

# Please Help! Best Answer Gets Brainliest. Find P On NM That Is The Given Fractional Distance From N To

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Mathematics problems involving points dividing segments in a specific ratio are common in geometry and coordinate geometry. Whether you're working on a geometry homework, preparing for exams, or trying to improve your problem-solving skills, understanding how to find a point  $P$  on a segment  $NM$  that is a fractional distance from one endpoint is crucial. This guide will walk you through the process step-by-step, explaining concepts clearly and providing practical examples. By mastering these techniques, you'll be equipped to confidently solve similar problems and earn that "brainliest" answer.

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## Understanding the Problem: The Basics of Segment Division

Before diving into formulas and calculations, it's essential to grasp what the problem is asking.

### What Does 'Fractional Distance' Mean?

- The term "fractional distance" indicates that  $P$  divides the segment  $NM$  in a ratio related to a fraction.
- For example, if  $P$  is a fractional distance  $\frac{1}{3}$  from  $N$ , it means that  $P$  is located such that the distance from  $N$  to  $P$  is one-third of the entire length of  $NM$ .

### What Is the Segment $NM$ ?

- $NM$  represents the segment with endpoints  $N$  and  $M$ .
- The goal is to find a point  $P$  on this segment that is a specific fractional distance from  $N$  (or from  $M$ ), depending on the problem).

### Coordinate Geometry Approach

- When points  $N$  and  $M$  are given in coordinate form, the problem becomes finding the coordinates of  $P$  that divide  $NM$  in the specified ratio.
- This approach involves the section formula, which generalizes the concept of dividing a

segment in a given ratio.

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## Key Concepts and Formulas for Finding Point $P$

### The Section Formula

- The section formula is used to find a point dividing a segment internally in a given ratio.
- If a point  $P$  divides the segment  $NM$  in the ratio  $m:n$ , then the coordinates of  $P$  are given by:

$$P(x, y) = \left( \frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n} \right)$$

where:

- $N(x_1, y_1)$
- $M(x_2, y_2)$
- $P$  divides  $NM$  in ratio  $m:n$ .

### Expressing Fractional Distance as a Ratio

- If the fractional distance from  $N$  to  $P$  is  $f$  (for example,  $\frac{1}{3}$ ), then:

$$\text{Distance from } N \text{ to } P = f \times \text{Total length of } NM$$

- The ratio  $m:n$  can be related to  $f$ :

$$\frac{\text{Distance from } N \text{ to } P}{\text{Total length of } NM} = \frac{m}{m + n} = f$$

- Therefore, the ratio  $m:n$  is:

$$m:n = f : (1 - f)$$

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# Step-by-Step Guide to Find Point $(P)$

## Step 1: Identify Coordinates of $(N)$ and $(M)$

- Obtain the coordinate points:

$$\begin{aligned} &N(x_1, y_1), \quad M(x_2, y_2) \end{aligned}$$

## Step 2: Determine the Fractional Distance $(f)$

- Understand the fractional distance from  $(N)$  to  $(P)$ :

$$f = \text{Fractional distance from } N$$

- For instance, if  $(P)$  is halfway between  $(N)$  and  $(M)$ , then  $(f = 0.5)$ .

## Step 3: Compute the Ratio $(m:n)$

- Use the fractional distance to find the ratio:

$$m = f, \quad n = 1 - f$$

- For example, if  $(f = \frac{1}{4})$ , then:

$$m = 1, \quad n = 3$$

- The ratio  $(m:n)$  becomes  $(1:3)$ .

## Step 4: Apply the Section Formula

- Plug the ratio into the section formula:

$$P(x, y) = \left( \frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n} \right)$$

- Using the ratio from step 3, calculate the coordinates.

## Step 5: Simplify and Get the Coordinates of $(P)$

- Perform the calculations carefully to find the exact coordinates.

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## Practical Examples

To solidify understanding, let's work through some sample problems.

### Example 1: Find $(P)$ at One-Third Distance from $(N)$ on Segment $(NM)$

Given:

-  $(N(2, 3))$

-  $(M(8, 15))$

- Fractional distance  $(f = \frac{1}{3})$

Solution:

1. Ratios:

$$\begin{aligned} m:n &= \frac{1}{3} : \frac{2}{3} = 1:2 \\ \end{aligned}$$

2. Apply the section formula:

$$\begin{aligned} P &= \left( \frac{(1)(8) + (2)(2)}{1+2}, \frac{(1)(15) + (2)(3)}{1+2} \right) \\ \end{aligned}$$

$$\begin{aligned} P &= \left( \frac{8 + 4}{3}, \frac{15 + 6}{3} \right) = \left( \frac{12}{3}, \frac{21}{3} \right) \\ &= (4, 7) \\ \end{aligned}$$

Answer:

-  $(P(4, 7))$  is one-third of the way from  $(N(2, 3))$  to  $(M(8, 15))$ .

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### Example 2: Find $(P)$ at Two-Fifths Distance from $(N)$

Given:

- $N(1, 2)$
- $M(5, 10)$
- Fractional distance  $f = \frac{2}{5}$

Solution:

1. Ratios:

$$m:n = \frac{2}{5} : \frac{3}{5} = 2:3$$

2. Calculate  $P$ :

$$P = \left( \frac{2 \times 5 + 3 \times 1}{2 + 3}, \frac{2 \times 10 + 3 \times 2}{2 + 3} \right)$$

$$P = \left( \frac{10 + 3}{5}, \frac{20 + 6}{5} \right) = \left( \frac{13}{5}, \frac{26}{5} \right) = (2.6, 5.2)$$

Answer:

- $P(2.6, 5.2)$  is two-fifths of the way from  $N$  to  $M$ .

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## Special Considerations and Variations

### Points Dividing the Segment Outside the Endpoints (External Division)

- Sometimes,  $P$  may lie outside the segment  $NM$ , which involves extending the line beyond endpoints.
- The section formula adapts with negative ratios.

### Using Vectors for Coordinate Calculation

- If you prefer vector methods, the position vector of  $P$  can be calculated as:

$$\vec{OP} = \vec{ON} + f(\vec{OM} - \vec{ON})$$

where:

-  $\vec{ON}$  and  $\vec{OM}$  are position vectors of  $N$  and  $M$ .

## Applications in Real-Life Contexts

- Dividing land plots proportionally.
- Finding midpoints or points at specific fractional distances.
- Designing paths or segments with precise ratios.

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## Summary and Tips for Success

- Always identify the coordinates of the endpoints before starting.
- Determine the fractional distance  $f$  clearly; convert it into a ratio  $m:n$ .
- Use the section formula carefully; double-check calculations.
- Remember, if  $P$  is exactly midway,  $f = 0.5$ , and the formula simplifies to finding the midpoint:

$$P = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

## Frequently Asked Questions

### How do I find point P on NM that divides the segment in a given fractional distance from N?

Use the section formula: P divides NM in the ratio  $m:n$ , so P's coordinates are  $\left( \frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right)$ .

### What is the first step to find P on NM given a fractional distance from N?

Identify the ratio in which P divides the segment based on the fractional distance, then apply the section formula accordingly.

### If N and M are points with coordinates $N(x_1, y_1)$ and $M(x_2, y_2)$ , and P is at a fractional distance from N, how do I determine P's coordinates?

Determine the ratio  $m:n$  based on the fractional distance, then compute P's coordinates using  $P = \left( \frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right)$ .

## **Can I find P without knowing the coordinates of N and M?**

No, you need the coordinates of N and M to apply the section formula and find the exact location of P.

## **What if the fractional distance from N to P is $\frac{1}{3}$ ? How do I find P?**

Set the ratio  $m:n$  to  $1:2$  because P divides the segment so that NP is  $\frac{1}{3}$  of the total, then apply the section formula accordingly.

## **Is there a shortcut to find P if the fractional distance from N is given directly?**

Yes, if P divides NM such that NP is a certain fraction of NM, you can directly interpolate between N and M:  $P = N + (\text{fraction}) (M - N)$ .

## **What does it mean if P is at a fractional distance of $\frac{1}{2}$ from N to M?**

It means P is the midpoint of segment NM, so coordinates of P are the average of N and M's coordinates.

## **How do I verify that P is at the correct fractional distance from N?**

Calculate the distance from N to P and from N to M; the ratio of these distances should match the given fractional ratio.

## **What should I do if the points N and M are given in coordinate form and I need P at a fractional distance from N?**

Use the section formula with the ratio corresponding to the fractional distance, substituting the coordinates of N and M.

## **Are there any common mistakes to avoid when finding P based on fractional distance from N?**

Yes, common mistakes include mixing up the ratio  $m:n$ , forgetting to add 1 to the ratio, or mixing up coordinates of N and M during calculations.

# Additional Resources

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## Introduction

Mathematics often presents intriguing problems that challenge our understanding of geometric concepts, ratios, and coordinate systems. One such problem involves finding a specific point  $P$  on a segment  $NM$  such that  $P$  divides the segment in a given fractional distance from point  $N$ . These types of problems are foundational in coordinate geometry, vector analysis, and algebra, and they are frequently encountered in exams, competitions, and real-world applications like engineering and navigation.

This detailed guide aims to walk you through the process of solving such a problem step-by-step, clarifying key concepts, and providing strategies to approach similar problems confidently. Whether you're a student struggling to grasp the concept or someone preparing for competitive exams, this comprehensive guide will serve as an invaluable resource.

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## Understanding the Core Concepts

### 1. The Segment $NM$

- Definition: A segment  $NM$  is a straight line connecting two points,  $N$  and  $M$ , in a coordinate plane.
- Coordinates: Typically, points are given as coordinates:
  - $N = (x_N, y_N)$
  - $M = (x_M, y_M)$
- Visualization: Imagine a straight line between  $N$  and  $M$ . The point  $P$  lies somewhere along this line segment.

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### 2. Fractional Distance and Division of Segments

- Fractional Distance: When the problem states that  $P$  is a certain fractional distance from  $N$  to  $M$ , it refers to how far along the segment  $NM$  point  $P$  is, relative to  $N$ .
- Example: If  $P$  is  $\frac{1}{3}$  of the way from  $N$  to  $M$ , it means  $P$  divides  $NM$  into two parts:  $NP$  is  $\frac{1}{3}$  of the total length, and  $PM$  is  $\frac{2}{3}$ .
- Implication: This concept relates to the idea of section formula or coordinate division.

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## The Section Formula: Finding $P$

The key to solving this problem is understanding the section formula, which provides a direct way to find the coordinates of a point dividing a segment in a given ratio.

### 1. The Basic Section Formula

If a point  $P$  divides the segment  $NM$  in the ratio  $m:n$ , then:

$$P = \left( \frac{mx_M + nx_N}{m + n}, \frac{my_M + ny_N}{m + n} \right)$$

-  $P$  divides  $NM$  such that:

$$NP : PM = m : n$$

- When the ratio is fractional, say  $\frac{a}{b}$ , the division ratio becomes  $m:n = a : b$ .

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### 2. Applying the Formula for Fractional Distance

- If the point  $P$  is at a fractional distance  $r$  from  $N$  to  $M$ , then:

$$P = \left( x_N + r(x_M - x_N), y_N + r(y_M - y_N) \right)$$

- Here,  $r$  is a decimal or fraction representing the fractional distance from  $N$ .

- Example: If  $r = \frac{1}{4}$ , then  $P$  is one-quarter of the way from  $N$  to  $M$ .

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## Step-by-Step Solution Approach

### Step 1: Gather Data

- Identify points  $N$  and  $M$ : Obtain their coordinates.
- Determine the fractional distance  $r$ : This may be given directly or inferred from the problem statement.

### Step 2: Convert Fractional Distance to Numerical Value

- Express  $r$  as a decimal if given as a fraction, or keep it as a fraction for exact calculations.

### Step 3: Use the Section Formula

- Calculate the  $(x)$ -coordinate of  $(P)$ :

$$x_P = x_N + r(x_M - x_N)$$

- Calculate the  $(y)$ -coordinate of  $(P)$ :

$$y_P = y_N + r(y_M - y_N)$$

- The point  $(P)$  is then  $(x_P, y_P)$ .

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### Worked Example

Suppose:

-  $(N = (2, 3))$

-  $(M = (8, 7))$

-  $(P)$  is at  $(\frac{1}{4})$  the distance from  $(N)$  to  $(M)$ .

Solution:

- Fractional distance,  $(r = \frac{1}{4})$ .

- Calculate  $(x_P)$ :

$$x_P = 2 + \frac{1}{4}(8 - 2) = 2 + \frac{1}{4} \times 6 = 2 + 1.5 = 3.5$$

- Calculate  $(y_P)$ :

$$y_P = 3 + \frac{1}{4}(7 - 3) = 3 + \frac{1}{4} \times 4 = 3 + 1 = 4$$

- Answer:  $(P = (3.5, 4))$ .

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### Advanced Considerations

#### 1. Variable Ratios and Complex Divisions

- Sometimes, the problem involves dividing  $(NM)$  in ratios other than simple fractions,

such as  $(m:n)$ .

- Example: Find  $P$  dividing  $NM$  in ratio  $2:3$ .

- Use the section formula:

$$P = \left( \frac{2x_M + 3x_N}{2 + 3}, \frac{2y_M + 3y_N}{2 + 3} \right)$$

## 2. Coordinate Geometry in 3D

- The same principles extend to three dimensions, with points  $N = (x_N, y_N, z_N)$  and  $M = (x_M, y_M, z_M)$ .

- The formula becomes:

$$P = (x_N + r(x_M - x_N), y_N + r(y_M - y_N), z_N + r(z_M - z_N))$$

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## Practical Applications and Real-World Relevance

Understanding how to find a point at a fractional distance along a segment has numerous practical applications:

- Navigation and Geolocation: Determining a point between two landmarks.
- Engineering: Structural analysis involving dividing beams or components.
- Computer Graphics: Interpolating points for drawing or modeling.
- Physics: Calculating center of mass or points of equilibrium.
- Robotics: Path planning along a straight line between two points.

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## Common Mistakes to Avoid

- Misinterpreting the Fractional Distance: Confusing the fractional distance from  $N$  to  $M$  with the ratio of division.
- Incorrect Use of the Formula: Forgetting to adjust the ratio or fractional value properly.
- Ignoring Coordinate Units: Ensuring that all coordinate points are in the same units.
- Neglecting Edge Cases: When  $r = 0$  (at  $N$ ) or  $r = 1$  (at  $M$ ), the point is exactly at those points.

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## Strategies for Success

- Visualize the Problem: Draw a diagram to better understand the segment and the point  $P$  position.

- Double-Check Ratios: Convert fractional distances carefully.
- Use Coordinates: Plug in the known coordinates precisely.
- Practice Variations: Work through multiple examples with different ratios and coordinate systems.
- Understand the Concept: Mastering the section formula is key to solving similar problems efficiently.

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## Summary

Finding a point  $P$  on the segment  $NM$  at a given fractional distance from  $N$  is a fundamental skill in coordinate geometry. The process involves:

- Recognizing the problem as a division of a segment.
- Applying the section formula or the parametric form.
- Carefully converting fractional distances to ratios.
- Calculating the exact coordinates of  $P$ .

Mastering this technique enhances your problem-solving toolkit, enabling you to tackle a wide array of geometric problems with confidence. Remember, practice makes perfect—work through various problems to develop a strong intuition and procedural fluency.

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## Final Tips

- Always verify your calculations.
- Visualize the segment and the point's position.
- Practice with different coordinate points and fractional distances.
- Use graphing tools or software for complex problems to confirm your solutions.

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Good luck! With a solid grasp of these concepts, you'll be able to find points dividing segments in fractional distances with ease and precision, earning that coveted brainliest!

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