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Three Dimensional Geometry — CBSE Class 12 Mathematics Chapter Test

FREE CHAPTER TEST · CLASS XII · MATHEMATICS (041) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	40	19 (A 10 · B 3 · C 2 · D 2 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 19 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. In Section A, Questions 1 to 8 are multiple choice questions (MCQs) and Questions 9 and 10 are assertion-reason based questions of 1 mark each.
4. In Section B, Q11–13 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section C, Q14–15 are short answer (SA) type questions, carrying 3 marks each.
6. In Section D, Q16–17 are long answer (LA) type questions, carrying 5 marks each.
7. In Section E, Q18–19 are case study based questions, carrying 4 marks each, with sub-parts of the values of 1, 1 and 2 marks.
8. There is no overall choice. However, an internal choice has been provided in 1 question of Section B, 1 question of Section C, 1 question of Section D and in the 2-mark sub-part of each question of Section E.
9. Use of calculators is not allowed. log x denotes the natural logarithm of x.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Mathematics (041) Sample Question Paper 2026-27, released on 21 September 2026 at cbseacademic.nic.in, at half the length of the 80-mark board paper: 40 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Three Dimensional Geometry · **Topics:** Direction cosines and direction ratios · Vector and Cartesian equations of a line · Angle between two lines · Skew, parallel and intersecting lines · Shortest distance between two lines · Foot of the perpendicular and image

SECTION A

This section comprises 10 questions of 1 mark each: 8 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. The direction cosines of the line joining the points (1, 2, 3) and (3, 4, 4) are 1

(A) 2, 2, 1

(B) $\frac{2}{3}, \frac{2}{3}, \frac{1}{3}$

(C) $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$

(D) $\frac{2}{5}, \frac{2}{5}, \frac{1}{5}$

2. A line makes angles 90°, 60° and 30° with the x-, y- and z-axes. Its direction cosines are 1

(A) $0, \frac{\sqrt{3}}{2}, \frac{1}{2}$

(B) $1, \frac{1}{2}, \frac{\sqrt{3}}{2}$

(C) $0, \frac{1}{2}, \frac{\sqrt{3}}{2}$

(D) 0, 1, 1

3. The angle between the lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ and $\frac{x}{3} = \frac{y}{0} = \frac{z}{-1}$ is 1

(A) $\frac{\pi}{2}$

(B) $\frac{\pi}{4}$

(C) $\frac{\pi}{3}$

(D) 0

4. The vector equation of the line through the point (1, −2, 3) parallel to the vector $2\hat{i} + \hat{j} - \hat{k}$ is 1

(A) $\vec{r} = (2\hat{i} + \hat{j} - \hat{k}) + \lambda(\hat{i} - 2\hat{j} + 3\hat{k})$

(B) $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + \hat{j} - \hat{k})$

(C) $\vec{r} = (\hat{i} - 2\hat{j} - 3\hat{k}) + \lambda(2\hat{i} + \hat{j} - \hat{k})$

(D) $\vec{r} = (\hat{i} - 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + \hat{j} - \hat{k})$

5. The lines $\frac{x-2}{1} = \frac{y+1}{k} = \frac{z-3}{2}$ and $\frac{x+1}{2k} = \frac{y-4}{3} = \frac{z-1}{-4}$ are perpendicular. The value of k is 1

(A) $\frac{8}{5}$

(B) $-\frac{8}{5}$

(C) $\frac{5}{8}$

(D) $-\frac{5}{8}$

6. The direction ratios of the line $\frac{x-2}{3} = \frac{1-y}{2} = \frac{z+4}{5}$ are 1

(A) 3, 2, 5

(B) 3, −2, 5

(C) 2, 1, −4

(D) −3, 2, 5

7. The distance between the parallel lines $\vec{r} = (\hat{i} + \hat{j} + \hat{k}) + \lambda(2\hat{i} - \hat{j} + 2\hat{k})$ and $\vec{r} = (4\hat{i} + \hat{j} + \hat{k}) + \mu(2\hat{i} - \hat{j} + 2\hat{k})$ is 1

(A) 3

(B) $3\sqrt{5}$

(C) $\sqrt{5}$

(D) 5

8. The angle between two lines with direction ratios 1, 1, 0 and 0, 1, 1 is 1

(A) $\frac{\pi}{6}$

(B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$

(D) $\frac{\pi}{3}$

9. **Assertion (A):** The lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ and $\frac{x-1}{-2} = \frac{y-2}{-4} = \frac{z-3}{-6}$ are the same line. 1

Reason (R): Two lines whose direction ratios are proportional are parallel.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

10. **Assertion (A):** The direction cosines l, m, n of any line satisfy $l^2 + m^2 + n^2 = 1$. 1

Reason (R): If a, b, c are direction ratios of a line, then $a^2 + b^2 + c^2 = 1$.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

SECTION B

This section comprises 3 very short answer (VSA) type questions of 2 marks each.

11. Find the Cartesian equation of the line that passes through the point (4, −1, 2) and is parallel to the vector $2\hat{i} - \hat{j} + 3\hat{k}$. 2

12. (a) Find the angle between the lines with direction ratios 2, 1, 2 and 1, 2, 2. 2

OR

(b) Find the vector and Cartesian equations of the line through the points (1, 4, −2) and (1, 4, 5).

13. Show that the line through the points (3, 5, 2) and (1, 1, 0) is parallel to the line through the points (2, −1, 4) and (5, 5, 7). 2

SECTION C

This section comprises 2 short answer (SA) type questions of 3 marks each.

14. (a) Find the shortest distance between the lines $\vec{r} = (2\hat{i} + \hat{j}) + \lambda(\hat{i} + \hat{j} - \hat{k})$ and $\vec{r} = (\hat{i} - \hat{j} + 3\hat{k}) + \mu(2\hat{i} - \hat{j} + \hat{k})$. 3

OR

(b) Find the value of p so that the lines $\frac{2-x}{1} = \frac{2y-6}{p} = \frac{z+1}{2}$ and $\frac{x+1}{p} = \frac{3-y}{2} = \frac{z-4}{1}$ are perpendicular to each other.

15. Find the foot of the perpendicular from the point P(3, 1, 8) to the line $\frac{x-1}{1} = \frac{y}{2} = \frac{z-1}{2}$, and the length of the perpendicular. 3

SECTION D

This section comprises 2 long answer (LA) type questions of 5 marks each.

16. (a) Find the shortest distance between the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-2}{1}$ and $\frac{x+2}{1} = \frac{y-3}{-1} = \frac{z+1}{2}$. 5

OR

(b) Show that the lines $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{1}$ and $\frac{x}{2} = \frac{y-5}{-1} = \frac{z-1}{3}$ intersect, and find their point of intersection.

17. Find the image of the point P(5, 2, 1) in the line $\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-2}{2}$. Also find the length of the perpendicular from P to the line. 5

SECTION E

This section comprises 2 case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.

18. Two drones fly along straight paths $L_1: \vec{r} = (\hat{i} + 2\hat{j}) + \lambda(\hat{i} - \hat{j} + 2\hat{k})$ and $L_2: \vec{r} = (3\hat{i} - \hat{k}) + \mu(2\hat{i} + \hat{j} + \hat{k})$. For safety the paths must not meet.

(i) Write the direction ratios of L_1. [1]

(ii) Are the two paths parallel? Give a reason. [1]

(iii) Find the shortest distance between the two paths. [2]

OR

(iii) Find the angle between the two paths. [2]

19. A straight tunnel is drilled from the point A(2, 3, 1) to the point B(4, 7, 5) (coordinates in hundreds of metres).

(i) Write the direction ratios of the tunnel line AB. [1]

(ii) Find the direction cosines of the tunnel line. [1]

(iii) Find the Cartesian equation of the tunnel line. [2]

OR

(iii) Check whether the point C(6, 11, 9) lies on the line AB. [2]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
(B)	(C)	(A)	(D)	(A)	(B)	(C)	(D)	(B)	(C)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (B). Direction ratios 2, 2, 1; dividing by $\sqrt{(4 + 4 + 1)} = 3$ gives 2/3, 2/3, 1/3.

Q2. Answer (C). $\cos 90° = 0$, $\cos 60° = 1/2$, $\cos 30° = \sqrt{3}/2$.

Q3. Answer (A). $(1)(3) + (2)(0) + (3)(-1) = 0$, so the lines are perpendicular.

Q4. Answer (D). $\vec{r} = \vec{a} + \lambda\vec{b}$ with $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ (the point) and $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}$ (the direction).

Q5. Answer (A). $(1)(2k) + (k)(3) + (2)(-4) = 0 \Rightarrow 5k = 8 \Rightarrow k = 8/5$.

Q6. Answer (B). $(1 - y)/2 = (y - 1)/(-2)$, so the direction ratios are 3, −2, 5.

Q7. Answer (C). $d = |\vec{b} \times (\vec{a_2} - \vec{a_1})|/|\vec{b}| = |(2\hat{i} - \hat{j} + 2\hat{k}) \times 3\hat{i}|/3 = |6\hat{j} + 3\hat{k}|/3 = 3\sqrt{5}/3 = \sqrt{5}$.

Q8. Answer (D). $\cos\theta = 1/(\sqrt{2} \times \sqrt{2}) = 1/2$, so $\theta = \pi/3$.

Q9. Answer (B). The direction ratios 1, 2, 3 and −2, −4, −6 are proportional, so the lines are parallel (R is true), and (1, 2, 3) lies on both, so they coincide (A is true). R alone does not give A: a common point is also needed. Answer (B).

Q10. Answer (C). A is true. Direction ratios are any numbers proportional to the direction cosines (e.g. 2, 2, 1), so R is false. Answer (C).

Q11. (2 marks) Answer: $(x - 4)/2 = (y + 1)/(-1) = (z - 2)/3$.
The direction ratios are 2, −1, 3. [1]
Equation: $(x - 4)/2 = (y + 1)/(-1) = (z - 2)/3$. [1]

Q12. (2 marks) Answer: (a) $\cos^{-1}(8/9)$; (b) $\vec{r} = \hat{i} + 4\hat{j} - 2\hat{k} + \lambda(7\hat{k})$; $(x - 1)/0 = (y - 4)/0 = (z + 2)/7$.
(a) $\cos\theta = |2 + 2 + 4|/(\sqrt{9} \times \sqrt{9})$ [1] $= 8/9$, so $\theta = \cos^{-1}(8/9)$. [1]
OR (b) Direction ratios: 1 − 1, 4 − 4, 5 + 2 = 0, 0, 7. [1] Vector form $\vec{r} = \hat{i} + 4\hat{j} - 2\hat{k} + \lambda(7\hat{k})$; Cartesian form $(x - 1)/0 = (y - 4)/0 = (z + 2)/7$. [1]

Q13. (2 marks) Answer: direction ratios −2, −4, −2 and 3, 6, 3 are proportional.
Direction ratios of the first line: 1 − 3, 1 − 5, 0 − 2 = −2, −4, −2; of the second: 5 − 2, 5 + 1, 7 − 4 = 3, 6, 3. [1]
$-2/3 = -4/6 = -2/3$: proportional, so the lines are parallel. [1]

Q14. (3 marks) Answer: (a) $1/\sqrt{2}$; (b) $p = 1$.
(a) $\vec{b_1} \times \vec{b_2} = (\hat{i} + \hat{j} - \hat{k}) \times (2\hat{i} - \hat{j} + \hat{k}) = (1 - 1)\hat{i} - (1 + 2)\hat{j} + (-1 - 2)\hat{k} = 0\hat{i} - 3\hat{j} - 3\hat{k}$, $|\vec{b_1} \times \vec{b_2}| = 3\sqrt{2}$. [1] $\vec{a_2} - \vec{a_1} = -\hat{i} - 2\hat{j} + 3\hat{k}$. [½] $(\vec{a_2} - \vec{a_1}) \cdot (\vec{b_1} \times \vec{b_2}) = 0 + 6 - 9 = -3$. [½] Shortest distance $= |-3|/(3\sqrt{2}) = 1/\sqrt{2}$. [1]
OR (b) In standard form the lines are $(x - 2)/(-1) = (y - 3)/(p/2) = (z + 1)/2$ and $(x + 1)/p = (y - 3)/(-2) = (z - 4)/1$. [1]
Perpendicular: $(-1)(p) + (p/2)(-2) + (2)(1) = 0$ [1], so $-2p + 2 = 0$ and $p = 1$. [1]

Q15. (3 marks) Answer: (3, 4, 5); $3\sqrt{2}$ units.
Any point on the line is $Q(t + 1, 2t, 2t + 1)$; $\vec{PQ} = (t - 2)\hat{i} + (2t - 1)\hat{j} + (2t - 7)\hat{k}$. [1]
$\vec{PQ} \perp$ line: $(t - 2) + 2(2t - 1) + 2(2t - 7) = 0 \Rightarrow 9t = 18 \Rightarrow t = 2$, so the foot is Q(3, 4, 5). [1]
$PQ = \sqrt{(0 + 9 + 9)} = 3\sqrt{2}$ units. [1]

Q16. (5 marks) Answer: (a) $18/\sqrt{83}$ units; (b) (2, 4, 4).
(a) $\vec{a}_1 = \hat{i} - \hat{j} + 2\hat{k}$, $\vec{b}_1 = 2\hat{i} + 3\hat{j} + \hat{k}$; $\vec{a}_2 = -2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{b}_2 = \hat{i} - \hat{j} + 2\hat{k}$. [1] $\vec{b}_1 \times \vec{b}_2 = (6 + 1)\hat{i} - (4 - 1)\hat{j} + (-2 - 3)\hat{k} = 7\hat{i} - 3\hat{j} - 5\hat{k}$, $|\vec{b}_1 \times \vec{b}_2| = \sqrt{83}$. [2] $\vec{a}_2 - \vec{a}_1 = -3\hat{i} + 4\hat{j} - 3\hat{k}$; $(\vec{a}_2 - \vec{a}_1)\cdot(\vec{b}_1 \times \vec{b}_2) = -21 - 12 + 15 = -18$. [1] Shortest distance = $18/\sqrt{83}$ units. [1]
OR (b) General points: $(s + 1, 2s + 2, s + 3)$ and $(2t, 5 - t, 3t + 1)$. [1] Equating: $s + 1 = 2t$, $2s + 2 = 5 - t$, $s + 3 = 3t + 1$. [1] From the first, $s = 2t - 1$; the second gives $4t = 5 - t$, so $t = 1$ and $s = 1$. [1] Check in the third: $1 + 3 = 4 = 3(1) + 1$ ✓, so the lines intersect. [1] Point of intersection (2, 4, 4). [1]

Q17. (5 marks) Answer: image (1, −2, 7); $\sqrt{17}$ units.
Any point on the line is $M(2t + 1, t - 1, 2t + 2)$; $\vec{PM} = (2t - 4)\hat{i} + (t - 3)\hat{j} + (2t + 1)\hat{k}$. [1]
$\vec{PM} \perp$ line: $2(2t - 4) + (t - 3) + 2(2t + 1) = 0 \Rightarrow 9t = 9 \Rightarrow t = 1$; foot M(3, 0, 4). [2]
M is the mid-point of P and its image P′: $P' = (6 - 5, 0 - 2, 8 - 1) = (1, -2, 7)$. [1]
$PM = \sqrt{(4 + 4 + 9)} = \sqrt{17}$ units. [1]

Q18. (4 marks) Answer: (i) 1, −1, 2; (ii) no; (iii) $5/\sqrt{3}$ units, or $\pi/3$.
(i) 1, −1, 2. [1]
(ii) No: 1/2, −1/1, 2/1 are not equal, so the direction ratios are not proportional. [1]
(iii)(a) $\vec{b}_1 \times \vec{b}_2 = (-1 - 2)\hat{i} - (1 - 4)\hat{j} + (1 + 2)\hat{k} = -3\hat{i} + 3\hat{j} + 3\hat{k}$, $|\vec{b}_1 \times \vec{b}_2| = 3\sqrt{3}$; $\vec{a}_2 - \vec{a}_1 = 2\hat{i} - 2\hat{j} - \hat{k}$, so $(\vec{a}_2 - \vec{a}_1)\cdot(\vec{b}_1 \times \vec{b}_2) = -6 - 6 - 3 = -15$. [1] Shortest distance = $15/(3\sqrt{3}) = 5/\sqrt{3}$ units, which is not zero: the paths never meet. [1]
OR (iii)(b) $\cos\theta = |2 - 1 + 2|/(\sqrt{6} \times \sqrt{6})$ [1] $= 3/6 = 1/2$, so $\theta = \pi/3$. [1]

Q19. (4 marks) Answer: (i) 1, 2, 2; (ii) 1/3, 2/3, 2/3; (iii) $(x - 2)/1 = (y - 3)/2 = (z - 1)/2$, or yes.
(i) 2, 4, 4 (or 1, 2, 2). [1]
(ii) Dividing 1, 2, 2 by 3: 1/3, 2/3, 2/3. [1]
(iii)(a) Through A with direction ratios 1, 2, 2 [1]: $(x - 2)/1 = (y - 3)/2 = (z - 1)/2$. [1]
OR (iii)(b) $(6 - 2)/1 = 4$, $(11 - 3)/2 = 4$, $(9 - 1)/2 = 4$. [1] All equal, so C lies on the line AB. [1]

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