

MATHEMATICS • CLASS 11

CHAPTER 11

Introduction to Three Dimensional Geometry

CHAPTER NOTES



COORDINATE AXES AND PLANES IN SPACE

A point in a plane needs two coordinates. A point in space needs three coordinates, like the position of a flying aeroplane or a bulb hanging in a room.

Rectangular coordinate system

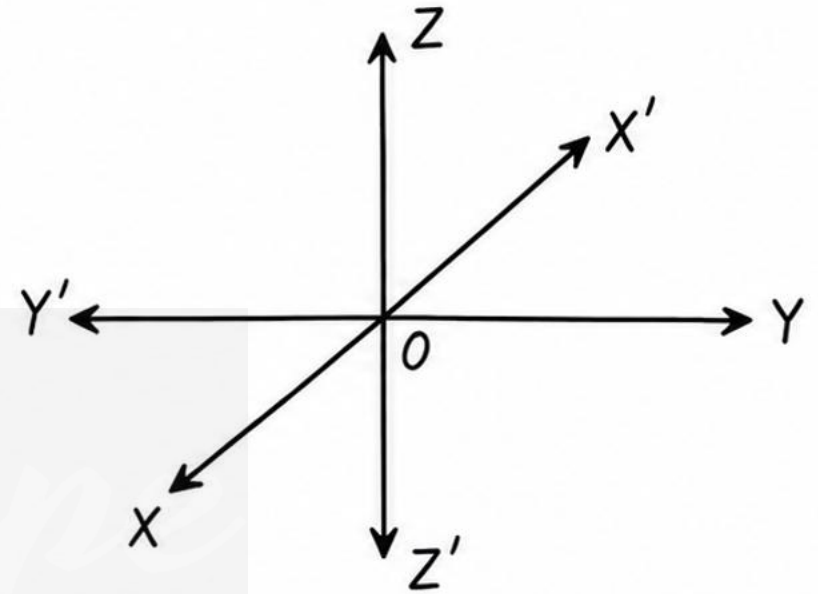
Three mutually perpendicular axes meet at the origin.

x -axis: $X'OX$

y -axis: $Y'OY$

z -axis: $Z'OZ$

$O = (0, 0, 0)$



Coordinate planes

Each pair of axes determines a coordinate plane. The three planes are mutually perpendicular.

XY -plane: x -axis and y -axis

YZ -plane: y -axis and z -axis

ZX -plane: z -axis and x -axis

COORDINATES OF A POINT IN SPACE

Every point in space has one ordered triple of real numbers.
The order of the coordinates matters.

$$P = (x, y, z)$$

Locating the point

- Move along the first axis to the required position.
- Move parallel to the second axis within the horizontal coordinate plane.
- Move perpendicular to this plane to reach the point.

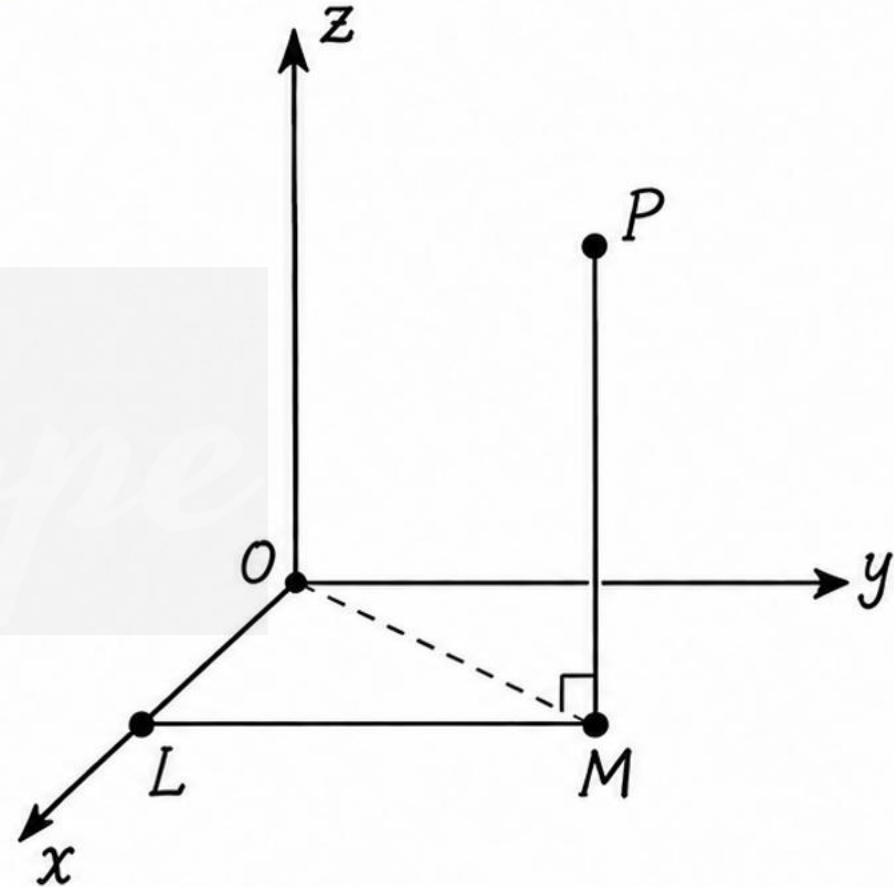
$$L = (x, 0, 0)$$

$$M = (x, y, 0)$$

$$P = (x, y, z)$$

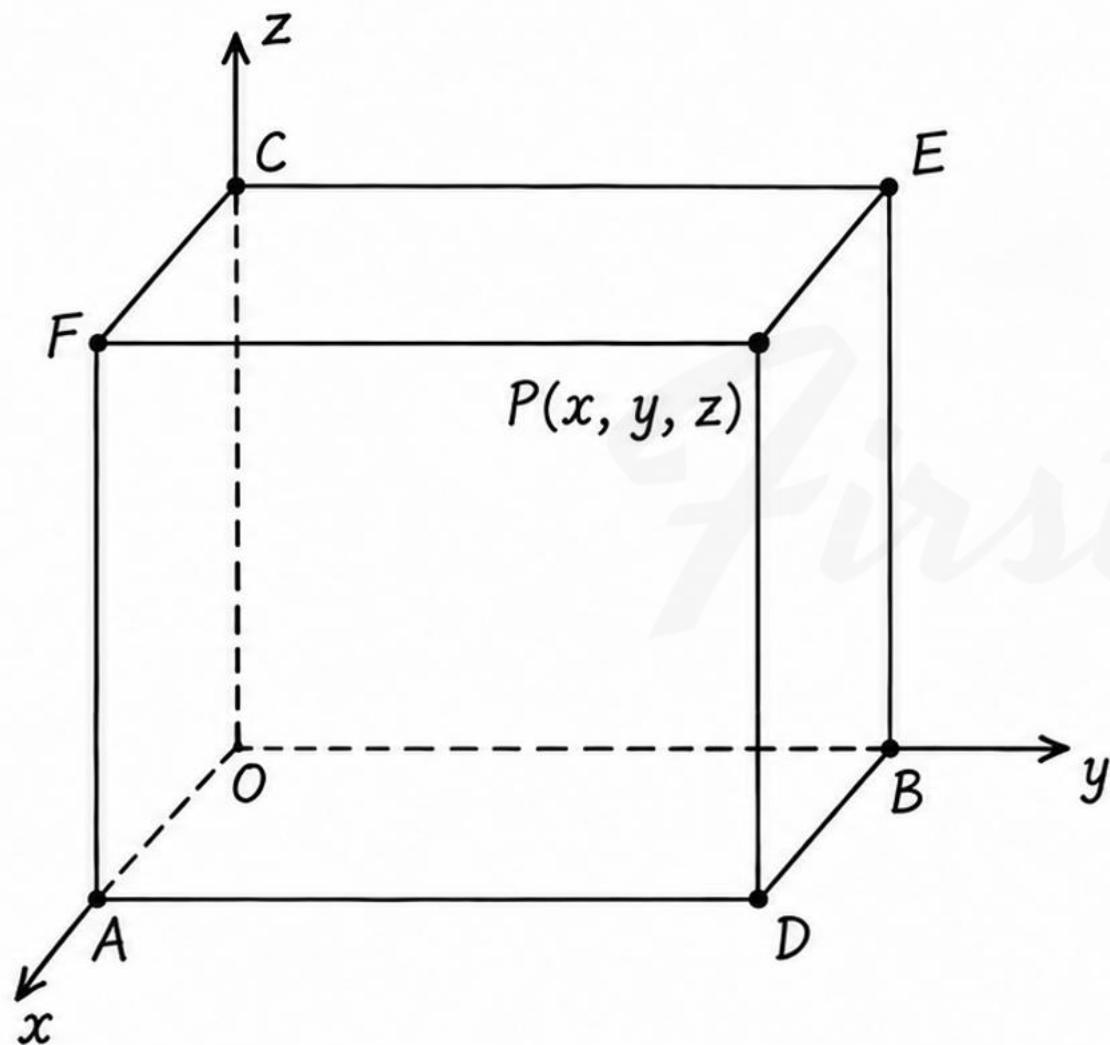
$$OL = x, \quad LM = y, \quad MP = z \quad (\text{first octant})$$

Reversing these steps reads the coordinates of a given point.
Thus every ordered triple determines one point in space.



First-octant schematic, not to scale

SIGNED COORDINATES AND PARALLEL PLANES



Schematic, not to scale.

Signed coordinates

A coordinate can be positive, negative or zero. It is a signed perpendicular distance from its corresponding coordinate plane.

x -coordinate: from the YZ -plane

y -coordinate: from the ZX -plane

z -coordinate: from the XY -plane

Actual distances: $|x|$, $|y|$, $|z|$

The chosen positive directions are forward, right and upward. The opposite directions are negative.

Parallel-plane construction

Through the point, draw planes parallel to the three coordinate planes. Their intersections with the axes give its coordinates.

$OA = x$, $OB = y$, $OC = z$

$ADPF \parallel YZ$ -plane

$BDPE \parallel ZX$ -plane

$CEPF \parallel XY$ -plane

POINTS ON AXES AND COORDINATE PLANES

A coordinate is zero when the point lies on its corresponding coordinate plane.

Coordinate planes

XY -plane: $(x, y, 0)$

YZ -plane: $(0, y, z)$

ZX -plane: $(x, 0, z)$

A point on an axis has two zero coordinates because it lies on two coordinate planes.

Coordinate axes

x -axis: $(x, 0, 0)$

y -axis: $(0, y, 0)$

z -axis: $(0, 0, z)$

Origin

$O = (0, 0, 0)$

The origin lies on all three axes and all three coordinate planes.

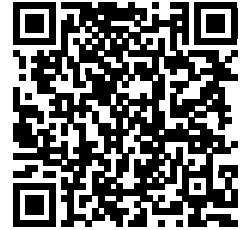


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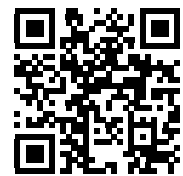


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