What You Will Learn

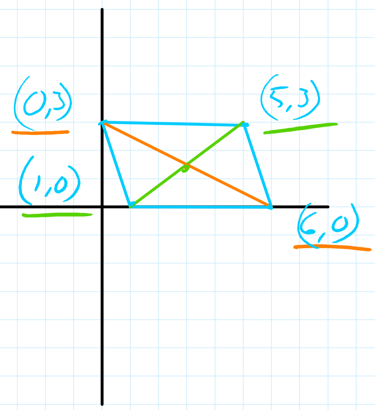
- Identify and verify parallelograms.
- Show that a quadrilateral is a parallelogram in the coordinate plane.
- Use parallelograms in the coordinate plane.

Find the coordinates of the intersection of the diagonals of ▱*ABCD* with vertices *A*(1, 0), *B*(6, 0), *C*(5, 3), and *D*(0, 3). $\left(3, \frac{3}{2}\right)$

$$\left(\frac{0+6}{2}, \frac{3+0}{2}\right) = \left(\frac{6}{2}, \frac{3}{2}\right) = \left(3, \frac{3}{2}\right)$$

$$\left(\frac{1+5}{2}, \frac{0+3}{2}\right) = \left(\frac{6}{2}, \frac{3}{2}\right) = \left(3, \frac{3}{2}\right)$$

$$\boxed{\left(3, \frac{3}{2}\right)}$$

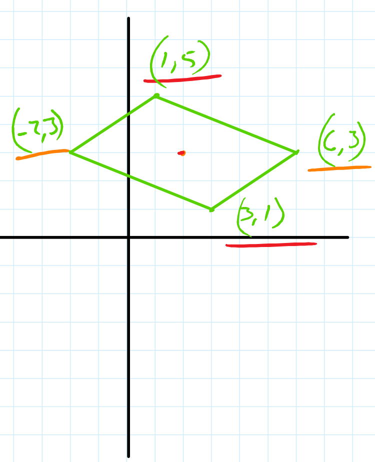


Find the coordinates of the intersection of the diagonals of ▱*STUV* with vertices *S*(−2, 3), *T*(1, 5), *U*(6, 3), and *V*(3, 1).

$$\left(\frac{-2+6}{2}, \frac{3+3}{2}\right) = \left(\frac{4}{2}, \frac{6}{2}\right) = (2,3)$$

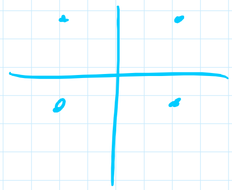
$$\left(\frac{1+3}{2}, \frac{5+1}{2}\right) = \left(\frac{4}{2}, \frac{6}{2}\right) = (2,3)$$

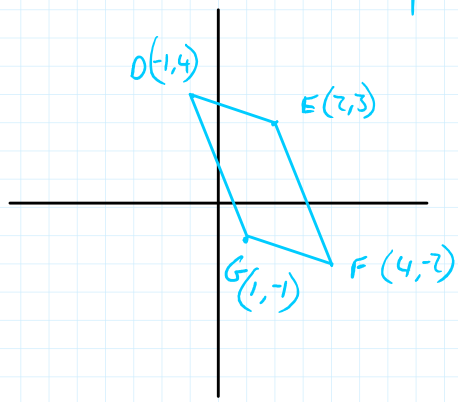
$$\boxed{(2,3)}$$

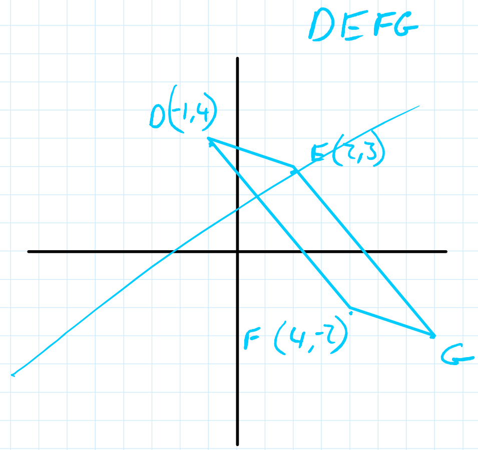


Three vertices of ▱*DEFG* are *D*(–1, 4), *E*(2, 3), and *F*(4, –2). Find the coordinates of vertex *G*. (1, –1)

$\boxed{(1,-1)}$

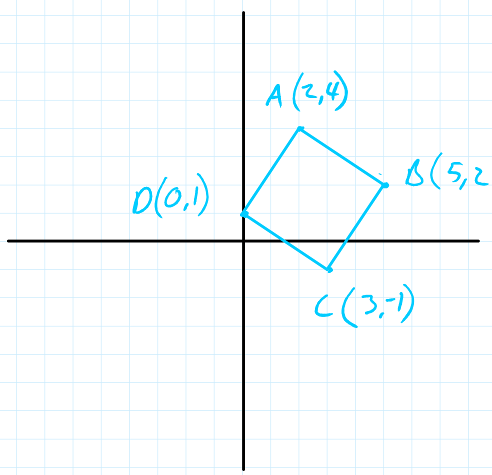






Three vertices of ▱*ABCD* are *A*(2, 4), *B*(5, 2), and *C*(3, −1). Find the coordinates of vertex *D*.

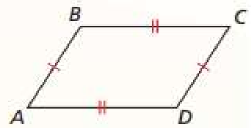
$\boxed{D\ (0,1)}$



Theorem 7.7 Parallelogram Opposite Sides Converse

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

If $\overline{AB} \cong \overline{CD}$ and $\overline{BC} \cong \overline{DA}$, then $ABCD$ is a parallelogram.

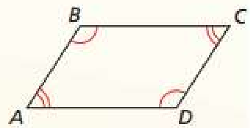


Theorem 7.8 Parallelogram Opposite Angles Converse

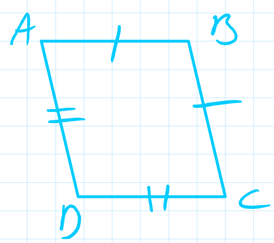
If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

If $\angle A \cong \angle C$ and $\angle B \cong \angle D$, then $ABCD$ is a parallelogram.

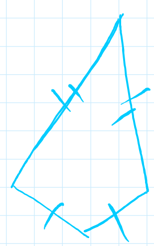
Proof Ex. 39, p. 383



In quadrilateral $ABCD$, $AB = BC$ and $CD = AD$. Is $ABCD$ a parallelogram? Explain your reasoning. You cannot

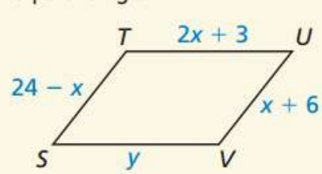


No Because opposite sides are not $\cong$



Finding Side Lengths of a Parallelogram

For what values of x and y is quadrilateral $STUV$ a parallelogram?



$2x+3=y$; $x=9$

$2 \cdot 9+3=y$

$18+3=y$

$21=y$

$24-x=x+6$

$24=2x+6$

$\frac{18}{2}=\frac{2x}{2}$

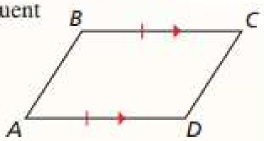
$9=x$

Theorem 7.9 Opposite Sides Parallel and Congruent Theorem

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

If $\overline{BC} \parallel \overline{AD}$ and $\overline{BC} \cong \overline{AD}$, then $ABCD$ is a parallelogram.

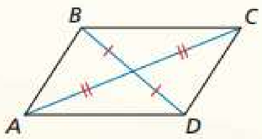
Proof Ex. 40, p. 383



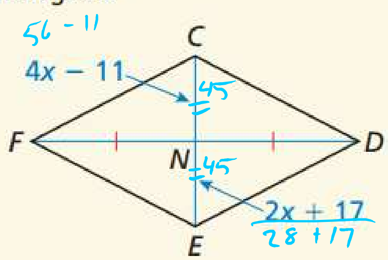
Theorem 7.10 Parallelogram Diagonals Converse

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

If $\overline{BD}$ and $\overline{AC}$ bisect each other, then $ABCD$ is a parallelogram.



For what value of x is quadrilateral $CDEF$ a parallelogram?



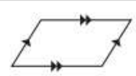
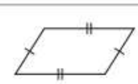
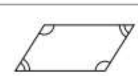
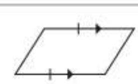
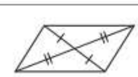
$4x - 11 = 2x + 17$

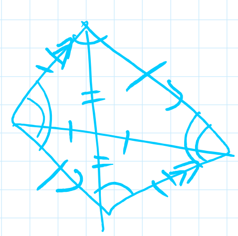
$2x - 11 = 17$

$2x = 28$

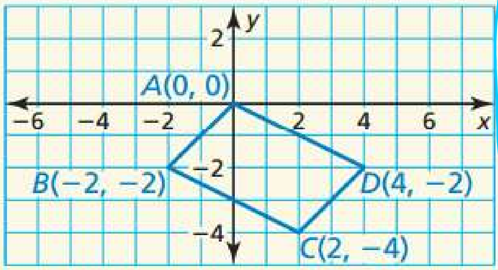
$\boxed{x = 14}$

Ways to Prove a Quadrilateral Is a Parallelogram

1. Show that both pairs of opposite sides are parallel. *(Definition)*	
2. Show that both pairs of opposite sides are congruent. *(Parallelogram Opposite Sides Converse)*	
3. Show that both pairs of opposite angles are congruent. *(Parallelogram Opposite Angles Converse)*	
4. Show that one pair of opposite sides are congruent and parallel. *(Opposite Sides Parallel and Congruent Theorem)*	
5. Show that the diagonals bisect each other. *(Parallelogram Diagonals Converse)*	



Show that quadrilateral *ABCD* is a parallelogram.



$m\overline{AB} = \frac{2}{2} = 1$

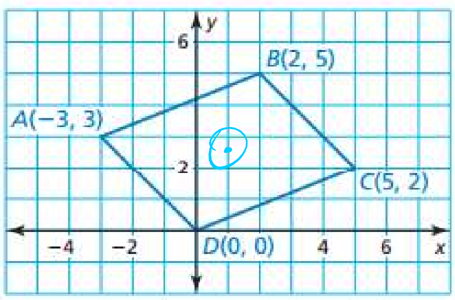
$m\overline{CD} = \frac{2}{2} = 1$

$m\overline{BC} = \frac{-2}{4} = \frac{-1}{2}$

$m\overline{AD} = \frac{-2}{4} = \frac{-1}{2}$

yes, parallelogram

Show that quadrilateral *ABCD* is a parallelogram.



$\left(\frac{2+0}{2}, \frac{5+0}{2}\right) = \left(1, \frac{5}{2}\right)$

$\left(\frac{-3+5}{2}, \frac{3+2}{2}\right) = \left(1, \frac{5}{2}\right)$

$m\overline{AB} = \frac{2}{5}$

$m\overline{DC} = \frac{2}{5}$

$m\overline{AD} = -1$

$m\overline{BC} = -1$

yes, parallelogram

Practice *sec 7.2* **pg. 372: 25-27A, 29;** *sec 7.3* **pg. 381: 1, 3-9A, 11-19EO**