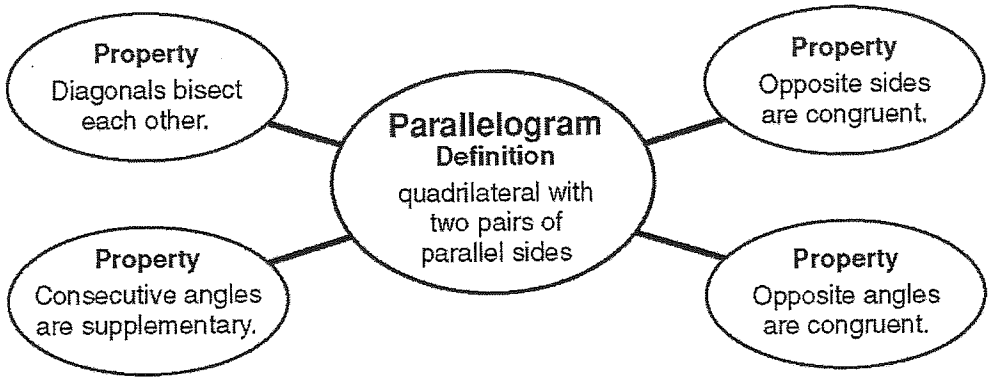
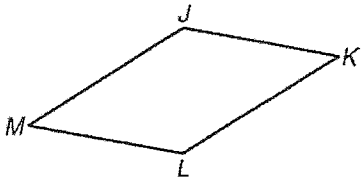
Name _____ Date _____ Class _____

LESSON 9-1

Properties of Parallelograms



Use the graphic aid above to help answer Problems 1–10.



In parallelogram *JKLM*, *LM* = 86 millimeters, *LK* = 100 millimeters, and m∠*JML* = 42°. Find each measure.

1. *JM*

_____

2. m∠*KJM*

_____

3. *KJ*

_____

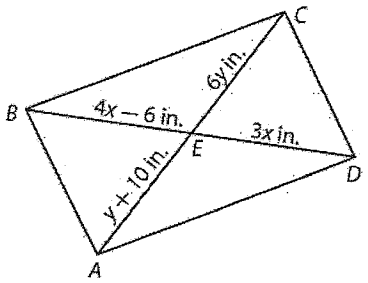
4. m∠*LKJ*

_____

5. m∠*MLK*

_____

Use parallelogram *ABCD* to find each measure.



6. *AE*

_____

7. *BE*

_____

8. *CE*

_____

9. *AC*

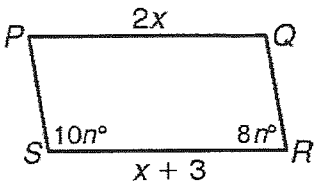
_____

10. *BD*

_____

Name _____ Date _____ Class _____

$PQRS$ is a parallelogram. Find each measure.

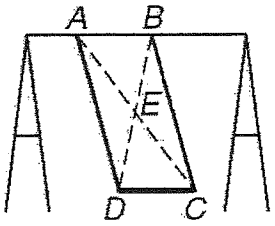


11. RS _____

12. $m\angle S$ _____

13. $m\angle R$ _____

The figure shows a swing blown to one side by a breeze. As long as the seat of the swing is parallel to the top bar, the swing makes a parallelogram. In parallelogram $ABCD$, $DC = 2$ ft, $BE = 4\frac{1}{2}$ ft, and $m\angle BAD = 75°$.



Find each measure.

14. AB _____

15. ED _____

16. BD _____

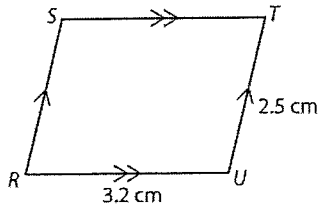
17. $m\angle ABC$ _____

18. $m\angle BCD$ _____

19. $m\angle ADC$ _____

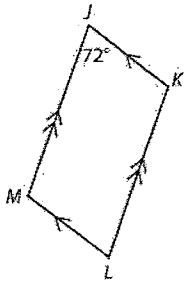
Find each measure.

20. RS



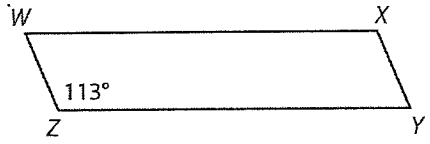
_____

21. $m\angle K$



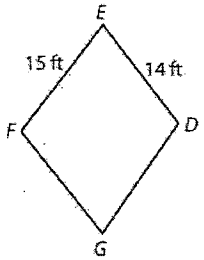
_____

22. Angle Y of parallelogram $WXYZ$

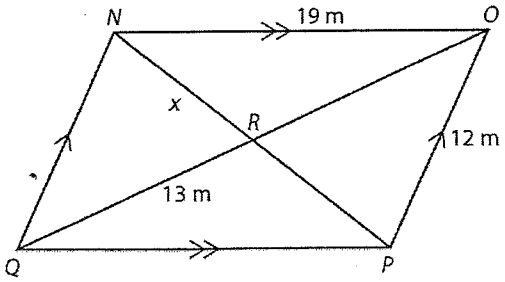


_____

23. Side GD of parallelogram $DEFG$



_____



24. QP _____

25. NQ _____

26. OR _____

27. QO _____

28. NP _____

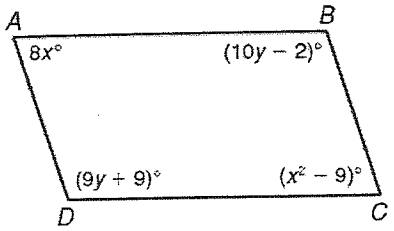
Name _____ Date _____ Class _____

LESSON 9-2

Conditions for Parallelograms

Determine whether each figure is a parallelogram for the given values of the variables. Explain your answers.

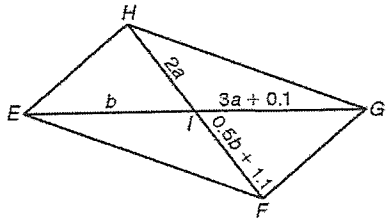
1. $x = 9$ and $y = 11$



_____

_____

2. $a = 4.3$ and $b = 13$

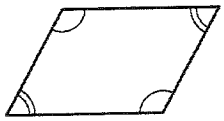


_____

_____

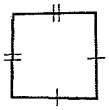
In the figures below, interpret the symbols and conclude if the figure is a parallelogram. Write *parallelogram* or *not a parallelogram.* Use the conditions in the table for reasons *why* or *why not.*

3. _____



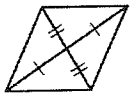
Why or why not? _____

4. _____



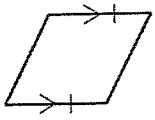
Why or why not? _____

5. _____



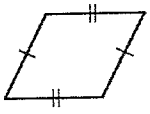
Why or why not? _____

6. _____



Why or why not? _____

7. _____



Why or why not? _____

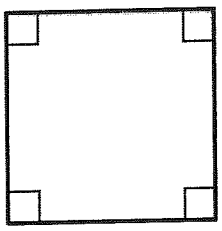
Name _____ Date _____ Class _____

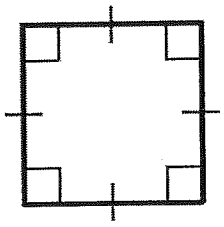
LESSON 9-3

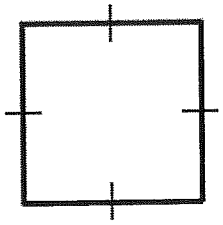
Properties of Rectangles, Rhombuses, and Squares

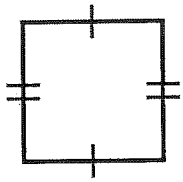
Practice and Problem Solving: A/B

Tell whether each figure is a parallelogram, rectangle, rhombus, or square based on the information given. Use the most specific name possible.

1. 

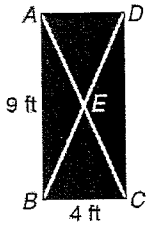
2. 

3. 

4. 

_____ _____ _____ _____

A modern artist's sculpture has rectangular faces. The face shown here is 9 feet long and 4 feet wide. Find each measure in simplest radical form. (*Hint:* Use the Pythagorean Theorem.)



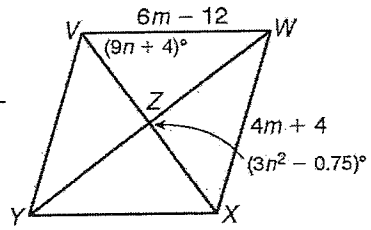
5. $DC =$ _____

6. $AD =$ _____

7. $DB =$ _____

8. $AE =$ _____

***VWXY* is a rhombus. Find each measure.**



9. $XY =$ _____

10. $m\angle YVW =$ _____

11. $m\angle VYX =$ _____

12. $m\angle XYZ =$ _____

Answer each of the following.

13. Is a rhombus always a parallelogram? _____

14. Is a rectangle always a rhombus? _____

15. Is a quadrilateral always a parallelogram? _____

16. What must be true about a rhombus in order for it to be a square?

_____

17. What must be true about a rectangle in order for it to be a square?

_____

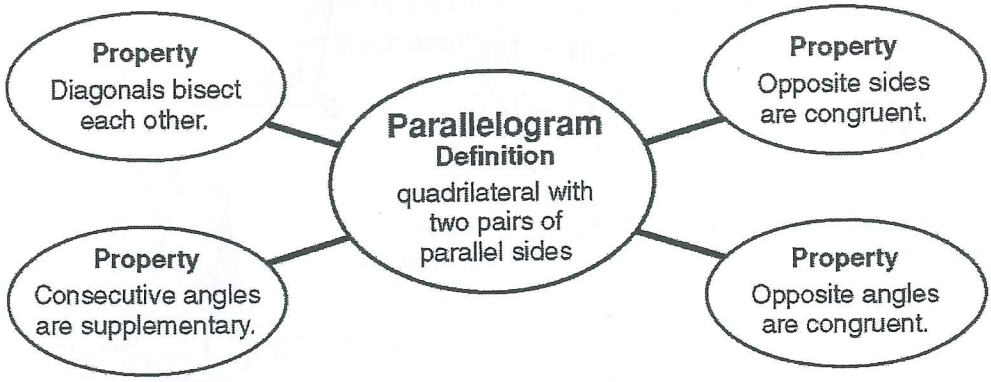
18. What must be true about a rhombus in order for it to be a rectangle?

_____

Name Key Date Class

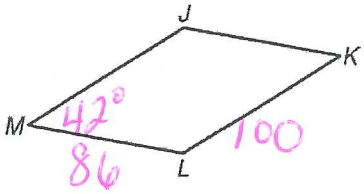
LESSON 9-1

Properties of Parallelograms



Use the graphic aid above to help answer Problems 1–10.

In parallelogram *JKLM*, *LM* = 86 millimeters, *LK* = 100 millimeters, and m∠*JML* = 42°. Find each measure.



1. *JM*
100

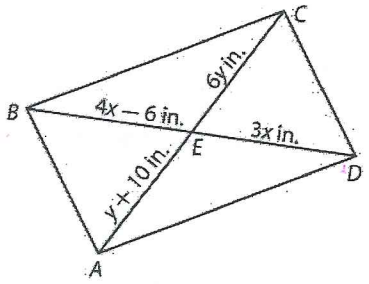
2. m∠*KJM*
138°

3. *KJ*
86

4. m∠*LKJ*
42°

5. m∠*MLK*
138°

Use parallelogram *ABCD* to find each measure.



$6y = y + 10$
$5y = 10$
$y = 2$

$4x - 6 = 3x$
$x = 6$

6. *AE*
12

7. *BE*
18

8. *CE*
12

9. *AC*
24

10. *BD*
36

Name _____ Date _____ Class _____

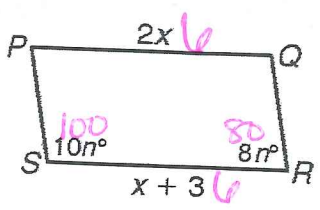
PQRS is a parallelogram. Find each measure.

11. RS 6

12. $m\angle S$ 100°

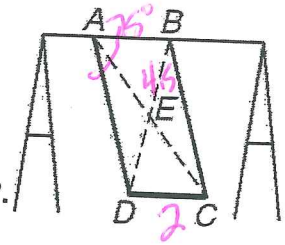
13. $m\angle R$ 80°

$10n + 8n = 180$
$18n = 180$
$n = 10$



$2x = x + 3$
$x = 3$

The figure shows a swing blown to one side by a breeze. As long as the seat of the swing is parallel to the top bar, the swing makes a parallelogram. In parallelogram $ABCD$, $DC = 2$ ft, $BE = 4\frac{1}{2}$ ft, and $m\angle BAD = 75°$.



Find each measure.

14. AB 2

15. ED 4½

16. BD 9

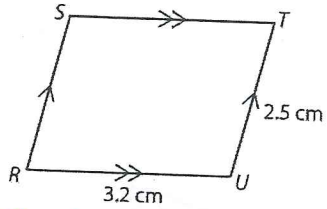
17. $m\angle ABC$ 105°

18. $m\angle BCD$ 75°

19. $m\angle ADC$ 105°

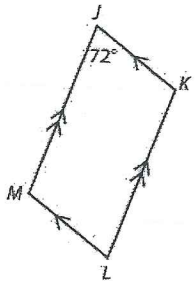
Find each measure.

20. RS



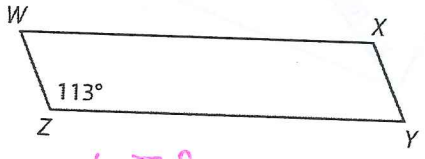
2.5 cm

21. $m\angle K$



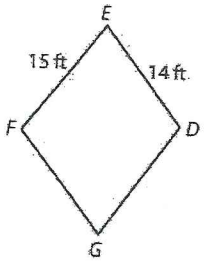
108°

22. Angle Y of parallelogram $WXYZ$

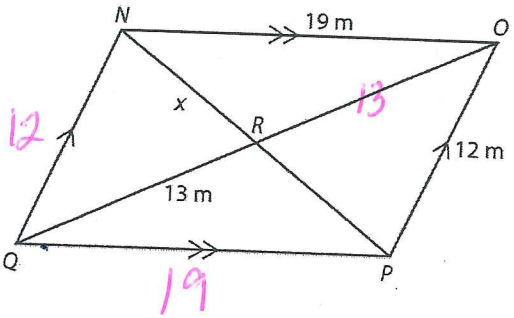


67°

23. Side GD of parallelogram $DEFG$



15 ft



19

24. QP 19

25. NQ 12

26. OR 13

27. QO 26

28. NP 2x

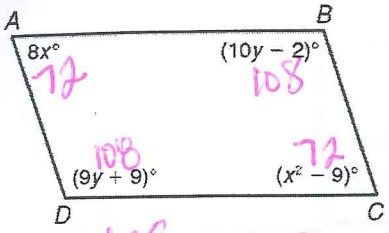
Name _____ Date _____ Class _____

LESSON 9-2

Conditions for Parallelograms

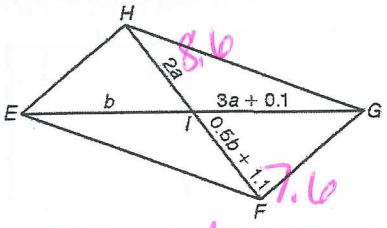
Determine whether each figure is a parallelogram for the given values of the variables. Explain your answers.

1. $x = 9$ and $y = 11$



yes - opp. ∠s ≅

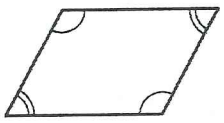
2. $a = 4.3$ and $b = 13$



no - diagonals don't bisect

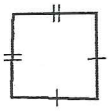
In the figures below, interpret the symbols and conclude if the figure is a parallelogram. Write *parallelogram* or *not a parallelogram.* Use the conditions in the table for reasons *why* or *why not.*

3. Yes



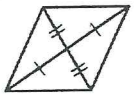
Why or why not? both pairs opp. ∠s ≅

4. no



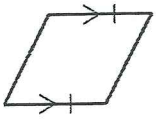
Why or why not? need to know opp. sides ≅

5. yes



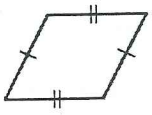
Why or why not? diagonals bisect

6. yes



Why or why not? 1 pair opp sides ≅ and ||

7. yes



Why or why not? both pairs opp sides ≅

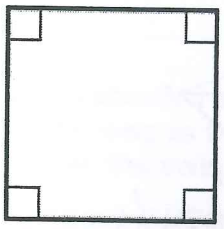
Name _____ Date _____ Class _____

LESSON 9-3

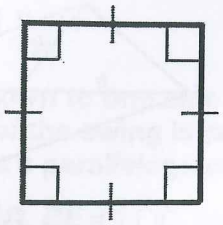
Properties of Rectangles, Rhombuses, and Squares

Practice and Problem Solving: A/B

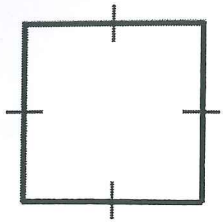
Tell whether each figure is a parallelogram, rectangle, rhombus, or square based on the information given. Use the most specific name possible.

1. 

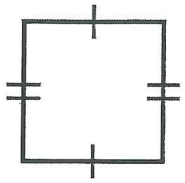
rectangle

2. 

square

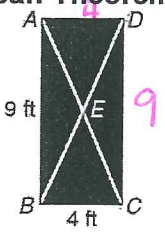
3. 

rhombus

4. 

parallelogram

A modern artist's sculpture has rectangular faces. The face shown here is 9 feet long and 4 feet wide. Find each measure in simplest radical form. (*Hint:* Use the Pythagorean Theorem.)



5. $DC =$ 9 ft

6. $AD =$ 4 ft

7. $DB =$ $\sqrt{97}$ ft

$9^2 + 4^2 = c^2$ $97 = c^2$

8. $AE =$ $\frac{\sqrt{97}}{2}$ ft

***VWXY* is a rhombus. Find each measure.**

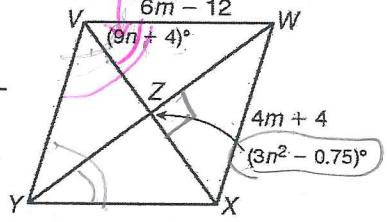
9. $XY =$ 36

10. $m\angle YVW =$ 107°

11. $m\angle VYX =$ 73°

12. $m\angle XYZ =$ 36.5°

53.5



$3n^2 - .75 = 90$

$3n^2 = 90.75$

$n^2 = 30.25$

$n = 5.5$

Answer each of the following.

13. Is a rhombus always a parallelogram? yes

14. Is a rectangle always a rhombus? no

15. Is a quadrilateral always a parallelogram? no

16. What must be true about a rhombus in order for it to be a square?

Also must be a rectangle.

17. What must be true about a rectangle in order for it to be a square?

Also must be a rhombus.

18. What must be true about a rhombus in order for it to be a rectangle?

1 right angle or diagonals $\cong$ (Must be a square)

Name _____ Date _____ Class _____

LESSON 9-4

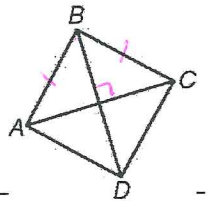
Conditions for Rectangles, Rhombuses, and Squares

Practice and Problem Solving: A/B

Fill in the blanks to complete each theorem.

1. If one pair of consecutive sides of a parallelogram are congruent, then the parallelogram is a rhombus.
2. If the diagonals of a parallelogram are perpendicular, then the parallelogram is a rhombus.
3. If the diagonals of a parallelogram are congruent, then the parallelogram is a rectangle.
4. If one diagonal of a parallelogram bisects a pair of opposite angles, then the parallelogram is a rhombus.
5. If one angle of a parallelogram is a right angle, then the parallelogram is a rectangle.

Use the figure for Problems 6–7. Determine whether each conclusion is valid. If not, tell what additional information is needed to make it valid.



6. **Given:** $\overline{AC}$ and $\overline{BD}$ bisect each other. $\overline{AC} \cong \overline{BD}$

   Conclusion: *ABCD* is a square.

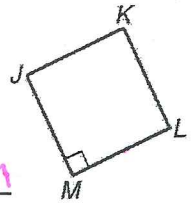
   no - need to know it's a rhombus

7. **Given:** $\overline{AC} \perp \overline{BD}$, $\overline{AB} \cong \overline{BC}$

   Conclusion: *ABCD* is a rhombus.

   no - need to know it's a parallelogram

Complete Problems 8–11 to show that the conclusion is valid.



Given: $\overline{JK} \cong \overline{ML}$, $\overline{JM} \cong \overline{KL}$, and $\overline{JK} \cong \overline{KL}$. $\angle M$ is a right angle.

Conclusion: *JKLM* is a square.

8. Because $\overline{JK} \cong \overline{ML}$ and $\overline{JM} \cong \overline{KL}$, *JKLM* is a parallelogram
9. Because *JKLM* is a parallelogram and $\angle M$ is a right angle, *JKLM* is a rectangle.
10. Because *JKLM* is a parallelogram and $\overline{JK} \cong \overline{KL}$, *JKLM* is a rhombus.
11. Because *JKLM* is a rectangle and a rhombus, *JKLM* is a square.