

(a) Express The Following Points In Cartesian Coordinates: I. $P(1,60,2)$. Ii. $Q(2,90,4)$. Iii. $T(4,/2,/6)$.

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Understanding how to express points in Cartesian coordinates is fundamental in fields like mathematics, physics, engineering, and computer graphics. Cartesian coordinates provide a straightforward way to represent points in space using a set of numerical values corresponding to positions along perpendicular axes, typically labeled as x, y, and z in three dimensions. This article will guide you through the process of expressing given points in Cartesian coordinates, analyze each point individually, and explore the significance of these representations in various applications.

What are Cartesian Coordinates?

Before diving into specific points, it's essential to understand what Cartesian coordinates are and why they are used.

Definition of Cartesian Coordinates

Cartesian coordinates are a coordinate system that specifies each point uniquely in a space by a set of numerical values. These values are distances from fixed perpendicular axes:

- In 2D space, points are described by (x, y).
- In 3D space, points are described by (x, y, z).

Importance of Cartesian Coordinates

Cartesian coordinates allow for:

- Precise location of points in space.
- Simplified mathematical operations such as distance calculation, transformation, and plotting.
- Clear visualization of spatial relationships.

Expressing Points in Cartesian Coordinates

The process involves identifying or converting given data points into the standard (x, y, z) format. Let's analyze the specific points provided:

- P(1,60,2)
- Q(2,90,4)
- T(4,/2,/6)

Analysis of Point P(1,60,2)

Coordinates Breakdown

The point P is given as (1, 60, 2). This notation directly indicates the Cartesian coordinates:

- x-coordinate: 1
- y-coordinate: 60
- z-coordinate: 2

Interpretation and Significance

- The point P is located 1 unit along the x-axis.
- It is 60 units along the y-axis.
- It is 2 units along the z-axis.

This point could represent a position in space such as a point on a 3D graph, a location in a physical environment, or a data point in a 3D dataset.

Applications of Point P

- In geometry, P could be a vertex of a 3D shape.
- In physics, it could denote a position in space where an event occurs.
- In computer graphics, P might represent a vertex coordinate for rendering.

Analysis of Point Q(2,90,4)

Coordinates Breakdown

The point Q is given as (2, 90, 4). As with P, these are direct Cartesian coordinates:

- x-coordinate: 2
- y-coordinate: 90
- z-coordinate: 4

Understanding Q's Position

- Located 2 units along the x-axis.
- Positioned 90 units along the y-axis, indicating a significant displacement along this axis.
- Situated 4 units along the z-axis.

Implications and Use Cases

- The high y-value suggests Q is far along the y-axis compared to P.
- Useful in applications where spatial positioning is crucial, such as navigation, robotics, or 3D modeling.

Visualizing Point Q

Visualizing Q in a 3D coordinate system helps understand its spatial relation to other points, such as P or T.

Analysis of Point T(4,/2,/6)

Identifying the Coordinates

The point T is given as (4, /2, /6). Noticing the notation, the slashes (/) appear to be placeholders or formatting errors.

Clarifying the Coordinates

Assuming the intended notation is T(4, 2, 6), which aligns with standard Cartesian coordinate notation, the coordinates are:

- x-coordinate: 4
- y-coordinate: 2
- z-coordinate: 6

If the slashes were meant to be decimal points or other symbols, please clarify. For this article, we proceed with $T(4, 2, 6)$.

Positioning of T

- 4 units along the x-axis.
- 2 units along the y-axis.
- 6 units along the z-axis.

Applications of Point T

- T could represent a point in a 3D space for applications such as physics simulations, CAD modeling, or spatial analysis.

Converting Points to Cartesian Coordinates

In this context, the points are already given in Cartesian coordinates. However, in many real-world scenarios, data points might be provided in other formats, such as polar, cylindrical, or spherical coordinates, requiring conversion.

Conversion Process Overview

- From Polar to Cartesian: Use $x = r \cos(\theta)$, $y = r \sin(\theta)$.
- From Cylindrical to Cartesian: Use $x = r \cos(\theta)$, $y = r \sin(\theta)$, $z = z$.
- From Spherical to Cartesian: Use $x = \rho \sin(\phi) \cos(\theta)$, $y = \rho \sin(\phi) \sin(\theta)$, $z = \rho \cos(\phi)$.

Since our points are directly provided, conversion isn't necessary here.

Practical Applications of Cartesian Coordinates

Understanding how to express and interpret points in Cartesian coordinates is vital across various domains:

- Mathematics: Solving geometric problems, plotting functions, and analyzing shapes.
- Physics: Locating objects in space, analyzing motion, and calculating forces.
- Engineering: Designing components in CAD software, structural analysis.

- Computer Graphics: Rendering 3D models, animations, virtual reality environments.
- Robotics: Navigating space, path planning, and spatial awareness.

Key Points to Remember When Expressing Points in Cartesian Coordinates

1. Coordinates are ordered triples in 3D space: (x, y, z) .
2. Units are consistent across axes.
3. Direct notation allows for straightforward interpretation unless conversion is necessary.
4. Visualization helps in understanding spatial relationships.
5. Conversions from other coordinate systems require specific formulas.

Conclusion

Expressing points in Cartesian coordinates is a fundamental skill that underpins many scientific and engineering disciplines. The points $P(1, 60, 2)$, $Q(2, 90, 4)$, and $T(4, 2, 6)$ exemplify how straightforward it is to represent spatial data in a clear, numerical format. Whether used for designing 3D models, analyzing physical phenomena, or plotting data, Cartesian coordinates provide an intuitive and powerful framework for understanding and manipulating spatial information.

By mastering these concepts, students, professionals, and enthusiasts can enhance their ability to work effectively in three-dimensional environments, ensuring accurate analysis, visualization, and communication of spatial data.

SEO Keywords: Cartesian coordinates, 3D points, spatial data, coordinate system, (x, y, z) points, 3D visualization, mathematical coordinates, coordinate conversion, physics, engineering, computer graphics, 3D modeling

Frequently Asked Questions

How do you convert the point $P(1, 60, 2)$ from Cartesian coordinates to a different coordinate

system?

The point $P(1, 60, 2)$ is already in Cartesian coordinates, representing (x, y, z) . To convert it to another coordinate system like cylindrical or spherical, you'd use the respective formulas: for cylindrical, (r, θ, z) ; for spherical, (ρ, θ, ϕ) .

What are the Cartesian coordinates of point $Q(2, 90, 4)$?

Point Q is given in Cartesian coordinates as $(x, y, z) = (2, 90, 4)$.

How can I find the distance between points $P(1, 60, 2)$ and $Q(2, 90, 4)$?

Use the distance formula in 3D: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$.
Substituting the values: $\sqrt{(2 - 1)^2 + (90 - 60)^2 + (4 - 2)^2} = \sqrt{1 + 900 + 4} = \sqrt{905} \approx 30.08$ units.

What is the Cartesian coordinate of point $T(4, /2, /6)$?

Assuming the slashes represent missing or misprinted data, if T is intended as $T(4, 2, 6)$, then its Cartesian coordinates are $(4, 2, 6)$.

How do you plot points $P(1, 60, 2)$, $Q(2, 90, 4)$, and $T(4, 2, 6)$ in a 3D Cartesian coordinate system?

Plot each point by locating their respective x , y , and z values on the 3D axes. P at $(1, 60, 2)$, Q at $(2, 90, 4)$, and T at $(4, 2, 6)$. Use graphing software or 3D plotting tools for accurate visualization.

Are the given points P , Q , and T colinear in 3D space?

To check colinearity, compute the vectors PQ and PT and see if one is a scalar multiple of the other. If yes, points are colinear. For the given points, vectors are $PQ = (1, 30, 2)$ and $PT = (3, -58, 4)$, which are not scalar multiples, so the points are not colinear.

How can I find the midpoint between points $P(1, 60, 2)$ and $Q(2, 90, 4)$?

Midpoint $M = ((x_1 + x_2)/2, (y_1 + y_2)/2, (z_1 + z_2)/2)$. Substituting: $M = ((1+2)/2, (60+90)/2, (2+4)/2) = (1.5, 75, 3)$.

What is the significance of the coordinates given for points P, Q, and T in spatial analysis?

These coordinates help determine the positions of points in 3D space, analyze distances, angles, and relationships like colinearity, which are essential in fields like engineering, physics, and computer graphics.

If the points are to be used in vector calculations, how do I find the vector from P to Q?

Subtract the coordinates of P from Q: Vector PQ = $(x_2 - x_1, y_2 - y_1, z_2 - z_1)$
 $= (2 - 1, 90 - 60, 4 - 2) = (1, 30, 2)$.

Can the points P, Q, and T be used to define a plane in 3D space?

Yes, three non-colinear points can define a plane. Since P, Q, and T are not colinear based on prior calculations, they can be used to determine the equation of the plane passing through these points.

Additional Resources

Cartesian Coordinates: A Comprehensive Analysis of Point Representation

In the realm of mathematics and geometry, the Cartesian coordinate system stands as a foundational framework that provides a precise method for representing spatial points and their relationships. Whether navigating the complexities of three-dimensional space or designing intricate engineering models, understanding how to express points in Cartesian coordinates is essential. This article delves into the process of converting specific points—namely P(1, 60, 2), Q(2, 90, 4), and T(4, /2, /6)—into their Cartesian coordinate representations, exploring the principles, methodologies, and implications involved.

Understanding the Cartesian Coordinate System

Before analyzing the specific points, it's crucial to grasp the fundamentals of the Cartesian coordinate system:

What Is the Cartesian Coordinate System?

The Cartesian coordinate system, named after the mathematician René Descartes, provides a way to specify the position of points in space using

ordered sets of numbers called coordinates. These coordinates correspond to distances along perpendicular axes—usually labeled as x, y, and z axes in three-dimensional space.

Significance in Mathematics and Engineering

- Universality: The system is universally accepted in various scientific fields, enabling consistent communication of spatial data.
- Precision: Coordinates precisely locate points in space, essential for calculations, CAD design, physics simulations, and more.
- Versatility: Extensible from 2D to 3D and higher dimensions, supporting complex modeling.

Deciphering the Given Points

The points provided are:

- P(1, 60, 2)
- Q(2, 90, 4)
- T(4, /2, /6)

At first glance, points P and Q appear to follow standard Cartesian notation with three numerical components. However, point T presents some ambiguity with the notation "/2" and "/6."

Clarifying Notation and Assumptions

- Standard format: (x, y, z)
- Potential typo or notation error: "/2" and "/6" may denote fractions, such as $\frac{2}{2}$ and $\frac{6}{6}$, or could be typographical placeholders.

Assumption for clarity:

- T(4, /2, /6) likely represents T(4, $\frac{2}{2}$, $\frac{6}{6}$), which simplifies to T(4, 1, 1).
- Alternatively, if "/2" and "/6" are meant as placeholders, then specific values are missing.
- For this analysis, we proceed with the assumption that the intended point is T(4, 1, 1).

Expressing Points in Cartesian Coordinates

Expressing points in Cartesian coordinates involves identifying their

position along each axis:

- The first coordinate corresponds to the x-axis.
- The second coordinate corresponds to the y-axis.
- The third coordinate corresponds to the z-axis.

Let's examine each point in detail.

Point P(1, 60, 2)

Understanding the Coordinates:

- x-coordinate: 1
- y-coordinate: 60
- z-coordinate: 2

Interpretation and Significance:

- The point P is located 1 unit along the x-axis.
- It is 60 units along the y-axis, indicating a position quite far from the origin in the y-direction.
- It is 2 units above (or below, depending on context) the xy-plane in the z-direction.

Applications and Implications:

- In a 3D modeling context, P could represent an object or point located at these specific offsets from the origin.
- The large y-coordinate signifies a significant displacement, which might be relevant in terrain modeling or spatial analysis.

Point Q(2, 90, 4)

Understanding the Coordinates:

- x-coordinate: 2
- y-coordinate: 90
- z-coordinate: 4

Interpretation and Significance:

- Located 2 units along the x-axis.
- Positioned 90 units along the y-axis, indicating an even greater

displacement than point P.

- Situated 4 units above the xy-plane.

Applications and Implications:

- Such a point might be used in high-altitude modeling or in scenarios where the y-dimension dominates spatial considerations.
- For example, in geographic information systems (GIS), this could correspond to a point far along the north-south axis.

Point T(4, 1, 1)

Understanding the Coordinates:

- x-coordinate: 4
- y-coordinate: 1
- z-coordinate: 1

Interpretation and Significance:

- Positioned 4 units along the x-axis.
- Slightly offset along the y-axis at 1 unit.
- Slightly above the xy-plane at 1 unit in the z-direction.

Applications and Implications:

- T could represent a point closer to the origin compared to P and Q, perhaps in a region of interest where proximity to the origin is relevant.
- In engineering, T might mark a specific feature or reference point in a design.

Practical Methods to Express Points in Cartesian Coordinates

While the points given are already in coordinate form, understanding how to convert other representations into Cartesian coordinates is vital. Here are common methods:

1. From Polar or Cylindrical Coordinates

- Conversion formulas:
- $x = r \cos \theta$

- $(y = r \sin \theta)$
- $(z = z)$ (unchanged)

2. From Spherical Coordinates

- Conversion formulas:
- $(x = \rho \sin \phi \cos \theta)$
- $(y = \rho \sin \phi \sin \theta)$
- $(z = \rho \cos \phi)$

3. From Other Coordinate Systems

- Apply the relevant mathematical transformations.
- Ensure units and conventions match.

Applications of Cartesian Coordinates in Real-World Contexts

Expressing points accurately in Cartesian coordinates isn't purely academic; it has tangible applications:

Engineering and Design

- Precise placement of components in CAD models.
- Structural analysis where exact point locations determine load points.

Computer Graphics

- Rendering objects in 3D space.
- Animation trajectories based on coordinate data.

Geospatial Analysis

- Mapping locations with latitude/longitude converted into Cartesian coordinates for computation.
- Terrain modeling and environmental simulations.

Physics and Robotics

- Path planning for robotic arms.
- Analyzing motion trajectories in three-dimensional space.

Conclusion: The Significance of Accurate Coordinate Representation

In summary, expressing points like $P(1, 60, 2)$, $Q(2, 90, 4)$, and $T(4, 1, 1)$ in Cartesian coordinates exemplifies fundamental principles that underpin a wide array of scientific and engineering disciplines. These coordinates serve as the lingua franca for spatial data, enabling precise analysis, visualization, and manipulation of objects within a three-dimensional framework.

Understanding how to interpret and convert various point representations into Cartesian coordinates enhances both theoretical knowledge and practical application, ensuring clarity and consistency across diverse fields. Whether designing complex machinery, modeling terrains, or creating immersive virtual environments, mastery of Cartesian coordinate expression remains an essential skill—one that bridges abstract mathematical concepts with tangible real-world solutions.

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