

Lesson 3.4 - Parallelograms

Learning Objectives: SWBAT

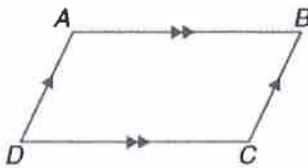
1. Explain and identify the properties of parallelograms related to their opposite sides, opposite angles and diagonals
2. Use the properties of parallelograms to solve problems

Making a connection

- Lesson 3.3 introduced us to quadrilaterals and we identified basic characteristics that make them special.
- This lesson is about one parent quadrilateral, the parallelogram.

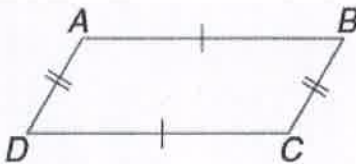
What is a parallelogram?

- A parallelogram is a quadrilateral that has its opposite sides parallel.

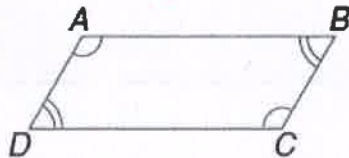


- If a quadrilateral is a parallelogram, then the following must always be true:

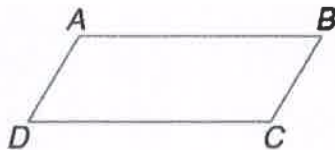
1. Opposite sides are congruent



2. Opposite angles are congruent



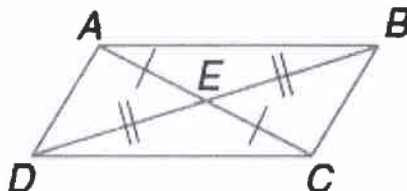
3. Consecutive angles add to 180



$$m\angle A + m\angle B = 180$$

$$m\angle A + m\angle D = 180$$

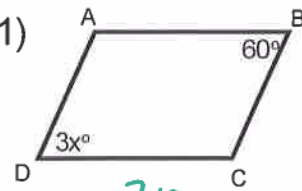
4. The diagonals bisect each other



Lesson 3.4 - Parallelograms

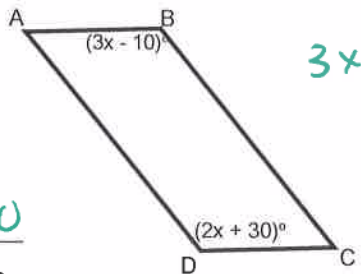
Using the properties of parallelograms

Your Turn 1 - Opposite angles of a Parallelogram are equal/congruent

1) 

$3x = 60$
 $x = 20$

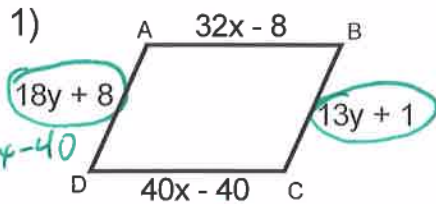
angle D = 60
 angle A = 120
 angle C = 120

2) 

$3x - 10 = 2x + 30$
 $x = 40$

angle D = _____
 angle A = _____
 angle C = _____

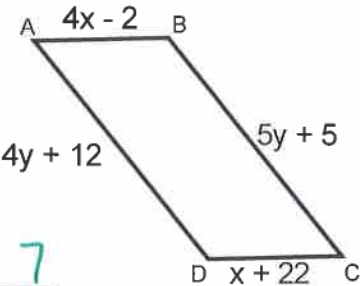
Your Turn 2 - Opposite sides of a Parallelogram are equal/congruent

1) 

$32x - 8 = 40x - 40$
 $32 = 8x$
 $x = 4$

$18y + 8 = 13y + 1$
 $5y = -7$
 $y = X$

Side AB = 120 Side AD = 4

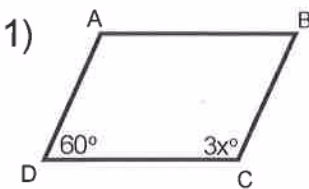
2) 

$4x - 2 = x + 22$
 $3x = 24$
 $x = 8$

$4y + 12 = 5y + 5$
 $-y = -7$
 $y = 7$

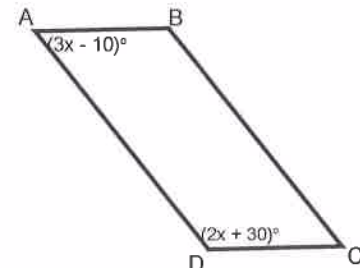
Side AB = 30 Side AD = 40

Your Turn 3 - Consecutive angles of a parallelogram are supplementary (add to 180°)

1) 

$3x + 60 = 180$
 $3x = 120$
 $x = 40$

$x = 40$
 angle C = 120
 angle A = 120
 angle B = 60

2) 

$3x - 10 + 2x + 30 = 180$
 $5x + 20 = 180$
 $5x = 160$
 $x = 32$

$x = 32$
 angle A = 86
 angle B = 94
 angle C = 86

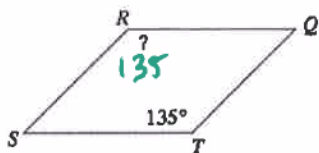
$3x - 10 + 2x + 30 = 180$
 $5x + 20 = 180$
 $5x = 160$
 $x = 32$

Lesson 3.4 - Parallelograms

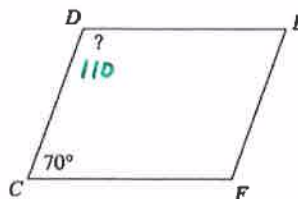
Practice

Find the measurement indicated in each parallelogram.

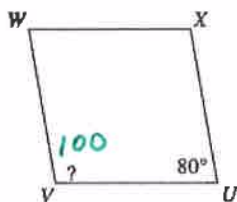
1)



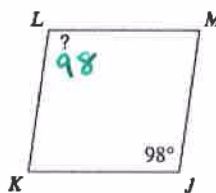
2)



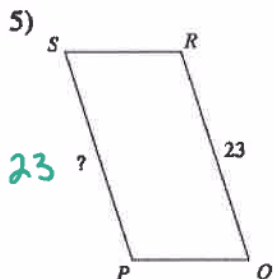
3)



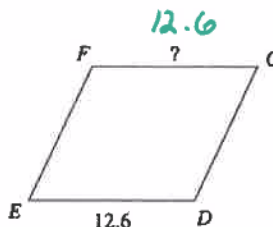
4)



5)

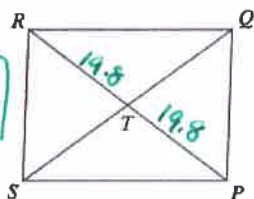


6)

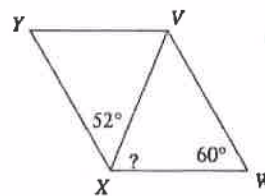


7) $RT = 19.8$
Find RP

$RP = 39.6$



8)

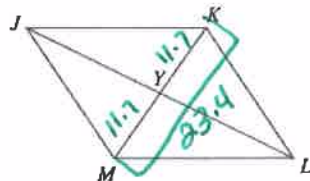


$60 + 52 + x = 180$

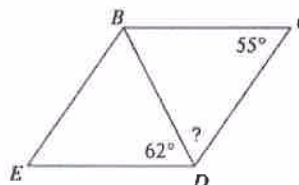
$x = 68$

9) $KM = 23.4$
Find YM

$YM = 11.7$



10)



$62 + x + 55 = 180$

$x = 63$

Lesson 3.4 - Parallelograms

Practice

Solve for x . Each figure is a parallelogram.

11) $11x - 10 + 80 = 180$
 $x = 10$

12) $2x + 15 = x + 15$
 $x = 0$

13) $9x + 15 + 6x + 15 = 180$
 $x = 10$

14) $35 + 14x + 5 = 180$
 $x = 10$

15) $7 = x + 1$
 $x = 6$

16) $50x + 130x = 180$
 $x = 1$

17) $UH = 19$
 $FH = 5x - 7$
 $19 + 19 = 5x - 7$
 $x = 9$

18) $KU = 3x + 3$
 $UM = 4x - 4$
 $3x + 3 = 4x - 4$
 $x = 7$

Find the measurement indicated in each parallelogram.

19) Find RQ
 $-1 + 4x = 3x + 3$
 $x = 4$
 $RQ = 15$

20) Find $m\angle G$
 $3x + 11 = 5x - 9$
 $x = 10$

21) $TE = 4 + 2x$
 $EV = 4x - 4$
 Find TE
 $4 + 2x = 4x - 4$
 $x = 2$
 $TE = 12$

22) Find $m\angle TSR$
 $2x + 14 + 2x - 7 + 125 = 180$
 $x = 24$
 $\angle TSR = 2(24) - 7 + 2(24) + 14$

Lesson 3.4 - Parallelograms

Practice

Find each measure.

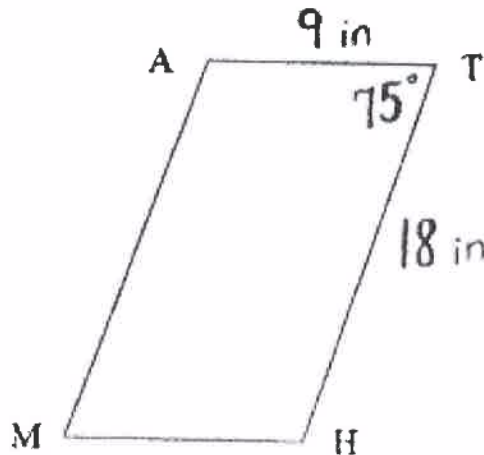
1) $MA = 18 \text{ in}$

2) $MH = 9 \text{ in}$

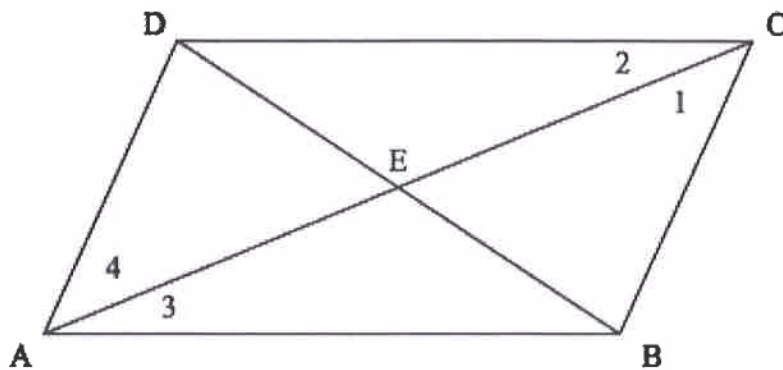
3) $m\angle AMH = 75^\circ$

5) $m\angle MHT = 105^\circ$

6) $m\angle MAT = 105^\circ$



II. Complete each statement, using Parallelogram DCBA



If $AC = 30$ and $AE = 3x + 3$,
then $x = \underline{4}$

$$\begin{aligned} 3x+3 + 3x+3 &= 30 \\ 6x+6 &= 30 \\ 6x &= 24 \quad x=4 \end{aligned}$$

If $AD = 20$, then $BC = \underline{20}$

If $AB = 13$, then $DC = \underline{13}$

If $DB = 22$, then $DE = \underline{11}$

If $AE = 18$, then $AC = \underline{36}$

If $m\angle ADC = 115^\circ$, then $m\angle ABC = \underline{115}$

If $m\angle DAB = 75^\circ$, $m\angle ADC = \underline{105^\circ}$

Lesson 3.4 - Parallelograms

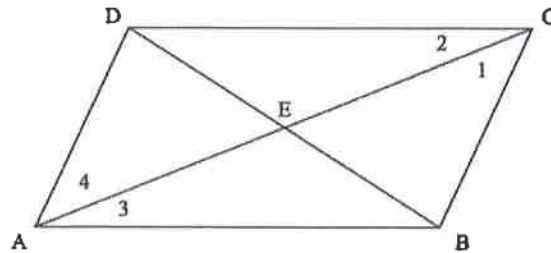
Practice

I. Complete each statement.

- In a parallelogram, opposite sides are parallel and congruent.
- In a parallelogram, consecutive angles are supplementary.
- In a parallelogram, diagonals bisect each other, which means they split each other in half.

II. Complete each statement, using Parallelogram DCBA

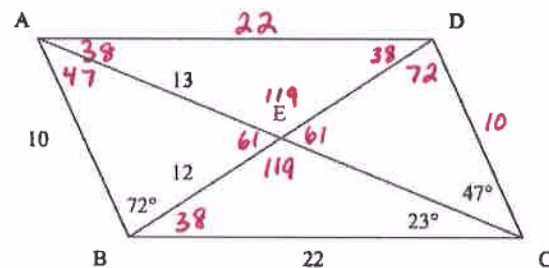
- If $AD = 20$, then $BC = \underline{20}$
- If $AB = 13$, then $DC = \underline{13}$
- If $DB = 22$, then $DE = \underline{11}$
- If $AE = 18$, then $AC = \underline{36}$
- If $m\angle ADC = 115^\circ$, then $m\angle ABC = \underline{115}$
- If $m\angle DAB = 75^\circ$, $m\angle ADC = \underline{105}$
- If $m\angle AED = 72^\circ$, $m\angle DEC = \underline{108}$
- If $AC = 30$ and $AE = 3x + 3$, then $x = \underline{4}$



- If $m\angle 1 = 30^\circ$, then $m\angle 4 = \underline{30}$
- If $m\angle ADC = 130^\circ$, and $m\angle 1 = 35^\circ$, $m\angle 2 = \underline{15}$
- ~~If $DC = 6x + y$, $BC = 3x + 2y$, $AB = 25$ and $AD = 14$, then $x =$ and $y =$~~

III. Find the missing measurements of Parallelogram ADCB.

- | | |
|---------------------------------------|-------------------------------------|
| 15. $CD = \underline{10}$ | 16. $DA = \underline{22}$ |
| 17. $AC = \underline{26}$ | 18. $DB = \underline{24}$ |
| 19. $CE = \underline{13}$ | 20. $DE = \underline{12}$ |
| 21. $m\angle ABC = \underline{110}$ | 22. $m\angle BCE = \underline{23}$ |
| 23. $m\angle BCD = \underline{\quad}$ | 24. $m\angle ADC = \underline{110}$ |
| 25. $m\angle BAD = \underline{70}$ | 26. $m\angle CDE = \underline{72}$ |
| 28. $m\angle DAE = \underline{70}$ | 29. $m\angle EAB = \underline{47}$ |
| 31. $m\angle BEC = \underline{119}$ | 32. $m\angle CED = \underline{61}$ |



- $m\angle EDA = \underline{38}$
- $m\angle AEB = \underline{61}$
- $m\angle DEA = \underline{119}$