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 UNIT 4

Date: \_\_\_\_\_  
 LESSON 2

AIM: APPLYING PROPERTIES OF PARALLELOGRAMS AND RECTANGLES

Do Now:  $x^2 + 5x + 6 = 0$

$$(x+3)(x+2) = 0$$

$x = -3$	$x = -2$
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PARALLELOGRAMS	RECTANGLES
<ul style="list-style-type: none"> <li>• Opposite sides are <b>PARALLEL</b>.</li> <li>• Opposite sides are <b>CONGRUENT</b>.</li> <li>• Opposite angles are <b>CONGRUENT</b>.</li> <li>• Consecutive angles are <b>SUPPLEMENTARY</b>.</li> <li>• Diagonals <b>BISECT</b> each other.</li> </ul>	<p><b>ALL PROPERTIES OF PARALLELOGRAMS PLUS:</b></p> <ul style="list-style-type: none"> <li>• Diagonals are <b>CONGRUENT</b>.</li> <li>• Angles are <b>CONGRUENT</b> (90 degree angles)</li> </ul>

1. Which statement is not always true about a parallelogram?  
 2. Which statement is true about every parallelogram?

- 1) The diagonals are congruent. *→ in rectangles*  
 2) The opposite sides are congruent.  
 3) The opposite angles are congruent.  
 4) The opposite sides are parallel.
- 1) All four sides are congruent. *↳ rhombus*  
 2) The interior angles are all congruent.  
 3) Two pairs of opposite sides are congruent.  
 4) The diagonals are perpendicular to each other.

3. In the accompanying diagram of parallelogram ABCD,  $m\angle A = (2x + 10)$  and  $m\angle B = 3x$ . Find the number of degrees in  $m\angle B$ .

$$2x + 10 + 3x = 180$$

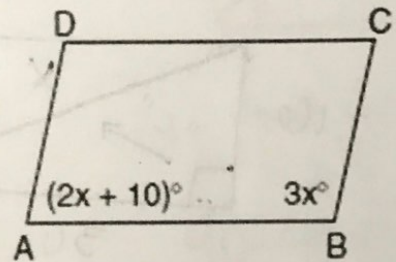
$$5x + 10 = 180$$

$$\underline{-10 \quad -10}$$

$$5x = 170$$

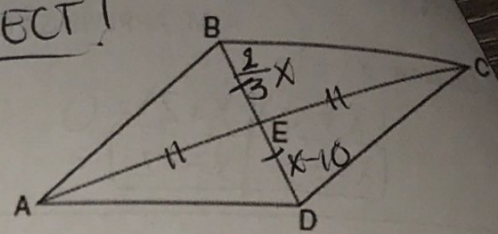
$$x = 34$$

$$m\angle B = 3(34) = \boxed{102^\circ}$$



4. In the accompanying diagram of parallelogram  $ABCD$ , diagonals  $\overline{AC}$  and  $\overline{BD}$  intersect at  $E$ ,  $BE = \frac{2}{3}x$ , and  $ED = x - 10$ . What is the value of  $x$ ?

DIAGONALS BISECT!



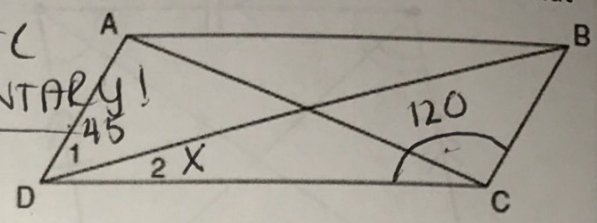
$$\frac{2}{3}x = x - 10$$

$$-\frac{1}{3}x = -10$$

$$\boxed{x = 30}$$

5. In the diagram below of parallelogram  $ABCD$  with diagonals  $\overline{AC}$  and  $\overline{BD}$ ,  $m\angle 1 = 45$  and  $m\angle DCB = 120$ . What is the measure of  $\angle 2$ ?

CONSECUTIVE ARC SUPPLEMENTARY!

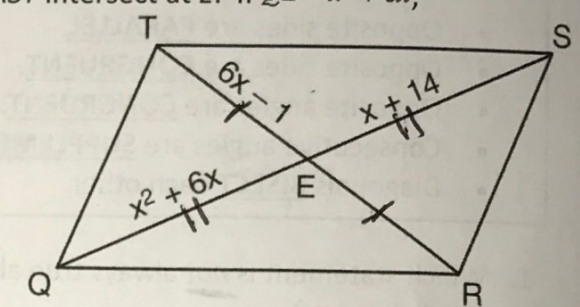


$$120 + 45 + x = 180$$

$$165 + x = 180$$

$$\boxed{x = 15 = \angle 2}$$

6. As shown in the diagram below, the diagonals of parallelogram  $QRST$  intersect at  $E$ . If  $QE = x^2 + 6x$ ,  $SE = x + 14$ , and  $TE = 6x - 1$ , determine  $TE$  algebraically



DIAGONALS BISECT!

$$x^2 + 6x = x + 14$$

$$-x - 14 -x - 14$$

$$TE = 6(2) - 1$$

$$\boxed{TE = 11}$$

$$x^2 + 5x - 14 = 0$$

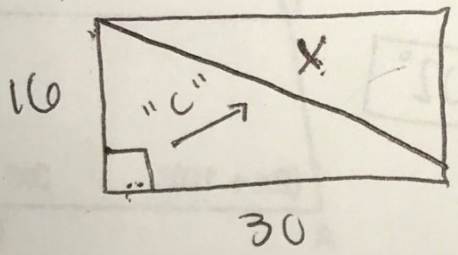
$$(x + 7)(x - 2) = 0$$

$$x = -7 \quad \boxed{x = 2}$$

reject

7. A builder is building a rectangular deck with dimensions of 16 feet by 30 feet. To ensure that the sides form  $90^\circ$  angles, what should each diagonal measure?

PYTHAGOREAN THM -  $a^2 + b^2 = c^2$



$$16^2 + 30^2 = x^2$$

$$\sqrt{1156} = \sqrt{x^2}$$

$$\boxed{x = 34}$$

As shown in the diagram of rectangle  $ABCD$  below, diagonals  $\overline{AC}$  and  $\overline{BD}$  intersect at  $E$ . If  $AE = x + 2$  and  $BE = 4x - 16$ , then the length of  $\overline{AC}$  is

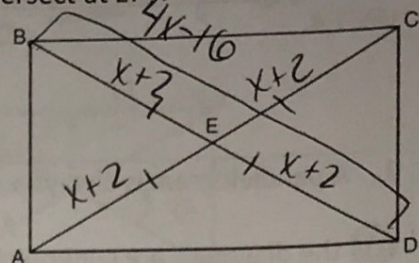
$$x + 2 + x + 2 = 4x - 16$$

$$\begin{array}{r} 2x + 4 = 4x - 16 \\ -2x + 16 \quad -2x + 16 \\ \hline 20 = 2x \end{array}$$

$$20 = 2x$$

$$x = 10$$

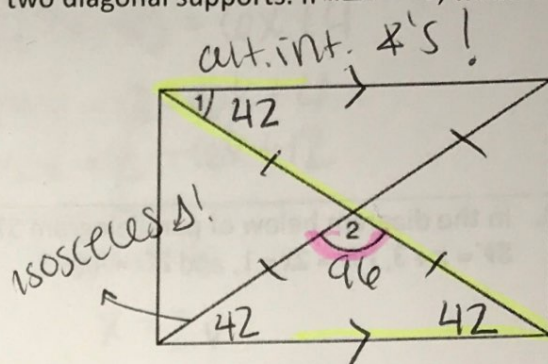
$$\overline{AC} = \overline{BD} = 4(10) - 16 = \boxed{24}$$



Diagonals are  $\cong$ !

9. As shown in the accompanying diagram, a rectangular gate has two diagonal supports. If  $m\angle 1 = 42$ , what is  $m\angle 2$ ?

$$180 - 42 - 42 = \boxed{96 = 42}$$



Diagonals are  $\cong$   
isosceles  $\Delta$ !

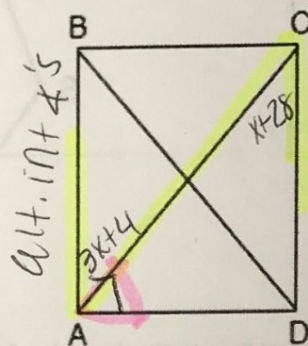
10. In the accompanying diagram of rectangle  $ABCD$ ,  $m\angle BAC = 3x + 4$  and  $m\angle ACD = x + 28$ . What is  $m\angle CAD$ ?

$$\begin{array}{r} 3x + 4 = x + 28 \\ -x - 4 \quad -x - 4 \\ \hline 2x = 24 \end{array}$$

$$2x = 24$$

$$x = 12$$

$$m\angle BAC = 3(12) + 4 = 40$$



4  $90^\circ$   
 $\times 5$

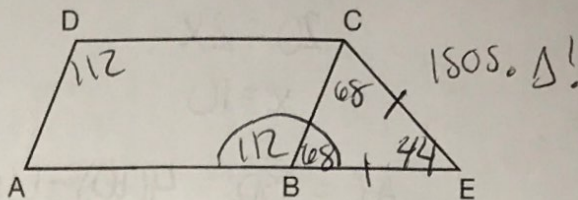
$$90 - 40 = \boxed{50^\circ}$$

EXTRA PRACTICE

1. A parallelogram is always a rectangle if

- ① the diagonals are congruent
- 2) the diagonals bisect each other
- 3) the diagonals intersect at right angles
- 4) the opposite angles are congruent

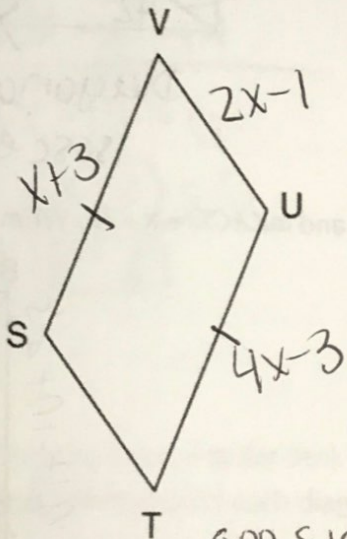
2. In the diagram below,  $ABCD$  is a parallelogram,  $\overline{AB}$  is extended through  $B$  to  $E$ , and  $\overline{CE}$  is drawn.



If  $\overline{CE} \cong \overline{BE}$  and  $m\angle D = 112^\circ$ , what is  $m\angle E$ ?

$$180 - 68 - 68 = 44 \quad \boxed{m\angle E = 44^\circ}$$

3. In the diagram below of parallelogram  $STUV$ ,  $SV = x + 3$ ,  $VU = 2x - 1$ , and  $TU = 4x - 3$ .

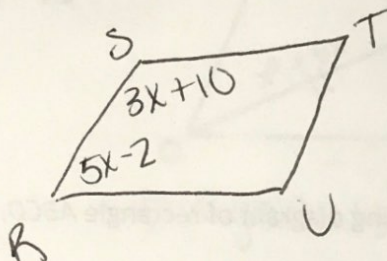


Opp. sides are  $\cong$

What is the length of  $\overline{SV}$ ?

$$\begin{array}{r} x+3 = 4x-3 \\ -x+3 \quad -x+3 \\ \hline 0 = 3x \\ x = 2 \end{array} \quad \begin{array}{l} \overline{SV} = (2)+3 \\ \boxed{\overline{SV} = 5} \end{array}$$

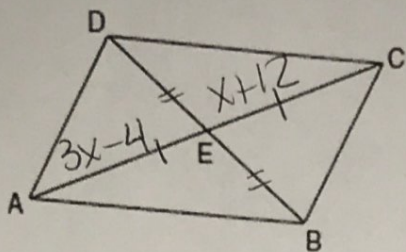
In parallelogram  $RSTU$ ,  $m\angle R = 5x - 2$  and  $m\angle S = 3x + 10$ . Determine and state the value of  $x$ .



consecutive  $\angle$ 's are supplementary!

$$\begin{aligned} 5x - 2 + 3x + 10 &= 180 \\ 8x + 8 &= 180 \\ 8x &= 172 \\ \boxed{x = 21.5} \end{aligned}$$

In the accompanying diagram of parallelogram  $ABCD$ , diagonals  $\overline{AC}$  and  $\overline{DB}$  intersect at  $E$ ,  $\overline{AE} = 3x - 4$ , and  $\overline{EC} = x + 12$ .

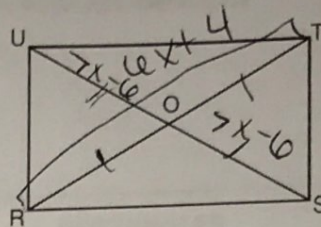


What is the value of  $x$ ?

Diagonals BISECT!

$$\begin{array}{r} 3x - 4 = x + 12 \\ -x + 4 - x + 4 \\ \hline 2x = 16 \\ \boxed{x = 8} \end{array}$$

In the diagram below of rectangle  $RSTU$ , diagonals  $\overline{RT}$  and  $\overline{SU}$  intersect at  $O$ .



If  $\overline{RT} = 6x + 4$  and  $\overline{SO} = 7x - 6$ , what is the length of  $\overline{US}$ ?

Diagonals are  $\cong$ !

$$\begin{array}{r} 2(7x - 6) = 6x + 4 \\ 14x - 12 = 6x + 4 \\ -6x + 12 - 6x + 12 \\ \hline 8x = 16 \\ x = 2 \end{array}$$

$$\begin{array}{r} \overline{US} = \overline{RT} = 6(2) + 4 \\ = 12 + 4 \\ \boxed{\overline{US} = 16} \end{array}$$