Three Dimensional Geometry Class 12 Important Questions

10 questions · 27 marks · no calculator · step-marked answers

Name _____ Date _____ Score / 27

- Original questions in the board paper's question types, from 1-mark MCQs to a case study. Try every question before you look at the answers.
- No calculator: as in the CBSE board exam, everything works by hand.
- Worked answers with step marks for 5 questions start after the questions. The other 5 open free on the chapter page with a free account (no card): the link is next to each one.
- Online, with more practice: cbsemathrevision.com/class-12/three-dimensional-geometry

Section A · Multiple choice and assertion–reason (1 mark each)

1. **1 mark · Direction cosines and ratios**

What are the direction cosines of the line from $A(1, 0, 2)$ to $B(3, 3, 8)$?

(a) $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$

(b) $2, 3, 6$

(c) $\frac{6}{7}, \frac{3}{7}, \frac{2}{7}$

(d) $\frac{2}{11}, \frac{3}{11}, \frac{6}{11}$

2. **1 mark · Angle between two lines**

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

(a) $30°$ (b) $45°$

(c) $60°$ (d) $90°$

3. **1 mark · Angle between two lines**

In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.

Assertion (A): The lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{4} = \frac{y+1}{6} = \frac{z}{8}$ are parallel.

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

(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 · Short answer (2 marks each)

4. **2 marks · Equation of a line**

Find the vector and Cartesian equations of the line through $(2, -1, 3)$ parallel to $\hat{i} + 2\hat{j} - 2\hat{k}$.

5. **2 marks · Angle between two lines**

Find k if the lines $\frac{x-1}{2} = \frac{y+2}{k} = \frac{z}{3}$ and $\frac{x+3}{k} = \frac{y-1}{-1} = \frac{z-2}{1}$ are perpendicular.

Section C · Short answer (3 marks each)

6. **3 marks · Angle between two lines**

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

7. **3 marks · Equation of a line**

Find the points on the line $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$ that are 5 units from the point $(1, 3, 3)$.

Section D · Long answer (5 marks each)

8. **5 marks · Shortest distance between lines**

The skew lines $\vec{r} = (\hat{i} + 2\hat{k}) + \lambda(\hat{i} + \hat{j})$ and $\vec{r} = (\hat{j} - \hat{k}) + \mu(\hat{j} + \hat{k})$ never meet. How far apart are they at their closest?

9. **5 marks · Equation of a line**

Find the foot of the perpendicular from $P(4, 3, -2)$ to the line $\dfrac{x-1}{2} = \dfrac{y+1}{1} = \dfrac{z-2}{-2}$, the perpendicular distance of P from the line, and the image of P in the line.

Section E · Case study (4 marks)

10. **4 marks · Shortest distance between lines**

Two drone paths. Two drones fly along straight paths $L_1 : \vec{r} = \lambda(\hat{i} + \hat{j})$ and $L_2 : \vec{r} = 2\hat{k} + \mu(\hat{i} - \hat{j})$ (units: metres).

i. Write the direction ratios of L_1. *[1 mark]*

ii. Are the paths parallel? Give a reason. *[1 mark]*

iii. How close do the two flight paths come to each other? *[2 marks]*

Answers and worked solutions

Question 1 — 1 mark

Direction ratios $2, 3, 6$; length $\sqrt{4+9+36} = 7$; direction cosines $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$ **A1**

Correct option: (a) $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$

Question 2 — 1 mark

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/three-dimensional-geometry#iq-2

Question 3 — 1 mark

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/three-dimensional-geometry#iq-3

Question 4 — 2 marks

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

$\vec{r} = (2\hat{i} - \hat{j} + 3\hat{k}) + \lambda(\hat{i} + 2\hat{j} - 2\hat{k})$ **A1**

$\frac{x-2}{1} = \frac{y+1}{2} = \frac{z-3}{-2}$ **A1**

Question 5 — 2 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/three-dimensional-geometry#iq-5

Question 6 — 3 marks

Answer: $\cos^{-1}\frac{4}{9}$

$\vec{b}_1 \cdot \vec{b}_2 = 4 + 2 - 2 = 4$ **M1**

$|\vec{b}_1| = |\vec{b}_2| = 3$, so $\cos\theta = \frac{4}{9}$ **A1**

$\theta = \cos^{-1}\frac{4}{9}$ **A1**

Question 7 — 3 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/three-dimensional-geometry#i

Question 8 — 5 marks

Answer: $\frac{5\sqrt{3}}{3}$ units

$\vec{b}_1 \times \vec{b}_2 = (\hat{i} + \hat{j}) \times (\hat{j} + \hat{k}) = \hat{i} - \hat{j} + \hat{k}$ **M1**

$|\vec{b}_1 \times \vec{b}_2| = \sqrt{3}$ **A1**

$\vec{a}_2 - \vec{a}_1 = -\hat{i} + \hat{j} - 3\hat{k}$ **A1**

$d = \frac{|(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2)|}{|\vec{b}_1 \times \vec{b}_2|} = \frac{|-1-1-3|}{\sqrt{3}}$ **M1**

$= \frac{5}{\sqrt{3}} = \frac{5\sqrt{3}}{3}$ units **A1**

Question 9 — 5 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/three-dimensional-geometry#i

Question 10 — 4 marks

i. $1, 1, 0$ **A1**

ii. No: $1, 1, 0$ and $1, -1, 0$ are not proportional **A1**

iii. $\vec{b}_1 \times \vec{b}_2 = -2\hat{k}$, $\vec{a}_2 - \vec{a}_1 = 2\hat{k}$ **M1**

$d = \frac{|2\hat{k} \cdot (-2\hat{k})|}{2} = 2\ m$ **A1**

More on this chapter, free: revision notes, a Route to 95 and practice with instant feedback at cbsemathrevision.com/class-12/three-dimensional-geometry

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