MATHEMATICS · GRADES 10-12

Three-dimensional coordinates

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you describe a point in space, like the position of a drone in the air or a shelf in a warehouse, when two numbers cannot say how high up it is. Two numbers can tell you where something is on a flat map, but they say nothing about height. A third number adds the up and down, so the point is pinned down in real space. That is how a drone is tracked, a warehouse shelf is found, or a point is placed in a 3D model.



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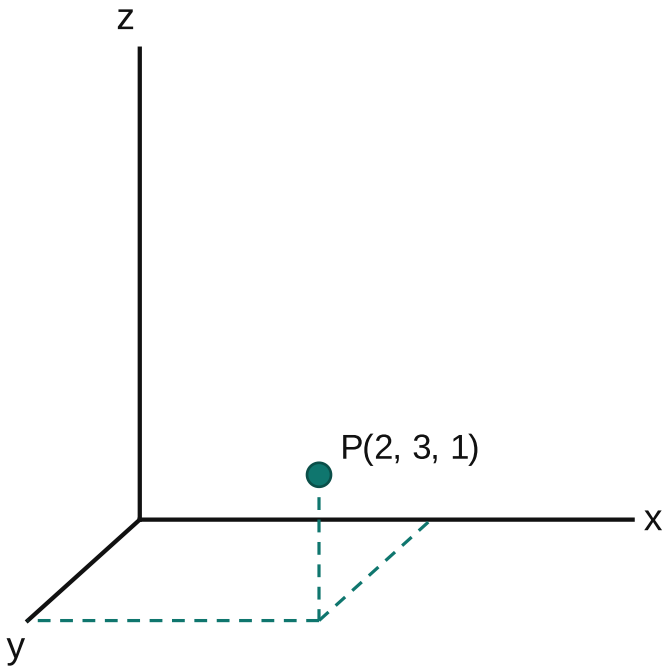

Worked examples

EXAMPLE 1

Q Describe how to plot the point (2, 3, 4) in three-dimensional space.

SOLUTION

This is a plotting in 3D question, so the one rule to remember is: read the ordered triple in order, x first, then y, then z, and each number is a distance along its own axis.

Go 2 units along the x-axis, then 3 units in the y direction, then 4 units up in the z direction.

That lands on the point (2, 3, 4), with the x and y steps marking its place on the floor, the xy-plane, and the z step lifting it up.

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EXAMPLE 2

Q Find the distance from the origin to the point (1, 2, 2).

SOLUTION

This is a distance in 3D question, so the one rule to remember is: the distance from the origin is the square root of $x^2 + y^2 + z^2$, the 2D distance formula with one more square added.

Put the numbers in: $\sqrt{(1^2+2^2+2^2)} = \sqrt{(1+4+4)} = \sqrt{9}$

$\sqrt{9} = 3$, so the point is 3 units from the origin.

Practice questions

1 On which axis does the point (5, 0, 0) lie?

- **A** The x-axis
- **B** The y-axis
- **C** The z-axis
- **D** The origin

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2 Find the distance of the point $(3, -2, 4)$ from the origin.

A $\sqrt{25}$

B $\sqrt{29}$

C $\sqrt{30}$

D $\sqrt{35}$

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3 Find the distance between the points $(1, 2, 3)$ and $(1, 2, 6)$.

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4 Which of these points lies in the xy-plane?

- **A** (2, 3, 0)
- **B** (2, 0, 3)
- **C** (0, 3, 2)
- **D** (2, 3, 1)

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5 What point do you get if you drop the point (4, 5, 6) straight down onto the xy-plane?

- **A** (4, 5, 0)
- **B** (4, 5, 6)
- **C** (5, 4, 0)
- **D** (4, 0, 6)

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6 Find the distance between the points (2, 3, 1) and (8, −5, 0).

A $\sqrt{99}$

B $\sqrt{101}$

C $\sqrt{103}$

D $\sqrt{109}$

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7 Find x if the distance between (5, −1, 7) and (x, 5, 1) is 9 units.

A 8

B 2

C 8 or 2

D 11

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8 Find the midpoint of the points (2, 4, 6) and (6, 2, 10).

- **A** (4, 3, 8)
- **B** (4, 3, 7)
- **C** (4, 2, 8)
- **D** (3, 3, 8)

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9 The point (0, 4, −2) has an x-coordinate of 0. Which coordinate plane does it lie in?

- **A** The xy-plane
- **B** The xz-plane
- **C** The yz-plane
- **D** The x-axis

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10 **Find the distance from the origin to the point (6, 3, 2).**

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ANSWER KEY

1. The x-axis

2. $\sqrt{29}$

3. 3

4. (2, 3, 0)

5. (4, 5, 0)

6. $\sqrt{101}$

7. 8 or 2

8. (4, 3, 8)

9. The yz-plane

10. 7

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