Class 11 Maths Chapter 11: Introduction to Three Dimensional Geometry - Notes, Important Questions and MCQs (2026-27)

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Class 11 Maths Chapter 11, Introduction to Three Dimensional Geometry, extends coordinate geometry from the plane to space by adding a third axis.

These notes cover coordinate axes and planes, the eight octants and their sign conventions, coordinates of a point in space and the distance formula, as prescribed in the rationalised 2026-27 syllabus.

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Chapter Overview

To locate a point in space, such as a ball in a room, we need three measurements: its distances from two walls and from the floor. These become the x, y and z coordinates.

Three mutually perpendicular lines through a point O (the origin) – the x-, y- and z-axes – form the rectangular coordinate system in space.

Important Topics and Concepts

Coordinate Axes and Coordinate Planes

- The x-, y- and z-axes are mutually perpendicular lines meeting at the origin O.
- The three coordinate planes are the XY-plane, YZ-plane and ZX-plane.

- These planes divide space into eight octants, named XOYZ, X′OYZ, X′OY′Z, XOY′Z and their counterparts below the XY-plane.

Coordinates of a Point in Space

- A point P is written as (x, y, z), where x, y and z are its perpendicular distances (with sign) from the YZ-, ZX- and XY-planes respectively.
- The origin is (0, 0, 0).
- A point on the x-axis is (x, 0, 0); on the y-axis (0, y, 0); on the z-axis (0, 0, z).
- A point in the XY-plane is (x, y, 0); in the YZ-plane (0, y, z); in the ZX-plane (x, 0, z).

Signs in the Octants

- Octant I (+, +, +); II (−, +, +); III (−, −, +); IV (+, −, +).
- Octant V (+, +, −); VI (−, +, −); VII (−, −, −); VIII (+, −, −).
- Example: (−3, 1, 2) lies in octant II; (−3, 1, −2) lies in octant VI.

Distance Between Two Points

- For $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$: $PQ = \sqrt{((x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2)}$.
- Distance of P(x, y, z) from the origin: $\sqrt{(x^2 + y^2 + z^2)}$.
- Used to check collinearity (sum of two distances equals the third), and to classify triangles as isosceles, equilateral or right-angled.

Octants and Signs of Coordinates

Octant	I	II	III	IV	V	VI	VII	VIII
x	+	−	−	+	+	−	−	+
y	+	+	−	−	+	+	−	−
z	+	+	+	+	−	−	−	−

Important Definitions and Terms

Term	Meaning
Origin	Point O(0, 0, 0) where the axes meet.
Coordinate planes	XY, YZ and ZX planes.
Octant	One of eight regions into which the coordinate planes divide space.
Coordinates	Ordered triplet (x, y, z) locating a point.
Distance formula	$\sqrt{((x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2)}$.

Short Answer Questions

Q1. Name the octant of (−4, 2, −5).

x −, y +, z − ⇒ octant VI.

Q2. What are the coordinates of a point on the y-axis?

(0, y, 0).

√(4 + 0 + 16) = √20 = 2√5.

Q4. Find the distance of (3, 4, 12) from the origin.

√(9 + 16 + 144) = 13.

Q5. What is the z-coordinate of every point in the XY-plane?

0.

Q6. Find the distance between (−1, 3, −4) and (1, −3, 4).

√(4 + 36 + 64) = √104 = 2√26.

Q7. How many octants are there?

Eight.

Q8. Write the coordinates of the foot of perpendicular from (3, −2, 5) on the XY-plane.

(3, −2, 0).

Long Answer Questions

Q1. Show that (−2, 3, 5), (1, 2, 3) and (7, 0, −1) are collinear.

PQ = √(9 + 1 + 4) = √14; QR = √(36 + 4 + 16) = √56 = 2√14; PR = √(81 + 9 + 36) = √126 = 3√14.

PQ + QR = √14 + 2√14 = 3√14 = PR.

Hence the points are collinear.

Q2. Verify that (0, 7, −10), (1, 6, −6) and (4, 9, −6) are vertices of an isosceles triangle.

AB = √(1 + 1 + 16) = √18; BC = √(9 + 9 + 0) = √18; AC = √(16 + 4 + 16) = 6.

AB = BC = √18.

So the triangle is isosceles.

Q3. Find the equation of the set of points P such that $PA^2 + PB^2 = 2k^2$, where A(3, 4, 5) and B(−1, 3, −7).

Let P = (x, y, z). $PA^2 = (x-3)^2 + (y-4)^2 + (z-5)^2$; $PB^2 = (x+1)^2 + (y-3)^2 + (z+7)^2$.

Adding: $2x^2 + 2y^2 + 2z^2 - 4x - 14y + 4z + 109 = 2k^2$.

Required set: $2(x^2 + y^2 + z^2) - 4x - 14y + 4z + 109 - 2k^2 = 0$.

MCQs with Answers

1. Number of octants:(a) 4 (b) 6 (c) 8 (d) 12Answer: (c) 8

2. Point (0, 0, 5) lies on:(a) x-axis (b) y-axis (c) z-axis (d) XY-planeAnswer: (c) z-axis

3. (2, −3, 4) is in octant:(a) I (b) II (c) IV (d) VIIIAnswer: (c) IV

4. Distance of (1, 2, 2) from origin:(a) 3 (b) 5 (c) √5 (d) 9Answer: (a) 3

5. Points in YZ-plane have:(a) y = 0 (b) x = 0 (c) z = 0 (d) x = yAnswer: (b) x = 0

6. (−1, −1, −1) is in octant:(a) I (b) III (c) VII (d) VIIIAnswer: (c) VII

8. Foot of perpendicular of (a,b,c) on z-axis:(a) (a,0,0) (b) (0,b,0) (c) (0,0,c) (d) (a,b,0)Answer: (c) (0,0,c)

9. Number of coordinate planes:(a) 2 (b) 3 (c) 4 (d) 8Answer: (b) 3

10. Coordinates of origin:(a) (1,1,1) (b) (0,0,0) (c) (0,0,1) (d) (1,0,0)Answer: (b) (0,0,0)

Quick Revision Points

- Three mutually perpendicular axes meet at O.
- Coordinate planes: XY, YZ, ZX.
- Eight octants with sign patterns.
- Point (x, y, z): signed distances from YZ, ZX, XY planes.
- Axes: (x,0,0), (0,y,0), (0,0,z).
- Planes: z = 0, x = 0, y = 0.
- Distance formula in 3D.
- Distance from origin $\sqrt{(x^2 + y^2 + z^2)}$.
- Collinearity: sum of two distances = third.
- Section formula is outside 2026-27 scope.

Chapter Summary

Three-dimensional geometry uses three perpendicular axes and three coordinate planes that divide space into eight octants. Every point in space has coordinates (x, y, z), with signs depending on its octant.

The distance between two points in space is found using an extension of the 2D distance formula. This helps test collinearity and classify triangles in space.

Exam Tips and PYQ Pattern

- Memorise the octant sign table – it is often a 1-mark question.
- Write coordinates of points on axes and planes carefully.
- Simplify surds in distance answers.
- For collinearity, compute all three distances first.
- The section formula has been removed in rationalisation.
- Draw a 3D sketch for clarity.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 11 Mathematics textbook, prescribed in the CBSE 2026-27 syllabus.

Can I download these notes as a PDF?

Yes. Use the free PDF link at the top of this page – no signup needed.

What topics are in Class 11 Maths Chapter 11 for 2026-27?

How many octants are there in space?

Eight.

What is the distance formula in 3D?

$\sqrt{((x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2)}$.

Conclusion

Introduction to Three Dimensional Geometry is short and scoring. Learn the octant table and distance formula, practise collinearity problems, and download the free PDF.

More Notes: Class 11 Maths Chapter 10: Conic Sections notes | Class 11 Maths Chapter 12: Limits and Derivatives notes | All Class 11 Maths notes

Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE maths educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 11 Maths textbook, Mathematics (Class XI) (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 28 November 2026.