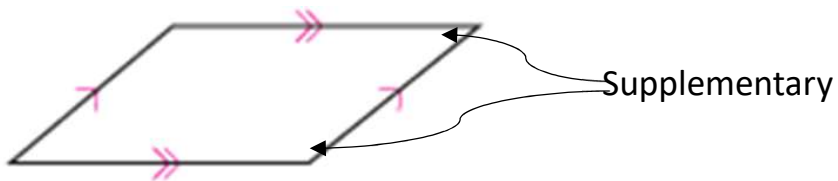## Lesson 5.5 – Properties of Parallelograms

Parallelogram Opposite Angles Conjecture - The opposite angles of a parallelogram are congruent.
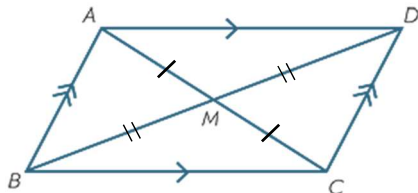
Parallelogram Consecutive Angles Conjecture - The consecutive angles of a parallelogram are supplementary.
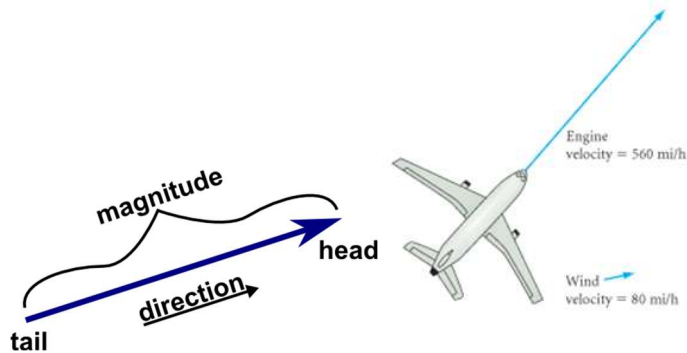
Supplementary

Parallelogram Opposite Sides Conjecture - The opposite sides of a parallelogram are congruent.
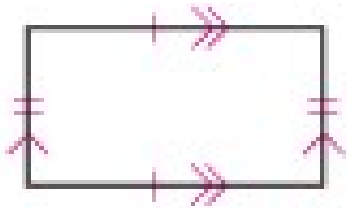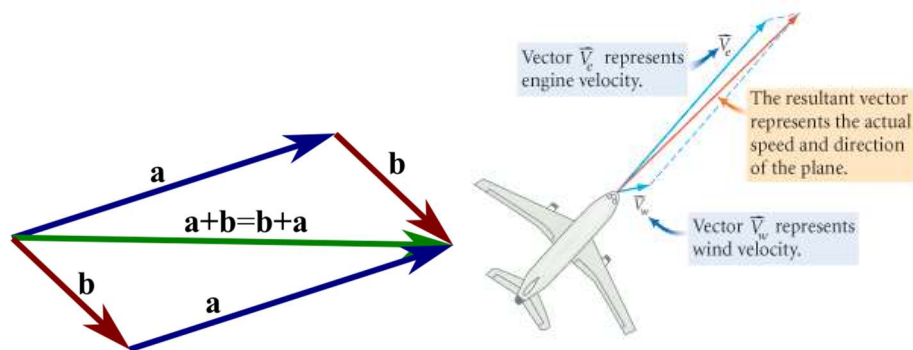
Parallelogram Diagonals Conjecture - The diagonals of a parallelogram bisect each other.

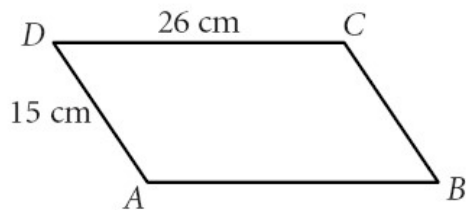Vector - A vector is a quantity that has both magnitude and direction.

Engine velocity = 560 mi/h

Wind velocity = 80 mi/h

Resultant Vector - A resultant vector is the sum of vectors. It can be found by drawing the diagonal of the parallelogram with the vectors as sides.

Vector V_e represents engine velocity.

The resultant vector represents the actual speed and direction of the plane.

Vector V_w represents wind velocity.

a + b = b + a

Example 1: Find the missing measures in the parallelogram.

Perimeter $ABCD =$_____

We know that the opposite sides of a parallelogram are congruent. That means that $AB = 26$ cm and $CB = 15$ cm. To find the perimeter, we can add all four sides.
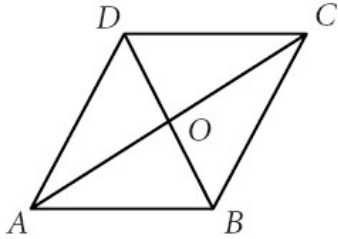
$15 + 26 + 15 + 26 = 82$
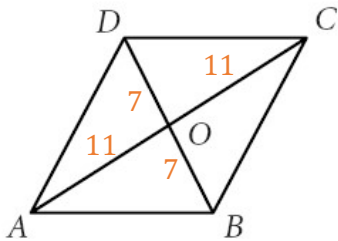
Perimeter $ABCD = 82$ cm

Example 2: Find the missing measures in the parallelogram.

$AO = 11$, and $BO = 7$

$AC =$ _____ , $BD =$ _____

We know that the diagonals of a parallelogram bisect each other. So, $AO = OC$ and $BO = OD$.

To find AC, we need to add AO and OC.

$11 + 11 = 22$
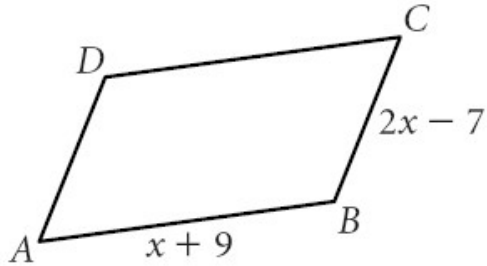
$AC = 22$

To find BD, we need to add BO and OD.

$7 + 7 = 14$

$BD = 14$

Example 3: Find the missing measures in the parallelogram.

Perimeter $ABCD = 46$

$AB =$_____ , $BC =$_____

We know that opposite sides of a parallelogram are congruent. So, this parallelogram has two sides with length $x + 9$ and two sides with length $2x - 7$. If we add up all four sides, we should get the perimeter of 46.

$2(x + 9) + 2(2x - 7) = 46$

$2x + 18 + 4x - 14 = 46$

$6x + 4 = 46$

$-4 \quad -4$

$6x = 42$

$\overline{6} \quad \overline{6}$

$x = 7$

$AB = x + 9 = 7 + 9 = 16$

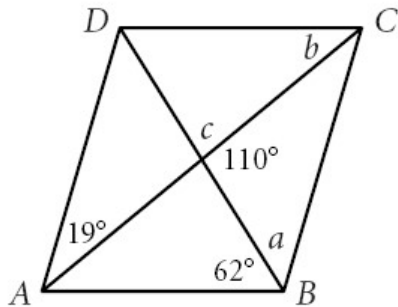$\boldsymbol{AB = 16}$

$BC = 2x - 7 = 2(7) - 7 = 14 - 7 = 7$

$\boldsymbol{BC = 7}$

Example 4: Find the missing measures in the parallelogram.
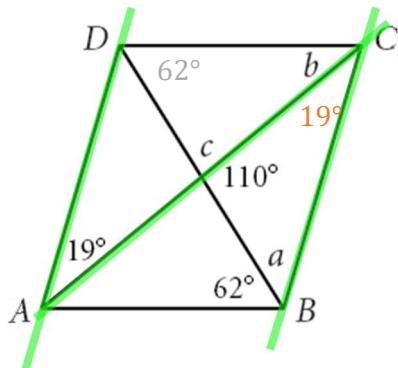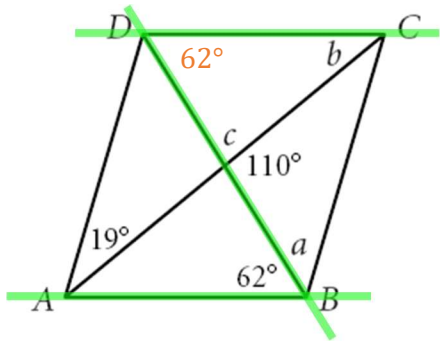
$a =$ _____ , $b =$ _____ , $c =$ _____

We can start by finding c since we know it is a linear pair with the 110° angle.

$180 - 110 = 70$

$c = 70°$

Since this is a parallelogram, we can find the measures of alternate interior angles to those we know.

We can find a using the triangle with a, 110°, and 19°.

$110 + 19 = 129$

$180 - 129 = 51$

$a = \mathbf{51°}$

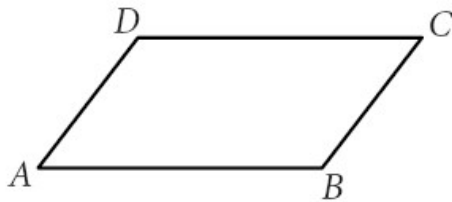We can find b using the triangle with $b, c,$ and $62°$.

$70 + 62 = 132$

$180 - 132 = 48$

$b = \mathbf{48°}$

Example 5: Find the missing measures in the parallelogram.

Perimeter $ABCD = 119$, and $BC = 24$

$AB = $_____

We know that opposite sides of a parallelogram are congruent. Since $BC = 24$ then $AD = 24$.
We do not know the length of AB or DC, but we know they will be the same. So, let's use x to
represent their measures. Adding all of the sides will give us the perimeter of 119.

$2(24) + 2(x) = 119$

$48 + 2x = 119$

$-48 \qquad -48$

$2x = 71$

$\overline{2} \quad \overline{2}$

$x = 35.5$ \qquad **This means both sides AB and DC have a measure of 35.5

$AB = \mathbf{35.5}$

Example 6: Find the missing measures in the parallelogram.

Perimeter $ABCD = 16x - 12$

$AD =$_____
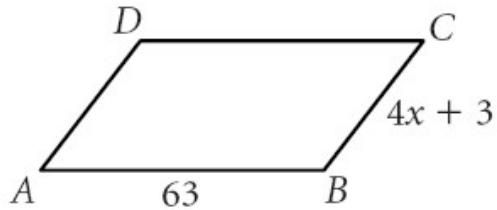
Opposite sides of a parallelogram are congruent. We can add up the four sides and set that equal to the perimeter.

$2(63) + 2(4x + 3) = 16x - 12$

$126 + 8x + 6 = 16x - 12$

$132 + 8x = 16x - 12$

$ -8x \quad\; - 8x$

$132 = 8x - 12$
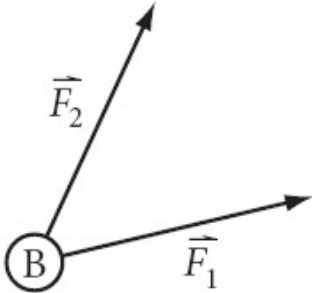
$+12 \qquad + 12$

$144 = 8x$

$\;\;\overline{8} \;\;\; \overline{8}$

$18 = x$

$AD = 4x + 3 = 4(18) + 3 = 72 + 3 = 75$

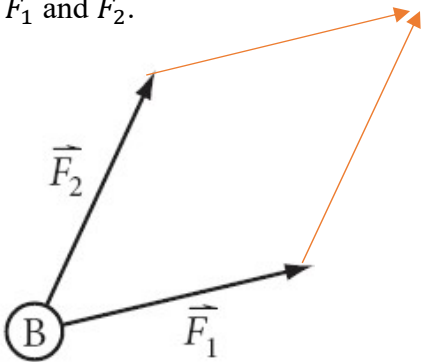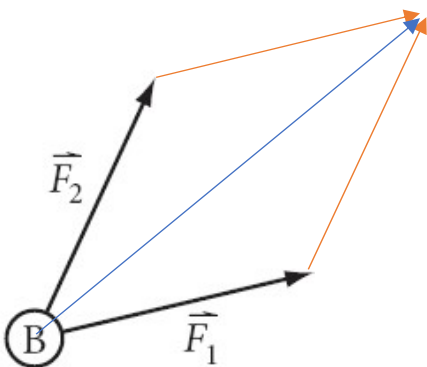$\boldsymbol{AD = 75}$

Ball B is struck at the same instant by two forces, $\vec{F_1}$ and $\vec{F_2}$. Show the resultant force on the ball.

In order to find the resultant vector, we need to create a parallelogram using vectors equaivalent to $\vec{F_1}$ and $\vec{F_2}$.

The diagonal of the parallelogram is the resultant vector. So, we need to draw that in.

The blue arrow shows the resultant force on the ball.