CHAPTER-11

THREE DIMENSIONAL GEOMETRY

01 MARK TYPE QUESTIONS

Q. NO	**QUESTION**	**MARK**
1.	If a line makes angles 90°,60° And 130° with the positive direction of x,y and z axis respectively, then its direction cosines. (a)0, $\frac{1}{2}, \frac{\sqrt{3}}{2}$ (b) 1, $\frac{1}{2}, \frac{\sqrt{3}}{2}$ (c) 1, $\frac{\sqrt{3}}{2}, \frac{1}{2}$, (d) 1, $\frac{\sqrt{3}}{2}, -\frac{1}{2}$,	1 MARK
2.	Two lines with direction ratios a_1 ,b_1 ,c_1 and a_2 ,b_2 , c_2 are parallel if (a) $\frac{a1}{a2} = \frac{b1}{b2} = \frac{c1}{c2}$ (b) $\frac{a1}{a2} = \frac{b1}{b2} \neq \frac{c1}{c2}$ (c) $\frac{a1}{a2} \neq \frac{b1}{b2} = \frac{c1}{c2}$ (d) $\frac{a1}{a2} \neq \frac{b1}{b2} \neq = \frac{c1}{c2}$	1 MARK
3.	The distance 0f a point(2 ,5,7) from the X axis is (a) 2 (b) $\sqrt{74}$ (c) $\sqrt{29}$ (d) $\sqrt{53}$	1 MARK
4.	If the direction cosines of a given line are $\frac{1}{k}, \frac{1}{k}, \frac{1}{k}$ then the value of k is (a) $\frac{1}{\sqrt{2}}$ (b) $\pm\frac{1}{\sqrt{3}}$ (c) 1 (d) $\pm\sqrt{3}$	1 MARK
5.	What are the direction cosines of a line, which makes equal angles with the coordinate axes. (a) $\pm\frac{1}{\sqrt{3}}, \pm\frac{1}{\sqrt{3}}, \pm\frac{1}{\sqrt{3}}$ (b) $\pm\frac{1}{\sqrt{2}}, \pm\frac{1}{\sqrt{2}}, \pm\frac{1}{\sqrt{2}}$ (c) $\pm\frac{1}{\sqrt{5}}, \pm\frac{1}{\sqrt{5}}, \pm\frac{1}{\sqrt{5}}$ (d) $\pm\sqrt{3}, \pm\sqrt{3}, \pm\sqrt{3}$	1 MARK
6.	The equation of y axis in space are x=0 , y =0 (b) $x = 0, z = 0$ (c) y=0 , z =0 (d) y =0	1 MARK
7.	Find the direction cosines of the line $\frac{4-x}{2} = \frac{y}{6} = \frac{1-z}{3}$ (a) $\frac{-2}{7}, \frac{6}{7}, \frac{-3}{7}$ (b) $\frac{2}{7}, \frac{6}{7}, \frac{-3}{7}$ (c) $\frac{-2}{7}, \frac{6}{7}, \frac{3}{7}$ (d) $\frac{-2}{7}, \frac{-6}{7}, \frac{-3}{7}$	1 MARK
8.	Angle between the lines with direction ratios 2,1,2 and 3,2,-6 is a) $\cos^{-1}(-4)$ (b) $\cos^{-1}\frac{-4}{21}$ (c) $\frac{-4}{21}$ (d) none of these	1 MARK
9.	Find the vector equation of a line $\frac{x-1}{1} = \frac{4-y}{2} = \frac{z+1}{3}$ (a) $\vec{r} = \frac{i-4j-k}{\sqrt{14}}$ (b) $\frac{i-4j-k}{\sqrt{6}}$ (c) $\frac{i+4j+k}{\sqrt{14}}$ (d) none of these	1 MARK
10.	Find the vector equation of the line passing through the points A(3,4,-7) and B(1,-1,6). (a) $\vec{r} = 3i + 4j - 7k + \mu(-2i - 5j + 13k)$	1 MARK

	(b) $\vec{r} = 3i + 4j - 7k + \mu(i - j + 6k)$ (c) $\vec{r} = i - 4j - k + \mu(i - 4j - k)$ (d) none of these	
11.	If a bullet shot from the gun travels a straight line path which makes angles 90°, 60° and 30° with the positive direction of x-axis, y-axis and z-axis respectively, find its direction cosines. (a) $1, \frac{\sqrt{3}}{2}, \frac{1}{2}$ (b) $\frac{\sqrt{3}}{2}, \frac{1}{\sqrt{2}}, \frac{1}{2}$ (c) $0, \frac{1}{2}, \frac{\sqrt{3}}{2}$ (d) none of these	1
12.	An electricity straight wire has direction ratios 2,–3, 4, determine its direction cosines. (a) 2, -3, 4 (b) 4, -6, 8 (c) $\frac{2}{\sqrt{29}}, \frac{-3}{\sqrt{29}}, \frac{4}{\sqrt{29}}$ (d) $\frac{4}{\sqrt{29}}, \frac{-6}{\sqrt{29}}, \frac{8}{\sqrt{29}}$	1
13.	Three stars in sky are positioned at A (2, -4, 6), B (4, 6, -8) and C (6, 16, -22) with respect to a common reference point O (0, 0, 0). A student is confused whether those three stars are in same line or not. He asks his teacher to help him to solve this problem. Help him to answer this question. (a) Three stars are collinear (b) Three stars are not in a same line (c) Only A and B are collinear, not C (d) None of these	1
14.	Find the direction ratios of a ray of light passing through the points (1, 2, 3) and (-1, -3, 5). (a) -2, 5, 2 (b) -2, -5, 2 (c) -2, -5, 8 (d) 2, -5, 8	1
15.	What are direction ratios of the line $\vec{r} = (3\hat{i} + 4\hat{j} - 5\hat{k}) + m(0\hat{i} + 7\hat{j} + 3\hat{k})$? (a) 3, 4, -5 (b) -3, -4, 5 (c) 3, 11, -2 (d) 0, 7, 3	1
16.	What are the direction cosines of the line having direction ratios 0, -3, 4? (a) 0, -3, 4 (b) 0, -8, 10 (c) 0, 3/5, 4/5 (d) 0, -3/5, 4/5	1
17.	Find the Cartesian equation of a line parallel to y-axis and passing through the point (1, -2, 7) (a) $\frac{x-1}{1} = \frac{y+2}{-2} = \frac{z-7}{7}$ (b) $\frac{x-1}{1} = \frac{y+2}{0} = \frac{z-7}{1}$ (c) $\frac{x+1}{1} = \frac{y-2}{-2} = \frac{z+7}{7}$ (d) $\frac{x-1}{0} = \frac{y+2}{1} = \frac{z-7}{0}$	1
18.	Write down the vector form of the following equation of line $\frac{x-6}{2} = \frac{y-4}{1} = \frac{z-1}{-3}$ (a) $\vec{r} = (6\hat{i} + 4\hat{j} + 1\hat{k}) + \alpha(2\hat{i} + \hat{j} - 3\hat{k})$ (b) $\vec{r} = (2\hat{i} + \hat{j} - 3\hat{k}) + \alpha(6\hat{i} + 4\hat{j} + 1\hat{k})$ (c) $\vec{r} = (-2\hat{i} - \hat{j} + 3\hat{k}) + \alpha(6\hat{i} + 4\hat{j} + 1\hat{k})$ (d) $\vec{r} = (-6\hat{i} - 4\hat{j} - 1\hat{k}) + \alpha(2\hat{i} + \hat{j} - 3\hat{k})$	1
19.	Two lines with direction ratios a, b, c and p, q, r respectively are said to be …… if ap + bq	1

	+ cr = 0. (a) Parallel (b) Perpendicular (c) coincident (d) Skew	
20.	For what value of p, given two lines are parallel? $\frac{x-1}{1} = \frac{y+2}{-2} = \frac{z-7}{7}$ and $\frac{x-8}{2} = \frac{y-2}{p} = \frac{z+2}{14}$ (a) p = -2 (b) p = 4 (c) p = -4 (d) can't be determined	1
21.	P is a point on the line joining the points A (1,5,-2) and B (3,-1,2). If the X co-ordinates of P is 5 , then its Y co-ordinate is -5 (b) -6 (c) -7 (d) -8	1
22.	The sum of the direction cosines of X-axis is (a) 0 (b) 1 (c) 2 (d) 3	1
23.	The cartesian equation of a line is given by $\frac{3x-1}{\sqrt{3}} = \frac{y+2}{2} = \frac{z-3}{3}$, the direction cosines of the line is (a) $\frac{\sqrt{3}}{2\sqrt{30}}, \frac{3}{\sqrt{30}}, \frac{9}{2\sqrt{30}}$ (b) $\frac{\sqrt{3}}{2\sqrt{30}}, \frac{\sqrt{5}}{2\sqrt{30}}, \frac{\sqrt{3}}{\sqrt{30}}$ (c) $\frac{\sqrt{3}}{2\sqrt{30}}, \frac{3}{2\sqrt{30}}, \frac{9}{2\sqrt{30}}$ (d) $\frac{\sqrt{3}}{2\sqrt{30}}, \frac{\sqrt{3}}{2\sqrt{30}}, \frac{\sqrt{5}}{2\sqrt{30}}$	1
24.	The point where the line joining the points (2,5,4) and (1,3,6) meets YZ- plane (a)(0,2,7) (b) (0,3,8) (c) (1,2,8) (d)(0,1,8)	1
25.	Assertion (A) : Let P be a point on the line joining the pints A(1,5,-4) and B(4,-2,1) . If X-co-ordinate of P is 3, then its Y co-ordinate is $\frac{1}{3}$. Reason (R) : The equation of line passing through two points A (x_1,y_1,z_1) and B (x_2,y_2,z_2) is given by $(x-x_1)/(x_2-x_1) = (y-y_1)/(y_2-y_1) = (z-z_1)/(z_2-z_1)$. (a)Both A and R are true and R is the correct explanation of A . (b) Both A and R are true but R is not the correct explanation of A (c) A is true but R is false (d)A is false but R is true.	1
26.	If a line makes an angle α , β, γ with X-axis, Y – axis and Z – axis respectively, then cos 2α + cos $2\beta + cos\ 2\gamma$ is (a) 1 (b) -1 (c) 0 (d) 2	1
27.	The co-ordinates of the point where the line $\frac{x+4}{4} = \frac{y-3}{-3} = \frac{z-5}{-5}$ cuts the XZ plane is (a) (0,0,0) (b) (1,1,1) (c)(2,2,2) (d) (3,3,3)	1

28.	 A car race was organized in a town , where the maximum speed limit was set by organizers . No participants are allowed to cross the specified limit , but two cars A and B are running at the speed more than allowed speed on the road along the lines $\vec{r} = \lambda(\hat{\imath} + 2\hat{\jmath} - \hat{k})$ and $\vec{r} = 3\hat{\imath} + 3\hat{\jmath} + \mu(2\hat{\imath} + \hat{\jmath} + \hat{k})$ respectively. The cartesian equation of the line along which motorcycle A is running (a) $\frac{x}{1} = \frac{y}{2} = \frac{z}{-1}$ (b) $\frac{2x}{1} = \frac{y}{3} = \frac{z}{-1}$ (c) $\frac{x}{1} = \frac{y}{2} = \frac{3z}{-1}$ (d) $\frac{x}{1} = \frac{y}{3} = \frac{z}{-1}$	1
29.	 The equation of motion of a missile are x = 3t , y = -4t , z = 2t, where the time t is given in the seconds and the distance is measured in kilometers. Which of the following points lie on the path of the missile at t = 3 s. (a)(6,8,12) (b) (9,-12,6) (c)(5,10, 15) (d) (5,10, -15)	1
30.	If the direction cosines of a line are k,k,k then (a) k>0 (b) 0<k<1 (c) k = 1 (d) k= $\pm\frac{1}{\sqrt{3}}$	1
31.	What is the value of $l^2 + m^2 + n^2$?	1
32.	If equation of a straight line in space is : $\frac{x-3}{2} = \frac{y+1}{3} = \frac{z}{2\sqrt{3}}$ What are its direction cosines.	1
33.	If equations of two straight lines in space are : $\frac{x-3}{2} = \frac{y+1}{3} = \frac{z}{2\sqrt{3}}$ and $\frac{x+1}{1} = \frac{y-2}{2} = \frac{z+2}{2}$, find the angle between these two lines.	1
34.	Show that the line through the points $(4, 7, 8)$, $(2, 3, 4)$ is parallel to the line through the points $(-1, -2, 1), (1, 2, 5)$.	1
35.	The Cartesian equation of a line is $\frac{x+5}{4} = \frac{y-1}{3} = \frac{z-2}{1}$, write it in vector form.	1

36.	Find the value of p so that the lines $\frac{x-1}{-3}=\frac{7y-14}{2p}=\frac{z-3}{2}$ and $\frac{x+1}{2}=\frac{y-3}{7}=\frac{z+5}{5}$ are perpendicular.	1
37.	If a line makes angles $90°, 135°, 45°$ with the x, y and $z-$axes respectively, find its direction cosines.	1
38.	Find the direction cosines of a line which makes equal angles with the co – ordinates axes.	1
39.	Find the direction – cosines of x, y, and z – axis .	1
40.	Find the Vector and Cartesian equation of the line through the point $(5, 2, -4)$ and which is parallel to the vector $3\hat{\imath}+2\hat{\jmath}-8\hat{k}$.	1
41.	$The\ equation\ of\ y-axis\ in\ space\ are$ $(a)x=0, y=0 \quad (b)x=0, z=0$ $(b)y=0, z=0 \quad (d)y=0$	1
42.	$A\ line\ makes\ an\ angle \frac{\pi}{4}, \frac{3\pi}{4}\ with\ xandy - axis\ respectively. Then\ the\ angles\ which\ makes\ with\ z - axis\ can\ be$	1
43.	If the direction cosines of a line are $\frac{k}{3}, \frac{k}{3}, \frac{k}{3}$ then the value of k is?	1
44.	Write the direction cosines of a line parallel to the z-axis.	1
45.	If a line has direction ratios 2, -1, -2, then what are its direction cosines?	1
46.	Using direction ratios, show that the points (2,3,4), (-1, -2,1) and (5,8,7) are collinear	1
47.	Find the direction cosines of the line $\frac{4-x}{2}$, $=\frac{y}{6}=\frac{1-z}{3}$	1
48.	Direction ratios of a line passing through the points (2,1,0) and (3,2, -1) are: (a.) (1,1, -1) (b.) 1,1,-1 (c.) <5,3,-1> (d.) None of these	1
49.	The distance of point (2,5,7) from the x-axis is a.) 2 b.)$\sqrt{74}$ c.) $\sqrt{29}$ d.) $\sqrt{53}$	1
50.	The direction cosines of the y-axis are: a. (9, 0, 0) b. (1, 0, 0) c. (0, 1, 0) d. (0, 0, 1)	1

ANSWERS:

Q. NO	ANSWER	MARKS
1.	a) 0, $\frac{1}{2}, \frac{\sqrt{3}}{2}$	1
2.	a) $\frac{a1}{a2} = \frac{b1}{b2} = \frac{c1}{c2}$	1
3.	(b) $\sqrt{74}$	1
4.	(d) $\pm\sqrt{3}$	1
5.	(a) $\pm \frac{1}{\sqrt{3}}$, $\pm \frac{1}{\sqrt{3}}$, $\pm \frac{1}{\sqrt{3}}$	1
6.	(b) $x = 0$, $z = 0$	1
7.	(a) $\frac{-2}{7}, \frac{6}{7}, \frac{-3}{7}$	1
8.	(b) $\cos^{-1}\frac{-4}{21}$	1
9.	a) $\vec{r} = \frac{i - 4j - k}{\sqrt{14}}$	1
10.	(a) $\vec{r} = 3i + 4j - 7k + \mu(-2i - 5j + 13k)$	1
11.	(c)	1
12.	(c)	1
13.	(a)	1
14.	(b)	1
15.	(d)	1
16.	(d)	1
17.	(d)	1
18.	(a)	1
19.	(b)	1
20.	(c)	1
21.	c	1
22.	b	1
23.	a	1
24.	d	1
25.	a	1
26.	b	1
27.	a	1
28.	a	1
29.	b	1
30.	d	1
31.	1	1
32.	$l = \frac{2}{5}, m = \frac{3}{5}, n = \frac{2\sqrt{3}}{5}$	1
33.	$\cos^{-1}\frac{8 + 4\sqrt{3}}{15}$	1
34.	Direction ratios of both the lines are : $(2, 4, 4)$. Hence, $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$.	1
35.	$\vec{r} = (-5\hat{\imath} + \hat{\jmath} + 2\hat{k}) + \alpha(4\hat{\imath} + 3\hat{\jmath} + \hat{k})$	1
36.	Direction ratios of the lines are : $\left(-3, \frac{2p}{7}, 2\right)$ & $(2, 7, 5)$ and $-3 \times 2 + \frac{2p}{7} \times 7 + 2 \times 5 = 0$ So that, $p = -2$	1

37.	$(0, \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$	1
38.	Here, $l = m = n$ so that, $l^2 + m^2 + n^2 = 1 \Rightarrow l = m = n = \frac{1}{\sqrt{3}}$	1
39.	The direction – cosines of x, y, and z – axis are : $(1, 0, 0), (0, 1, 0)$ and $(0, 0, 1)$ respectively.	1
40.	Vector equation is : $\vec{r} = 5\hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(3\hat{\imath} + 2\hat{\jmath} - 8\hat{k})$. Cartesian equation is : $\frac{x-5}{3} = \frac{y-2}{2} = \frac{z+4}{-8}$	1
41.	$(b) y = 0, z = 0$	1
42.	As	1
43.	As $3 \times \frac{k^2}{9} = 1\ k = \pm\sqrt{3}$	1
44.	$\Rightarrow \alpha + \beta\ + sin^2\gamma$	1
45.	$\Rightarrow 2\alpha + \beta\ + cos\ \ 2\gamma + 1 = 0$	1
46.	Dc's are 0,0,1	1
47.	We got dc's $\frac{2}{7}, \frac{6}{7}, \frac{3}{7}$	1
48.	(a.) (1,1, -1	1
49.	(b.)$\sqrt{74}$	1
50.	c. (0, 1, 0)	1

CHAPTER-11

THREE DIMENSIONAL GEOMETRY

02 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Find the distance between the two planes: 2x+3y+4z=4 and 4x+6y+8z=12	2
2.	Show that the planes: 2x-y+4z=5 and 5x-2.5y+10z=6 are parallel.	2
3.	Find the angle between the planes whose vector equations are $\vec{r}$.(2 i + 2j − 3k)=5 and $\vec{r}$.(3 i − 3j + 5k)=3	2
4.	If the lines $\frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-3}{2}$ and $\frac{x-1}{3k} = \frac{y-1}{1} = \frac{z-6}{-5}$ are perpendicular ,find the value of k.	2
5.	Find the foot of perpendicular drawn from the point (4,2,3) to the line joining (1,-2,3) and (1,1,0).	2
6.	Check whether the given two lines are coincident, skew, parallel or perpendicular? $\vec{r} = (6\hat{\imath} + 4\hat{\jmath} + 1\hat{k}) + \beta\,(2\hat{\imath} + \hat{\jmath} - 3\hat{k})$ $\vec{r} = (-2\hat{\imath} - \hat{\jmath} + 3\hat{k}) + \alpha\,(6\hat{\imath} + 3\hat{\jmath} - 9\hat{k})$	2
7.	Find the direction cosines of the sides of the triangle with vertices A (1, 3, 5), B (2, 5, 7) and C (-1, -4, 3)	2
8.	Show that the line passing through two points (2, 3, 5) and (5, 6, 8) is parallel to the line through the points (1, 6, -5) and (4, 9, -2).	2
9.	Find the angle between the pair of lines: $\vec{r} = (8\hat{\imath} + 4\hat{\jmath} + 9\hat{k}) + \beta\,(2\hat{\imath} + \hat{\jmath} - 3\hat{k})$ $\vec{r} = (7\hat{\imath} - 3\hat{\jmath} + 1\hat{k}) + \alpha\,(6\hat{\imath} + 3\hat{\jmath} - 9\hat{k})$	2
10.	Find the value of 'm' so that the given lines are perpendicular. $\frac{-x+1}{1} = \frac{y+2}{2} = \frac{z-7}{4}$ and $\frac{x-8}{2} = \frac{y-2}{m} = \frac{z+2}{6}$	2
11.	Find the acute angle which the line with direction cosines $1/\sqrt{2}$, ½ , n makes with positive direction of Z-axis.	2
12.	Find the direction cosine of a line equally inclined to the three co-ordinate axes.	2
13.	The cartesian equation of motion of a rocket is $\frac{x-2}{5} = \frac{y+4}{7} = \frac{6-z}{2}$	2

	 Write the vector equation of the line.	
14.	An insect is crawling along the line passing through two points (-2,-3,4) and (2,-1,3). Find the direction cosine of the line of an insect. 	2
15.	If the x-co-ordinate of a point P on the join of Q (2,2,1) and R (5,1,-2) is 3 then find its y – co-ordinate.	2
16.	Show that the lines given by $\frac{x-5}{2} = \frac{2y+5}{4} = \frac{3z+8}{5}$ and $\frac{3-x}{1} = \frac{y-2}{2} = \frac{8-5z}{6}$	2
17.	Find the angle between the lines whose direction ratios are (a, b, c) and $(b-c, c-a, a-b)$.	2
18.	Find the equation of a line parallel to $x-$ axis and passing through the point P $(1, 2, 3)$.	2
19.	Find equation of a line passing through points P $(3, 4, -1)$ and Q $(-2, 0, 4)$.	2
20.	Find the angle between the lines joining the points A $(1, -2, 3)$, B $(2, -1, 1)$ and C $(0, -2, 2)$, D $(0, 3, 4)$	2
21.	Find the vector equation of the line $\frac{x-5}{3} = \frac{y-5}{3} = \frac{z+1}{5}$ cuts YZ-plane.	2
22.	A line makes angles 60° and 45° with the x and y axes respectively, find the angle which it makes with the z-axis	2
23.	Find the direction cosines of the line passing through the following points: (-2,4, -5), (1,2,3)	2
24.	What are the direction cosines of a line, which makes equal angles with the coordinate axes?	2
25.	Write the equation of the line x-1 = 2y = 3z in vector form	2

ANSWERS:

Q. NO	ANSWER	MARKS
1.	$\frac{2}{\sqrt{29}}$ units	
2.	$\frac{A1}{A2} = \frac{B1}{B2} = \frac{C1}{C2}$ for parallel condition	
3.	$\cos^{-1}\frac{15}{\sqrt{731}}$	
4.	k = $\frac{-10}{7}$	
5.	(1,0,1)	
6.	These are parallel lines because their direction ratios are proportional.	2
7.	Direction cosines of AB are: $\frac{1}{3}, \frac{2}{3}, \frac{2}{3}$ Direction cosines of BC are: $\frac{-3}{\sqrt{106}}, \frac{-9}{\sqrt{106}}, \frac{-4}{\sqrt{106}}$ Direction cosines of CA are: $\frac{2}{\sqrt{57}}, \frac{7}{\sqrt{57}}, \frac{2}{\sqrt{57}}$	2
8.	Direction ratios of 1st line: 3, 3, 3 Direction ratios of 2nd line:3, 3, 3 Since direction ratios of both lines are same/ proportional, hence the lines are parallel.	2
9.	These are parallel lines because their direction ratios are proportional. So, angle between the given lines is 0°	2
10.	m = -11, using condition of perpendicularity i.e. sum of product of direction ratios of two perpendicular lines is zero.	2
11.	$l^2 + m^2 + n^2 = 1$ $(1/2)^2 + (1/\sqrt{2})^2 + n^2 = 1$ ¼ +1/2 + n^2 = 1 n^2 = 1-3/4 n^2 = ¼ n = ½ cos γ = ½ = cos 60^0 γ = 60^0	2
12.	Let direction cosine of a line equally inclined to co-ordinate axes are l,l,l So, $l^2 + l^2 + l^2 = 1$ Or, $3\,l^2 = 1$ Or, $l^2 = 1/3$ Or, $l = \pm\frac{1}{3}$ So, Direction cosines are $+\frac{1}{\sqrt{3}}, +\frac{1}{\sqrt{3}}, +\frac{1}{\sqrt{3}}$ or $-\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}$	2
13.	The cartesian equation of motion of a rocket is $\frac{x-2}{5} = \frac{y+4}{7} = \frac{6-z}{2}$ Or, $\frac{x-2}{5} = \frac{y+4}{7} = \frac{z-6}{-2}$ The standard form of line of equation is $(x - x_1)/a = (y-y_1)/b = (z-z_1)/c$ By comparing Point is (2,-4,6) and direction ratios are (5,7,-2). So, vector equation of motion of rocket $\vec{r} = 2\hat{\imath} - 4\hat{\jmath} + 6\hat{k} + \lambda(5\hat{\imath} + 7\hat{\jmath} - 2\hat{k})$	2

14.	Let line passing through two points P (-2,-3,4) and Q(2,-1,3) PQ = $\sqrt{16 + 4 + 1} = \sqrt{21}$ So, Direction cosines of the line joining two points are $\frac{2+2}{\sqrt{21}}, \frac{-1+3}{\sqrt{21}}, \frac{3-4}{\sqrt{21}}$ $= \frac{4}{\sqrt{21}}, \frac{2}{\sqrt{21}}, \frac{-1}{\sqrt{21}}$	2
15.	Let P divides QR in the ratio λ :1 Co-ordinates of P are $(\frac{5\lambda+2}{\lambda+1}, \frac{\lambda+2}{\lambda+1}, \frac{-2\lambda+1}{\lambda+1})$ x – co-ordinate of P = 3 So, $\frac{5\lambda+2}{\lambda+1} = 3$ Or, $5\lambda + 2 = 3\lambda + 3$ Or, $\lambda = ½$ So, y – co-ordinate of P = $\frac{\frac{1}{2}+2}{\frac{1}{2}+1} = 5/3$	2
16.	Equations of lines can be written in standard form as : $\frac{x-5}{2} = \frac{y+\frac{5}{2}}{2} = \frac{z+\frac{8}{3}}{\frac{5}{3}}$ and $\frac{x-3}{-1} = \frac{y-2}{2} = \frac{z-\frac{8}{5}}{\frac{-6}{5}}$ So that Direction ratios of the lines are : $\left(2, 2, \frac{5}{3}\right)$ & $(-1, 2, \frac{-6}{5})$ and $2 \times (-1) +$ $2 \times 2 + \frac{5}{3} \times \left(\frac{-6}{5}\right) = 0.$	1 1
17.	Here, $a \times (b - c) + b \times (c - a) + c \times (a - b)$ $= ab - ac + bc - ba + ca - cb = 0$ So that lines are perpendicular.	1 1
18.	Direction – cosines of x – axis are given by $(1, 0, 0)$ So that the equation of line passing through the point P $(1, 2, 3)$ and parallel to $x -$ axis is given by $\frac{x-1}{1} = \frac{y-2}{0} = \frac{z-3}{0}$.	1 1
19.	The direction ratios of the line passing through points P $(3, 4, -1)$ and Q $(-2, 0, 4)$ are : $(5, 4, -5)$. So that its equation can be given as $\frac{x+2}{5} = \frac{y}{4} = \frac{z-4}{-5}$.	1 1
20.	Direction ratios of the line joining the points A $(1, -2, 3)$, B $(2, -1, 1)$ is given by $(2 - 1, -1 + 2, 1 - 3) = (1, 1, -2)$ Direction ratios of the line joining the points C $(0, -2, 2)$, D $(0, 3, 4)$ is given by $(0, 3 + 2, 4 - 2) = (0, 5, 2)$. Therefore, angle between the lines is given by $\cos\theta = \frac{1\times0+1\times5-2\times2}{\sqrt{1+1+4}\times\sqrt{0+25+4}} = \frac{1}{\sqrt{174}}$.	1 1
21.	$\vec{b} = \vec{a} + \lambda\vec{b} \Rightarrow \vec{r} = (5i\hat{} - 4j\hat{} + 6k\hat{} + \lambda(3i\hat{} + 7j\hat{} - 2k)$	2
22.	$\gamma = 60° \text{ or } 120°$	2
23.	Dc's are: $\frac{3}{\sqrt{77}}, \frac{-2}{\sqrt{77}}, \frac{8}{\sqrt{77}}$	2
24.	Dc's are: $\pm\frac{1}{\sqrt{3}} \pm \frac{1}{\sqrt{3}} \pm \frac{1}{\sqrt{3}}$	2
25.	$\vec{r} = (i\hat{} + 0j\hat{} + 0k\hat{}) + \lambda(6i\hat{} + 3j\hat{} + 2k\hat{})$	2

CHAPTER-11

THREE DIMENSIONAL GEOMETRY

03 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Find the distance of a point (2,4,-1) from the line $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9}$	3
2.	Find the shortest distance between the lines $\vec{r} = (\mathbf{i} + 2\mathbf{j} + \mathbf{k}) + \gamma(\mathbf{i} - \mathbf{j} + \mathbf{k})$ and $\vec{r} = (2\mathbf{i} - \mathbf{j} - \mathbf{k}) + \mu(2\mathbf{i} + \mathbf{j} + 2\mathbf{k})$	3
3.	Find the equation of the plane with intercepts 2, 3 and 4 on the x, y and z axis respectively.	3
4.	Find the shortest distance between the following lines: $\vec{r} = (2\hat{\imath} + 4\hat{\jmath} - 8\hat{k}) + \beta(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ $\vec{r} = (\hat{\imath} - 2\hat{\jmath} - 4\hat{k}) + \alpha(4\hat{\imath} + 6\hat{\jmath} + 12\hat{k})$	3
5.	Find the shortest distance between the following lines whose vector equation are given: $\vec{r} = (2\hat{\imath} + 4\hat{\jmath} - 8\hat{k}) + \beta(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ $\vec{r} = (\hat{\imath} - 2\hat{\jmath} - 4\hat{k}) + \alpha(\hat{\imath} + 2\hat{\jmath} + 4\hat{k})$	3
6.	Find the angle between the pair of lines: $\vec{r} = (6\hat{\imath} + 4\hat{\jmath} - 8\hat{k}) + \gamma(2\hat{\imath} + 4\hat{\jmath} + 4\hat{k})$ $\vec{r} = (10\hat{\imath} - 4\hat{\jmath}) + \delta(6\hat{\imath} + 4\hat{\jmath} + 12\hat{k})$	3
7.	 Read the following text and answer the question on the basis of the same. A cycle race was organized in a town , where the maximum speed limit was set by the organizers . No participant are allowed to cross the specified speed limit, but two cycles A and B are running at the speed more than allowed speed on the road along the lines $\vec{r} = \hat{\imath} + \hat{\jmath} - \hat{k} + \lambda(\hat{\imath} + 2\hat{\jmath} - 2\hat{k})$ and $\vec{r} = \hat{\imath} + 2\hat{\jmath} + 2k + \mu(2\hat{\imath} + \hat{\jmath} + \hat{k})$ Find the angle between two lines.	3
8.		3

	 An insect is crawling along the line $\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{5z-10}{11}$ and another insect is crawling along the line $\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ .Find the value of p so that the lines are perpendicular to each other.	
9.	 An insect is crawling along the line which passes through the point (-2,4,-5) and parallel to the line given by $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$ then find the cartesian equation of of the line.	3
10.	Find the distance of the point P $(-2, 4, -5)$ from the line $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$.	3
11.	Find the co-ordinates of the foot of perpendicular drawn from the point A (1, 8, 4) to the line joining the points B (0, –1, 3) and C (2, –3, –1).	3
12.	Find the image of the point (1, 6, 3) in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$.	3
13.	Find the point on the line $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$ at a distance of $3\sqrt{2}$ from the point (1,2,3).	3
14.	Find the point on the line $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$ at a distance of 5 units from the point P (1,3,3).	3
15.	Show that the lines $\frac{5-x}{-4} = \frac{y-7}{4} = \frac{z+3}{-5}$ and $\frac{x-8}{7} = \frac{2y-8}{2} = \frac{2-5}{3}$ are coplanar.	3

ANSWERS:

Q. NO	ANSWER	MARKS
1.	7 units	
2.	$\frac{3\sqrt{2}}{2}$	
3.	$\frac{x}{2}+\frac{y}{3}+\frac{z}{4}=1$	
4.	Since, the given lines are parallel as their direction ratios are proportional, so shortest distance between these lines is given by; d = $\left\lvert\frac{\vec{b}\ X\ (\vec{a_2}-\vec{a_1})}{\lvert\vec{b}\rvert}\right\rvert$, where $\vec{a_1}$ = $(2\hat{\imath} + 4\hat{\jmath} - 8\hat{k})$ $\vec{a_2}$ = $(\hat{\imath} - 2\hat{\jmath} - 4\hat{k})$ $\vec{b}$ = $(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ d = $\frac{\sqrt{2581}}{7}$	3
5.	Since, the given lines are not parallel as their direction ratios are not proportional, so shortest distance between these lines is given by; d = $\left\lvert\frac{(\vec{b_1}\ X\ \vec{b_2})\ .\ (\vec{a_2}-\vec{a_1})}{\lvert\vec{b_1}\ X\ \vec{b_2}\rvert}\right\rvert$, where $\vec{a_1}$ = $(2\hat{\imath} + 4\hat{\jmath} - 8\hat{k})$ $\vec{a_2}$ = $(\hat{\imath} - 2\hat{\jmath} - 4\hat{k})$ $\vec{b_1}$ = $(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ $\vec{b_2}$ = $(\hat{\imath} + 2\hat{\jmath} + 4\hat{k})$ d = $\frac{16}{\sqrt{5}}$	3
6.	The angle between the two given lines is given by: θ = $\left\lvert\frac{\vec{b_1}.\vec{b_2}}{\lvert b_1\rvert\lvert b_2\rvert}\right\rvert$, where $\vec{b_1}$ = $(2\hat{\imath} + 4\hat{\jmath} + 4\hat{k})$ $\vec{b_2}$ = $(6\hat{\imath} + 4\hat{\jmath} + 12\hat{k})$ $\theta = \cos^{-1}\frac{19}{21}$	3
7.	$b_1 = (\hat{\imath} + 2\hat{\jmath} - 2\hat{k})$ and b_2 = $(2\hat{\imath} + \hat{\jmath} + \hat{k})$ $b_1 . b_2 = (\hat{\imath} + 2\hat{\jmath} - 2\hat{k}).(2\hat{\imath} + \hat{\jmath} + \hat{k})$ = 2+2-2 = 2 I b_1I = $\sqrt{1+4+4}$ = 3 I b_2 I = $\sqrt{4+1+1}$ = $\sqrt{6}$ the angle between two lines, cos θ = $2/3\sqrt{6}$ So, θ = $\cos^{-1}$ $(2/3\sqrt{6})$	3
8.	The given lines $\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{5z-10}{11}$ and $\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ OR, $\frac{x-1}{-3} = \frac{y-2}{2p/7} = \frac{z-2}{11/5}$ and $\frac{x-1}{-3p/7} = \frac{y-5}{1} = \frac{z-6}{-5}$ Direction ratios of the lines are -3,2p/7, 11/5 and -3p/7 , 1 ,-5 As the lines are perpendicular So, -3 X -3p/7 + 2p/7 X 1 + 11/5 X (-5) = 0 9p/7 + 2p/7 -11 = 0 11p -77 = 0 11 p = 77 So, p = 7.	3
9.	The equation of given line is $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$	3

	Direction ratios of the line are 3,5 and 6 Now, the equation of the line passing through point (-2,4,5) and having direction ratios 3,5,6 is $\frac{x+2}{3} = \frac{y-4}{5} = \frac{z+5}{6}$	
10.	Any general point on the line $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$……(1) is given by Q $(-3+3\lambda, 4+5\lambda, -8+6\lambda)$…….(2) If this point Q is to be foot of the perpendicular drawn to the line (1) from the point P$(-2, 4, -5)$, then Direction ratios of line $\overrightarrow{PQ}$ are given by $(3\lambda - 3 + 2, 5\lambda + 4 - 4, 6\lambda - 8 + 5) = (3\lambda - 1, 5\lambda, 6\lambda - 3)$ Now, as $\overrightarrow{PQ}$ is perpendicular to the line (1) hence, we have $3.(3\lambda - 1) + 5.(5\lambda) + 6.(6\lambda - 3) = 0$ $\Rightarrow 70\lambda - 21 = 0 \Rightarrow \lambda = \frac{21}{70} = \frac{3}{10}$ Hence, $\overrightarrow{PQ} = \left(-1 + \frac{9}{10}\right)\hat{\imath} + \frac{15}{10}\hat{\jmath}\left(-3 + \frac{18}{10}\right)\hat{k} = \frac{1}{10}\hat{\imath} + \frac{15}{10}\hat{\jmath} - \frac{12}{10}\hat{k}$ Therefore, $\left\|\overrightarrow{PQ}\right\| = \frac{1}{10}\sqrt{1 + 225 + 144} = \sqrt{\frac{37}{10}}$.	1 1 1
11.	Let Q be the foot of perpendicular drawn from the points A (1, 8, 4) to the line passing through B and C as shown in the Fig. 11.2. The equation of line BC by using the formula, $\vec{r} = \overrightarrow{a_1} + \lambda(\overrightarrow{a_2} - \overrightarrow{a_1})$ Here, $\overrightarrow{a_1} = -\hat{\jmath} + 3\hat{k}, \overrightarrow{a_2} = 2\hat{\imath} - 3\hat{\jmath} - \hat{k}$ So that equation of $\overrightarrow{BC} = -\hat{\jmath} + 3\hat{k} + \lambda(2\hat{\imath} - 2\hat{\jmath} - 4\hat{k})$……(1) Any general point Q on line (1) is given by Q $(2\lambda, -1 - 2\lambda, 3 - 4\lambda)$…..(2) If this point Q is to be foot of the perpendicular drawn to the line (1) from the point P$(1, 8, 4)$, then Direction ratios of line $\overrightarrow{PQ}$ are given by $2\lambda - 1, -1 - 2\lambda - 8, 3 - 4\lambda - 4) = (2\lambda - 1, -2\lambda - 9, -4\lambda - 1)$ Now, as $\overrightarrow{PQ}$ is perpendicular to the line (1) hence, we have $2.(2\lambda - 1) - 2.(-2\lambda - 9).-4.(-4\lambda - 1) = 0 \Longrightarrow 24\lambda + 20 = 0 \Longrightarrow \lambda = \frac{-5}{6}$ The required point is obtained by putting value of λ in (2) which is Q $(\frac{-5}{3}, \frac{2}{3}, \frac{19}{3})$	1 1 1
12.	Any general point on the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$……(1) is given by Q $(\lambda, 1 + 2\lambda, 2 + 3\lambda)$…….(2) Let P (1, 6, 3) be the given point and let Q be the foot of perpendicular from point P to the line (1) Direction ratios of line $\overrightarrow{PQ}$ are given by $(\lambda - 1, 1 + 2\lambda - 6, 3\lambda + 2 - 3) = (\lambda - 1, 2\lambda - 5, 3\lambda - 1)$ Now, as $\overrightarrow{PQ}$ is perpendicular to the line (1) hence, we have $1.(\lambda - 1) + 2.(2\lambda - 5) + 3.(3\lambda - 1) = 0$ $\Rightarrow 14\lambda - 14 = 0 \Rightarrow \lambda = 1$ Hence, co – ordinates of point Q are : Q $(1, 3, 5)$ Now, if R (x, y, z) be image point of the point P (1, 6, 3) then, Q (1, 3, 5) will be mid – point of line – segment PR. So that, $\frac{x+1}{2} = 1, \frac{y+6}{2} = 3, \frac{z+3}{2} = 5$ Hence, $x = 1, y = 0, z = 7$.	1 1 1

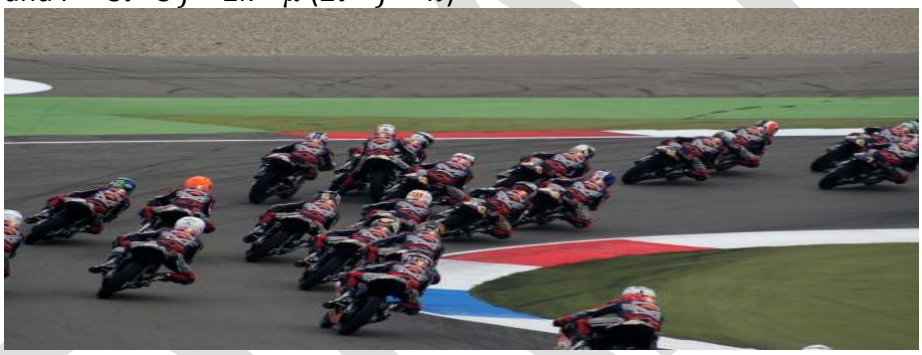
	So that image point is : (1, 0, 7).	
13.	A $(\frac{56}{17}, \frac{43}{17}, \frac{111}{17})$	3
14.	R(4,3,7) or R(-2,-1,3)	3
15.	-51 -141 +192=0	3

CHAPTER-11

THREE DIMENSIONAL GEOMETRY

04 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Find the distance between the point P(6,5,9) and the plane determined by the points A(3,-1,2) ,B(5,2,4) and C(-1,-1,6)	4 MARKS
2.	Find the coordinates of the point where the line through the points A(3,4,1) and B(5,1,6) crosses the XY-plane.	4
3.	The equation of motion of a missile are x = 2t, y = 3t, z = t, where the time 't' is given in seconds and distance is measured in kilometers. Based on it, answer the following question; (i) What is the path of the missile? (a) Straight line (b) Parabola (c) Circle (d) Ellipse (ii) Which of the following points lie on the path of missile? (a) (1, 2, 3) (b) (2, 3, 1) (c) (4, 1, -2) (d) (1, -2, 3) (iii) At what distance will the missile be in 10 seconds from the starting point (0, 0, 0)? (a) $10\sqrt{14}$ km (b) $20\sqrt{14}$ km (c) $10\sqrt{7}$ km $(d)20\sqrt{14}$ km (iv) The position of missile at a certain instant of time is (2,-8, 15) then what will be height of the missile from the ground if ground is considered as xy-plane? (a) 2 km (b) 8 km (c) 15 km (d) 7 km	4
4.	In a class, teacher asks students what they know about space or three dimensional system, he asks students some basic questions. Help students to answer the following; (i) What is the equation of x-axis in space? (a) x = 0, y = 0 (b) y = 0, z = 0 (c) x = 0 (d) none of these (ii) What are direction ratios of y-axis? (a) 0,0,1 (c) 0,1,0 (b) 1,0,0 (d) 1,0,1 (iii) DC of a line are < m, m, m >, then (a) m > 0 (c) m < 1 (b) m < 0 (d) m = $\frac{1}{\sqrt{3}}$ or $\frac{-1}{\sqrt{3}}$ (iv) Which of the following statement is correct? (a) Direction ratios of a line are equal to its direction cosines. (b) Direction ratios of two perpendicular lines are proportional. (c) Direction ratios of two parallel lines are proportional. (d) All of these are correct.	4
5.	The equation of motion of a rocket are x = 4t , y = -4t , z = t, where the time t is given in the seconds and the distance is measured in kilometers.	4

	 (i)Find the points lie on the path of the rocket at t = 5 s. (ii) Find the distance of the rocket from the starting point (0,0,0) in 5 seconds .	
6.	Read the following text and answer the question on the basis of the same. A motor cycle race was organized in a town , where the maximum speed limit was set by the organizers . No participant are allowed to cross the specified speed limit, but two motorcycles A and B are running at the speed more than allowed speed on the road along the lines $\vec{r}$ = $\hat{\imath}$ +2 $\hat{\jmath}$ − $\hat{k}$ + λ ($\hat{\imath}$ +2 $\hat{\jmath}$ − $\hat{k}$) and $\vec{r}$ = 3$\hat{\imath}$ +3 $\hat{\jmath}$ + 2k + μ (2$\hat{\imath}$ + $\hat{\jmath}$ + $\hat{k}$)  (i) Find the cartesian equation of the line along which motorcycle B is running. (ii) Find the shortest distance between the lines.	4
7.	Find the shortest distance between the lines l_1 & l_2 whose vector equations are given by : $\vec{r} = \hat{\imath} + \hat{\jmath} + \lambda(2\hat{\imath} - \hat{\jmath} + \hat{k})$ and $\vec{r} = 2\hat{\imath} + \hat{\jmath} - \hat{k} + \mu(3\hat{\imath} - 5\hat{\jmath} + 2\hat{k})$.	4
8.	Find the distance between the lines l_1 & l_2 whose vector equations are given by : $\vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ and $\vec{r} = 3\hat{\imath} + 3\hat{\jmath} - 5\hat{k} + \mu(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$.	4
9.	Find the shortest distance between the following two lines $r \rightarrow = (1+\lambda)\ \hat{\imath} + (2-\lambda)\hat{\jmath} + (\lambda+1)\hat{k};$ $r \rightarrow = (2\hat{\imath} - \hat{\jmath} - \hat{k}) + \mu(2\hat{\imath} + \hat{\jmath} + 2\hat{k})$	4
10.	Find the shortest distance between the lines whose vector equations are $r \rightarrow = (1-t)\ \hat{\imath} + (t-2)\hat{\jmath} + (3-2t)\hat{k};$ and	4

	$r \rightarrow = (s+1)\ \hat{\imath} + (2s-1)\hat{\jmath} - (2s+1)\hat{k};$	

ANSWERS:

Q. NO	ANSWER	MARKS
1.	$\frac{3\sqrt{34}}{17}$	
2.	$(\frac{13}{5}, \frac{23}{5}, 0)$	
3.	(i) (a) (ii) (b) (iii) (a) (iv) (c)	4
4.	(i) (b) (ii) (c) (iii) (d) (iv) (c)	4
5.	(i) The equation of motion of a rocket are x = 4t , y = -4t , z = t, at t = 5 x= 20, y = -20, z = 5 so, points lie on the path = (20,-20,5) (ii) points lie on the path after 5 seconds = (20,-20,5) Distance from starting point (0,0,0) = I $\sqrt{400 + 400 + 25}$ I = I $\sqrt{825}$ I =5 $\sqrt{33}$	4
6.	(i)The line along which motorcycle B is running $\vec{r}$ = $3\hat{\imath}$ +3 $\hat{\jmath}$ + 2k + μ ($2\hat{\imath}$ + $\hat{\jmath}$ + $\hat{k}$) ($x\hat{\imath}$ +y $\hat{\jmath}$ + $z\hat{k}$) = (3+2μ)$\hat{\imath}$ +(3 +μ)$\hat{\jmath}$ +(2+ μ) k x = (3+2μ) , y =(3 +μ) , z = (2+ μ) Or, (x-3)/2 = μ , y-3 = μ , z-2 = μ The required cartesian equation = (x-3)/2 = y-3 = z-2 (iii) $a_1 = \hat{\imath} + 2\hat{\jmath} - \hat{k}$, $a_2 = 3\hat{\imath} + 3\hat{\jmath} + 2k$ $b_1 = \hat{\imath} + 2\hat{\jmath} - \hat{k}$, $b_2 = 2\hat{\imath} + \hat{\jmath} + \hat{k}$ $a_2 - a_1 = 3\hat{\imath} + 3\hat{\jmath} + 2\hat{k} - \hat{\imath} - 2\hat{\jmath} + \hat{k} = 2\hat{\imath} + \hat{\jmath} + 3\hat{k}$ $b_1 \times b_2 = \begin{bmatrix} i & j & k \\ 1 & 2 & -1 \\ 2 & 1 & 1 \end{bmatrix} = 3\hat{\imath} + 3\hat{\jmath} - 3\hat{k}$ $(a_2 - a_1).(b_1 \times b_2) = (2\hat{\imath} + \hat{\jmath} + 3\hat{k}) . (3\hat{\imath} + 3\hat{\jmath} - 3\hat{k})$ =6 +3 – 9 = 0 So, Shortest distance between given lines = 0.	4
7.	Given equation of lines are given by :	

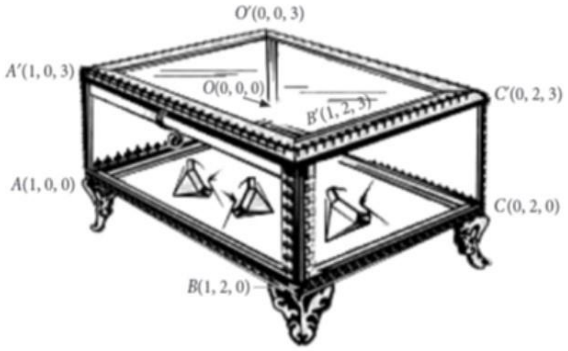
	$\vec{r} = \hat{\imath} + \hat{\jmath} + \lambda(2\hat{\imath} - \hat{\jmath} + \hat{k})$ ……(1) $\vec{r} = 2\hat{\imath} + \hat{\jmath} - \hat{k} + \mu(3\hat{\imath} - 5\hat{\jmath} + 2\hat{k})$……(2) Comparing (1) and (2) by the standard equations $\vec{r} = \overrightarrow{a_1} + \lambda\overrightarrow{b_1}$ and $\vec{r} = \overrightarrow{a_2} + \lambda\overrightarrow{b_2}$ respectively, we get $\overrightarrow{a_1} = \hat{\imath} + \hat{\jmath}$, $\overrightarrow{b_1} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$, $\overrightarrow{a_2} = 2\hat{\imath} + \hat{\jmath} - \hat{k}$, $\overrightarrow{b_2} = 3\hat{\imath} - 5\hat{\jmath} + 2\hat{k}$ Therefore, $\overrightarrow{a_2} - \overrightarrow{a_1} = \hat{\imath} - \hat{k}$, and $\overrightarrow{b_1} \times \overrightarrow{b_2} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 2 & -1 & 1 \\ 3 & -5 & 2 \end{vmatrix} = 3\hat{\imath} - \hat{\jmath} - 7\hat{k}$ So, $\left\|\overrightarrow{b_1} \times \overrightarrow{b_2}\right\| = \sqrt{9 + 1 + 4} = \sqrt{59}$ Hence, the shortest distance between the given lines is given by $d = \left\|\frac{(\overrightarrow{b_1} \times \overrightarrow{b_2}).(\overrightarrow{a_2} - \overrightarrow{a_1})}{\|\overrightarrow{b_1} \times \overrightarrow{b_2}\|}\right\| = \left\|\frac{(3\hat{\imath} - \hat{\jmath} - 7\hat{k}).(\hat{\imath} - \hat{k})}{\sqrt{59}}\right\| = \frac{10}{\sqrt{59}}$ units.	1 1 1 1
8.	The given equations of lines are: $\vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ ……..(1) $\vec{r} = 3\hat{\imath} + 3\hat{\jmath} - 5\hat{k} + \mu(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$…….(2) Clearly, lines given in (1) and (2) are parallel. Comparing (1) and (2) by the standard equations $\vec{r} = \overrightarrow{a_1} + \lambda\vec{b}$ and $\vec{r} = \overrightarrow{a_2} + \lambda\vec{b}$ respectively, we get, $\overrightarrow{a_1} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k}$, $\overrightarrow{a_2} = 3\hat{\imath} + 3\hat{\jmath} - 5\hat{k}$, $\vec{b} = 2\hat{\imath} + 3\hat{\jmath} + 6\hat{k}$. Therefore, $\overrightarrow{a_2} - \overrightarrow{a_1} = 2\hat{\imath} + \hat{\jmath} - \hat{k}$, Also, $\vec{b} \times (\overrightarrow{a_2} - \overrightarrow{a_1}) = (2\hat{\imath} + 3\hat{\jmath} + 6\hat{k}) \times (2\hat{\imath} + \hat{\jmath} - \hat{k}) = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 2 & 3 & 6 \\ 2 & 1 & -1 \end{vmatrix} = -9\hat{\imath} + 14\hat{\jmath} - 4\hat{k}$. Hence, the distance between the given lines is given by $d = \left\|\frac{\vec{b} \times (\overrightarrow{a_2} - \overrightarrow{a_1})}{\|\vec{b}\|}\right\| = \left\|\frac{-9\hat{\imath} + 14\hat{\jmath} - 4\hat{k}}{\sqrt{4 + 9 + 36}}\right\| = \frac{\sqrt{81 + 196 + 16}}{7}$ $d = \frac{\sqrt{293}}{7}$ units.	1 1 $\frac{3}{2}$ $\frac{1}{2}$
9.	$-3\hat{\imath} + 3\hat{k}$	4
10.	$\left\|\frac{-4+12}{\sqrt{29}}\right\| = \frac{8}{\sqrt{29}}$ units	4

CHAPTER-11

THREE DIMENSIONAL GEOMETRY

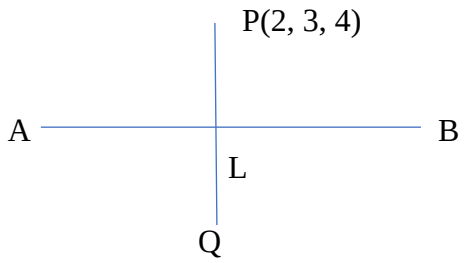
05 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	The Indian Coast Guard (ICG) while patrolling, saw a suspicious boat with four men. They were nowhere looking like fishermen. The soldiers were closely observing the movement of the boat for an opportunity to seize the boat. They observe that the boat is moving along a planar surface. At an instant of time, the coordinates of the position of coast guard helicopter and boat are (2, 3, 5) and (1, 4, 2) respectively.  Based on the above information, answer the following questions. (i) If the line joining the positions of the helicopter and boat is perpendicular to the plane in which boat moves, then equation of plane is (a) $x - y + 3z = 2$ (b) $x + y + 3z = 2$ (c) $x - y + 3z = 3$ (d) $x + y + 3z = 3$ (ii) If the soldier decides to shoot the boat at given instant of time, where the distance measured in metres, then what is the distance that bullet has to travel? (a) $\sqrt{5}$ m (b) $\sqrt{8}$ m (c) $\sqrt{10}$ m (d) $\sqrt{11}$ m (iii) If the speed of bullet is 30 m/sec, then how much time will the bullet take to hit the boat after the shot is fired? (a) 30 seconds (b) 1 second (c) $\frac{1}{2}$ second (d) $\frac{\sqrt{11}}{30}$ seconds (iv) At the given instant of time, the equation of line passing through the positions of helicopter and boat is (a) $\frac{x}{1} = \frac{y}{-1} = \frac{z}{3}$ (b) $\frac{x-1}{1} = \frac{y-4}{-1} = \frac{z-2}{3}$ (c) $\frac{x}{1} = \frac{y}{1} = \frac{z}{-3}$ (d) $\frac{x-1}{1} = \frac{y-4}{1} = \frac{z-2}{-3}$ (v) At a different instant of time, the boat moves to a different position along the planar surface. What should be the coordinates of the location of the boat for the bullet to hit the boat if soldier shoots the bullet along the line whose equation is $\frac{x-1}{1} = \frac{y-1}{-2} = \frac{z-2}{3}$? (a) $\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ (b) $\left(\frac{3}{4}, \frac{3}{2}, \frac{5}{4}\right)$ (c) $\left(\frac{1}{3}, \frac{1}{4}, \frac{1}{5}\right)$ (d) none of these	5

2.	In a diamond exhibition, a diamond is covered in cubical glass box having coordinates $O(0, 0, 0)$, $A(1, 0, 0)$, $B(1, 2, 0)$, $C(0, 2, 0)$, $O'(0, 0, 3)$, $A'(1, 0, 3)$, $B'(1, 2, 3)$ and $C'(0, 2, 3)$.  Based on the above information, answer the following questions. (i) Direction ratios of OA are (a) $< 0, 1, 0 >$ (b) $< 1, 0, 0 >$ (c) $< 0, 0, 1 >$ (d) none of these (ii) Equation of diagonal OB' is (a) $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ (b) $\frac{x}{0} = \frac{y}{1} = \frac{z}{2}$ (c) $\frac{x}{1} = \frac{y}{0} = \frac{z}{2}$ (d) none of these (iii) Equation of plane $OABC$ is (a) $x = 0$ (b) $y = 0$ (c) $z = 0$ (d) none of these (iv) Equation of plane $O'A'B'C'$ is (a) $x = 3$ (b) $y = 3$ (c) $z = 3$ (d) $z = 2$ (v) Equation of plane $ABB'A'$ is (a) $x = 1$ (b) $y = 1$ (c) $z = 2$ (d) $x = 3$	5 MARKS
3.	Find the coordinates of the image of the point (2, 3, 4) with respect to the line $\vec{r} = (2\hat{j} + 4\hat{k}) + \gamma\,(2\hat{\imath} + 4\hat{j} + 1\hat{k})$; where γ is a scalar. Also, find the distance of the image from the origin.	5
4.	An aeroplane is flying along the line $\vec{r} = \alpha\,(2\hat{\imath} + 3\hat{j} + 4\hat{k})$; where α is a scalar and another aeroplane is flying along the line $\vec{r} = (\hat{\imath} + \hat{j}) + \gamma\,(3\hat{j} + 2\hat{k})$; where γ is a scalar. At what points on the line should they reach, so that distance between them is shortest. Find the shortest possible distance between them.	5
5.	 A snake is crawling along the line $\vec{r} = 3\hat{\imath} + 2\hat{j} + 3\hat{k} + \lambda\,(\hat{\imath} - 2\hat{j} + 2\hat{k})$ and another snake is crawling along the line $\vec{r} = -4\hat{\imath} - 2\hat{k} + \mu\,(3\hat{\imath} - 2\hat{j} - 2\hat{k})$. At what points on the lines should they reach so that the distance between them is the shortest ? Find the shortest possible distance between them.	5
6.	 The equation of motion of an airplane are x= 4t, y = -4t , z = - 2t, where the time t is given in minutes and the co-ordinates of a moving point in km. What is the path of the airplane	5

	? At what distances will the rocket be from the starting point O(0,0,0) and from the following line in 10 minutes ? $\vec{r}$ =40$\hat{\imath}$ -10 $\hat{\jmath}$ -20 $\hat{k}$ + λ (10$\hat{\imath}$ -20 $\hat{\jmath}$ +10 $\hat{k}$)	
7.	Find the Vector equation of the line passing through the point P $(1, 2, -4)$ and perpendicular to the two lines : $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$.	5
8.	Find the angle between the lines whose direction cosines are given by the equations : $3l + m + 5n = 0$ and $6mn - 2nl + 5lm = 0$	5
9.	Show that the lines $r \rightarrow = 3\hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda\left(\hat{\imath} + 2\hat{\jmath} + 2\hat{k}\right)$; $r \rightarrow = 5\hat{\imath} - 2\hat{\jmath} + \mu\left(3\hat{\imath} + 2\hat{\jmath} + 6\hat{k}\right)$ are intersecting. Hence, find their points of intersection.	5
10.	If a variable line in two adjacent positions has direction cosines l, m, n and $l + \delta l, m + \delta m, n + \delta n$, show that the small angle $(\delta\theta)^2 = (\delta l)^2 + (\delta m)^2 + (\delta n)^2$.	5

ANSWERS:

Q. NO	ANSWER	MARKS
1.	1. (i) (c) : Let $P(2, 3, 5)$ and $Q(1, 4, 2)$ be the positions of helicopter and boat respectively. Now, direction ratios of PQ are proportional to $1-2, 4-3, 2-5$, *i.e.*, $-1, 1, -3$. So, equation of plane passing through $Q(1, 4, 2)$ and perpendicular to PQ is $-(x-1)+(y-4)+(-3)(z-2)=0 \Rightarrow x-y+3z=3$ (ii) (d) : Required distance = Distance between P and Q $=\sqrt{(1-2)^2+(4-3)^2+(2-5)^2}=\sqrt{1+1+9}=\sqrt{11}$ m (iii) (d) : We know, Distance = Speed × Time $\therefore$ Required time = $\frac{\sqrt{11}}{30}$ seconds (iv) (b) : Equation of line PQ is $\frac{x-1}{1}=\frac{y-4}{-1}=\frac{z-2}{3}$. (v) (b) : Any point on the line $\frac{x-1}{1}=\frac{y-1}{-2}=\frac{z-2}{3}$ is given by $(\lambda+1, -2\lambda+1, 3\lambda+2)$. Now, on substituting this point in the equation of plane $x-y+3z=3$, we get $(\lambda+1)-(-2\lambda+1)+3(3\lambda+2)=3$ $\Rightarrow \lambda+1+2\lambda-1+9\lambda+6=3 \Rightarrow 12\lambda=-3$ $\Rightarrow \lambda=\frac{-1}{4}$ Thus, the required point is $\left(\frac{-1}{4}+1, \frac{1}{2}+1, \frac{-3}{4}+2\right)$ *i.e.*, $\left(\frac{3}{4}, \frac{3}{2}, \frac{5}{4}\right)$.	
2.	2. (i) (b) : D.R's of OA are $<1-0, 0-0, 0-0>$, *i.e.*, $<1, 0, 0>$. (ii) (a) : Equation of diagonal OB' is $\frac{x-0}{1}=\frac{y-0}{2}=\frac{z-0}{3}$ *i.e.*, $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$ (iii) (c) : $OABC$ is xy-plane, therefore its equation is $z=0$. (iv) (c) : Plane $O'A'B'C'$ is parallel to xy-plane passing through $(0, 0, 3)$, therefore its equation is $z=3$. (v) (a) : Plane $ABB'A'$ is parallel to yz-plane passing through $(1, 0, 0)$, therefore its equation is $x=1$.	
3.	Let P(2, 3, 4) be the given point, L be the foot of perpendicular from 'P' to the given line AB  The coordinates of the general point on the given line are given by: $\frac{x-0}{2}=\frac{y-2}{4}=\frac{z-4}{1} = \gamma$, where γ is a scalar Let coordinates of L be $(2\gamma, 4\gamma+2, \gamma+4)$ Direction ratios of PL are $2\gamma-2, 4\gamma-1, \gamma$ Direction ratios of given line are 2, 4, 1 which is perpendicular to PL So, $2(2\gamma-2)+4(4\gamma-1)+\gamma=0$ i.e. $\gamma = 8/21$ so coordinates of L are (16/21, 74/21, 92/21)	5

	let Q(a, b ,c) be the image of P(2, 3, 4), then L is mid-point of PQ. So, $\frac{a+2}{2}=\frac{16}{21}$, $\frac{b+3}{2}=\frac{74}{21}$, $\frac{c+4}{2}=\frac{92}{21}$ i.e. a = $\frac{-10}{21}$, b = $\frac{85}{21}$, c = $\frac{100}{21}$ so, image of P in the given line is $(\frac{-10}{21}, \frac{85}{21}, \frac{100}{21})$ Distance of point $(\frac{-10}{21}, \frac{85}{21}, \frac{100}{21})$ from origin is 6.27 approximately using distance formula.	
4.	The equations of two given straight lines in Cartesian form are: $\frac{x}{2}=\frac{y}{3}=\frac{z}{4}$ …….. (i) and $\frac{x-1}{0}=\frac{y-1}{3}=\frac{z}{2}$ ……(ii) Lines are not parallel as direction ratios are not proportional. Let P and Q be the points on the straight lines (i) and (ii) respectively such that PQ is perpendicular to both of the lines, Let the coordinates of P be $(2\gamma, 3\gamma, 4\gamma)$ and Q be $(1, 3\beta+1, 2\beta)$ where β and γ are scalars Then the direction ratios of the line PQ will be $(2\gamma-1, 3\gamma-3\beta-1, 4\gamma-2\beta)$ Since, PQ is perpendicular to both (i) and (ii), so $2(2\gamma-1)+3(3\gamma-3\beta-1)+4(4\gamma-2\beta)=0$ …….(iii) $3(3\gamma-3\beta-1)+2(4\gamma-2\beta)=0$ ……..(iv) Solving (iii) and (iv) we get, $\gamma=\frac{7}{44}$, $\beta=\frac{-1}{44}$ Hence, coordinates of P are $(\frac{14}{44}, \frac{21}{44}, \frac{28}{44})$ and Q are $(1, \frac{129}{44}, \frac{-2}{44})$ The required shortest distance can be found by distance formula.	5
5.	The given lines are non-parallel lines. There is a unique line segment PQ which is at right angles to both the lines. Hence, shortest distance between the snakes = PQ The position vector of P lying on the line $\vec{r}$ =3$\hat{\imath}$ +2 $\hat{\jmath}$ +3 $\hat{k}$ + λ ($\hat{\imath}$ -2 $\hat{\jmath}$ +2 $\hat{k}$) is (3+ λ) $\hat{\imath}$ +(2-2 λ) $\hat{\jmath}$ +(3 + 2 λ) $\hat{k}$ for some λ The position vector of Q lying on the line $\vec{r}$ =-4$\hat{\imath}$ -2 $\hat{k}$ + μ (3$\hat{\imath}$ -2 $\hat{\jmath}$ -2 $\hat{k}$) is (-4+ 3μ) $\hat{\imath}$ - 2 $\mu\hat{\jmath}$ +(-2 - 2 μ) $\hat{k}$ for some μ $\overrightarrow{PQ}$ = (-7+ 3μ − λ) $\hat{\imath}$ – (-2-2 μ + 2 λ)$\hat{\jmath}$ +(-2 - 2 μ − 3 − 2 λ) $\hat{k}$ Since, Pq is perpendicular to both the lines . So, (-7+ 3μ − λ)- (-2-2 μ + 2 λ)(-2) +(-2 - 2 μ − 3 − 2 λ)2 = 0 -7+ 3μ − λ -4 -4 μ +4λ -10 -4 μ -4 λ = 0 - λ - 5 μ =21 (i) (-7+ 3μ − λ)3- (-2-2 μ + 2 λ)(-2) +(-2 - 2 μ − 3 − 2 λ)(-2)= 0 -21+ 9μ − 3λ -4 -4 μ +4λ +10 +4 μ +4λ = 0 5λ +9 μ =15 (ii) Solving equn. (i) and (ii) λ =33/2 and μ = -15/2 The position vector of the points at which they should be so that the distance between them is the shortest are (39$\hat{\imath}$ -62 $\hat{\jmath}$ +70 $\hat{k}$)/2 and (-53$\hat{\imath}$ +30 $\hat{\jmath}$ +26 $\hat{k}$)/2 $\overrightarrow{PQ}$=(-92$\hat{\imath}$ +92 $\hat{\jmath}$ +44 $\hat{k}$)/2 =(-46$\hat{\imath}$ +46 $\hat{\jmath}$ +22 $\hat{k}$) The shortest distance = I $\overrightarrow{PQ}$ I = $\sqrt{2116+2116+484}$ = $\sqrt{4716}$ = $2\sqrt{1179}$ Unit	5
6.	x= 4t, y = -4t , z = -2t, Or, x/4 = t, -y/4 = t , z/-2 = t	5

	So, x/4 = y/-4 = z/-2 Direction Ratios are 4,-4,-2 When t = 10 seconds, the airplane will be at the points (40,-40,-20) Distance from the origin in 10 minutes = $\sqrt{1600+1600+400}$ = $\sqrt{3600}$ = 60 km Distance of the point (40,-40,-20) from the given line = I $(a_2 - a_1)$X$\vec{b}$I/I $\vec{b}$I = I -30$\hat{j}$ X ((10$\hat{\imath}$ -20 $\hat{j}$ +10 $\hat{k}$)I/I(10$\hat{\imath}$ -20 $\hat{j}$ +10 $\hat{k}$)I = I -300 $\hat{\imath}$ + 300 $\hat{k}$ I/ I(10$\hat{\imath}$ -20 $\hat{j}$ +10 $\hat{k}$)I =300 $\sqrt{2}$ /10 $\sqrt{6}$ = 10 $\sqrt{3}$ km	
7.	Let, the direction ratios of the line be (a, b, c) then the equation of the line will be $\vec{r} = \hat{\imath} + 2\hat{j} - 4\hat{k} + (a\hat{\imath} + b\hat{j} + c\hat{k})$ ……(i) Equations of the given lines are : $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$. Line given in equation (i) is perpendicular to these lines so that $3a - 16b + 7c = 0$ & $3a + 8b - 5c = 0$. Solving above by cross – multiplication method we get , $\frac{a}{80-56} = \frac{b}{21+15} = \frac{c}{24+48}$ $\frac{a}{24} = \frac{b}{36} = \frac{c}{72} = k(let)$ Hence, $a = 2k, b = 3k, c = 6k$ So that required vector equation of line is: $\vec{r} = \hat{\imath} + 2\hat{j} - 4\hat{k} + (2\hat{\imath} + 3\hat{j} + 6\hat{k})$.	1 1 1 1 1
8.	The relation between direction – cosines are given by $3l + m + 5n = 0$ ……..(1) $6mn - 2nl + 5lm = 0$ ……(2) From, (1) we get, $m = -3l - 5n$ ……..(3) Putting this value in (2) we get, $6(-3l-5n)n - 2nl + 5l(-3l-5n) = 0$ $\Rightarrow l^2 + 3ln + 2n^2 = 0 \Rightarrow (l+n).(l+2n) = 0$ $\Rightarrow l = -n \; or \; l = -2n$ Now, if $l = -n, then \; m = -2n$ using (3) and if $l = -2n, then \; m = n.$ using (3) Thus the direction ratios of two lines are proportional to $-\boldsymbol{n}, -\boldsymbol{2n}, \boldsymbol{n}$ and $-\boldsymbol{2n}, \boldsymbol{n}, \boldsymbol{n}$ i.e. $\boldsymbol{1}, \boldsymbol{2}, -\boldsymbol{1}$ and $-\boldsymbol{2}, \boldsymbol{1}, \boldsymbol{1}$ Hence, angle between these lines are given by $\cos\theta = \frac{1\times(-2)+2\times1+(-1)\times1}{\sqrt{1+4+1}\times\sqrt{4+1+1}} = \frac{-1}{6}$ $\Rightarrow \theta = \cos^{-1}(\frac{-1}{6})$.	1 2 1 1
9.	$\left\lvert\frac{-3+6}{3\sqrt{2}}\right\rvert = \left\lvert\frac{3\sqrt{2}}{2}\right\rvert$	5
10.	$(\delta\theta)^2 = (\delta l)^2 + (\delta m)^2 + (\delta n)^2$	5

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