MATHEMATICS · GRADES 10-12

Position vectors

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how a GPS describes exactly where you are, as a direction and distance from a fixed starting point. A phone finds your position by measuring how far you are from known points, and a drone finds its way home by knowing its direction and distance from where it took off. A ship reports its position the same way, as a distance and a bearing from a harbour. One direction and one distance are all it takes to pin down a place.



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Rule

A position vector starts at the origin (0, 0) and ends at the point, so the position vector of a point is just its coordinates.

AB = (position of B) - (position of A).

The magnitude of a vector is its length. A unit vector is a vector with magnitude 1 that points in the same direction as the original vector.

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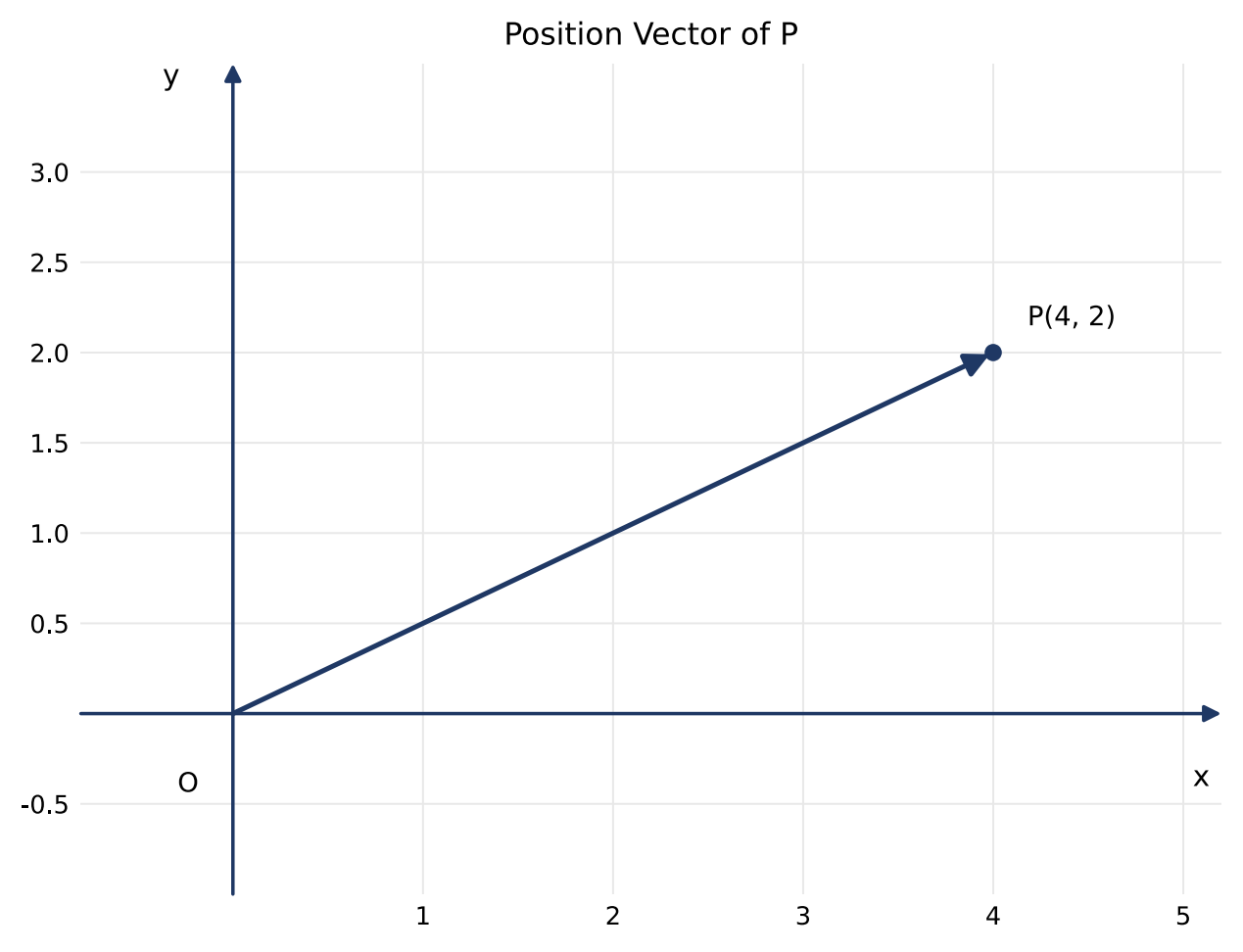
Worked examples

EXAMPLE 1

Q What is the position vector of the point (4, 2)?



SOLUTION

A position vector runs from the origin (0, 0) to the point, so it is just the point's coordinates written as a vector.

The position vector is (4, 2).

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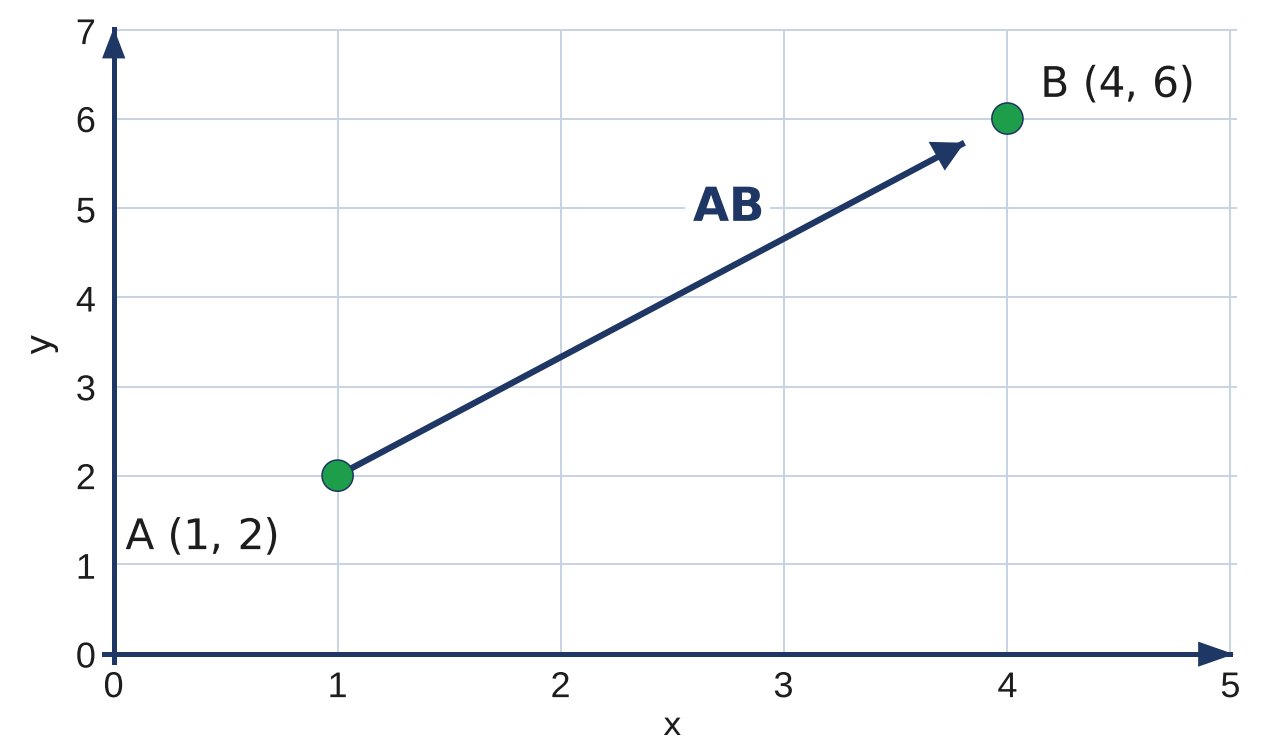
EXAMPLE 2

Q Points A (1, 2) and B (4, 6). Find the vector AB.



SOLUTION

To get vector AB, take B's position and subtract A's position.

$(4 - 1,\ 6 - 2) = (3,\ 4)$

Vector AB = (3, 4)

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Practice questions

1 What is the position vector of the point (5, 3)?

- **A** (5, 3)
- **B** (3, 5)
- **C** (-5, 3)
- **D** (5, -3)

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2 Points A (2, 1) and B (6, 4). What is vector AB?

- **A** (4, 3)
- **B** (3, 4)
- **C** (-4, -3)
- **D** (8, 5)

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3 Points A (1, 2) and B (4, 6). What is vector BA?

- A (–3, –4)
- B (3, 4)
- C (–3, 4)
- D (3, –4)

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4 Sara says a position vector can start anywhere. Is she right, and where does a position vector start?

- A No, at the origin
- B Yes, anywhere
- C No, at the point itself
- D Yes, at the origin

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5 The position vector of P is (3, 3). What are the coordinates of P?

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

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6 A ship is sitting exactly at the origin O. What is its position vector?

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

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7 What is the magnitude of AB = (3, 4)?

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8 Point A is (2, 3) and vector AB is (4, 1). What are the coordinates of B?

A (6, 4)

B (4, 6)

C (-2, 2)

D (2, 3)

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9 Point B is (5, 7) and vector AB is (2, 3). What are the coordinates of A?

- **A** (3, 4)
- **B** (4, 3)
- **C** (7, 10)
- **D** (5, 7)

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10 What is the unit vector in the direction of (3, 4)?

- **A** $(\frac{3}{5}, \frac{4}{5})$
- **B** $(\frac{4}{5}, \frac{3}{5})$
- **C** $(\frac{3}{5}, \frac{-4}{5})$
- **D** $(\frac{5}{3}, \frac{5}{4})$

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ANSWER KEY

1. (5, 3)

2. (4, 3)

3. (–3, –4)

4. No, at the origin

5. (3, 3)

6. (0, 0)

7. 5

8. (6, 4)

9. (3, 4)

10. $(\frac{3}{5}, \frac{4}{5})$

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