PRACTICE PAPER 01 (2026-27) – ANSWER KEY WITH SOLUTIONS
CHAPTER 11 : THREE DIMENSIONAL GEOMETRY

SUBJECT: MATHEMATICS	**MAX. MARKS:** 40
CLASS: XII	**DURATION:** 1½ hrs

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. DRs 2, −1, −2

Ans: (c) 2/3, −1/3, −2/3

$\sqrt{2^2+(-1)^2+(-2)^2}=\sqrt{9}=3$, so the direction cosines are 2/3, −1/3, −2/3.

2. Line joining (1, 2, −1) and (4, 6, 11)

Ans: (b) 3/13, 4/13, 12/13

DRs: 4 − 1, 6 − 2, 11 + 1 = 3, 4, 12. $\sqrt{9+16+144}=13$, so the direction cosines are 3/13, 4/13, 12/13.

3. $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$

Ans: (d) 2

$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$, so $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 3 - 1 = 2$.

4. Line through (2, −1, 0), DRs 3, 1, −2

Ans: (a) $\frac{x-2}{3}=\frac{y+1}{1}=\frac{z}{-2}$

The line through (x_1, y_1, z_1) with DRs a, b, c is $(x - x_1)/a = (y - y_1)/b = (z - z_1)/c$.

5. Angle between DRs (1, 2, 2) and (2, −2, 1)

Ans: (d) 90°

$a_1a_2 + b_1b_2 + c_1c_2 = 2 - 4 + 2 = 0$, so $\cos\theta = 0$ and $\theta = 90°$.

6. Parallel lines

Ans: (b) 4

DRs are 2, 3, 4 and k, 6, 8. For parallel lines: k/2 = 6/3 = 8/4 = 2, so k = 4.

7. Distance between parallel lines

Ans: (c) 5

$\vec{a_2}-\vec{a_1}=5\hat{k},\ \vec{b}=3\hat{i}+4\hat{j}.\ (\vec{a_2}-\vec{a_1})\times\vec{b}=5\hat{k}\times(3\hat{i}+4\hat{j})=15\hat{j}-20\hat{i}$, magnitude 25, and |b| = 5. Distance = 25/5 = 5.

8. l = m = n

Ans: (b) ±1/√3

$l^2 + m^2 + n^2 = 1 \Rightarrow 3l^2 = 1 \Rightarrow l = \pm 1/\sqrt{3}$.

9. Assertion–Reason

Ans: (a) Both A and R are true and R is the correct explanation of A

DRs 1, 2, 3 give $\sqrt{1+4+9}=\sqrt{14}$, so the direction cosines are as stated in A. R states the rule used, so R explains A.

10. Assertion–Reason

Ans: (c) A is true but R is false

(2, 4, 6) = 2(1, 2, 3), so the lines are parallel and A is true. R is false: $a_1a_2 + b_1b_2 + c_1c_2 = 0$ is the condition for perpendicular lines. Parallel lines have proportional DRs.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. DCs of the line through (1, 1, 1) and (3, 4, 7)

DRs: 3 − 1, 4 − 1, 7 − 1 = 2, 3, 6, and $\sqrt{4+9+36} = 7$. (1)

Direction cosines: **2/7, 3/7, 6/7**. (1)

12. Line through (3, −1, 2) and (1, 1, 3)

DRs: 1 − 3, 1 + 1, 3 − 2 = −2, 2, 1. (1)

Equation: $\frac{x-3}{-2} = \frac{y+1}{2} = \frac{z-2}{1}$. (1)

13. Angle between the lines

Direction vectors: $\vec{b_1} = \hat{i} + \hat{k},\ \vec{b_2} = \hat{i}.\ \vec{b_1} \cdot \vec{b_2} = 1,\ |\vec{b_1}| = \sqrt{2},\ |\vec{b_2}| = 1$. (1)

$\cos\theta = \frac{1}{\sqrt{2} \cdot 1} = \frac{1}{\sqrt{2}}$, so **θ = 45°**. (1)

14. Line making 90°, 135°, 45° with the axes

l = cos 90° = 0, m = cos 135° = −1/√2, n = cos 45° = 1/√2. (1)

Check: $l^2 + m^2 + n^2 = 0 + 1/2 + 1/2 = 1$. The direction cosines are **0, −1/√2, 1/√2**. (1)

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Line through (2, −1, 3) perpendicular to two lines

The given lines have direction vectors $\vec{b_1} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b_2} = 2\hat{i} + \hat{j} - \hat{k}$. (1)

The required direction is along

$\vec{b_1} \times \vec{b_2} = \hat{i}(-2-1) - \hat{j}(-1-2) + \hat{k}(1-4) = -3\hat{i} + 3\hat{j} - 3\hat{k}$, i.e. DRs 1, −1, 1. (1)

Equation: $\frac{x-2}{1} = \frac{y+1}{-1} = \frac{z-3}{1}$. (1)

16. Show that the lines are perpendicular

Direction vectors: $\vec{b_1} = 2\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b_2} = \hat{i} - 2\hat{j} + 2\hat{k}$. (1)

$\vec{b_1} \cdot \vec{b_2} = 2(1) + 2(-2) + 1(2) = 2 - 4 + 2 = 0$. (1)

Hence the lines are perpendicular to each other. (1)

17. Shortest distance between the skew lines

$\vec{a_1} = 4\hat{i} + \hat{j} + 2\hat{k},\ \vec{b_1} = \hat{i} + 2\hat{j} + 2\hat{k},\ \vec{a_2} = \hat{i} + \hat{j} + 2\hat{k},\ \vec{b_2} = 2\hat{i} + \hat{j} - 2\hat{k}.\ \vec{a_2} - \vec{a_1} = -3\hat{i}.$ (1)

$\vec{b_1} \times \vec{b_2} = \hat{i}(-4-2) - \hat{j}(-2-4) + \hat{k}(1-4) = -6\hat{i} + 6\hat{j} - 3\hat{k}$, with magnitude $\sqrt{36+36+9} = 9$. (1)

Distance = $\frac{|(\vec{a_2}-\vec{a_1})\cdot(\vec{b_1}\times\vec{b_2})|}{|\vec{b_1}\times\vec{b_2}|}=\frac{|(-3)(-6)|}{9}=2$ units. (1)

SECTION – D

Question 18 carries 5 marks.

18. Skew lines (x − 1)/1 = (y − 2)/2 = (z + 1)/2 and (x − 3)/2 = (y − 1)/1 = (z − 2)/(−2)

Points and directions:

$\vec{a_1}=\hat{i}+2\hat{j}-\hat{k},\ \vec{b_1}=\hat{i}+2\hat{j}+2\hat{k},\ \vec{a_2}=3\hat{i}+\hat{j}+2\hat{k},\ \vec{b_2}=2\hat{i}+\hat{j}-2\hat{k}$. (1)

$\vec{a_2}-\vec{a_1}=2\hat{i}-\hat{j}+3\hat{k}$. (1)

$\vec{b_1}\times\vec{b_2}=\hat{i}(-4-2)-\hat{j}(-2-4)+\hat{k}(1-4)=-6\hat{i}+6\hat{j}-3\hat{k}$, with magnitude 9. (1)

$(\vec{a_2}-\vec{a_1})\cdot(\vec{b_1}\times\vec{b_2})=2(-6)+(-1)(6)+3(-3)=-12-6-9=-27$. (1)

Shortest distance = $\frac{|-27|}{9}=3$ units. Since the distance is not 0, the lines do **not** intersect (they are skew). (1)

OR

Both lines have the same direction $\vec{b}=\hat{i}+2\hat{j}+2\hat{k}$, so they are parallel; |b| = 3. (1)

$\vec{a_2}-\vec{a_1}=2\hat{i}+\hat{j}-2\hat{k}$. (1)

$(\vec{a_2}-\vec{a_1})\times\vec{b}=\hat{i}(2+4)-\hat{j}(4+2)+\hat{k}(4-1)=6\hat{i}-6\hat{j}+3\hat{k}$. (2)

Distance = $\frac{|(\vec{a_2}-\vec{a_1})\times\vec{b}|}{|\vec{b}|}=\frac{\sqrt{36+36+9}}{3}=\frac{9}{3}=3$ units. (1)

SECTION – E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. Two drone paths

(i) DRs of path 1 are 2, 3, 6 and $\sqrt{4+9+36}=7$. Direction cosines: **2/7, 3/7, 6/7**. (1)

(ii) DRs of path 2: 6, 2, −3. $a_1a_2 + b_1b_2 + c_1c_2 = 12 + 6 - 18 = 0$, so the paths are perpendicular: **90°**. (1)

(iii) $\vec{a_1}=\hat{i}+\hat{j}+\hat{k},\ \vec{a_2}=\hat{i}+3\hat{j}$, so $\vec{a_2}-\vec{a_1}=2\hat{j}-\hat{k}$.

$\vec{b_1}\times\vec{b_2}=\hat{i}(-9-12)-\hat{j}(-6-36)+\hat{k}(4-18)=-21\hat{i}+42\hat{j}-14\hat{k}$, magnitude 49. (1)

Dot product: 0(−21) + 2(42) + (−1)(−14) = 98. Distance = 98/49 = **2 (hundred metres) = 200 m**. (1)

OR

(iii) From the working above, the shortest distance between the paths is 2 ≠ 0. (1)
If the paths met, the shortest distance would be 0. Hence the paths do not meet (they are skew). (1)

20. Cable from A(1, 2, 0) to B(3, −4, 3)

(i) DRs: 3 − 1, −4 − 2, 3 − 0 = **2, −6, 3**. $\sqrt{4+36+9}=7$, so the direction cosines are **2/7, −6/7, 3/7**. (1)

(ii) $\vec{r} = (\hat{i} + 2\hat{j}) + \lambda(2\hat{i} - 6\hat{j} + 3\hat{k})$. (1)

(iii) Cartesian equation: $\frac{x-1}{2} = \frac{y-2}{-6} = \frac{z}{3}$. (1)

The angle with the z-axis: cos γ = 3/7, so **γ = $\cos^{-1}$(3/7)**. (1)

OR

(iii) A general point is (1 + 2λ, 2 − 6λ, 3λ). z = 6 gives 3λ = 6, so λ = 2. (1)

The point is (1 + 4, 2 − 12, 6) = **(5, −10, 6)**. (1)

— End of Solutions —