Class 11 Mathematics · Chapter 11: Introduction to Three Dimensional Geometry

Answer key and marking scheme · 20 marks · about 40 minutes · based on NCERT

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1. The coordinate planes XOY and YOZ intersect along the [1]

(a) x-axis (b) z-axis

(c) origin only (d) y-axis

Answer: (d) The plane XOY contains the x and y axes and the plane YOZ contains the y and z axes; the line common to both is Y′OY, the y-axis.

2. A point lies in octant IV. The signs of its x, y and z coordinates are, respectively, [1]

(a) −, −, + (b) +, +, −

(c) +, −, + (d) +, −, −

Answer: (c) From Table 11.1, octant IV is XOY′Z: x positive, y negative, z positive, i.e. (+, −, +).

3. In how many of the eight octants is the z-coordinate of every point positive? [1]

(a) 2 (b) 4

(c) 6 (d) 8

Answer: (b) From Table 11.1, z is positive in octants I, II, III and IV and negative in V to VIII: four octants.

4. The foot of the perpendicular drawn from P(4, −3, 6) to the XY-plane is [1]

(a) (4, −3, 0) (b) (0, 0, 6)

(c) (4, 0, 6) (d) (0, −3, 6)

Answer: (a) The foot M of the perpendicular PM on the XY-plane keeps the x and y coordinates of P and has z = 0: M is (4, −3, 0), and MP = 6.

5. Which of the following points lies on the y-axis? [1]

(a) (0, −4, 0) (b) (−4, 0, 0)

(c) (0, 0, −4) (d) (0, −4, 1)

Answer: (a) A point on the y-axis has the form (0, y, 0): its x and z coordinates are both zero. Only (0, −4, 0) has this form.

6. Find the point on the z-axis that is equidistant from A(1, 5, 7) and B(5, 1, −4). [2]

Let the point be P(0, 0, z). $PA^2 = 1 + 25 + (z - 7)^2$ and $PB^2 = 25 + 1 + (z + 4)^2$. Equating, $-14z + 49 = 8z + 16$, so $22z = 33$ and $z = \frac{3}{2}$. The point is $(0, 0, \frac{3}{2})$, i.e. z = 1.5.

- takes P(0, 0, z) and equates PA^2 and PB^2 (1)
- $z = \frac{3}{2}$, the point $(0, 0, \frac{3}{2})$ (1)

7. A point P(x, y, z) is such that xy > 0 and z < 0. Using the signs of the coordinates in the eight octants, name the octants in which P can lie. [2]

xy > 0 means x and y have the same sign: (+, +) or (−, −). With z negative the sign patterns are (+, +, −) and (−, −, −), which are octants V and VII.

- x and y of the same sign, z negative: (+, +, −) or (−, −, −) (1)
- octants V and VII (1)

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8. The distance of the point (a, 2a, 2a) from the origin is 12 units. Find the possible values of a. [2]

$OQ^2 = a^2 + 4a^2 + 4a^2 = 9a^2 = 144$, so $a^2 = 16$ and $a = 4$ or $a = -4$.

- $9a^2 = 144$ (1)
- $a = \pm 4$ (1)

9. Find the point that is equidistant from the origin O and from the points A(4, 0, 0), B(0, 6, 0) and C(0, 0, 2). [3]

Let P be (x, y, z). PO = PA gives $x^2 = (x - 4)^2$, i.e. $8x = 16$, $x = 2$. PO = PB gives $y^2 = (y - 6)^2$, i.e. $12y = 36$, $y = 3$. PO = PC gives $z^2 = (z - 2)^2$, i.e. $4z = 4$, $z = 1$. The point is (2, 3, 1).

- $x = 2$ from PO = PA (1)
- $y = 3$ from PO = PB (1)
- $z = 1$, the point (2, 3, 1) (1)

10. The vertices of a triangle are A(4, 1, −2), B(−1, 5, 3) and C(3, 0, 5). Find its centroid G and the distance of G from the origin. [3]

$G = \left(\frac{4 - 1 + 3}{3}, \frac{1 + 5 + 0}{3}, \frac{-2 + 3 + 5}{3}\right) = (2, 2, 2)$. $OG = \sqrt{(4 + 4 + 4)} = \sqrt{12} = 2\sqrt{3}$ units.

- the centroid as the mean of the vertices' coordinates (1)
- G = (2, 2, 2) (1)
- $OG = 2\sqrt{3}$ units (1)

11. Through a point P, planes parallel to the coordinate planes form the box OADBCFPE of Fig. 11.3, with A, B, C on the x, y and z axes, D in the XY-plane, F above A and E above B. If D is (4, 3, 0) and C is (0, 0, 6), write the coordinates of P, E and F, and find the length of the diagonal OP. [3]

D(4, 3, 0) gives OA = 4 and OB = 3; C gives OC = 6. So P = (4, 3, 6). E, above B, is (0, 3, 6) and F, above A, is (4, 0, 6). $OP = \sqrt{(16 + 9 + 36)} = \sqrt{61}$ units.

- P(4, 3, 6) (1)
- E(0, 3, 6) and F(4, 0, 6) (1)
- $OP = \sqrt{61}$ units (1)

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