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MATHEMATICS

Quarter 2 - Module 7:
The Distance Formula, the Midpoint, and the Coordinate Proof

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MATHEMATICS 10
Quarter 2 - Module 7: The Distance Formula, the Midpoint, and the Coordinate Proof
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MATHEMATICS

Quarter 2 - Module 7:
The Distance Formula, the Midpoint, and the Coordinate Proof

DEPARTMENT OF EDUCATION

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

Target

Do you remember what a plane is? A plane is any flat surface which can go on infinitely in both of the directions. Now, if there is a point on a plane, you can easily locate that point with the help of coordinate geometry. Using the two numbers of the coordinate geometry, a location of any point on the plane can be found. Let us know more!

A coordinate geometry is a branch of geometry where the position of the points on the plane is defined with the help of an ordered pair of numbers also known as coordinates.

This module is all about Plane Coordinate Geometry specifically on the lessons about the Distance Formula, the Midpoint, and the Coordinate Proof.

After going through this module, you are expected to "apply the distance formula to prove some geometric properties" (**M10GE-IIg-2**).

Specifically, you should be able to:

1. Derive the distance and midpoint formula.
2. Determine the distance and midpoint of two given points in the coordinate plane
3. Apply the distance and midpoint formula in proving some geometric properties.
4. Solve problems involving distance and midpoint formula.

Before you start doing the activities in this lesson, find out how much you already know about this module. Answer the pre-test below in a separate sheet of paper.

Pre-Assessment

Choose the letter of the correct answer and write it on a separate sheet of paper.

1. Which of the following is used to find the distance between two points situated in A (x_1, y_1) and B (x_2, y_2)?

A. Coordinate Proof   B. Distance Formula
C. Indirect Proof   D. Midpoint Formula

2. Which of the following represents the distance ***d*** between the two points (x_1, y_1) and (x_2, y_2)?

   A. $d = \sqrt{(x_{2+}x_1)^2 + (y_2 + y_1)^2}$ B. $d = \sqrt{(x_{2+}x_1)^2 - (y_2 + y_1)^2}$

   C. $d = \sqrt{(x_{2-}x_1)^2 + (y_2 - y_1)^2}$ D. $d = \sqrt{(x_{2-}x_1)^2 - (y_2 - y_1)^2}$

3. Point A is the midpoint of $\overline{BC}$. Which of the following is true about the distances among A, B, and C?

   A. $\overline{AB}$ = $\overline{BC}$ B. $\overline{AC}$ = $\overline{BC}$ C. $\overline{AB}$ = $\overline{AC}$ D. $\overline{BC}$ = $\overline{CB}$

4. What proof uses figures on a coordinate plane to prove geometric properties?

   A. coordinate proof   B. direct proof
   C. geometric proof   D. indirect proof

5. Which of the following represents the midpoint ***M*** of the segment whose endpoints are (x_1, y_1) and (x_2, y_2)?

   A. $M = \left(\frac{x_1 - x_2}{2}, \frac{y_1 - y_2}{2}\right)$ B. $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

   C. $M = \left(\frac{x_1 + y_1}{2}, \frac{x_2 + y_2}{2}\right)$ D. $M = \left(\frac{x_1 - y_1}{2}, \frac{x_2 - y_2}{2}\right)$

6. What are the coordinates of the midpoint of a segment whose endpoints are (-1, -3) and (11, 7)?

   A. (2, 5)   B. (6, 5)   C. (-5, -2)   D. (5, 2)

7. Determine the distance between A (4, 3) and B (4, -5).

   A. -8   B. -2   C. 2   D. 8

8. What is the distance between R (1, 3) and S (7, 11)?

   A. 8   B. 9   C. 10   D. 11

9. M and N are points on the coordinate plane. If the coordinates of M and N are (-1, 6) and (8, 4) respectively. Which of the following would give the distance between the two points?

   A. $|-1 - 4|$ B. $|8 - 6|$ C. $|8 - 1|$ D. $|-1 - 8|$

10. A map is drawn on a grid where 1 unit is equivalent to 1 km. On the same map, the coordinates of the point corresponding to San Fernando is (3, 8). Suppose San Fernando is 12 km away from San Juan. Which of the following could be the coordinates of the point corresponding to San Juan?

    A. (-9, 0)   B. (0, -9)   C. (0, 12)   D. (12, 0)

11. Point S is 3 units from point T whose coordinates are (7, 4). If the x-coordinate of S is 8 and lies in the first quadrant, what is its y-coordinate?

    A. 3   B. 4   C. 7   D. 9

12. What figure is formed when the points A (3, 7), B (11, 10), C (11, 5), and D (3, 2) are connected consecutively?

    A. Parallelogram B. rectangle   C. square   D. trapezoid

13. The coordinates of the vertices of a triangle are T (-1, -3), O (7, 5), and P (7, -2). What is the length of the segment joining the midpoint of $\overline{OT}$ and P?
    A. $\sqrt{7}$ B. 3 C. 4 D. 5

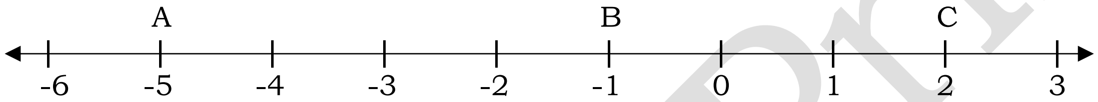
14. A new transmission tower will be put up midway between two existing towers. On a map drawn on a coordinate plane, the coordinates of the first existing tower are (-5, -3) and the coordinates of the second existing tower are (9, 13). What are the coordinates of the point where the new tower will be placed?
    A. (2, 5) B. (7, 8) C. (4, 10) D. (14, 16)

15. A tracking device in a car indicates that it is located at a point whose coordinates are (17, 14). In the tracking device, each unit on the grid is equivalent to 5 km. How far is the car from its starting point whose coordinates are (1, 2)?
    A. 20m B. 50m C. 100m D. 200m

Lesson 1 The Distance Formula

Jumpstart

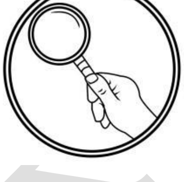
Consider this number line.



AB = |(-5) – (-1)| = |-4| = 4 or AB = |(-1) – (-5)| = |4| = 4
BC = |(-1) – 2| = |-3| = 3 or BC = |2 – (-1)| = |3| = 3
AC = |(-5) – 2| = |-7| = 7 or AC = |2 – (-5)| = |7| = 7

Questions:
1. How are the lengths of the segments determined?
2. Were the coordinates of the points used in finding the length of each segment?
3. Is the length of $\overline{AB}$ the same as the length of $\overline{BA}$? Why?
4. How about $\overline{AB}$ and $\overline{BC}$? Explain your answer.

The examples show that distance between two points is never a negative number. Also, the example shows that subtraction may be done from either direction.



Discover

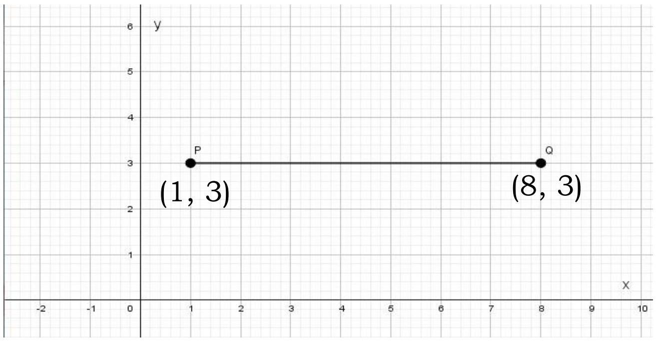
Distance between Two Points

The distance between two points is always nonnegative. It is positive when the points are different and zero if the points are the same. If P and Q are two points, then the distance from P to Q is the same as the distance from Q to P. That is, PQ = QP.

Consider two points that are aligned horizontally or vertically on the coordinate plane. The horizontal distance between these points is the absolute value of the difference of their x-coordinates. Likewise, the vertical distance between these points is the absolute value of the difference of their y-coordinates.

Example 1: Find the distance between P (1, 3) and Q (8, 3).

Solution:

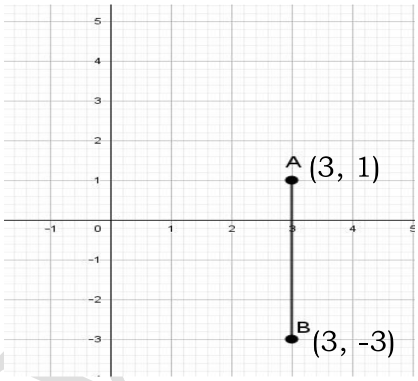


Since P and Q are aligned horizontally, then:

$$PQ = |1 - 8| \qquad \text{or} \qquad PQ = |8 - 1|$$
$$= |-7| \qquad\qquad\qquad = |7|$$
$$PQ = 7 \qquad\qquad\qquad PQ = 7$$

Example 2: Determine the distance between A (3, 1) and B (3, -3).

Solution:



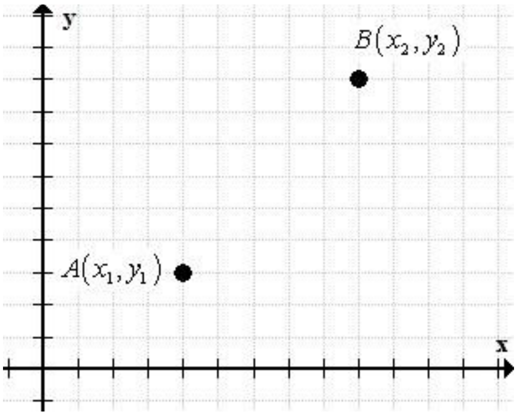
Points A and B are on the same vertical line. So the distance between them is:

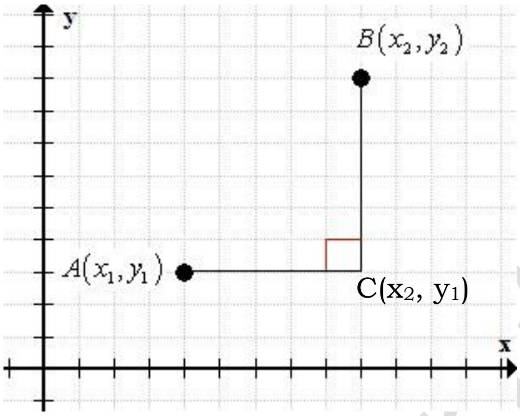
$$AB = |1 - (-3)| \qquad \text{or} \qquad AB = |(-3) - 1|$$
$$= |4| \qquad\qquad\qquad = |-4|$$
$$AB = 4 \qquad\qquad\qquad AB = 4$$

The Distance Formula

The distance between two points, whether or not they are aligned horizontally or vertically, can be determined using the distance formula.

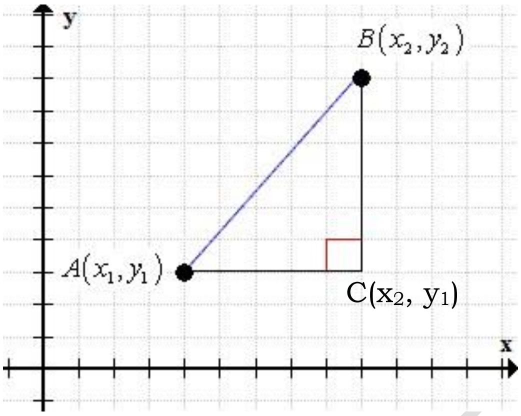
Consider the points **A** and **B** whose coordinates are (x_1, y_1) and (x_2, y_2) respectively. Suppose you want to know the distance between A and B. First, construct the vertical and horizontal line segments passing through each of the given points such that they meet at the 90-degree angle.

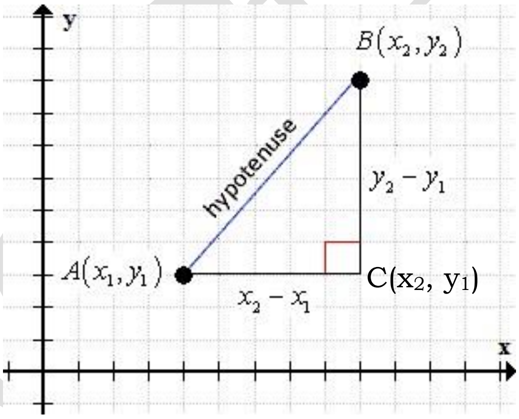




Next, connect points A and B to reveal a right triangle.

Find the legs of the right triangle by subtracting the x-values and the y-values accordingly.





Finally, applying the concept of the Pythagorean Theorem, the distance formula is calculated as follows:

Hypotenuse = distance between points A and B $=\sqrt{(\boldsymbol{x_2}-\boldsymbol{x_1})^2+(\boldsymbol{y_2}-\boldsymbol{y_1})^2}$

Therefore, the distance $\boldsymbol{d}$ between these points can be determined using the distance formula $d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$ or $AB=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$.

Example 1: Find the distance between P (2, 3) and Q (5, 7).

Solution:

Step 1: Let $(x_1, y_1) = (2, 3)$ and $(x_2, y_2) = (5, 7)$

Step 2: Substitute the corresponding values in the distance formula, then solve.

$$\boldsymbol{d}=\sqrt{(\boldsymbol{x_2}-\boldsymbol{x_1})^2+(\boldsymbol{y_2}-\boldsymbol{y_1})^2}$$
$$=\sqrt{(5-2)^2+(7-3)^2}$$
$$=\sqrt{(3)^2+(4)^2}$$
$$=\sqrt{9+16}$$
$$=\sqrt{25}$$

d = 5

Therefore, the distance between P and Q is 5 units.

Example 2: Find the distance between M (2, -3) and N (10, -3).

Solution:

Step 1: Let $(x_1, y_1) = (2, -3)$ and $(x_2, y_2) = (10, -3)$

Step 2: Substitute the corresponding values in the distance formula, then solve.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(10 - 2)^2 + (-3 - -3)^2}$$
$$= \sqrt{(8)^2 + (0)^2}$$
$$= \sqrt{64}$$
$$d = 8$$

Therefore, the distance between M and N is 8 units.

- The distance formula is used even if two points are on the same horizontal or vertical lines. Take note that if one point is the origin, the formula for distance is simply:

$$\boldsymbol{d = \sqrt{x^2 + y^2}}$$

Example 3:

Find the distance between the points L and M with coordinates (3, 4) and (0, 0).

Solution: using the formula

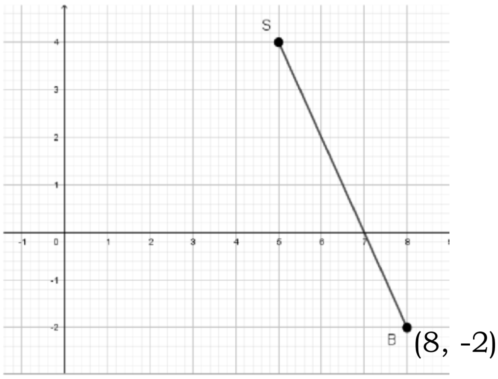
$$d = \sqrt{x^2 + y^2}$$
$$= \sqrt{(3)^2 + (4)^2}$$
$$= \sqrt{9 + 16}$$
$$= \sqrt{25}$$
$$d = 5$$

Therefore, the distance between point L and point M is 5 units.

- The distance formula has many applications in real life. In particular, it can be used to find the distance between two objects or places.

Example 4: Given the coordinates below, how far apart are San Fernando City and Bauang if 1 unit is equivalent to 1 km?

(5, 4)



Solution:

Let (x_1, y_1) = (5, 4) and (x_2, y_2) = (8, -2)

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(8-5)^2 + (-2-4)^2}$$
$$= \sqrt{(3)^2 + (-6)^2}$$
$$= \sqrt{9 + 36}$$
$$= \sqrt{45}$$
$$= \sqrt{9 \,.\, 5}$$
$$d = 3\sqrt{5} \text{ or } 6.7 \text{ units}$$

Therefore, the distance between SFC and Bauang is approximately 6.7 km.

Explore

Answer the following correctly.

1. How far is the point (6, 8) from the origin?
2. Find the distance between the two points (-3, 2) and (3, 5).
3. What is the distance between the points (-1, -1) and (4, -5)?
4. How many units apart are the points (-4, -3) and (4, 3)? Solve in two different ways and show that the final answer is the same.
5. Find the two points of the form (x, -4) that have the same distance of 10 units from the point (3, 2).

Deepen

Find the distance between the given points.

1. (-3, 7) and (5, 1)
2. (0, 0) and (4, 6)
3. (5, 1) and (1, 4)
4. (-2, -5) and (5, 3)
5. (5, 9) and (14, 18)
6. A tracking device attached to a kidnap victim prior to his abduction indicates that he is located at a point whose coordinates are (8, 10). In the tracking device, each unit on the grid is equivalent to 10 kilometers. How far is the tracker from the kidnap victim if he is located at a point whose coordinates are (1, 3).

Lesson 2 The Midpoint Formula

Jumpstart

With the distance formula, the coordinates of the midpoint of any given segment can be found.

Let us start with the idea of average. Recall that the average of two number is one-half the sum of the numbers.

For example:

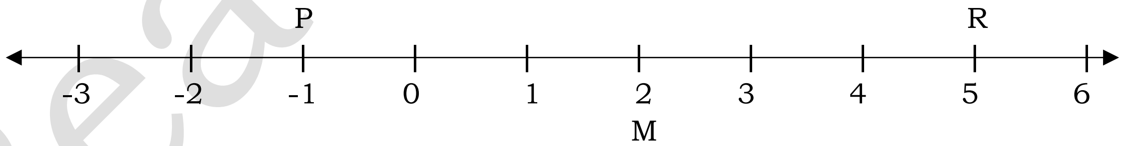
The average of 10 and 12 is $\frac{10+12}{2} = \frac{22}{2} = 11$

The average of 15 and -2 is $\frac{15+(-2)}{2} = \frac{13}{2} = 6.5$

Let us now use the number line.

Points P and R lie on a number line.

Find the coordinates of the midpoint of $\overline{PR}$.



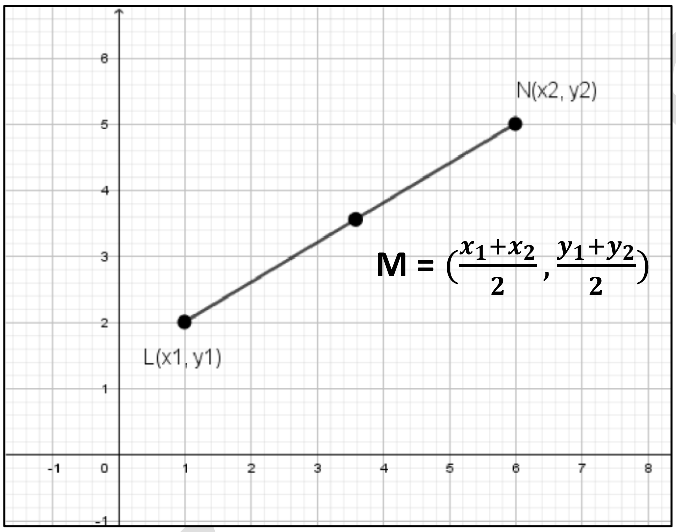
PR = $\frac{(-1)+5}{2} = \frac{4}{2} = 2$

The coordinates of the midpoint of $\overline{PR}$ is equal to the average of the coordinates of P and R. Therefore, point M is the **midpoint** of $\overline{PR}$ and $\overline{PM} = \overline{RM}$.

Discover

The Midpoint Formula

If point L(x_1, y_1) and point N(x_2, y_2) are the endpoints of a segment and M is the midpoint, then the coordinates of **M** = $(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$. This is also referred to as the **Midpoint Formula**.



Example 1: The coordinates of point C and point D are (10, 16) and (62, 28) respectively. What are the coordinates of the midpoint of $\overline{CD}$?

Solution:

Step 1: Let x_1 = 10, x_2 = 62, y_1 = 16, and y_2 = 28

Step 2: Substitute the given values in the midpoint formula, and solve.

$$M = (\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$$
$$= (\frac{10+62}{2}, \frac{16+28}{2})$$
$$= (\frac{72}{2}, \frac{44}{2})$$
$$M = (36, 22)$$

Therefore, the coordinates of the midpoint of $\overline{CD}$ are (36, 22).

Example 2: Find the midpoint of the line segment joining (-1, -5) and (7, 1).

Solution: Using the formula, the midpoint is:

$$M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$
$$= \left(\frac{-1+7}{2}, \frac{-5+1}{2}\right)$$
$$= \left(\frac{6}{2}, \frac{-4}{2}\right)$$
$$M = (3, -2)$$

Therefore, the coordinates of the midpoint of the line segment joining (-1, -5) and (7, 1) is (3,-2).

- The distance formula can also be used to show that a given point on a segment is the midpoint of that segment.

Example 3: Show that the point (-1, -1) is the midpoint of a segment with endpoints whose coordinates are (-6, -4) and (4, 2).

Solution:

If (-1, -1) is the midpoint of the given segment, then the distance between (-6,-4) and (-1,-1) should be equal to the distance between (-1,-1) and (4, 2).

$$\sqrt{(-1--6)^2+(-1--4)^2} = \sqrt{(4--1)^2+(2--1)^2}$$
$$\sqrt{(5)^2+(3)^2} = \sqrt{(5)^2+(3)^2}$$
$$\sqrt{25+9} = \sqrt{25+9}$$
$$\sqrt{34} = \sqrt{34}$$

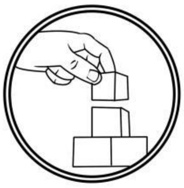
- The Midpoint Formula can also be used to solve word problems.

Example 4: Luis and Jean are eating lunch outside together when a cat falls from a tree and lands on top of them. They each run in opposite directions at exactly the same speed. If Luis ends up at coordinates L (-72, 120) and Jean ends up at J (21, -82), where did the cat land?

Solution: Use the midpoint formula

$$M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$
$$= \left(\frac{-72+21}{2}, \frac{120+-82}{2}\right)$$
$$= \left(\frac{-51}{2}, \frac{38}{2}\right)$$
$$M = (-25.5, 19)$$

Therefore, the cat landed at (-25.5, 19).



Explore

Answer the following correctly.

1. Find the midpoint of the line segment joined by the endpoints (-3, 3) and (5, 3).

2. Find the center point of the line segment joined by the endpoints (1, 5) and (1, -1) using the midpoint formula.

3. Find the midpoint of the line segment joined by the endpoints (-4, 5) and (2, -3).

4. Find the missing value of h in the points (5, 7) and (1, h) if its midpoint is at (3, -2).

5. Find the center of a circle whose diameter has endpoints (-1,-5) and (5,-1).

Deepen

A. **Use the midpoint formula to find the coordinates of the midpoint of each segment with the given endpoints.**

1. (2, 3) and (5, 7)
2. (0, 4) and (0, 8)
3. (-6, -10) and (5, 10)
4. (3, 7) and (-9, 1)
5. (4, 8) and (0, 0)

B. **Solve these problems correctly. Apply the midpoint formula.**

1. The town of San Gabriel is mapped on a coordinate grid with the origin being at City Hall. Evan's house is located at the point (-5, 7) and Billy's

house is located at (-3, 3). Where is the midpoint between the two houses located?

2. The Lotto Mart is mapped on a coordinate grid with the origin being at the main entrance. The chocolate bar is located at the point (-1, 3) and cake house is located at (1, 5). Where is the midpoint between the two points located?
3. Find the center point of the line segment joined by the endpoints (1, 5) and (1, –1) using the midpoint formula.

Lesson 3 The Coordinate Proof

Jumpstart

An easier way of proving theorems in geometry is by means of placing a given geometric figure in a proper position on the coordinate axes.

To start with, look at the squares on the coordinate axes.
Which position of the square would be most convenient in writing a proof about a square?

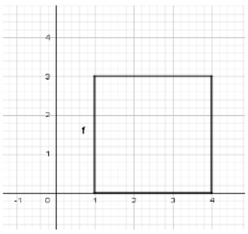


Figure 1

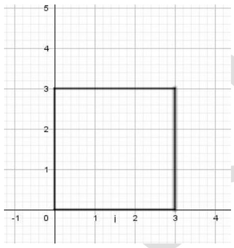


Figure 2

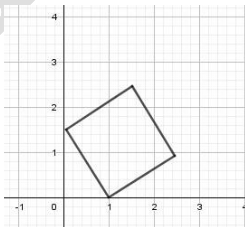


Figure 3

Obviously, the square with a vertex at the origin (Figure 2) and two sides on the axes will be most helpful. The labels for the vertices are not confusing. They show clearly that the figure is a *square*.

Discover

The **coordinate proof** is a proof of a geometric theorem which uses "generalized" points on the Cartesian plane to make an argument.

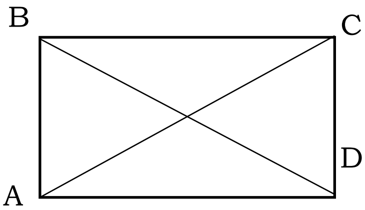
The method usually involves assigning variables to the coordinates of one or more points, and then using these variables in the midpoint or distance formulas.

To prove geometric properties using the methods of coordinate geometry, consider the following guidelines for placing figures on a coordinate plane.

1. Use the origin as vertex or center of a figure.
2. Place at least one side of a polygon on an axis.
3. If possible, keep the figure within the first quadrant.
4. Use coordinates that make computations simple and easy.
   Sometimes, using coordinates that are multiples of two would make the computation easier.

Example 1: Prove that the diagonals of a rectangle are congruent using the methods of coordinate geometry.

Solution:

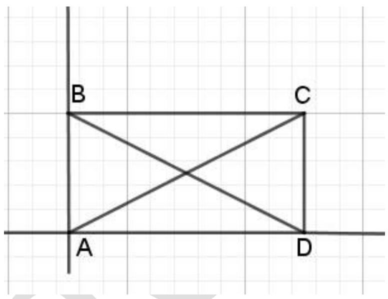


Given: ▭ ABCD with diagonals $\overline{AC}$ and $\overline{BD}$

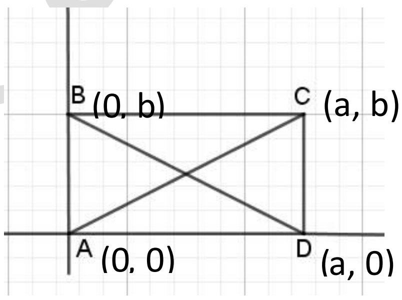
Prove: $\overline{AC} \cong \overline{BD}$

To Prove:

1. Place ▭ ABCD on a coordinate plane.



2. Label the coordinates as shown below.



3. Find the distance between A and C.

Given: A (0, 0) and C (a, b)

$AC = \sqrt{(a-0)^2 + (b-0)^2}$
$AC = \sqrt{a^2 + b^2}$

4. Find the distance between B and D.

   Given: B (0, b) and D (a, 0)
   $BD = \sqrt{(a-0)^2 + (0-b)^2}$
   $BD = \sqrt{a^2 + b^2}$

   Since $AC = \sqrt{a^2 + b^2}$ and $BD = \sqrt{a^2 + b^2}$, then AC = BD by substitution.

   Therefore, $\overline{AC} \cong \overline{BD}$. The diagonals of the rectangle are the congruent.

- Coordinate geometry proofs employ the use of formulas such as the Slope Formula, the Midpoint Formula and the Distance Formula, as well as postulates, theorems and definitions.

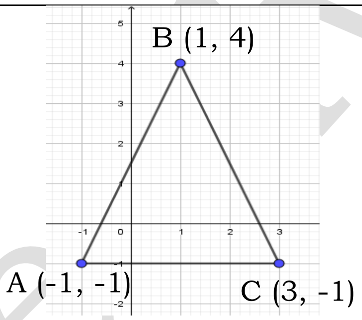
- Remember that problems asking you to "**PROVE**" or "**SHOW**" are asking for a **proof** and your response should be well detailed.

Example 2:

Always read the question carefully for hints. The word ***isosceles***, by definition, implies 2 congruent sides in ΔABC. Congruent means "of equal length", so the Distance Formula is needed.

Given: ΔABC with A(-1,-1), B(1, 4) and C(3,-1)
Show: ΔABC is isosceles

Solution:

	Always draw a neat, labeled graph for the problem. Show a scale and label the x and y axes. Use a ruler to draw straight lines or segments.
$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$	State the formula you will be using.
$AB = \sqrt{(1 - -1)^2 + (4 - -1)^2}$ $= \sqrt{(2)^2 + (5)^2}$ $= \sqrt{4 + 25}$ $= \sqrt{29}$ $BC = \sqrt{(3-1)^2 + (-1-4)^2}$ $= \sqrt{(2)^2 + (-5)^2}$ $= \sqrt{4 + 25}$ $= \sqrt{29}$	Show ALL work. Since isosceles triangles have two congruent sides, we can stop when we find the two sides. Always look at the figure and take your best guess as to which two sides may be congruent. Remember that this triangle is isosceles.

AB = BC implies $\overline{AB} \cong \overline{BC}$	
The triangle is isosceles because it has two congruent sides.	Conclude with a statement justifying why you know the triangle is isosceles. Think of using a theorem or a definition for this statement.

Explore

Write a coordinate proof of the following:

1. Prove that the quadrilateral defined by the points (4,0), (5,3), (1,1), (2,4) is a square.
2. Prove or disprove that the quadrilateral defined by the points (8,-4), (0,2), (-10,2), (-6,4) is a trapezoid.

Deepen

A. Draw the following in the coordinate plane.

1. Δ COA is a right triangle, ∠O is a right angle.
2. ROTS is a parallelogram. Point S can be named (a + b + c).

B. Write a coordinate proof to prove each of the following.

1. Given: Quadrilateral MATH; M(-4,-2), A(-2,2), T(4,2) and H(2,-2)
   Prove: MATH is a parallelogram
2. Given: ΔDEF with D(-3,3), E(3,3), F(0,-3)
   Show: ΔDEF is NOT an equilateral triangle

3. The diagonals of a square are perpendicular
   Given: Square ABCD
   Prove: $\overline{AC} \perp \overline{BD}$
   (slope of $\overline{AC}$)(slope of $\overline{BD}$) = -1

Gauge

Choose the letter of the correct answer and write it on a separate paper.

1. Which of the following represents the distance ***d*** between the two points (x_1, y_1) and (x_2, y_2)?

   A. $d = \sqrt{(x_2 + x_1)^2 + (y_2 + y_1)^2}$ B. $d = \sqrt{(x_2 + x_1)^2 - (y_2 + y_1)^2}$
   C. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ D. $d = \sqrt{(x_2 - x_1)^2 - (y_2 - y_1)^2}$

2. Point L is the midpoint of $\overline{KM}$. Which of the following is true about the distances among K, L, and M?

   A. $\overline{KL} = \overline{KM}$ B. $\overline{LM} = \overline{KM}$ C. $\overline{KL} = \overline{lM}$ D. $\overline{KM} = \overline{KL} + \overline{LM}$

3. Which best describe the distance between two points?

   A. equal B. negative C. positive D. unequal

4. The distance between two points, whether or not they are aligned horizontally or vertically can be determined using the ___ formula.

   A. distance B. equation C. midpoint D. standard

5. Find the distance between P (3, 2) and Q (10, 2).

   A. -10 B. -7 C. 7 D. 10

6. Determine the distance between (1, 3) and (7, 11).

   A. 10 B. 20 C. 50 D. 100

7. Which of the following determines the coordinates of the midpoint formula?

   A. $x_1 + y_1$ B. $x_1 - y_1$ C. $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$ D. $\left(\frac{x_1-x_2}{2}, \frac{y_1-y_2}{2}\right)$

8. The coordinates of the endpoints of $\overline{LG}$ are (-3, -2) and (8, 9) respectively. What is the value of x_2?

   A. -3 B. -2 C. 8 D. 9

9. What are the coordinates of the midpoint of (-3, -2) and (8, 9)?

   A. (5, 7) B. (-5, -7) C. $\left(\frac{5}{2}, \frac{7}{2}\right)$ D. $\left(\frac{11}{2}, \frac{11}{2}\right)$

10. What proof uses figures on a coordinate plane to prove geometric properties?

A. coordinate proof
B. direct proof
C. geometric proof
D. indirect proof

11. What geometric figure is formed when you connect the following points consecutively? G (4, -1); E (0, 0); O (2, 6); M (6, 5)
A. quadrilateral
B. square
C. trapezoid
D. triangle

For numbers 12 – 15, refer to the statement below:

Theorem: The median of a trapezoid
1. is parallel to the bases
2. has a length equal to half the sum of the lengths of the bases

Given: Trapezoid OPQR with median $\overline{ST}$

Prove: 1. $\overline{ST} \parallel \overline{PQ} \parallel \overline{OR}$
2. ST = ½ (PQ + OR)

12. What are the coordinates of point S?
A. (a, b)
B. (b, c)
C. (c, d)
D. (a, d)

13. Which of the following is the slope of a horizontal line?
A. 0
B. 1
C. 2
D. 3

14. Which of the following point has a coordinates of (0, 0)?
A. pt. O
B. pt. P
C. pt. Q
D. pt. R

15. Which of the following best describe the slopes of the line segments $\overline{ST}$, $\overline{PQ}$, and $\overline{OR}$?
A. equal
B. unequal
C. cannot be determined
D. undefined

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