

CLASS 12

MATHEMATICS

EXTRA QUESTIONS

Class 12 Mathematics Chapter 11 Three-Dimensional Geometry – Extra Questions with Answers

Three-Dimensional Geometry questions here work through direction cosines, the vector equation of a line, and the conditions that make two lines parallel or perpendicular.

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Three-Dimensional Geometry questions here work through direction cosines, the vector equation of a line, and the conditions that make two lines parallel or perpendicular.

Very Short Answer Questions (1 mark)

Q1. What is the relation satisfied by direction cosines l, m, n ?

Ans: $l^2 + m^2 + n^2 = 1$.

Q2. Write the vector equation of a line through point a along direction b .

Ans: $r = a + \lambda b$.

Q3. What is the condition for two lines with direction ratios (a_1, b_1, c_1) and (a_2, b_2, c_2) to be parallel?

Ans: $a_1/a_2 = b_1/b_2 = c_1/c_2$.

Q4. Write the Cartesian equation of a plane with normal direction ratios (a, b, c) passing through distance d from origin.

Ans: $ax + by + cz = d$.

Q5. What is the formula for distance of point (x_1, y_1, z_1) from plane $ax + by + cz = d$?

Ans: $|ax_1 + by_1 + cz_1 - d| / \sqrt{a^2 + b^2 + c^2}$.

Short Answer Questions (2–3 marks)

Q6. Find the direction cosines of the line joining points $(1, 2, 3)$ and $(4, 6, 15)$.

Ans: Direction ratios $= (4-1, 6-2, 15-3) = (3, 4, 12)$. Magnitude $= \sqrt{9+16+144} = \sqrt{169} = 13$. Direction cosines $= (3/13, 4/13, 12/13)$.

Q7. Find the angle between lines with direction ratios $(1, 1, 2)$ and $(-1, -1, 1)$.

Ans: $\cos \theta = |(1)(-1) + (1)(-1) + (2)(1)| / [\sqrt{1+1+4} \sqrt{1+1+1}] = |-1-1+2| / [\sqrt{6}\sqrt{3}] = 0/\sqrt{18} = 0$, so $\theta = 90^\circ$.

Q8. Find the distance of the point $(2, 3, -5)$ from the plane $x + 2y - 2z - 9 = 0$.

Ans: Distance $= |1(2) + 2(3) - 2(-5) - 9| / \sqrt{1+4+4} = |2+6+10-9|/3 = 9/3 = 3$ units.

Higher-Order Thinking / Application Questions

Q9. Find the equation of the plane passing through the points $(1, 1, 1)$, $(1, -1, 1)$, and $(-7, -3, -5)$, showing the full determinant method.

Ans: Let the plane pass through $A(1, 1, 1)$. Find two direction vectors in the plane:

$AB = B - A = (1-1, -1-1, 1-1) = (0, -2, 0)$, and $AC = C - A = (-7-1, -3-1, -5-1) = (-8, -4, -6)$. The normal to the plane is $AB \times AC$, computed via determinant: $\begin{vmatrix} i & j & k \\ 0 & -2 & 0 \\ -8 & -4 & -6 \end{vmatrix} = i[(-2)(-6) - (0)(-4)] - j[(0)(-6) - (0)(-8)] + k[(0)(-4) - (-2)(-8)] = i[12-0] - j[0-0] + k[0-16] = 12i + 0j - 16k = (12, 0, -16)$, simplifiable to $(3, 0, -4)$ by dividing by 4. So the plane has normal direction ratios $(3, 0, -4)$ and passes through $(1, 1, 1)$. Its equation is $3(x-1) + 0(y-1) - 4(z-1) = 0$, i.e., $3x - 4z - 3 + 4 = 0$, i.e., $3x - 4z + 1 = 0$. Verification: at $(1, -1, 1)$: $3(1) - 4(1) + 1 = 3 - 4 + 1 = 0$ ✓; at $(-7, -3, -5)$: $3(-7) - 4(-5) + 1 = -21 + 20 + 1 = 0$ ✓.

Q10. Find the shortest distance between the skew lines $r = (i+2j+3k) + \lambda(i-3j+2k)$ and $r = (4i+5j+6k) + \mu(2i+3j+k)$, explaining why the scalar triple product formula applies.

Ans: Since the two lines have different (non-parallel) direction vectors $b_1 = (1, -3, 2)$ and $b_2 = (2, 3, 1)$, and do not intersect (they are skew, existing in different planes despite not being parallel), the shortest distance between them is measured along the common perpendicular to both, which requires the scalar triple product formula: $d = |(a_2 - a_1) \cdot (b_1 \times b_2)| / |b_1 \times b_2|$. Here $a_2 - a_1 = (4-1, 5-2, 6-3) = (3, 3, 3)$. Compute $b_1 \times b_2$: $\begin{vmatrix} i & j & k \\ 1 & -3 & 2 \\ 2 & 3 & 1 \end{vmatrix} = i[(-3)(1) - (2)(3)] - j[(1)(1) - (2)(2)] + k[(1)(3) - (-3)(2)] = i[-3-6] - j[1-4] + k[3+6] = -9i + 3j + 9k = 3(-3i + j + 3k)$.

$2; 2 \ 3 \ 1] = i[(-3)(1) - (2)(3)] - j[(1)(1) - (2)(2)] + k[(1)(3) - (-3)(2)] = i[-3 - 6] - j[1 - 4] + k[3 + 6] = -9i + 3j + 9k = (-9, 3, 9)$. Its magnitude is $\sqrt{81 + 9 + 81} = \sqrt{171} = 3\sqrt{19}$. The scalar triple product (dot product with $(3, 3, 3)$) is $(3)(-9) + (3)(3) + (3)(9) = -27 + 9 + 27 = 9$. So $d = |9| / (3\sqrt{19}) = 3/\sqrt{19}$ units. This formula works because the numerator projects the connecting vector onto the direction perpendicular to both lines (given by $\mathbf{b}_1 \times \mathbf{b}_2$), isolating exactly the shortest (perpendicular) separation between the two skew lines.

Class 12 Mathematics Chapter 11 – Solutions and Notes

For complete step-by-step answers and a quick summary, check the [Class 12 Mathematics Chapter 11 Solutions](#) and [Class 12 Mathematics Chapter 11 Revision Notes](#).

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