonals?

Conclusion: The diagonals of a rhombus are perpendicular.

6. Do the following activity.

- a. Draw a rhombus on a graphing paper.
- b. Name your rhombus $ABCD$.
- c. Draw diagonal \overline{AC} .
- d. What do you notice? Into how many angles are the two opposite vertex angles divided?
- e. What do you conclude?

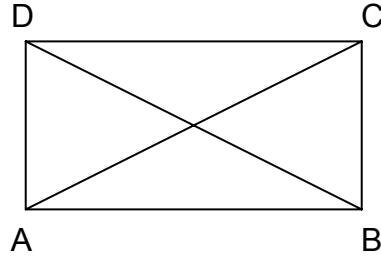
Conclusion: Each diagonal of a rhombus bisects a pair of opposite angles.

These properties of the diagonals of special quadrilaterals can also be proven deductively. Let us prove the first three properties deductively.

1. The diagonals of a rectangle are congruent.

Given: Rectangle $ABCD$
with diagonals \overline{AC} and \overline{BD} .

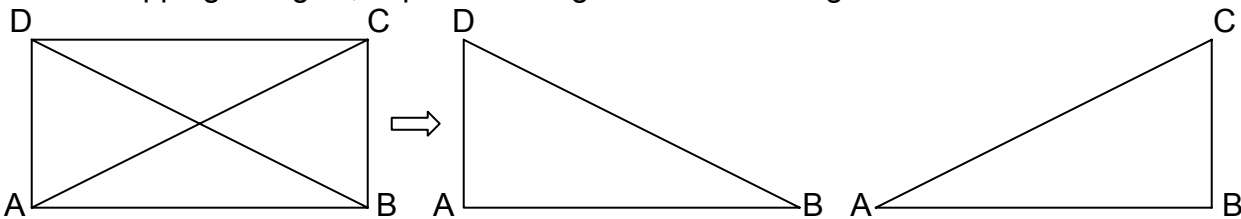
Prove: $\overline{BD} \cong \overline{AC}$



Proof:

Statements	Reasons
1. Rectangle $ABCD$ with diagonals \overline{AC} and \overline{BD}	1. Given
2. $\overline{AD} \cong \overline{BC}$ (S)	2. Opposite sides of a parallelogram are congruent (Remember, a rectangle is a parallelogram)
3. $\angle DAB$ and $\angle CBA$ are right angles	3. A rectangle is a parallelogram with four right angles
4. $\angle DAB \cong \angle CBA$ (A)	4. Any two right angles are congruent
5. $\overline{AB} \cong \overline{AB}$ (S)	5. Reflexive Property of Congruence
6. $\triangle DAB \cong \triangle CBA$	6. SAS Congruence
7. $\overline{BD} \cong \overline{AC}$	7. Corresponding Parts of Congruent Triangles are Congruent

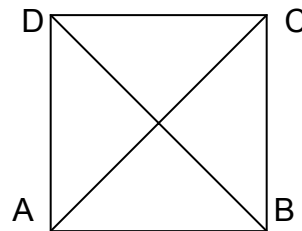
Triangles $\triangle DAB$ and $\triangle CBA$ overlap. If you find difficulty visualizing the two overlapping triangles, separate the figure into two triangles.



2. The diagonals of a square are congruent.

Given: $\square ABCD$ is a square with diagonals \overline{AC} and \overline{BD}

Prove: $\overline{BD} \cong \overline{AC}$



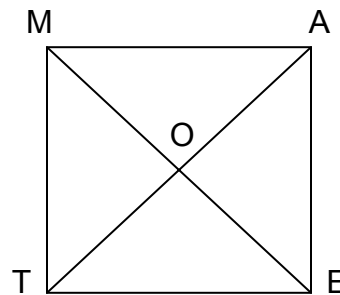
Proof

Statements	Reasons
1. $\square ABCD$ is a square with diagonals \overline{AC} and \overline{BD}	1. Given
2. $\overline{AD} \cong \overline{BC}$ (S)	2. Opposite sides of a parallelogram are congruent (Remember, a square is a parallelogram)
3. $\angle DAB$ and $\angle CBA$ are right angles	3. A rectangle has four right angles (Remember that a square is a rectangle with four congruent sides and a rectangle has four right angles.)
4. $\angle DAB \cong \angle CBA$ (A)	4. Any two right angles are congruent
5. $\overline{AB} \cong \overline{AB}$ (S)	5. Reflexive Property of Congruence
6. $\triangle DAB \cong \triangle CBA$	6. SAS Congruence
7. $\overline{BD} \cong \overline{AC}$	7. Corresponding Parts of Congruent Triangles are Congruent

3. The diagonals of a square are perpendicular

Given: $\square TEAM$ is a square with diagonals \overline{AT} and \overline{ME}

Prove: $\overline{ME} \perp \overline{AT}$



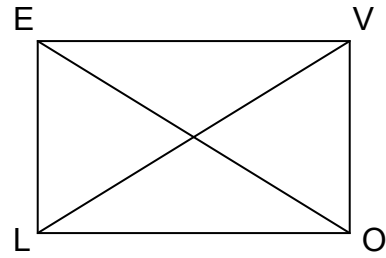
A proof can also be written in paragraph form.

Proof:

Side \overline{TM} and side \overline{EA} are congruent since they are sides of a square. A square is a rectangle with four congruent sides. $\overline{MO} \cong \overline{EO}$ by Reflexive Property of Congruence. The diagonals of a parallelogram bisect each other. Since a square is a parallelogram therefore $\overline{TO} \cong \overline{AO}$. $\triangle MOT \cong \triangle MOA$ by SSS congruence. Since $\angle MOT$ and $\angle MOA$ are supplementary and congruent, then each of them is a right angle. Therefore $\overline{ME} \perp \overline{AT}$ by the definition of perpendicular.

Example 1

The figure at the right is a rectangle.
If the diagonal $\overline{LV} = 2x$ and the diagonal $\overline{OE} = 12$ cm, find x .



Solution:

Step 1. The diagonals of a rectangle are congruent.

$$\begin{aligned}\overline{LV} &\cong \overline{OE} \\ \overline{LV} &= \overline{OE} \quad (\text{Congruent segments have equal lengths})\end{aligned}$$

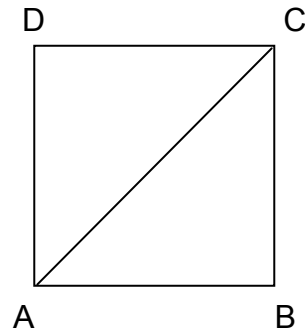
Step 2. Substitute $2x$ for \overline{LV} and 12 for \overline{OE} . Then solve for x .

$$\begin{aligned}2x &= 12 \\ x &= 6\end{aligned}$$

Answer: The value of x is 6 cm.

Example 2

Quadrilateral ABCD at the right is a square.
Find $m\angle CAB$



Solution:

Step 1, Quadrilateral ABCD is a square and a square is a rectangle.

Therefore: $m\angle DAB = 90$.

Step 2. But each diagonal of a square bisects a pair of opposite angles.

$$\text{Hence: } m\angle CAB = \frac{1}{2} m\angle DAB$$

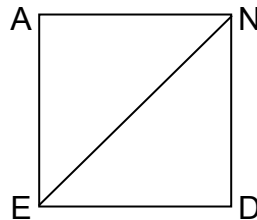
Step 3. Substitute 90 for $m\angle DAB$.

$$\begin{aligned}m\angle CAB &= \frac{1}{2} (90) \\ &= 45\end{aligned}$$

Answer: $m\angle CAB = 45$

Example 3 $\square EDNA$ is a square.

If $m\angle END$ is $3(x + 5)$, what is x ?



Solution:

- a. $m\angle DCB = 90$ since $\square ABCD$ is a square
- b. Each diagonal of a square bisects a pair of opposite angles.

Hence: $m\angle ACB = 45$

$$3(x + 5) = 45$$

$$3x + 15 = 45$$

$$3x = 45 - 15$$

$$3x = 30$$

$$x = 10$$

Example 4

The figure at the right is a rhombus.
If $m\angle CAB = 30$, what is the $m\angle CAD$?

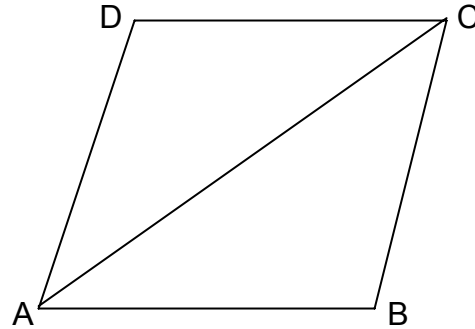
Step 1. Each diagonal of a rhombus bisects pair of opposite angles.

$$m\angle CAD = m\angle CAB$$

Step 2. Substitute 30 for $m\angle CAB$ in the above equation.

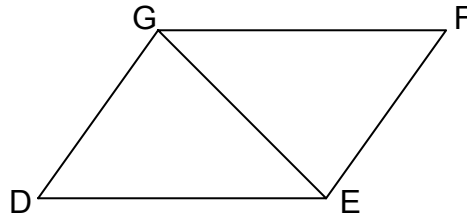
$$m\angle CAD = 30$$

Answer: The measure of $\angle CAD$ is 30° .



Example 5

$\square DEFG$ is a rhombus. If $m\angle FGE = 5x - 8$ and $m\angle DGE = 3x + 22$, find the measure of (a) $m\angle FGE$ (b) $m\angle DGE$ and (c) $m\angle FGD$



Solution:

Step 1. Each diagonal of a rhombus bisects a pair of opposite angles.

$$m\angle FGE = m\angle DGE$$

$$5x - 8 = 3x + 22$$

$$5x - 3x = 22 + 8$$

$$2x = 30$$

$$x = 15$$

Step 2. Substitute 15 for x

$$\begin{aligned} \text{a. } m\angle FGE &= 5x - 8 \\ &= 5(15) - 8 \\ &= 67 \end{aligned}$$

$$\begin{aligned} \text{b. } m\angle DGE &= 3x + 22 \\ &= 3(15) + 22 \\ &= 67 \end{aligned}$$

$$\begin{aligned} \text{c. } m\angle FGD &= m\angle FGE + m\angle DGE \\ &= 67 + 67 \\ &= 134 \end{aligned}$$

Answers: (a) $m\angle FGE = 67$

(b) $m\angle DGE = 67$

(c) $m\angle FGD = 134$

Example 6

- BETH is a rhombus. If $m\angle TBE = 35$, what is $m\angle HEB$?

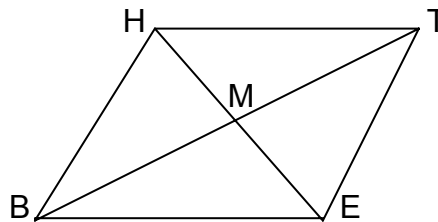
Solution:

Step 1. The diagonals of a rhombus are perpendicular. Hence, $\angle BME$ is a right angle and its measure is 90° .
 $m\angle BME = 90$

Step 2. The sum of the measures of the angles of a triangle is 180°
 $m\angle TBE + m\angle BME + m\angle HEB = 180$

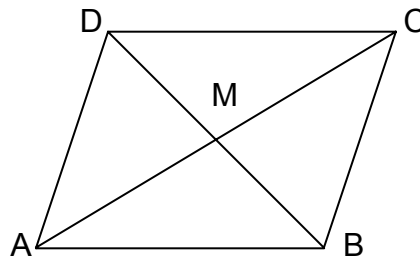
Step 3. Substitute 35 for $m\angle TBE$ and 90 for $m\angle BME$ in the above equation.
 $35 + 90 + m\angle HEB = 180$
 $125 + m\angle HEB = 180$
 $m\angle HEB = 180 - 125$
 $m\angle HEB = 55.$

Answer: $m\angle HEB = 55$



Example 7

- ABCD is a rhombus. If $\overline{AM} = 16$ cm, what is \overline{CM} ?



Solution:

Step 1. The diagonals of a rhombus

Bisect each other.

$$\overline{CM} = \overline{AM}$$

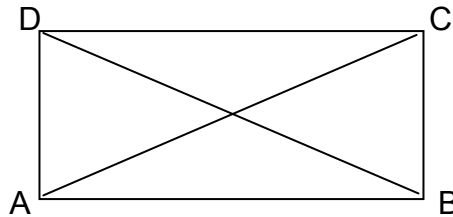
Step 2. Substitute $\overline{16}$ cm for \overline{AM} in the above equation.

$$\overline{CM} = 16 \text{ cm}$$

Answer: $\overline{CM} = 16 \text{ cm}$

Try this out

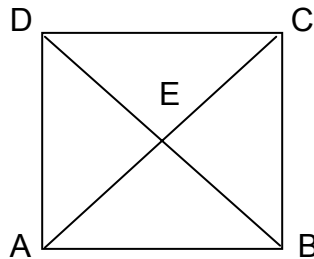
Set A. □ ABCD is a rectangle.



True or False

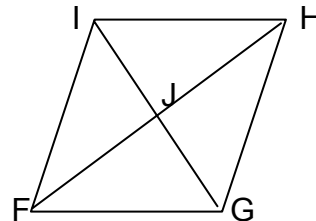
1. The lengths of \overline{AC} and \overline{BD} are equal.
2. Diagonals \overline{AC} and \overline{BD} are perpendicular.
3. The diagonal \overline{AC} bisects $\angle DCB$.
4. A rectangle is a parallelogram.

□ ABCD is a square



5. $\angle EAB \cong \angle EBC$
6. $\angle DEC$ is a right angle.

□ FGHI is a rhombus.

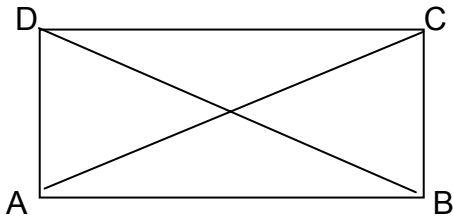


7. $m\angle FIG = m\angle HIG$
8. The sum of $m\angle JFG$ and $m\angle JGF$ is 45.
9. $\triangle FIG \cong \triangle HGI$

10. The diagonal \overline{FH} bisects the rhombus into two congruent triangles.

Set B

□ ABCD is a rectangle



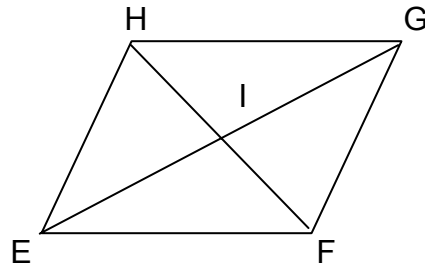
Find the indicated measure

1. $\overline{AC} = 15$ dm. Find \overline{BD}
2. $\overline{BD} = 23$ cm. Find \overline{AC}

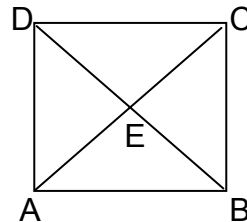
□ EFGH is a rhombus

Find the indicated measure.

3. $m\angle HGE = 35$. Find $m\angle FGE$.
4. $m\angle HEI = 20$. Find $m\angle FEI$.
5. $m\angle IEF = 30$. Find $m\angle IFE$
6. $m\angle IHE = 58$. Find $m\angle IEH$
7. $m\angle IEF = 20$. Find $m\angle IEF + m\angle EIF$
8. $m\angle IGH = 25$. Find $m\angle IGH + m\angle HIG$



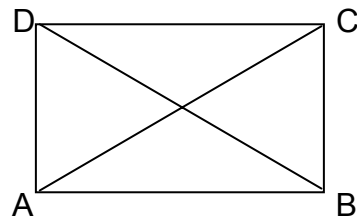
9. If □ ABCD is a square,
then $m\angle ACB =$ _____
10. If □ ABCD is square,
then $m\angle DEC =$ _____



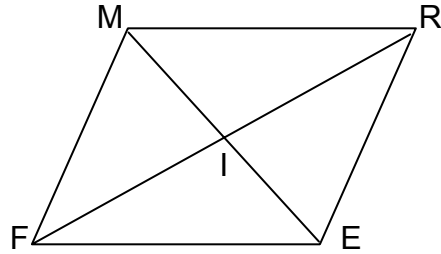
Set C

□ ABCD is a rectangle with diagonals \overline{AC} and \overline{BD} .

1. $\overline{AC} = 2x + 15$, $\overline{BD} = 3x + 10$. Find \overline{AC} .
2. $\overline{BD} = 6x + 5$, $\overline{AC} = 5x + 14$. Find \overline{BD} .

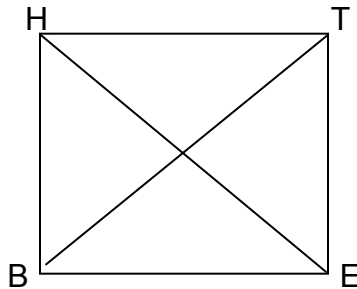


□ FERM is a rhombus.



3. If $m\angleIFE = x + 20$, $m\angleIEF = x + 26$, find x .
4. If $m\angleIMR = 4x + 20$, $m\angleIRM = 2x + 10$, find x .
5. $m\angleIFE + m\angleIEF =$ _____
6. $m\angleIMR + m\angleIRM =$ _____

□ BETH is a square.



7. If $\overline{HM} = x + 15$, $\overline{HE} = 40$, what is x ?
8. If $\overline{EM} = x + 9$, $\overline{HE} = 30$, what is x ?
9. If $\overline{BM} = x + 12$, $\overline{EM} = 2x - 20$, what is x ?
10. If $\overline{HM} = 44 - x$, $\overline{TM} = 4 + 3x$, what is x ?

Lesson 2

Conditions for a Parallelogram

The following are some conditions which guarantee that a given quadrilateral is a parallelogram.

1. If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
2. If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
3. If one pair of opposite sides of a quadrilateral are both congruent and parallel, then the quadrilateral is a parallelogram.
4. If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram.

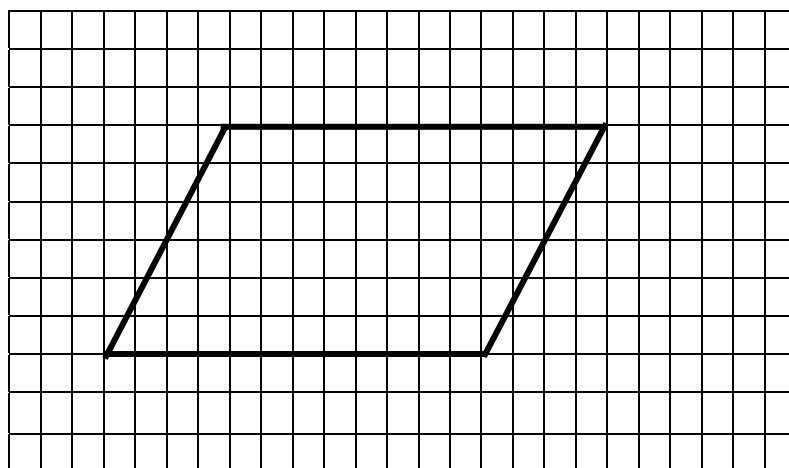
5. If the non-opposite angles of a quadrilateral are supplementary, then the quadrilateral is a parallelogram.

You can verify these sets of sufficient conditions which guarantee that a quadrilateral is a parallelogram. In the following activities you need a pencil, a ruler, a protractor and pieces of bond paper and graphing paper.

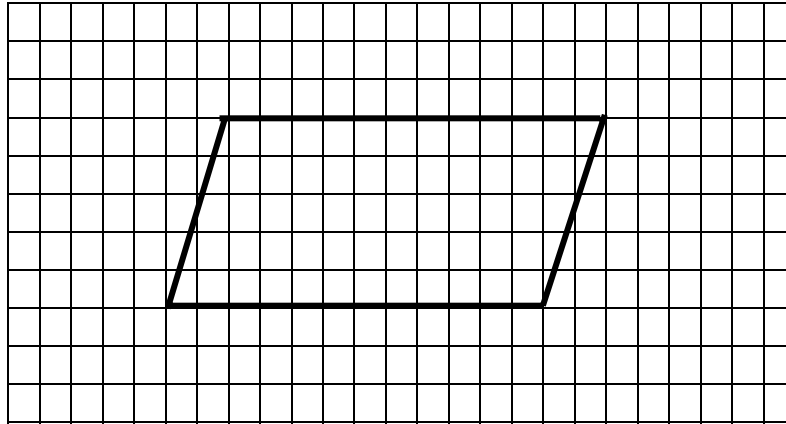
1. If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

Do this activity:

- a. On a graphing paper, draw a quadrilateral such that both pairs of opposite sides are congruent. (See the illustration.)



- b. Are the opposite sides equidistant? Find this out by using a ruler.
 - c. Are both pairs of sides parallel? (Remember, parallel lines are everywhere equidistant.)
 - d. Can you now conclude that the quadrilateral is a parallelogram? Why?
2. If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
 - a. On a graphing paper, with the aids of a ruler and a protractor, construct an quadrilateral such that both pairs of opposite angles are congruent. (See illustration)

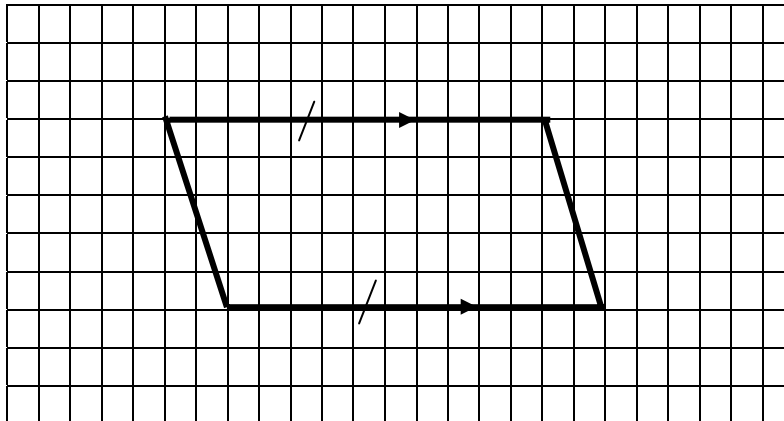


- b. Are the opposite sides congruent?
 - c. Can you now conclude that the quadrilateral is a parallelogram? Why?
3. If one pair of opposite sides of a quadrilateral are both congruent and parallel, then the quadrilateral is a parallelogram.

Do this activity

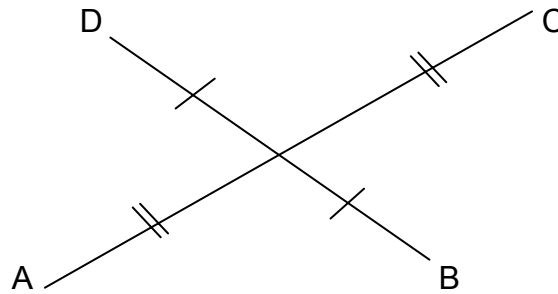
- a. On a graphing paper, draw a quadrilateral such that one pair of opposite sides are both congruent and parallel.

(See illustration below)

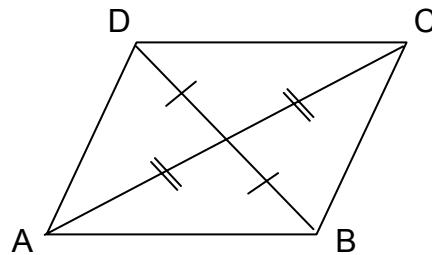


- b. Are the other two opposite sides congruent?
 - c. Can you now conclude that the quadrilateral is a parallelogram? Why?
4. If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram.

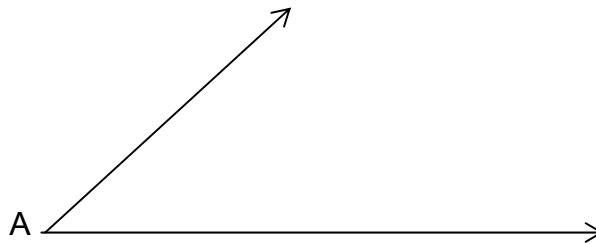
- a. On a bond paper, draw segments \overline{AC} and \overline{BD} bisecting each other. (See the illustration below.)



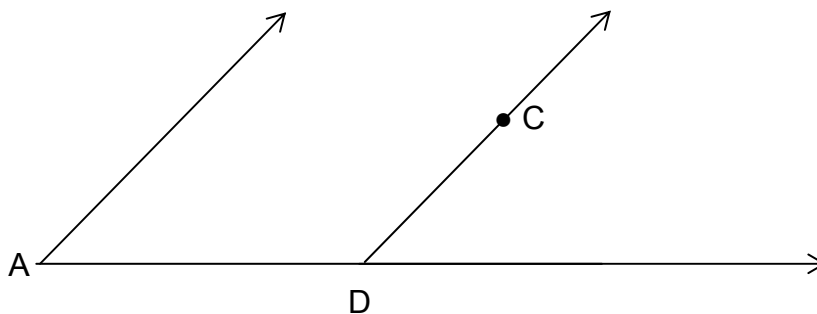
- b. Connect A to B, B to C, C to D and D to A .



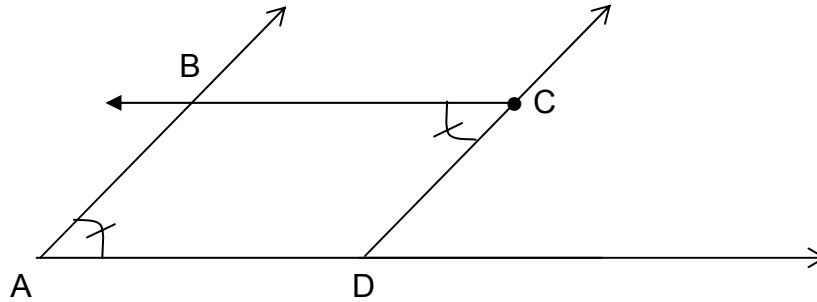
- c. Using a ruler, find the lengths of \overline{AB} and \overline{CD} . Are they equal?
 d. Using a ruler, find the lengths of \overline{AD} and \overline{BC} . Are the lengths equal?
 e. What kind of quadrilateral is $\square ABCD$?
5. If the non-opposite angles of a quadrilateral are supplementary, then the quadrilateral is a parallelogram.
- a. On a bond paper, draw angle A. (See the illustration below.)



- b. Draw angle ADC such that its measure is supplementary to that of angle A.



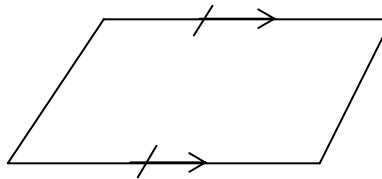
c. Draw angle DCB such that its measure is equal to that of angle A.



- d. Find the measure of angle CBA. Is it equal to the measure of angle ADC? Are $\angle A$ and $\angle B$ supplementary? How about $\angle B$ and $\angle C$? How about $\angle D$ and $\angle C$? Why?
- e. What kind of quadrilateral is $\square ABCD$?

Example 1

Determine whether the figure is a parallelogram. Identical “tick marks” indicate that the sides are congruent and identical “arrowheads” indicate the lines are parallel.



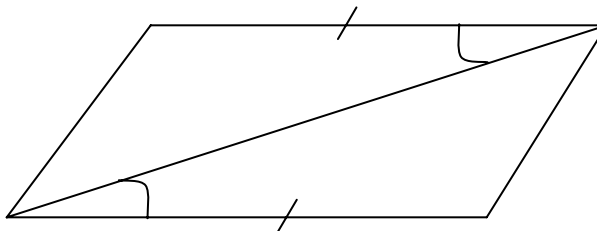
Solution:

If one pair of opposite sides of a quadrilateral are both congruent and parallel, then the quadrilateral is a parallelogram.

Hence the geometric figure is a parallelogram.

Example 2

Determine whether the figure is a parallelogram.



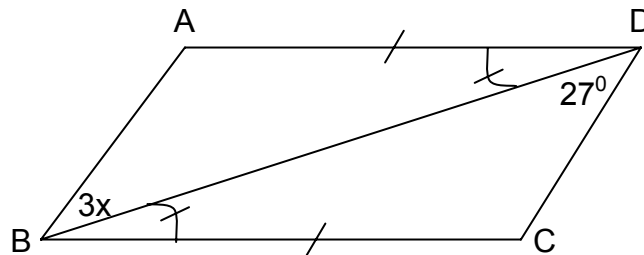
Solution:

A pair of alternate interior angles are congruent, therefore a pair of opposite sides are parallel. These parallel sides are also congruent. As can be seen in the figure, they have the same length.

Hence the figure is a parallelogram.

Example 3.

Find the value of x for which $\square ABCD$ is a parallelogram.



Solution:

If two lines are cut by a transversal and a pair of alternate interior angles are congruent, then the lines are parallel.

$$\begin{aligned} \overline{AD} & // \overline{BC} \text{ since } \angle ADB \cong \angle CBD \\ \overline{CD} & // \overline{AB} \text{ if } 3x = 27 \\ & x = 9 \end{aligned}$$

Hence the value of x should be 9.

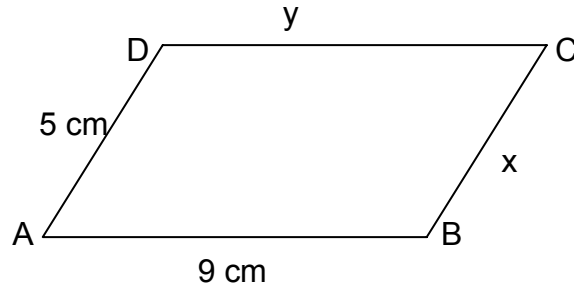
Try this out

Set A

True or False

1. If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
2. If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
3. If one pair of opposite sides of a quadrilateral are parallel, then the quadrilateral is a parallelogram.
4. If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram.
5. If the opposite angles of a quadrilateral are supplementary, then the quadrilateral is a parallelogram.

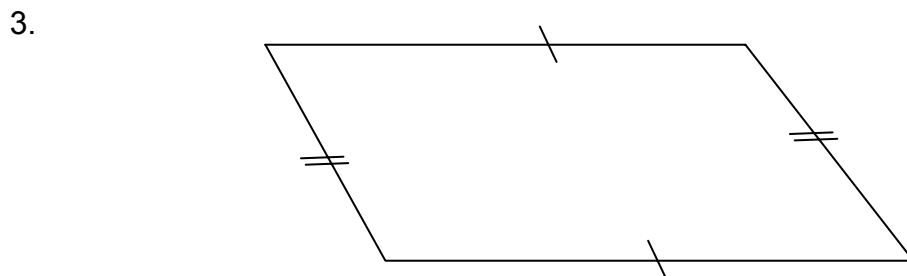
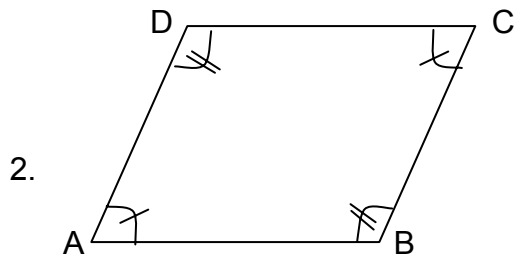
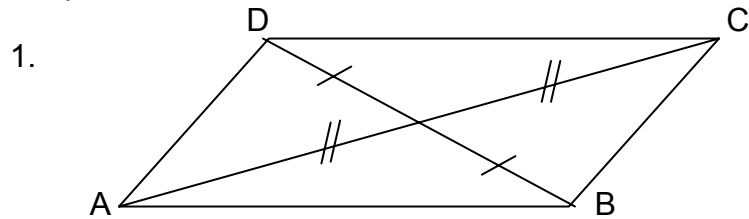
□ ABCD is a quadrilateral. $\overline{AD} = 5 \text{ cm}$ and $\overline{AB} = 9 \text{ cm}$.



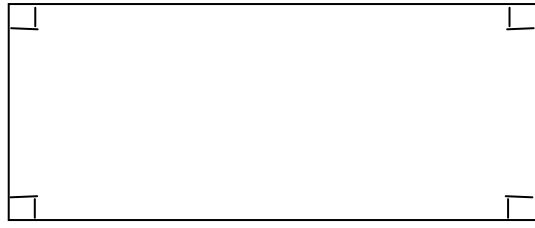
6. □ ABCD is a parallelogram if $x = 5 \text{ cm}$ and $y = 9 \text{ cm}$.
7. □ ABCD is a parallelogram if $m\angle C = 60$ and $m\angle B = 120$.
8. □ ABCD is a parallelogram if $\overline{AB} \parallel \overline{DC}$.
9. □ ABCD is a parallelogram if $m\angle B \cong m\angle D$
10. □ ABCD is a parallelogram if $\overline{AB} \cong \overline{DC} \cong \overline{AD} \cong \overline{BC}$.

Set B.

Determine whether each quadrilateral is a parallelogram. Identical “tick marks” indicate that the sides or angles are congruent and identical “arrowheads” indicate the lines are parallel.



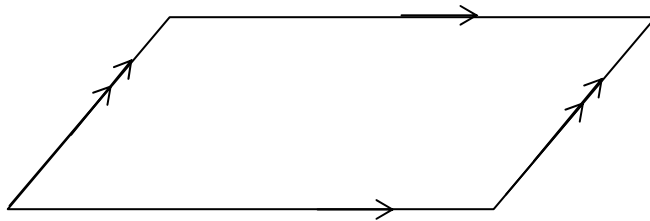
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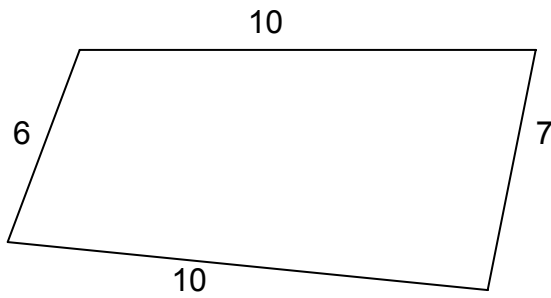
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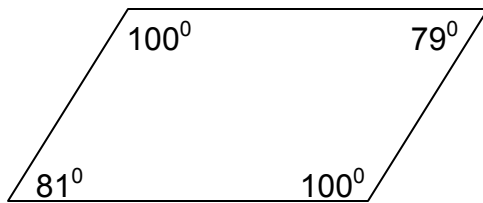
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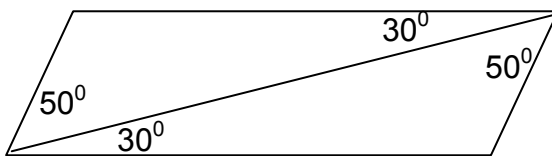
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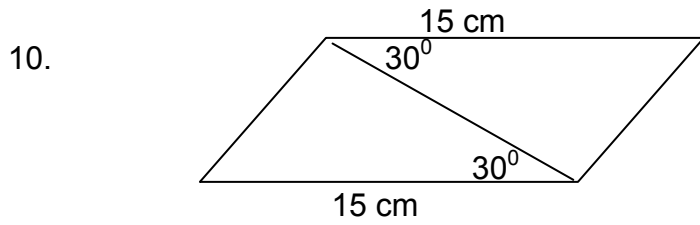


8.



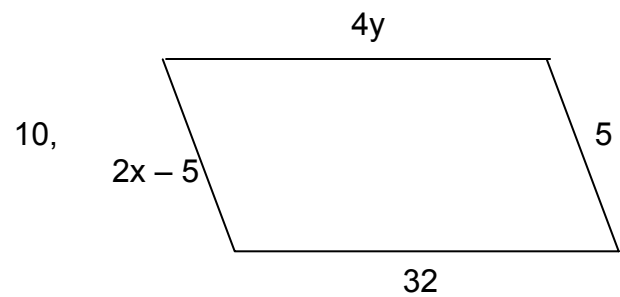
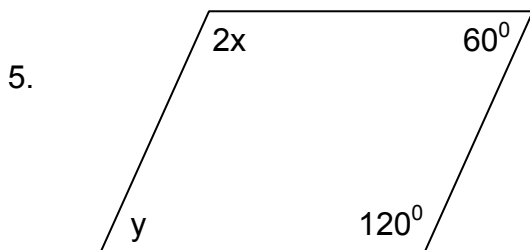
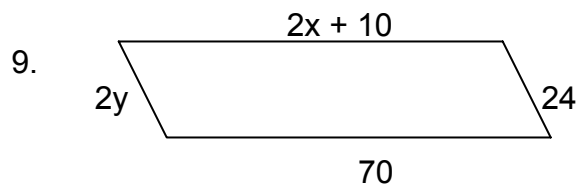
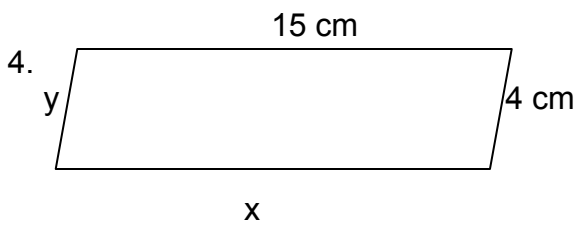
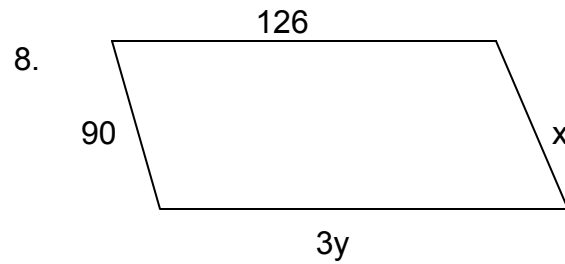
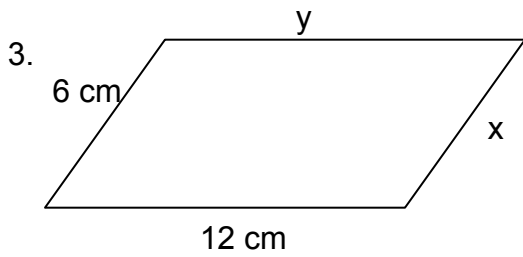
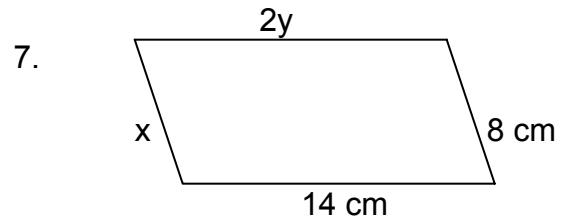
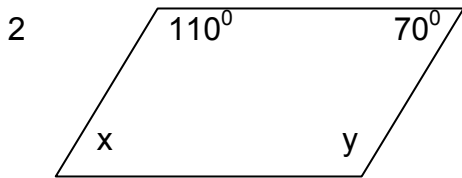
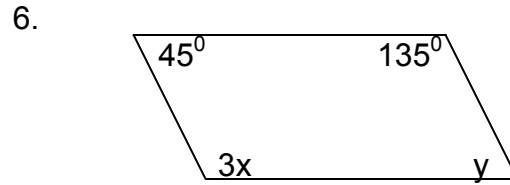
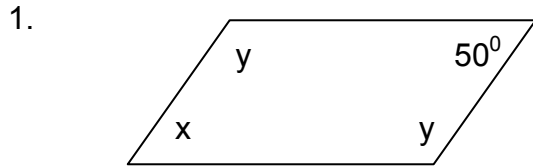
9.





Set C.

What values of x and y guarantee that each quadrilateral is a parallelogram.





Let's summarize

1. A diagonal of a quadrilateral is a segment which connects any two non-consecutive vertices.
2. The diagonals of a rectangle are congruent.
3. The diagonals of a square are congruent.
4. The diagonals of a square are perpendicular
5. Each diagonal of a square bisects a pair of opposite angles.
6. The diagonals of a rhombus are perpendicular.
7. Each diagonal of a rhombus bisects a pair of opposite angles
8. A square is a special type of rhombus.
9. If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
10. If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
11. If one pair of opposite sides of a quadrilateral are both congruent and parallel, then the quadrilateral is a parallelogram.
12. If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram.
13. If the non-opposite angles of a quadrilateral are supplementary, then the quadrilateral is a parallelogram.
14. A quadrilateral is a parallelogram if both pairs of opposite side are parallel

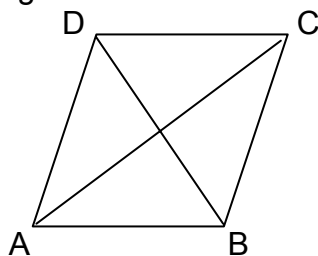


What have you learned

Multiple Choice. Choose the letter of the correct answer.

1. A parallelogram is a rhombus if
 - A. The diagonals bisect each other
 - B. The diagonals are perpendicular.
 - C. Two consecutive angles are supplementary.
 - D. The opposite sides are parallel.
2. Which of the following is sufficient to guarantee that a quadrilateral is a parallelogram?
 - A. The diagonals are perpendicular
 - B. A pair of adjacent sides are congruent
 - C. Two consecutive angles are congruent
 - D. The diagonals bisect each other

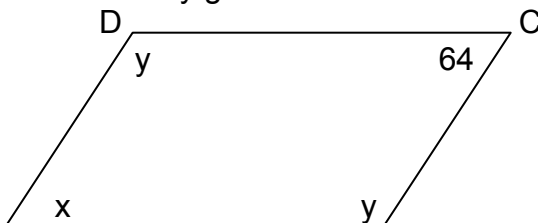
7. $\square ABCD$ is a rhombus . Diagonals \overline{AC} and \overline{BD} intersect at E.



What is $m\angle AED$?

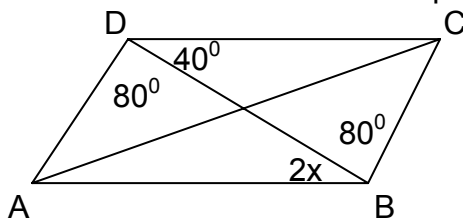
- A. 30
B. 45
C. 60
D. 90

8. What values of x and y guarantee that $\square ABCD$ is a parallelogram.



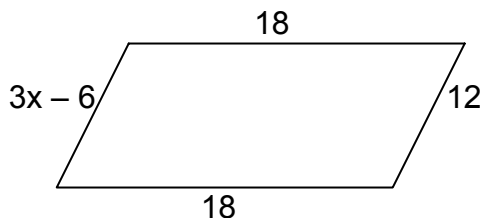
- A. $x = 64$, $y = 116$
B. $x = 32$, $y = 116$
C. $x = 64$, $y = 64$
D. $x = 32$, $y = 64$

9. Find the value of x for which $\square ABCD$ is a parallelogram.



- A. 10
B. 20
C. 30
D. 40

10. Find the value of x for which $\square ABCD$ is a parallelogram.



- A. 8
B. 6
C. 4
D. 2



Answer Key

How much do you know

1. True
2. False
3. True
4. True
5. True
6. True
7. $\overline{AC} = 100$
8. $\overline{AE} = 15$
9. $m\angle FCD = 20$
10. $x = 10$

Lesson 1

Set A

1. True
2. False
3. False
4. True
5. True
6. True
7. True
8. False
9. True
10. True

Set B

1. 15
2. 23
3. 35
4. 20
5. 60
6. 32
7. 110
8. 115
9. 45
10. 90

Set C

1. $\overline{AC} = 25$
2. $\overline{BD} = 59$
3. $x = 22$
4. $x = 10$
5. 90

6. 90

7. $x = 5$

8. $x = 6$

9. $x = 32$

10. $x = 10$

Lesson 2

Set A

1. True

2. True

3. False

4. True

5. False

6. True

7. True

8. True

9. True

10. False

Set B

1. Parallelogram

2. Parallelogram

3. Parallelogram

4. Parallelogram

5. Parallelogram

6. Parallelogram

7. Not a parallelogram

8. Not a parallelogram

9. Parallelogram

10. Parallelogram

Set C

1. $x = 50^\circ$
 $y = 130^\circ$

2. $x = 70^\circ$
 $y = 110^\circ$

3. $x = 6$ cm
 $y = 12$ cm

4. $x = 15$ cm
 $y = 4$ cm

5. $x = 60^\circ$
 $y = 60^\circ$

6. $x = 45^\circ$
 $y = 45^\circ$

7. $x = 8$ cm
 $y = 7$ cm

8. $x = 90$ units
 $y = 42$ units

9. $x = 30$ units
 $y = 12$ units

10. $x = 5$ units
 $y = 8$ units

What have you learned

1. B

2. D

3. B

4. C

5. C

6. B

7. D

8. A

9. B

10. B