Good morning!

1. "Here"

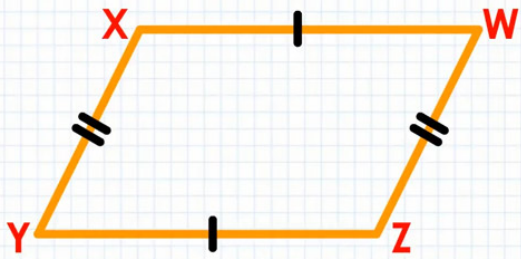
2. Notes on proving quadrilaterals on the coordinate plane

3. Practice

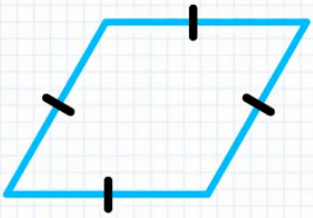
4. Picture due today!

Properties of Parallelograms

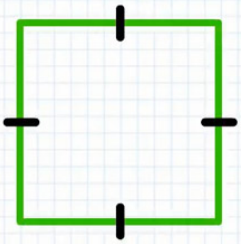
all angles add to 360°



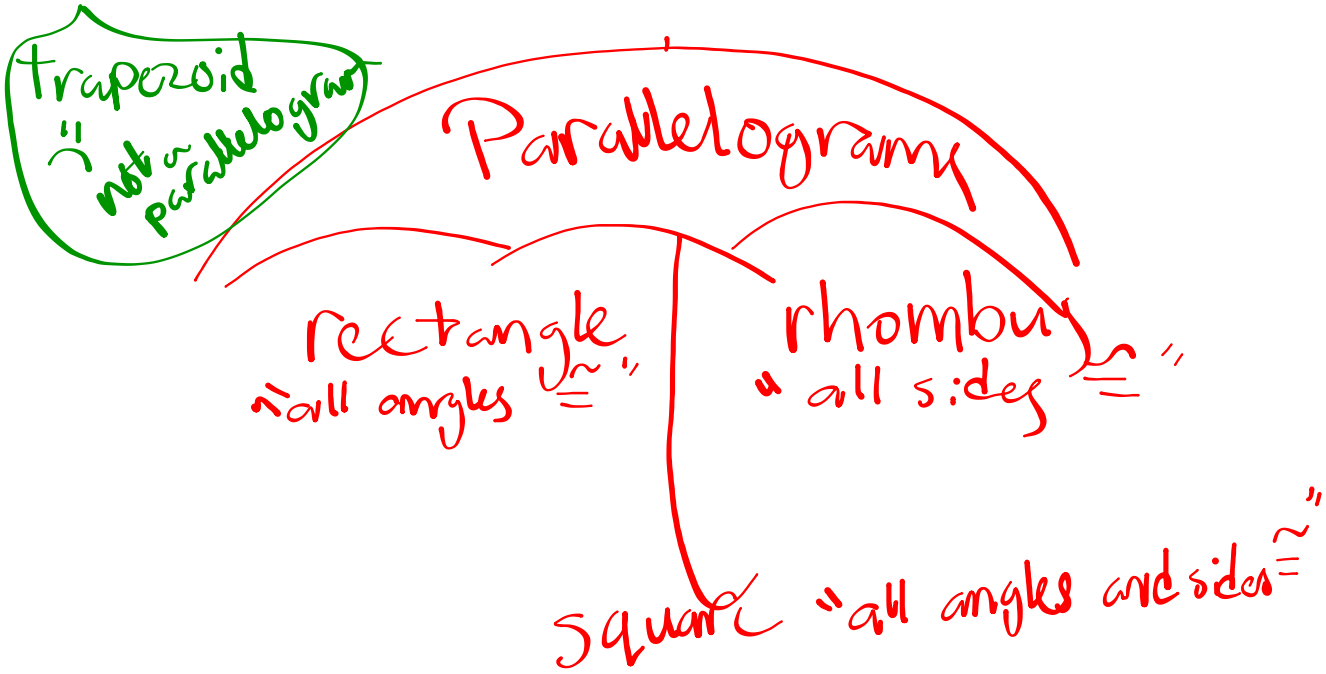
- The opposite sides are parallel
- The opposite sides are congruent (equal in length)

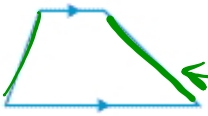


Rhombus



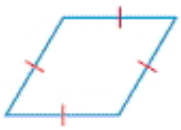
Square


trapezoid
not a parallelogram
Parallelograms
rectangle
all angles
rhombus
all sides
square
all angles and sides

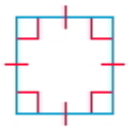
Trapezoid  A trapezoid is a quadrilateral with exactly 1 pair of parallel sides.

not parallelogram

Parallelogram  A parallelogram is a quadrilateral with both pairs of opposite sides parallel.

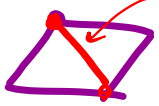
Rhombus  A rhombus is a parallelogram with 4 sides of equal length.

Rectangle  A rectangle is a parallelogram with 4 right angles.

Square  A square is a parallelogram with 4 sides of equal length and 4 right angles.

Ways to Prove a Parallelogram:

1. Prove both pairs of opposite sides are parallel. (4) ✓ (SAME SLOPE)
2. Prove one pair of opposite sides are parallel and congruent. (2 sides) ✓ (Parallel SLOPE formula / congruent distance)
3. Prove both pairs of opposite sides are congruent. ✓
4. Prove both pairs of opposite angles are congruent.
5. Prove one angle is supplementary to both of its consecutive angles.
6. Prove the diagonals bisect each other. ✓ (midpoint)



2 congruent halves

Given A(2,2) B (-4,-2) C (-2,-7) & D (4,-3)

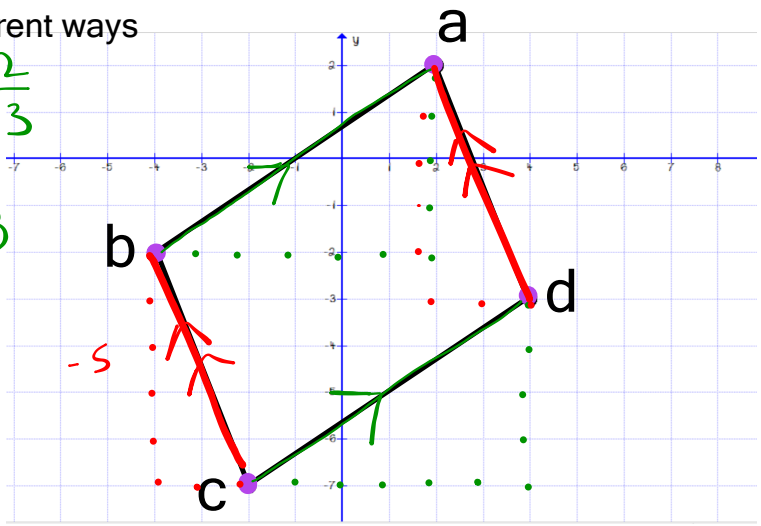
Prove it's a parallelogram 4 different ways

1. Slope $\overline{ba} = \frac{up\,4}{rt\,6} = \frac{2}{3}$

Slope $\overline{cd} = \frac{4}{6} = \frac{2}{3}$

Slope $\overline{bc} = \frac{-5}{2}$

Slope $\overline{ad} = \frac{-5}{2}$



Given A(2,2) B (-4,-2) C (-2,-7) & D (4,-3)

Prove it's a parallelogram 4 different ways

One pair opp sides, // & ≅

2.

① slope $\overline{bc} = \frac{2}{3}$ // ✓

slope $\overline{cd} = \frac{2}{3}$

$\overline{cd} // \overline{ba}$

② $6^2 + 4^2 = c^2$

$36 + 16$

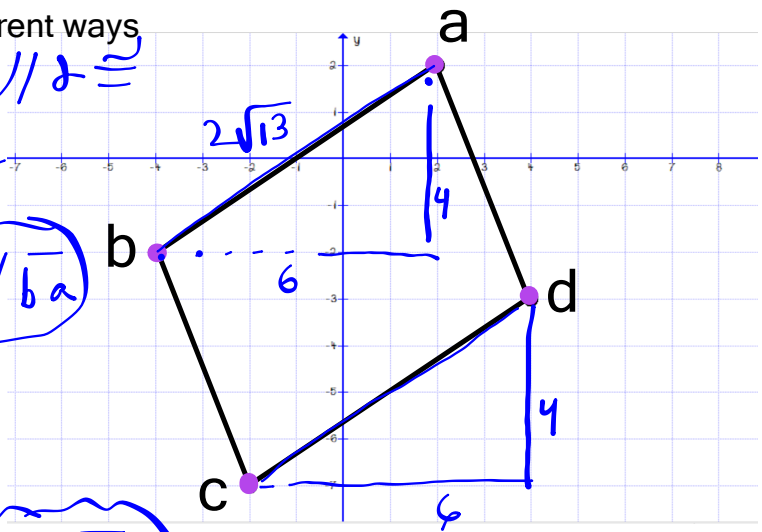
$\sqrt{52} = \sqrt{c^2}$

$c = 2\sqrt{13} = ba$

$\sqrt{6^2+4^2}$

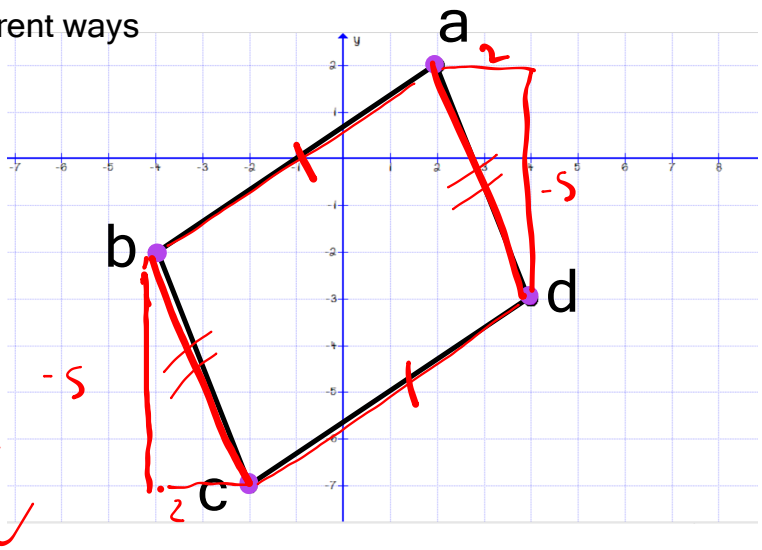
$= \sqrt{52} = 2\sqrt{13} = cd$

$\overline{cd} \cong \overline{ba}$



Given A(2,2) B (-4,-2) C (-2,-7) & D (4,-3)

Prove it's a parallelogram 4 different ways



3. ① $\overline{ba} \cong \overline{cd}$

$2\sqrt{13} = 2\sqrt{13}$

② $a^2+b^2=c^2$

$(-5)^2+(2)^2=c^2$

$25+4=c^2$

$\sqrt{29}=\sqrt{c^2}$ $bc=\sqrt{29}$ ✓

$ad=\sqrt{29}$ ✓

$\overline{bc} \cong \overline{ad}$

Given A(2,2) B (-4,-2) C (-2,-7) & D (4,-3)

Prove it's a parallelogram 4 different ways

4. midpoint of $\overline{ac}$

$\left(\frac{-2+2}{2}=0, \frac{-7+2}{2}=\frac{-5}{2}=-2.5\right)$

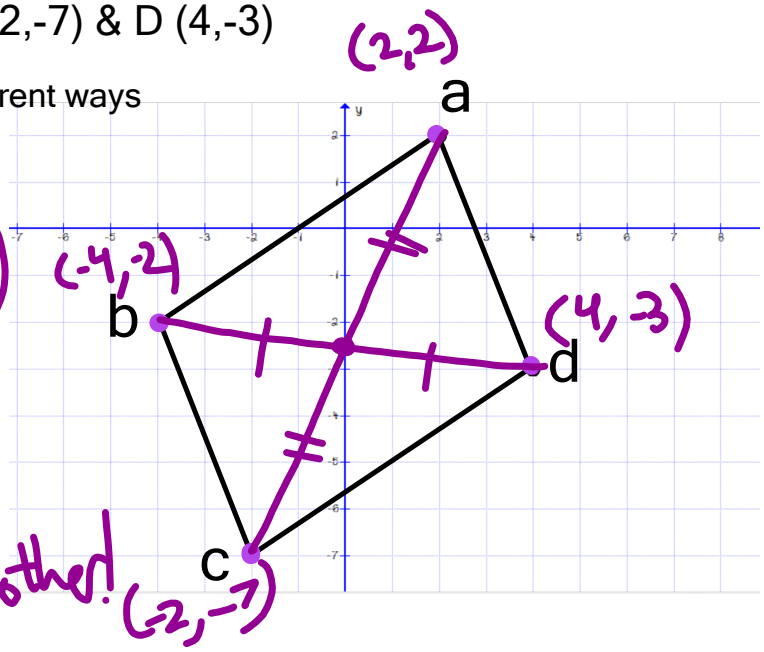
(0, -2.5)

midpoint of $\overline{bd}$

$\left(\frac{-4+4}{2}=0, \frac{-2+-3}{2}=\frac{-5}{2}=-2.5\right)$

(0, -2.5)

Diagonals bisect each other!



To prove a quadrilateral is a rectangle...

1) **First prove it is a parallelogram.** Then prove parallelogram contains at least one right angle.

↳ 1 slopes OR ① flip fraction ② change sign

2) **First prove it is a parallelogram.** Then, the diagonals of a parallelogram are congruent.

OR (Distance Formula)

3) You could prove that all four angles are right angles.

↳ 4 slopes for all sides

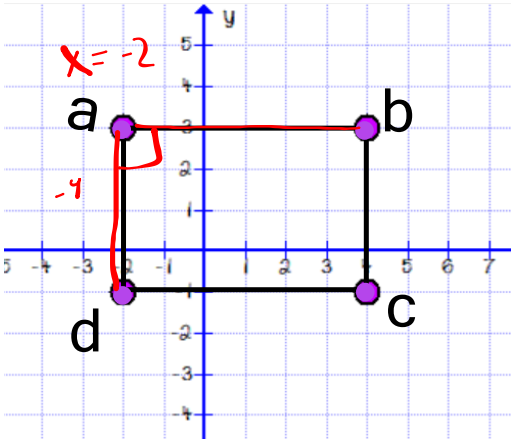
Given A(-2,3) B(4,3) C(4,-1) and D(-2,-1)

Prove ABCD is a rectangle 2 different ways

1. Slope of $\overline{ad}$: $\frac{-4}{0}$ undefined

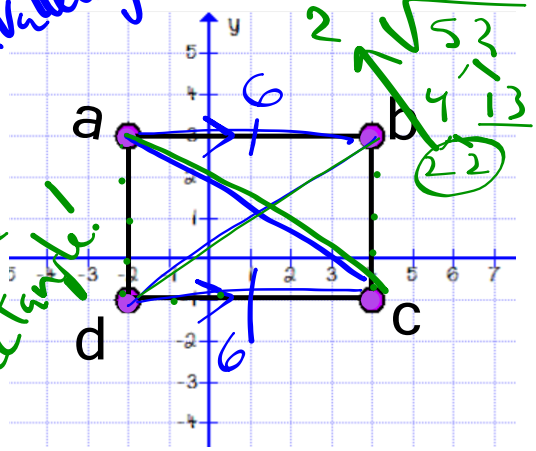
Slope of $\overline{ab}$: $\frac{0}{6} = 0$

$\overline{ab} \perp \overline{ad}$



Given A(-2,3) B(4,3) C(4,-1) and D(-2,-1)

Prove ABCD is a rectangle 2 different ways



2.

① Opp sides $\cong$ & $\parallel$
slope ab = 0 ab // dc
slope dc = 0

② 6 = 6 $\overline{ab} \cong \overline{dc}$

Parallelogram!

Diagonals $\cong$

$\overline{ac} \cong \overline{bd}$

$ac = \sqrt{(6)^2 + (-4)^2}$

$\sqrt{36+16} = \sqrt{52} = 2\sqrt{13}$

$bd = \sqrt{(-6)^2 + (-4)^2}$

$\sqrt{36+16} = \sqrt{52} = 2\sqrt{13}$

Rectangle!

To prove a quadrilateral is a rhombus...

First, prove the quadrilateral is a parallelogram. Then prove:

1) First prove the quadrilateral is a parallelogram. Then, prove it has a pair of consecutive sides that are congruent.

OR

2) First prove the quadrilateral is a parallelogram. Then, prove either diagonal bisects two angles of the parallelogram.

OR

3) Prove the diagonals are perpendicular bisector of each other.

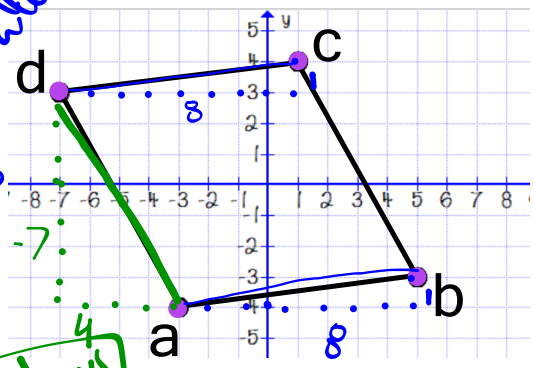
slopes ① flip fraction ② change signs → midpoints

Given: A(-3,-4) B(5,-3) C(1,4) and D(-7,3)

Prove it's a Rhombus 2 ways

1. ① slope $dc = \frac{1}{8}$ } $\overline{dc} \parallel \overline{ab}$
   slope $ab = \frac{1}{8}$ }
   ② $dc = \sqrt{8^2+1^2}$
   $= \sqrt{64+1} = \sqrt{65}$ } $\overline{dc} \cong \overline{ab}$
   $ab = \sqrt{8^2+1^2} = \sqrt{65}$ }
   $ad = \sqrt{4^2+(-7)^2}$
   $= \sqrt{16+49} = \sqrt{65}$ $\overline{ad} \cong \overline{dc}$
   ∎ Rhombus

Parallelogram



Given: A(-3,-4) B(5,-3) C(1,4) and D(-7,3)

Prove it's a Rhombus 2 ways

Diagonals ⊥ bisectors of each other ✓

2. slope $\overline{db} = \frac{-6}{12} = -\frac{1}{2}$ } ⊥

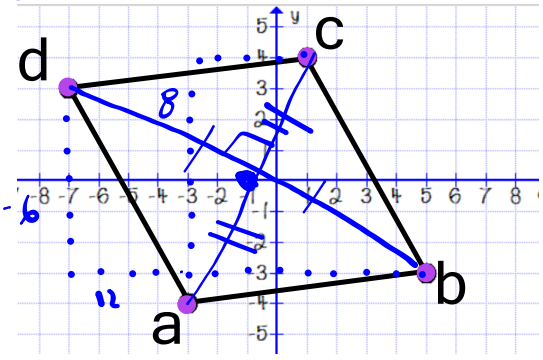
① slope $\overline{ac} = \frac{8}{4} = 2$

② mid $\overline{db} = \left(\frac{5+-7}{2} = \frac{-2}{2} = -1, \frac{-3+3}{2} = 0\right)$

(-1, 0)

mid $\overline{ac} = \left(\frac{-3+1}{2} = \frac{-2}{2} = -1, \frac{-4+4}{2} = 0\right)$ bisect

(-1, 0)



To prove a quadrilateral is a square...

Prove it is both a rectangle and a rhombus!

**HINT...prove 4 right angles & 4 congruent sides....

Given A(1,2) B(2,-1) C(5,0) D(4,3)

Prove ABCD is a Square ✓

⊥ slope ad & bc = $\frac{1}{3}$

① slope ab & dc = $\frac{-3}{1}$ = -3

Slopes ⊥! → 90° angles ✓

② $ad = \sqrt{3^2+1^2} = \sqrt{9+1} = \sqrt{10}$

$dc = \sqrt{3^2+1^2} = \sqrt{10}$

$bc = \sqrt{3^2+1^2} = \sqrt{10}$

$ab = \sqrt{3^2+1^2} = \sqrt{10}$