

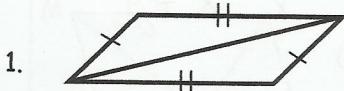
## 6-3 Notes: Proving that a Quadrilateral is a Parallelogram

You can show that a quadrilateral is a parallelogram if you can show that one of the following is true.

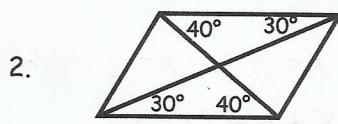
Def: Both pairs opp. Sides  $\parallel \leftrightarrow$  Parallelogram

- ❖ Both pairs of opp. Sides  $\cong \rightarrow$  Parallelogram
- ❖ Diagonals bisect each other  $\rightarrow$  Parallelogram
- ❖ Both pairs opp. Angles  $\cong \rightarrow$  Parallelogram
- ❖ One pair of opp. Sides are both  $\parallel$  and  $\cong \rightarrow$  Parallelogram

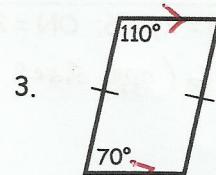
Determine if each quadrilateral is a parallelogram. Justify your answer.



Yes; both pairs opp. sides  $\cong$ .



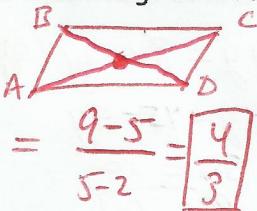
No; only 1 pair opp. sides  $\parallel$ .



No; same pair opp. sides NOT  $\cong + \parallel$ .

Determine whether quadrilateral ABCD with the given vertices is a parallelogram. Explain.

4. A(2,5), B(5,9), C(6,3), D(3,-1)



Using Slope  
Slope of AB =  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9-5}{5-2} = \frac{4}{3}$

" " BC =  $m = \frac{3-9}{6-5} = \frac{-6}{1}$

" " CD =  $m = \frac{-1-3}{3-6} = \frac{-4}{-3} = \frac{4}{3}$

" " AD =  $m = \frac{-1-5}{3-2} = \frac{-6}{1}$

5. A(-1,6), B(2,-3), C(5,0), D(2,9)

Using Slope  
m of AB =  $m = \frac{-3-6}{2+1} = \frac{-9}{3} = -3$

m of BC =  $m = \frac{0+3}{5-2} = \frac{3}{3} = 1$

m of CD =  $m = \frac{9-0}{2-5} = \frac{9}{-3} = -3$

m of AD =  $m = \frac{9-6}{2+1} = \frac{3}{3} = 1$

Yes; both pairs opp. sides  $\parallel$ .

Using Midpoint:

Midpt. AC =  $(\frac{2+6}{2}, \frac{5+3}{2}) = (4, 4)$

Midpt. BD =  $(\frac{5+3}{2}, \frac{9-1}{2}) = (4, 4)$

\* Same midpoint  $\rightarrow$  diagonals bisect each other.

Yes; both pairs opp. sides  $\parallel$ .

Using Midpoint:

Midpt. AC = (2, 3)

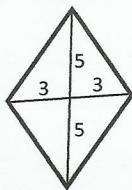
Midpt. BD = (2, 3)

Are the following parallelograms? If yes, why? (use one of the five reasons from section 6.3) If no, tell what else would be needed.

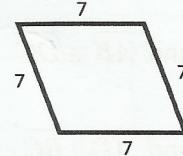
1. No; need another pair opp. sides  $\cong$  or  $\parallel$ .



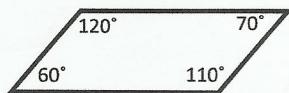
2. Yes; diag. bisect each other



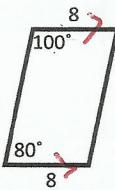
3. Yes; opp. sides  $\cong$  both pairs



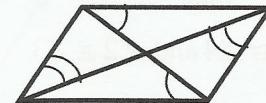
4. No; opp. Ls not  $\cong$



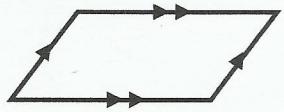
5. Yes; same pair of opp. sides both  $\cong$  and  $\parallel$ .



6. Yes; both pairs opp. sides  $\parallel$ .



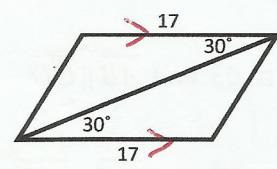
7. Yes; both pairs opp. sides  $\parallel$ .



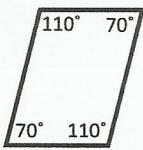
8. No; need another pair of sides  $\parallel$ .



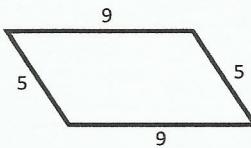
9. Yes; same pair opp. sides  $\cong$  and  $\parallel$ .



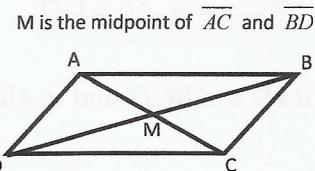
10. Yes; both pairs opp. Ls  $\cong$



11. Yes; both pairs opp. sides  $\cong$ .



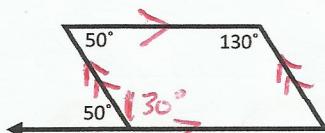
12. Yes; diagonals bisect each other.



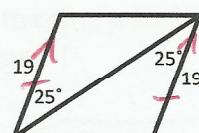
13. Yes, both pairs opp. Ls  $\cong$ .



14. Yes; both pairs opp. sides  $\parallel$ .



15. Yes, same pair opp. sides both  $\cong$  and  $\parallel$ .



State whether the given information is sufficient to support the statement, "Quadrilateral ABCD is a parallelogram." If the information is sufficient, state the reason.

16.  $\overline{AB} \cong \overline{CD}$  and  $\overline{AB} \parallel \overline{CD}$  Yes; 1 pair opp. sides both  $\cong + \parallel$

17.  $AO = OC$  and  $BO = OD$  Yes; diag. bisect each other

18.  $\overline{AB} \parallel \overline{CD}$  and  $\overline{BC} \parallel \overline{AD}$  Yes; opp. sides  $\parallel$ .

19.  $\overline{AC} \perp \overline{BD}$  and  $AO = OC$  No

20.  $\angle 1 \cong \angle 4$  and  $\overline{AB} \cong \overline{DC}$  Yes; one pair opp. sides  $\cong$  and  $\parallel$ .

21.  $\angle 1 \cong \angle 4$  and  $\overline{AD} \parallel \overline{BC}$  Yes; both pairs opp. sides  $\parallel$ .

22.  $\overline{AB} \cong \overline{CD}$  and  $\overline{BC} \cong \overline{AD}$  Yes; both pairs opp. sides  $\cong$ .

23.  $\angle 1 \cong \angle 4$  and  $\angle 2 \cong \angle 3$  Yes; both pairs opp. sides  $\parallel$ .

24.  $\overline{AB} \cong \overline{CD}$  and  $\overline{BC} \parallel \overline{AD}$  No

25.  $\overline{BC} \cong \overline{AD}$  and  $\overline{BC} \parallel \overline{AD}$  Yes; one pair opp. sides both  $\cong$  and  $\parallel$ .

26.  $\angle 2 \cong \angle 3$  and  $\overline{AB} \parallel \overline{CD}$  Yes; both pairs opp. sides  $\parallel$ .

27.  $\angle 2 \cong \angle 3$  and  $\overline{BC} \cong \overline{AD}$  Yes; one pair opp. sides both  $\cong$  and  $\parallel$ .

28.  $\angle 2 \cong \angle 3$  and  $\overline{AB} \cong \overline{CD}$  No

29.  $\angle BAD \cong \angle BCD$  and  $\angle ABC \cong \angle ADC$  Yes; both pairs opp.  $\angle s \cong$ .

30.  $\angle BAD$  is supplementary to  $\angle ADC$

$\angle ADC$  is supplementary to  $\angle BCD$  Yes; consecutive  $\angle s$  are supplementary,

which proves both pairs opp. sides are  $\parallel$ .

