# MATHS

## BOOKS - CENGAGE

## THREE DIMENSIONAL GEOMETRY

### Solved Examples And Exercises

**1.** Find the angle between the line whose direction cosines are given by $l + m + n = 0 and 2l^2 + 2m^2 - n^2 - 0.$

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**2.** A line makes angles $\alpha, \beta, \gamma and \delta$ with the diagonals of a cube. Show that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta = 4/3.$

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**3.** $ABC$ is a triangle and A=(2,3,5),B=(-1,3,2) and C= $(\lambda, 5, \mu)$. If the median through $A$ is equally inclined to the axes, then find the value of $\lambda$ and $\mu$

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**4.** A line $OP$ through origin $O$ is inclined at $30^0 and 45^0 \rightarrow OX and OY$, respectivley. Then find the angle at which it is inclined to $OZ$.

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**5.** If $\alpha, \beta, and \gamma$ are the an gles which a directed line makes with the positive directions of the co-ordinates axes, then find the value of $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$.

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**6.** If the sum of the squares of the distance of a point from the three coordinate axes is 36, then find its distance from the origin.

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**7.** If $A(3, 2, -4), B(5, 4, -6) and C(9, 8, -10)$ are three collinear points, then find the ratio in which point $C$ divides $AB$.

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**8.** Find the ratio in which the YZ-plane divides the line segment formed by joining the points $(-2, 4, 7)$ and $(3, -5, 8)$.

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**9.** Find the angle between the lines whose direction cosines are connected by the relations $l + m + n = 0 and 2lm + 2nl - mn = 0.$

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**10.** Find the point where line which passes through point $(1, 2, 3)$ and is parallel to line $\vec{r} = \hat{i} + \hat{j} + 2\hat{k} + \lambda\left(\hat{i} - 2\hat{j} + 3\hat{k}\right)$ meets the xy-plane.

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**11.** Find the equation of the line passing through the points $(1, 2, 3) and ( - 1, 0, 4)$.

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**12.** Find the equation of the line passing through the point $( - 1, 2, 3)$ and perpendicular to the lines $\frac{x}{2} = \frac{y-1}{-3} = \frac{z+2}{-2} and \frac{x+3}{-1} = \frac{y+3}{2} = \frac{z-1}{3}$.

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**13.** The line joining the points $(-2, 1, -8) and (a, b, c)$ is parallel to the line whose direction ratios are $6, 2, and 3.$ Find the values of $a, b$ and $c$

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**14.** A parallelepiped is formed by planes drawn through the points $P(6, 8, 10) and (3, 4, 8)$ parallel to the coordinate planes. Find the length of edges and diagonal of the parallelepiped.

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**15.** Find the angle between any two diagonals of a cube.

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**16.** Direction ratios of two lines are $a, b, c and 1/bc, 1/ca, 1/ab\cdot$ Then the lines are _____.

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**17.** Find the point of intersection of the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $\frac{x-4}{5}=\frac{y-1}{2}=z$.

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**18.** The straight line $\frac{x-3}{3}=\frac{y-2}{1}=\frac{z-1}{0}$ is (a)Parallel to x-axis (b)Parallel to the y-axis (c)Parallel to the z-axis (d)Perpendicular to the z-axis

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**19.** Find the equation of the plane containing the lines $\frac{x-5}{4}=\frac{y-7}{4}=\frac{z+3}{-5} and \frac{x-8}{7}=\frac{y-4}{1}=\frac{z-5}{3}$.

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**20.** Find the equation of the plane passing through the points $(1, 0, -1) and (3, 2, 2)$ and parallel to the line $x - 1 = \frac{1-y}{2} = \frac{z-2}{3}$.

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**21.** Find the equation of the sphere described on the joint of points $A and B$ having position vectors $2\hat{i} + 6\hat{j} - 7\hat{k} and - 2\hat{i} + 4\hat{j} - 3\hat{k}$, respectively, as the diameter. Find the center and the radius of the sphere.

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**22.** Find the radius of the circular section in which the sphere $\left|\vec{r}\right| = 5$ is cut by the plane $\vec{r}\,\hat{i} + \dot{\hat{j}} + \hat{k} = 3\sqrt{3.}$

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23. Find the equation of a sphere which passes through $(1, 0, 0)(0, 1, 0) and (0, 0, 1)$, and has radius as small as possible.

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24. Find the locus of appoint which moves such that the sum of the squares of its distance from the points $A(1, 2, 3), B(2, -3, 5) and C(0, 7, 4) is 120.$

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25. Find the equation of the sphere which has centre at the origin and touches the line $2(x+1) = 2 - y = z + 3.$

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26. Find the equation of the sphere which passes through $(10, 0), (0, 1, 0) and (0, 0, 1)$ and whose centre lies on the plane

$3x - y + z = 2.$

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**27.** Find the equation of a sphere whose centre is $(3, 1, 2)$ radius is $5$.

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**28.** Find the equation of the sphere passing through $(0, 0, 0), (1, 0, 0), (0, 1, 0) and (0, 0, 1)$.

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**29.** Find the image of the line $\frac{x-1}{9} = \frac{y-2}{-1} = \frac{z+3}{-3}$ in the plane $3x - 3y + 10z - 26 = 0.$

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**30.** Find the equations of the bisectors of the angles between the planes $2x - y + 2z + 3 = 0 and 3x - 2y + 6z + 8 = 0$ and specify the plane which bisects the acute angle and the plane which bisects the obtuse angle.

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**31.** If the x-coordinate of a point $P$ on the join of $Q(22, 1) and R(5, 1, -2) is 4,$ then find its $z-$ coordinate.

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**32.** A sphere of constant radius $k,$ passes through the origin and meets the axes at $A, B and C.$ Prove that the centroid of triangle $ABC$ lies on the sphere $9(x^2 + y^2 + z^2) = 4k^2.$

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**33.** A variable plane passes through a fixed point $(a, b, c)$ and cuts the coordinate axes at points $A, B, and C$. Show that eh locus of the centre of the sphere $OABCis \frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 2.$

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**34.** Show that the plane $2x - 2y + z + 12 = 0$ touches the sphere $x^2 + y^2 + z^2 - 2x - 4y + 2z - 3 = 0.$

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**35.** If $O$ is the origin, $OP = 3$ with direction ratios $-1, 2, and - 2,$ then find the coordinates of $P$.

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**36.** If $P(x, y, z)$ is a point on the line segment joining $Q(2, 2, 4) and R(3, 5, 6)$ such that the projections of $\overrightarrow{O}P$ on the axes are

13/5, 19/5 and 26/5, respectively, then find the ratio in which $P$ divides $QR$.

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**37.** If $\vec{r}$ is a vector of magnitude 21 and has direction ratios $2, -3 and 6,$ then find $\vec{r}$.

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**38.** The distance of the point $P(a, b, c)$ from the z axis is

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**39.** A line makes angles $\alpha, \beta and \gamma$ with the coordinate axes. If $\alpha + \beta = 90^0,$ then find $\gamma$.

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**40.** If a line makes angles $\alpha, \beta and \gamma$ with threew-dimensional coordinate axes, respectively, then find the value of $\cos 2\alpha + \cos 2\beta + \cos 2\gamma$.

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**41.** Find the distance between the parallel planes x +2y-2z +1= 0 and 2x + 4y - 4z+5=0.

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**42.** A ray of light passing through the point $A(1, 2, 3)$ , strikews the plane $xy + z = 12 at B$ and on reflection passes through point $C(3, 5, 9)$. Find the coordinate so point $B$.

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**43.** The plane $ax + by = 0$ is rotated through an angle $\alpha$ about its line of intersection with the plane $z = 0$. Show that he equation to the plane in the new position is $aby \pm z\sqrt{a^2 + b^2} and \alpha = 0.$

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**44.** Find the equation of the plane containing the line of intersection of the planes x + y + z - 6 = 0 and 2x + 3y + 4z + 5 = 0 and passing through the point $(1, 1, 1)$

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**45.** Find the locus of a point, the sum of squares of whose distance from the planes $x - z = 0, x - 2y + z = 0$ and $x + y + z = 0$ is 36

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**46.** Find the length and the foot of the perpendicular from the point $(7, 14, 5)$ to the plane $2x + 4y - z = 2$. Also, the find image of the point $P$ in the plane.

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**47.** Find the angle between the line $\vec{r} = \hat{i} + 2\hat{j} - \hat{k} + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right)$ and the plane $\vec{r}\,2\hat{i} - \dot{\hat{j}} + \hat{k} = 4$.

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**48.** Find the equation of the projection of the line $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-3}{4}$ on the plane $x + 2y + z = 9$.

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**49.** Find the equation the plane which contain the line of intersection of the planes $\overrightarrow{r}\dot{\hat{i}} + 2\hat{j} + 3\hat{k} - 4 = 0 and \overrightarrow{r} 2\hat{i} + \dot{\hat{j}} - \hat{k} + 5 = 0$ and which is perpendicular to the plane $\overrightarrow{r}\left(5\hat{i} + 3\hat{j} - 6\hat{k}\right) + 8 = 0$.

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**50.** Find the vector equation of the line passing through (1, 2, 3 ) and parallel to the planes $\rightarrow r\hat{i} - \dot{\hat{j}} + 2\hat{k} = 5\ and\ \rightarrow r3\hat{i} + \dot{\hat{j}} + \hat{k} = 6.$

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**51.** Find the distance of the point $P(3, 8, 2)$ from the line $\frac{1}{2}(x-1) = \frac{1}{4}(y-3) = \frac{1}{3}(z-2)$ measured parallel to the plane $3x + 2y - 2z + 15 = 0.$

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**52.** Find the distance of the point $(1, 0, -3)$ from the plane $x - y - z = 9$ measured parallel to the line $\frac{x-2}{2} = \frac{y+2}{2} = \frac{z-6}{-6}$.

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**53.** Show that $ax + by + r = 0, by + cz + p = 0 and cz + ax + q = 0$ are perpendicular to $x - y, y - z and z - x$ planes, respectively.

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**54.** Reduce the equation of line $x - y + 2z = 5 adn 3x + y + z = 6$ in symmetrical form. Or Find the line of intersection of planes $x - y + 2z = 5 and 3x + y + z = 6.$

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**55.** Find the angle between the lines $x-3y-4=0, 4y-z+5=0andx+3y-11=0, 2y=z+6=0.$

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**56.** If the line $x=y=z$ intersect the line $s \in A\dot{x}+s \in B\dot{y}+s \in C\dot{z}=2d^2, s \in 2A\dot{x}+s \in 2B\dot{y}+s \in 2C\dot{z}=d^2,$ then find the value of $\frac{\sin A}{2}\frac{\sin B}{2}\frac{\sin C}{2}whereA, B, C$ are the angles of a triangle.

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**57.** The point of intersecting of the line passing through $(0, 0, 1)$ and intersecting the lines $x+2y+z=1, -x+y-2z=2$ and $x+y=2, x+z=2$ with xy-plane is

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**58.** A horizontal plane $4x - 3y + 7z = 0$ is given. Find a line of greatest slope passes through the point $(2, 1, 1)$ in the plane $2x + y - 5z = 0$.

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**59.** Find the equation of the plane passing through the points $(-1, 1, 1)$ and $(1, -1, 1)$ and perpendicular to the plane $x + 2y + 2z = 5$.

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**60.** Find ten equation of the plane passing through the point $(0, 7, -7)$ and containing the line $\dfrac{x+1}{-3} = \dfrac{y-3}{2} = \dfrac{z+2}{1}$.

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**61.** If a plane meets the equations axes at $A, BandC$ such that the centroid of the triangle is $(1, 2, 4)$, then find the equation of the plane.

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**62.** Find the equation of the plane which is parallel to the lines $\overrightarrow{r}=\hat{i}+\hat{j}+\lambda\left(2\hat{i}+\hat{j}+4\hat{k}\right) and \frac{x+1}{-3}=\frac{y-3}{2}=\frac{z+2}{1}$ and is passing through the point $(0, 1, -1)$.

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**63.** Prove that the plane $\overrightarrow{r}=\left(\hat{i}+2\hat{j}-\hat{k}\right)=3$ contains the line $\overrightarrow{r}=\hat{i}+\hat{j}+\lambda\left(2\hat{i}+\hat{j}+4\hat{k}\right)$.

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**64.** Find the vector equation of the following planes in Cartesian form: $\overrightarrow{r}=\hat{i}-\hat{j}+\lambda\left(\hat{i}+\hat{j}+\hat{k}\right)+\mu\left(\hat{i}-2\hat{j}+3\hat{k}\right)$.

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65. Show that the line of intersection of the planes $\vec{r}\,\hat{i} + 2\hat{j} + 3\hat{k} = 0 and \vec{r} = \left(3\hat{i} + 2\hat{j} + \hat{k}\right) = 0$ is equally inclined to $iandk$. Also find the angle it makes with $j$.

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66. Find the equation of the plane passing through $A(2, 2, -1), B(3, 4, 2) and C(7, 0, 6)$. Also find a unit vector perpendicular to this plane.

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67. Find the equation of the plane such that image of point $(1, 2, 3)$ in it is$(-1, 0, 1)$.

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68. The foot of the perpendicular drawn from the origin to a plane is $(1, 2, -3)$. Find the equation of the plane. or If $O$ is the origin and the

coordinates of $P$ is $(1, 2, -3)$, then find the equation of the plane passing through $P$ and perpendicular to $OP$.

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**69.** Find the angel between the planes $2x + y - 2x + 3 = 0 and \vec{r} 6\hat{i} + 3\dot{\hat{j}} + 2\hat{k} = 5.$

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**70.** Find the equation of the plane passing through $(3, 4, -1)$, which is parallel to the plane $\vec{r} 2\hat{i} - 3\dot{\hat{j}} + 5\hat{k} + 7 = 0.$

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**71.** Find the distance of the point $(-1, -5, -10)$ from the point of intersection of the line $\dfrac{x-2}{3} = \dfrac{y+1}{4} = \dfrac{z-2}{12}$ and plane $x - y + z = 5.$

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**72.** Find the equation of the plane passing through the point (-1,3,2) and perpendicular to each of the planes x+2y+3z=5 and 3x+3y+z=0.

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**73.** Find the angle between the line $\frac{x-1}{3}=\frac{y-1}{2}=\frac{z-1}{4}$ and the plane $2x+y-3z+4=0$.

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**74.** Find the distance between the line $\frac{x+1}{-3}=\frac{y-3}{2}=\frac{z-2}{1}$ and the plane $x+y+z+3=0$.

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**75.** The extremities of a diameter of a sphere lie on the positive y- and positive z-axes at distance 2 and 4, respectively. Show that the sphere passes through the origin and find the radius of the sphere.

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**76.** A plane passes through a fixed point $(a, b, c)$. Show that the locus of the foot of the perpendicular to it from the origin is the sphere $x^2 + y^2 + z^2 - ax - by - cz = 0.$

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**77.** Find the radius of the circular section of the sphere $\left|\vec{r}\right| = 5$ by the plane $\vec{r}\left(\hat{i} + 2\hat{j} - \hat{k}\right) = 4\sqrt{3}.$

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**78.** A point $P(x, y, z)$ is such that $3PA = 2PB$, where $AandB$ are the point $(1, 3, 4)and(1, -2, -1)$, irrespectivley. Find the equation to the locus of the point $P$ and verify that the locus is a sphere.

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**79.** Find the angle between the planes $\vec{r} \cdot \left(\hat{i} + \hat{j} - 2\hat{k}\right) = 3 \text{ and } 2x - 2y + z = 2$

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**80.** Find the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-5}{5}$.

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**81.** Determine whether the following pair of lines intersect or not. (1) $\vec{r} = \hat{i} - 5\hat{j} + \lambda\left(2\hat{i} + \hat{k}\right); \vec{r} = 2\hat{i} - \hat{j} + \mu\left(\hat{i} + \hat{j} - \hat{k}\right)$ (2) $\vec{r} = \hat{i} + \hat{j} - \hat{k} + \lambda\left(3\hat{i} - \hat{j}\right); \vec{r} = 4\hat{i} - \hat{k} + \mu\left(2\hat{i} + 3\hat{k}\right)$

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**82.** Find the equation of plane which is at a distance $\frac{4}{\sqrt{14}}$ from the origin and is normal to vector $2\hat{i} + \hat{j} - 3\hat{k}\cdot$

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**83.** Find the unit vector perpendicular to the plane $\vec{r}\dot{2\hat{i} + \hat{j}} + 2\hat{k} = 5.$

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**84.** If the straight lines $x = -1 + s, y = 3 - \lambda s, z = 1 + \lambda s and x = \frac{t}{2}, y = 1 + t, z = 2 - t,$

with paramerters $sandt$, respectivley, are coplanar, then find $\lambda$.

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**85.** Find the shortest distance between the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $\frac{x-2}{3}=\frac{y-3}{4}=\frac{z-5}{5}$.

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**86.** Find the vector equation of a line passing through $3\hat{i}-5\hat{j}+7\hat{k}$ and perpendicular to theplane $3x-4y+5z=8$.

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**87.** Find the equation of the plane passing through the point $(2, 3, 1)$ having $(5, 3, 2)$ as the direction ratio is of the normal to the plane.

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**88.** Find the equation of the plane through the points $(2, 3, 1) and (4, -5, 3)$ and parallel to the x-axis.

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**89.** Find the equation of the image of the plane $x - 2y + 2z - 3 = 0$ in plane $x + y + z - 1 = 0$.

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**90.** Find the equation of a plane which passes through the point $(1, 2, 3)$ and which is equally inclined to the planes $x - 2y + 2z - 3 = 0 and 8x - 4y + z - 7 = 0$.

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**91.** Find the equation of a plane which is parallel to the plane $x - 2y + 2z = 5$ and whose distance from thepoint $(1, 2, 3)$ is 1.

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**92.** Find $\vec{a} \cdot \vec{b}$, When $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = 3\hat{i} + 2\hat{j} - \hat{k}$

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**93.** Find the equation of the plane which passes through the point $(1, 2, 3)$ and which is at the minimum distance from the point $(-1, 0, 2)$.

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**94.** Find the angle between the line $\vec{r} = \left(\vec{i} + 2\vec{j} - \vec{k}\right) + \lambda\left(\vec{i} - \vec{j} + \vec{k}\right)$ and the normal to the plane $\overrightarrow{r}\left(2\overrightarrow{i}-\overrightarrow{j}+\overrightarrow{k}\right)=4.$

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**95.** Find the equation of the plane passing through the line $\frac{x-1}{5}=\frac{y+2}{6}=\frac{z-3}{4}$ and point $(4, 3, 7)\cdot$

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**96.** Find the equation of the plane perpendicular to the line $\frac{x-1}{2}=\frac{y-3}{-1}=\frac{z-4}{2}$ and passing through the origin.

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**97.** Find the equation of the plane passing through the straight line $\frac{x-1}{2}=\frac{y+2}{-3}=\frac{z}{5}$ and perpendicular to the plane $x-y+z+2=0.$

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98. Find the equation of the line drawn through point (1, 0, 2) to meet the line $\frac{x+1}{3} = \frac{y-2}{-2} = \frac{z1}{-1}$ at right angles.

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99. If $\vec{r} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right)$ and $\vec{r} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) + \mu\left(\hat{i} + \hat{j} - \hat{k}\right)$ are two lines, then the equation of acute angle bisector of two lines is

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100. Find the coordinates of a point on the $\frac{x-1}{2} = \frac{y+1}{-3} = z$ atg a distance $4\sqrt{14}$ from the point $(1, -1, 0)$.

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**101.** Line $L_1$ is parallel to vector $\overrightarrow{\alpha} = -3\hat{i} + 2\hat{j} + 4\hat{k}$ and passes through a point $A(7, 6, 2)$ and line $L_2$ is parallel vector $\overrightarrow{\beta} = 2\hat{i} + \hat{j} + 3\hat{k}$ and point $B(5, 3, 4)$. Now a line $L_3$ parallel to a vector $\overrightarrow{r} = 2\hat{i} - 2\hat{j} - \hat{k}$ intersects the lines $L_1 and L_2$ at points $C and D$, respectively, then find $\left|\overrightarrow{C}D\right|$.

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**102.** Find the values of p so that the lines $\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{z-3}{2}$ and $\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ are at right angles.

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**103.** Find the angel between the following pair of lines: $\overrightarrow{r} = 2\hat{i} - 5\hat{j} + \hat{k} + \lambda\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right) and \overrightarrow{r} = 7\hat{i} - 6\hat{k} + \mu\left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$ $\frac{x}{2} = \frac{y}{2} = \frac{z}{1} and \frac{x-5}{4} = \frac{y-2}{1} = \frac{z-3}{8}$

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104. Find the condition if lines $x = ay + b, z = cy + dandx = a'y + b', z = c'y + d'$ are perpendicular.

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105. Find the acute angle between the lines $\frac{x-1}{l} = \frac{y+1}{m} = \frac{1}{n} and = \frac{x+1}{m} = \frac{y-3}{n} = \frac{z-1}{l} where l > m > n,$ are the roots of the cubic equation $x^3 + x^2 - 4x = 4.$

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106. Find the length of the perpendicular drawn from point $(2, 3, 4)$ to line $\frac{4-x}{2} = \frac{y}{6} = \frac{1-z}{3}.$

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**107.** Find the foot of the perpendicular drawn from the point (1,0, 3) to the join of points (4,7,1) and (3,5,3).

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**108.** Find the vector equation of the line passing through $(1, 2, 3)$ and parallel to the planes $\vec{r}\,\hat{i} - \dot{\hat{j}} + 2\hat{k} and \vec{r}\,3\hat{i} + \dot{\hat{j}} + \hat{k} = 6.$

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**109.** Find the value of $m$ for which thestraight line $3x - 2y + z + 3 = 0 = 4x + 3y + 4z + 1$ is parallel to the plane $2x - y + mz - 2 = 0.$

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**110.** Show that the lines $\frac{x-a+d}{\alpha+\delta}=\frac{y-a}{\alpha}=\frac{z-a-d}{\alpha+\delta}$ and $\frac{x-b+c}{\beta+\gamma}=\frac{y-b}{\beta}=\frac{z-b-c}{\beta+\gamma}$ are coplanar.

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**111.** Find the equation of line $x+y-z-3=0=2x+3y+z+4$ in symmetric form. Find the direction ratios of the line.

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**112.** Find the vector equation of the line passing through the point (1, 2, -4) and perpendicular to the two lines: $\frac{x-8}{3}=\frac{y+19}{-16}=\frac{z-10}{7}$ and $\frac{x-15}{3}=\frac{y-29}{8}=\frac{z-5}{-5}$

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**113.** Find the vector equation of line passing through $A(3, 4-7) and B(1, -1, 6)$. Also find its Cartesian equations.

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**114.** Find the cartesian equation of the line which passes through the point (-2,4,-5) and parallel to the line given by

$$\frac{x+3}{3}=\frac{y-4}{5}=\frac{z+8}{6}.$$

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**115.** Find the equation of a line which passes through the point $(2, 3, 4)$ and which has equal intercepts on the axes.

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116. Find the points where line $\frac{x-1}{2}=\frac{y+2}{-1}=\frac{z}{1}$ intersects $xy, yzandzx$ planes.

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117. A mirror and source of light are situated at the origin O and a point on OX respectively. A ray of light from the source strikes the mirror and is reflected. If the DRs of the normal to the plane of mirror are $1, -1, 1,$ then DCs for the reflacted ray are :

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118. The Cartesian equation of a line is $\frac{x-3}{2}=\frac{y+1}{-2}=\frac{z-3}{5}$ . Find the vector equation of the line.

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**119.** The Cartesian equations of a line are $6x - 2 = 3y + 1 = 2z - 2$. Find its direction ratios and also find a vector equation of the line.

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**120.** A line passes through the point with position vector $2\hat{i} - 3\hat{j} + 4\hat{k}$ and is in the direction of $3\hat{i} + 4\hat{j} - 5\hat{k}$. Find the equations of the line in vector and Cartesian forms.

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**121.** Find the plane of the intersection of $x^2 + y^2 + z^2 + 2x + 2y + 2 = 0 and 4x^2 + 4y^2 + 4z^2 + 4x + 4y + 4z - 1 =$

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**122.** 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 .

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**123.** Find the acute angle between the following lines.

$2x=3y=-z \text{ and } 6x=-y=-4z$

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**124.** Find the length of the perpendicular drawn from the point $(5, 4, -1)$ to the line $\overrightarrow{r}=\hat{i}+\lambda\left(2\hat{i}+9\hat{j}+5\hat{k}\right)$, wher $\lambda$ is a parameter.

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**125.** The equations of motion of a rocket are $x = 2t, y = -4t and z = 4t$, where time $t$ is given in seconds, and the coordinates of a moving points in kilometers. What is the path of the rocket? At what distance will be the rocket from the starting point $O(0, 0, 0)$ in $10s$?

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**126.** Find the shortest distance between the lines $\vec{r} = (1-\lambda)\hat{i} + (\lambda - 2)\hat{j} + (3 - 2\lambda)\hat{k} and \vec{r} = (\mu + 1)\hat{i} + (2\mu + 1)\hat{k}$.

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**127.** Find the image of the point $(1, 2, 3)$ in the line $\dfrac{x-6}{3} = \dfrac{y-7}{2} = \dfrac{z-7}{-2}$.

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**128.** If the two lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-m}{2} = z$ intersect at a point, find the value of m.

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**129.** Find the shortest distance between the z-axis and the line, $x + y + 2z - 3 = 0, 2x + 3y + 4z - 4 = 0.$

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**130.** The lines which intersect the skew lines $y = mx, z = c; y = -mx, z = -c$ and the x-axis lie on the surface:

(a.) $cz = mxy$ (b.) $xy = cmz$ (c.) $cy = mxz$ (d.) none of these

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**131.** Distance of the point $P\left(\overrightarrow{c}\right)$ from the line $\overrightarrow{r}=\overrightarrow{a}+\lambda\overrightarrow{b}$ is a. $\left|\left(\overrightarrow{a}-\overrightarrow{p}\right)+\dfrac{\left(\left(\overrightarrow{p}-\overrightarrow{a}\right)\dot{\overrightarrow{b}}\right)\overrightarrow{b}}{\left|\overrightarrow{b}\right|^{2}}\right|$ b. $\left|\left(\overrightarrow{b}-\overrightarrow{p}\right)+\dfrac{\left(\left(\overrightarrow{p}-\overrightarrow{a}\right)\dot{\overrightarrow{b}}\right)\overrightarrow{b}}{\left|\overrightarrow{b}\right|^{2}}\right|$ c. $\left|\left(\overrightarrow{a}-\overrightarrow{p}\right)+\dfrac{\left(\left(\overrightarrow{p}-\overrightarrow{b}\right)\dot{\overrightarrow{b}}\right)\overrightarrow{b}}{\left|\overrightarrow{b}\right|^{2}}\right|$ d. none of these

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**132.** The direction ratios of a normal to the plane through $(1, 0, 0)and(0, 1, 0)$ , which makes and angle of $\frac{\pi}{4}$ with the plane $x+y=3,$ are a. $\langle 1, \sqrt{2}, 1\rangle$ b. $\langle 1, 1, \sqrt{2}\rangle$ c. $\langle 1, 1, 2\rangle$ d. $\langle \sqrt{2}, 1, 1\rangle$

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133. The centre of the circle given by $\vec{r}\hat{i} + 2\hat{j} + 2\hat{k} = 15 and \left|\vec{r} - \left(\hat{j} + 2\hat{k}\right)\right| = 4$ is a. $(0, 1, 2)$ b. $(1, 3, 5)$ c. $(-1, 3, 4)$ d. none of these

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134. Two systems of rectangular axes have the same origin. If a plane cuts them at distance $a, b, c$ and $a', b', c'$ from the origin, then a. $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} + \frac{1}{a'^2} + \frac{1}{b'^2} + \frac{1}{c'^2} = 0$ b. $\frac{1}{a^2} - \frac{1}{b^2} - \frac{1}{c^2} + \frac{1}{a'^2} - \frac{1}{b'^2} - \frac{1}{c'^2} = 0$ c. $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} - \frac{1}{a'^2} - \frac{1}{b'^2} - \frac{1}{c'^2} = 0$ d. $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} + \frac{1}{a'^2} + \frac{1}{b'^2} + \frac{1}{c'^2} = 0$

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135. The plane which passes through the point $(3, 2, 0)$ and the line $\frac{x-3}{1} = \frac{y-6}{5} = \frac{z-4}{4}$ is a. $x - y + z = 1$ b. $x + y + z = 5$ c. $x + 2y - z = 1$ d. $2x - y + z = 5$

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**136.** If the lines $\frac{x-2}{1}=\frac{y-3}{1}=\frac{z-4}{-k}$ and $\frac{x-1}{k}=\frac{y-4}{2}=\frac{z-5}{1}$ are coplanar, then find the value of k.

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**137.** The point of intersection of the lines $\frac{x-5}{3}=\frac{y-7}{-1}=\frac{z+2}{1}$ and $\frac{x+3}{-36}=\frac{y-3}{2}=\frac{z-6}{4}$ is (A) $\left(21, \frac{5}{3}, \frac{10}{3}\right)$ (B) $(2, 10, 4)$ (C) $(-3, 3, 6)$ (D) $(5, 7, -2)$

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**138.** A tetrahedron has vertices $P(1, 2, 1), Q(2, 1, 3), R(-1, 1, 2)$ and $O(0, 0, 0)$. The angle beween the faces OPQ and PQR is :

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**139.** The radius of the circle in which the sphere $x^2 + y^2 + z^2 + 2z - 2y - 4z - 19 = 0$ is cut by the plane $x + 2y + 2z + 7 = 0$ is a. $2$ b. $3$ c. $4$ d. $1$

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**140.** The point of intersection of the line x-5/3=y-1/-1=z+2/1 and x+3/-36=y-3/2=z-6/4 is a)(21,5/3,10/3) b)(2,10,4) c)(-3,3,6) d)(5,7,-2)

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**141.** A plane passes through a fixed point $(a, b, c)\cdot$ The locus of the foot of the perpendicular to it from the origin is a sphere of radius a. $\frac{1}{2}\sqrt{a^2 + b^2 + c^2}$ b. $\sqrt{a^2 + b^2 + c^2}$ c. $a^2 + b^2 + c^2$ d. $\frac{1}{2}(a^2 + b^2 + c^2)$

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**142.** Equation of the plane containing the straight line $\frac{x}{2}=\frac{y}{3}=\frac{z}{4}$ and perpendicular to the plane containing the straight lines $\frac{x}{2}=\frac{y}{4}=\frac{z}{2}$ and $\frac{x}{4}=\frac{y}{2}=\frac{z}{3}$ is

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**143.** The equation of the plane through the intersection of the planes $x+2y+3z-4=0$ and $4x+3y+2z+1=0$ and passing through the origin is (a) $17x+14y+11z=0$ (b) $7x+4y+z=0$ (c) $x+14+11z=0$ (d) $17x+y+z=0$

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**144.** The plane $4x+7y+4z+81=0$ is rotated through a right angle about its line of intersection with the plane $5x+3y+10z=25.$ The equation of the plane in its new position is a. $x-4y+6z=106$ b. $x-8y+13z=103$ c. $x-4y+6z=110$ d. $x-8y+13z=105$

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**145.** The vector equation of the plane passing through the origin and the line of intersection of the planes $\vec{r} \cdot \vec{a} = \lambda and \vec{r} \cdot \vec{b} = \mu$ is a. $\vec{r} \lambda \vec{a} \cdot - \mu \vec{b} = 0$ b. $\vec{r} \lambda \vec{b} \cdot - \mu \vec{a} = 0$ c. $\vec{r} \lambda \vec{a} \cdot + \mu \vec{b} = 0$ d. $\vec{r} \lambda \vec{b} \cdot + \mu \vec{a} = 0$

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**146.** The lines $\vec{r} = \vec{a} + \lambda\left(\vec{b} \times \vec{c}\right) and \vec{r} = \vec{b} + \mu\left(\vec{c} \times \vec{a}\right)$ will intersect if a. $\vec{a} \times \vec{c} = \vec{b} \times \vec{c}$ b. $\vec{a} \cdot \vec{c} = \vec{b} \cdot \vec{c}$ c. $b \times \vec{a} = \vec{c} \times \vec{a}$ d. none of these

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**147.** The pair of lines whose direction cosines are given by the equations $3l + m + 5n = 0 and 6mn - 2nl + 5lm = 0$ are a. parallel b.

perpendicular c. inclined at $\cos^{-1}\left(\frac{1}{6}\right)$ d. none of these

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**148.** If the distance of the point $P(1, -2, 1)$ from the plane $x + 2y - 2z = \alpha, where\alpha > 0, is 5,$ then the foot of the perpendicular from $P$ to the place is a. $\left(\frac{8}{3}, \frac{4}{3}, -\frac{7}{3}\right)$ b. $\left(\frac{4}{3}, -\frac{4}{3}, \frac{1}{3}\right)$ c. $\left(\frac{1}{3}, \frac{2}{3}, \frac{10}{3}\right)$ d. $\left(\frac{2}{3}, -\frac{1}{3}, -\frac{5}{3}\right)$

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**149.** A line with positive direction cosines passes through the point $P(2, -1, 2)$ and makes equal angles with the coordinate axes. The line meets the plane $2x + y + z = 9$ at point Q. The length of the line segment PQ equals

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**150.** The value of $k$ such that $\frac{x-4}{1}=\frac{y-2}{1}=\frac{z-k}{2}$ lies in the plane $2x-4y+z=7$ is (A) 7 (B) -7 (C) no real value (D) 4

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**151.** The equation of the plane passing through lines $\frac{x-4}{1}=\frac{y-3}{1}=\frac{z-2}{2} and \frac{x-3}{2}=\frac{y-2}{-4}=\frac{z}{5}$ is a. $11x-y-3z=35$ b. $11x+y-3z=35$ c. $11x-y+3z=35$ d. none of these

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**152.** The line through $\hat{i}+3\hat{j}+2\hat{k}$ and $\perp$ to the line $\vec{r}=\left(\hat{i}+2\hat{j}-\hat{k}\right)+\lambda\left(2\hat{i}+\hat{j}+\hat{k}\right) and \vec{r}=\left(2\hat{i}+6\hat{j}+\hat{k}\right)+\mu\left(\hat{i}+2\hat{j}\right.$ is a. $\vec{r}=\left(\hat{i}+2\hat{j}-\hat{k}\right)+\lambda\left(-\hat{i}+5\hat{j}-3\hat{k}\right)$ b. $\vec{r}=\hat{i}+3\hat{j}+2\hat{k}+\lambda\left(\hat{i}-5\hat{j}+3\hat{k}\right)$ c. $\vec{r}=\hat{i}+3\hat{j}+2\hat{k}+\lambda\left(\hat{i}+5\hat{j}+3\hat{k}\right)$ d. $\vec{r}=\hat{i}+3\hat{j}+2\hat{k}+\lambda\left(-\hat{i}-5\hat{j}-3\hat{k}\right)$

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153. The equation of the plane through the line of intersection of the planes $ax + by + cz + d = 0$ and $a'x + b'y + c'z + d' = 0$ parallel to the line $y = 0$ and $z = 0$ is

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154. The three planes $4y + 6z = 5, 2x + 3y + 5z = 5$ and $6x + 5y + 9z = 10$ (a) meet in a point (b) have a line in common (c) form a triangular prism (d) none of these

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155. Find $\left[\vec{a}, \vec{b}, \vec{c}\right]$ if $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j} - 2\hat{k}$

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156. The shortest distance between the lines $\frac{x-3}{3}=\frac{y-8}{-1}=\frac{z-3}{1} and \frac{x+3}{-3}=\frac{y+7}{2}=\frac{z-6}{4}$ is a. $\sqrt{30}$ b. $2\sqrt{30}$ c. $5\sqrt{30}$ d. $3\sqrt{30}$

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157. $L_1 and L_2$ and two lines whose vector equations are $L_1:\vec{r}=\lambda\left(\left(\cos\theta+\sqrt{3}\right)\hat{i}\left(\sqrt{2}\sin\theta\right)\hat{j}+\left(\cos\theta-\sqrt{3}\right)\hat{k}\right)$ $L_2:\vec{r}=\mu\left(a\hat{i}+b\hat{j}+c\hat{k}\right)$, where $\lambda and \mu$ are scalars and $\alpha$ is the acute angel between $L_1 and L_2$. If the angel $\alpha$ is independent of $\theta$, then the value of $\alpha$ is a. $\frac{\pi}{6}$ b. $\frac{\pi}{4}$ c. $\frac{\pi}{3}$ d. $\frac{\pi}{2}$

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158. Value of $\lambda$ such that the line $\frac{x-1}{2}=\frac{y-1}{3}=\frac{z-1}{\lambda}$ is $\perp$ to normal to the plane $\vec{r}\,2\vec{i}+3\dot{\vec{j}}+4\vec{k}=0$ is a. $-\frac{13}{4}$ b. $-\frac{17}{4}$ c. 4 d.

none of these

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**159.** Equation of the pane passing through the points $(2, 2, 1) and (9, 3, 6), and \perp$ to the plane $2x + 6y + 6z - 1 = 0$ is a. $3x + 4y + 5z = 9$ b. $3x + 4y - 5z = 9$ c. $3x + 4y - 5z = 9$ d. none of these

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**160.** The equation of the plane which passes through the point of intersection of lines $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-3}{2}, \text{and} \frac{x-3}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ and at greatest distance from point $(0, 0, 0)$ is a. $4x + 3y + 5z = 25$ b. $4x + 3y = 5z = 50$ c. $3x + 4y + 5z = 49$ d. $x + 7y - 5z = 2$

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**161.** If the foot of the perpendicular from the origin to plane is $P(a, b, c)$, the equation of the plane is a. $\frac{x}{a} = \frac{y}{b} = \frac{z}{c} = 3$ b. $ax + by + cz = 3$ c. $ax + by + cz = a^2 + b^2 + c^2$ d. $ax + by + cz = a + b + c$

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**162.** Equation of a line in the plane $\pi = 2x - y + z - 4 = 0$ which is perpendicular to the line $l$ whose equation is $\frac{x-2}{1} = \frac{y-2}{-1} = \frac{z-3}{-2}$ and which passes through the point of intersection of $l$ and $\pi$ is (A) $\frac{x-2}{1} = \frac{y-1}{5} = \frac{z-1}{-1}$ (B) $\frac{x-1}{3} = \frac{y-3}{5} = \frac{z-5}{-1}$ (C) $\frac{x+2}{2} = \frac{y+1}{-1} = \frac{z+1}{1}$ (D) $\frac{x-2}{2} = \frac{y-1}{-1} = \frac{z-1}{1}$

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**163.** The intercept made by the plane $\vec{r} \dot{\vec{n}} = q$ on the x-axis is a. $\frac{q}{\hat{i} \dot{\vec{n}}}$ b. $\frac{\hat{i} \dot{\vec{n}}}{q}$ c. $\frac{\hat{i} \dot{\vec{n}}}{q}$ d. $\frac{q}{|\vec{n}|}$

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164. The coordinates o the foot of the perpendicular drawn from the origin to the line joining the point $(-9, 4, 5) and (10, 0, -1)$ will be a. $(-3, 2, 1)$ b. $(1, 2, 2)$ c. $4, 5, 3$ d. none of these

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165. The point on the line $\frac{x-2}{1} = \frac{y+3}{-2} = \frac{z+5}{-2}$ at a distance of 6 from the point $(2, -3, -5)$ is a. $(3, -5, -3)$ b. $(4, -7, -9)$ c. $0, 2, -1$ d. none of these

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166. Let $A(1, 1, 1), B(2, 3, 5) and C(-1, 0, 2)$ be three points, then equation of a plane parallel to the plane $ABC$ which is at distance $2$ is a. $2x - 3y + z + 2\sqrt{14} = 0$ b. $2x - 3y + z - \sqrt{14} = 0$ c. $2x - 3y + z + 2 = 0$ d. $2x - 3y + z - 2 = 0$

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**167.** Let $A\left(\vec{a}\right) and B\left(\vec{b}\right)$ be points on two skew lines $\vec{r}=\vec{a}+\lambda\vec{p} and \vec{r}=\vec{b}+u\vec{q}$ and the shortest distance between the skew lines is $1, where \vec{p} and \vec{q}$ are unit vectors forming adjacent sides of a parallelogram enclosing an area of 1/2 units. If angle between $AB$ and the line of shortest distance is $60^0$, then $AB=$ a. $\frac{1}{2}$ b. $2$ c. $1$ d. $\lambda R=\{10\}$

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**168.** Consider three planes $P_1: x-y+z=1$, $P_2: x+y-z=-1$ and $P_3: x-3y+3z=2$ Let $L_1, L_2$ and $L_3$ be the lines of intersection of the planes $P_2$ and $P_3$, $P_3$ and $P_1$ and $P_1$ and $P_2$ respectively.Statement 1: At least two of the lines $L_1, L_2$ and $L_3$ are non-parallel The three planes do not have a common point

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169. Consider the planes $3x - 6y - 2z - 15 = 0$ and $2x + y - 2z - 5 = 0$ Statement 1:The parametric equations of the line intersection of the given planes are $x = 3 + 14t, y = 2t, z = 15t$. Statement 2: The vector $14\hat{i} + 2\hat{j} + 15\hat{k}$ is parallel to the line of intersection of the given planes.

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170. The length of projection of the line segment joining the points $(1, 0, -1) and (-1, 2, 2)$ on the plane $x + 3y - 5z = 6$ is equal to a. 2 b. $\sqrt{\frac{271}{53}}$ c. $\sqrt{\frac{472}{31}}$ d. $\sqrt{\frac{474}{35}}$

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171. If $P_1 : \vec{r} . \vec{n}_1 - d_1 = 0$ $P_2 : \vec{r} . \vec{n}_2 - d_2 = 0$ and $P_3 : \vec{r} . \vec{n}_3 - d_3 = 0$ are three non-coplanar vectors, then three lines $P_1 = 0, P_2 = 0; P_2 = 0, P_3 = 0; P_3 = 0$ $P_1 = 0$ are

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**172.** Perpendiculars are drawn from points on the line $\frac{x+2}{2} = \frac{y+1}{-1} = \frac{z}{3}$ to the plane $x + y + z = 3$ The feet of perpendiculars lie on the line (a) $\frac{x}{5} = \frac{y-1}{8} = \frac{z-2}{-13}$ (b) $\frac{x}{2} = \frac{y-1}{3} = \frac{z-2}{-5}$ (c) $\frac{x}{4} = \frac{y-1}{3} = \frac{z-2}{-7}$ (d) $\frac{x}{2} = \frac{y-1}{-7} = \frac{z-2}{5}$

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**173.** The point P is the intersection of the straight line joining the points $Q(2, 3, 5)$ and $R(1, -1, 4)$ with the plane $5x - 4y - z = 1$. If S is the foot of the perpendicular drawn from the point $T(2, 1, 4)$ to QR, then the length of the line segment PS is (A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$ (C) $2$ (D) $2\sqrt{2}$

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**174.** A line $l$ passing through the origin is perpendicular to the lines $l_1 : (3+t)\hat{i} + (-1+2t)\hat{j} + (4+2t)\hat{k}, \infty < t < \infty, l_2 : (3+s)\hat{i} + (3+2$

then the coordinates of the point on $l_2$ at a distance of $\sqrt{17}$ from the point of intersection of $l \& l_1$ is/are:

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**175.** Two lines $L_1 : x = 5, \dfrac{y}{3-\alpha} = \dfrac{z}{-2}$ and $L_2 : x = \alpha, \dfrac{y}{-1} = \dfrac{z}{2-\alpha}$ are coplanar. Then $\alpha$ can take value (s) a. $1$ b. $2$ c. $3$ d. $4$

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**176.** The projection of point $P\left(\vec{p}\right)$ on the plane $\vec{r}\dot{\vec{n}} = q$ is $\left(\vec{s}\right)$, then

a. $\vec{s} = \dfrac{\left(q - \vec{p}\dot{\vec{n}}\right)\vec{n}}{\left|\vec{n}\right|^2}$ b. $\vec{s} = p + \dfrac{\left(q - \vec{p}\dot{\vec{n}}\right)\vec{n}}{\left|\vec{n}\right|^2}$ c. $\vec{s} = p - \dfrac{\left(\vec{p}\dot{\vec{n}}\right)\vec{n}}{\left|\vec{n}\right|^2}$ d. $\vec{s} = p - \dfrac{\left(q - \vec{p}\dot{\vec{n}}\right)\vec{n}}{\left|\vec{n}\right|^2}$

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177. The angle between $i+j$ line of the intersection of the plane $\overrightarrow{r}\hat{i}+2\dot{\hat{j}}+3\hat{k}=0 and \overrightarrow{r}3\hat{i}+\dot{3}\hat{j}+\hat{k}=0$ is a. $\cos^{-1}\left(\frac{1}{3}\right)$ b. $c0s^{-1}\left(\frac{1}{\sqrt{3}}\right)$ c. $\cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$ d. none of these

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178. From the point $P(a, b, c)$, let perpendiculars $PLandPM$ be drawn to $YOZandZOX$ planes, respectively. Then the equation of the plane $OLM$ is a. $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=0$ b. $\frac{x}{a}+\frac{y}{b}-\frac{z}{c}=0$ c. $\frac{x}{a}-\frac{y}{b}-\frac{z}{c}=0$ d. $\frac{x}{a}-\frac{y}{b}+\frac{z}{c}=0$

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179. The plane $\overrightarrow{r}\dot{\overrightarrow{n}}=q$ will contain the line $\overrightarrow{r}=\overrightarrow{a}+\lambda\overrightarrow{b}$, if a. $b.n\neq 0, a.n\neq q$ b. $b.n=, a.n\neq q$ c. $b.n=0, a.n=q$ d.

$b. n \neq 0, a. n = q$

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**180.** Consider triangle $AOB$ in the $x-y$ plane, where $A \equiv (1, 0, 0), B \equiv (0, 2, 0) and O \equiv (0, 0, 0)$. The new position of $O$, when triangle is rotated about side $AB$ by $90^0$ can be a. $\left(\frac{4}{5}, \frac{3}{5}, \frac{2}{\sqrt{5}}\right)$ b. $\left(\frac{-3}{5}, \frac{\sqrt{2}}{5}, \frac{2}{\sqrt{5}}\right)$ c. $\left(\frac{4}{5}, \frac{2}{5}, \frac{2}{\sqrt{5}}\right)$ d. $\left(\frac{4}{5}, \frac{2}{5}, \frac{1}{\sqrt{5}}\right)$

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**181.** Let $\vec{a} = \hat{i} + \hat{j} and \vec{b} = 2\hat{i} - \hat{k}$, then the point of intersection of the lines $\vec{r} \times \vec{a} = \vec{b} \times \vec{a}$ and $\vec{r} \times \vec{b} = \vec{a} \times \vec{b}$ is a. $(3, -1, 1)$ b. $(3, 1, -1)$ c. $(-3, 1, 1)$ d. $(-3, -1, -1)$

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182. The line $\frac{x+6}{5}=\frac{y+10}{3}=\frac{z+14}{8}$ is the hypotenuse of an isosceles right-angled triangle whose opposite vertex is $(7, 2, 4)\cdot$ Then which of the following in not the side of the triangle? a. $\frac{x-7}{2}=\frac{y-2}{-3}=\frac{z-4}{6}$ b. $\frac{x-7}{3}=\frac{y-2}{6}=\frac{z-4}{2}$ c. $\frac{x-7}{3}=\frac{y-2}{5}=\frac{z-4}{-1}$ d. none of these

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183. The equation of the plane which passes through the line of intersection of planes $\vec{r}\dot{\vec{n}}_1=, q_1, \vec{r}\dot{\vec{n}}_2=q_2$ and the is parallel to the line of intersection of planers $\vec{r}\dot{\vec{n}}_3=q_3 and \vec{r}\dot{\vec{n}}_4-q_4$ is

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184. The coordinates of the point $P$ on the line $\vec{r}=\left(\hat{i}+\hat{j}+\hat{k}\right)+\lambda\left(-\hat{i}+\hat{j}-\hat{k}\right)$ which is nearest to the origin is a. $\left(\frac{2}{4}, \frac{4}{3}, \frac{2}{3}\right)$ b. $\left(-\frac{2}{3}, -\frac{4}{3}, \frac{2}{3}\right)$ c. $\left(\frac{2}{3}, -\frac{4}{3}, \frac{2}{3}\right)$ d. none of these

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**185.** The ratio in which the line segment joining the points whose position vectors are $2\hat{i} - 4\hat{j} - 7\hat{k} and - 3\hat{i} + 5\hat{j} - 8\hat{k}$ is divided by the plane whose equation is $\hat{r}\hat{i} - 2\dot{\hat{j}} + 3\hat{k} = 13$ is a. $13 : 12$ internally b. $12 : 25$ externally c. $13 : 25$ internally d. $37 : 25$ internally

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**186.** The number of planes that are equidistant from four non-coplanar points is a. $3$ b. $4$ c. $7$ d. $9$

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**187.** In a three-dimensional coordinate system, $P$, $Q$ , and $R$are images of a point $A(a, b, c)$ in the $x - y, y - z$ and $z - x$ planes, respectively. If $G$ is the centroid of triangle $PQR,$ then area of triangle $AOG$ is ($O$ is the origin) (A) $0$ (B) $a^2 + b^2 + c^2$ (C) $\frac{2}{3}\left(a^2 + b^2 + c^2\right)$ (D) none of these

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**188.** A plane passing through $(1, 1, 1)$ cuts positive direction of coordinates axes at $A, BandC,$ then the volume of tetrahedron $OABC$ satisfies a. $V \leq \frac{9}{2}$ b. $V \geq \frac{9}{2}$ c. $V = \frac{9}{2}$ d. none of these

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**189.** If lines $x = y = zandx = \frac{y}{2} = \frac{z}{3}$ and third line passing through $(1, 1, 1)$ form a triangle of area $\sqrt{6}$ units, then the point of intersection of third line with the second line will be a. $(1, 2, 3)$ b. $2, 4, 6$ c. $\frac{4}{3}, \frac{6}{3}, \frac{12}{3}$ d. none of these

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**190.** Find the point of intersection of line passing through $(0, 0, 1)$ and the intersection lines

$x + 2u + z = 1, \; - x + y - 2z and x + y = 2, x + z = 2$ with the $xy$ plane.

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**191.** Shortest distance between the lines $\frac{x-1}{1} = \frac{y-1}{1} = \frac{z-1}{1} and \frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{1}$ is equal to a. $\sqrt{14}$ b. $\sqrt{7}$ c. $\sqrt{2}$ d. none of these

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**192.** Distance of point $P\left(\vec{p}\right)$ from the plane $\vec{r}\dot{\vec{n}} = 0$ is a. $\left|\vec{p}\dot{\vec{n}}\right|$ b. $\frac{\left|\vec{p} \times \vec{n}\right|}{\left|\vec{n}\right|}$ c. $\frac{\left|\vec{p}\dot{\vec{n}}\right|}{\left|\vec{n}\right|}$ d. none of these

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**193.** The reflection of the point $\vec{a}$ in the plane $\vec{r}\cdot\vec{n}=q$ is a. $\vec{a}+\frac{\left(\vec{q}-\vec{a}\cdot\vec{n}\right)}{\left|\vec{n}\right|}$ b. $\vec{a}+2\left(\frac{\left(\vec{q}-\vec{a}\cdot\vec{n}\right)}{\left|\vec{n}\right|}\right)\vec{n}$ c. $\vec{a}+\frac{2\left(\vec{q}+\vec{a}\cdot\vec{n}\right)}{\left|\vec{n}\right|^2}\vec{n}$ d. none of these

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**194.** Line $\vec{r}=\vec{a}+\lambda\vec{b}$ will not meet the plane $\vec{r}\cdot\vec{n}=q$, if a. $\vec{b}\cdot\vec{n}=0,\ \vec{a}\cdot\vec{n}=q$ b. $\vec{b}\cdot\vec{n}\neq 0,\ \vec{a}\cdot\vec{n}\neq q$ c. $\vec{b}\cdot\vec{n}=0,\ \vec{a}\cdot\vec{n}\neq q$ d. $\vec{b}\cdot\vec{n}\neq 0,\ \vec{a}\cdot\vec{n}=q$

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**195.** If a line makes an angle of $\frac{\pi}{4}$ with the positive direction of each of x-axis and y-axis, then the angel that the line makes with the positive direction of the z-axis is a. $\frac{\pi}{3}$ b. $\frac{\pi}{4}$ c. $\frac{\pi}{2}$ d. $\frac{\pi}{6}$

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**196.** A parallelepiped $S$ has base points $A, B, CandD$ and upper face points $A', B', C', andD'$ . The parallelepiped is compressed by upper face $A'B'C'D'$ to form a new parallepiped $T$ having upper face points $A$,B, $C$a n dD . The volume of parallelepiped $T$ is 90 percent of the volume of parallelepiped $S$. Prove that the locus of $A$ is a plane.

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**197.** Find the equation of the plane containing the lines 2x-y+z-3=0,3x+y+z=5 and a t a distance of $\frac{1}{\sqrt{6}}$ from the point (2,1,-1).

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**198.** A plane which prepndicular totwo planes $2x-2y+z=0$and $x-y+2z=4$ passes through the point $(1, -2, 1)$ is:

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**199.** Let $P(3, 2, 6)$ be a point in space and $Q$ be a point on line $\overrightarrow{r} = \left(\hat{i} - \hat{j} + 2\hat{k}\right) + \mu\left(-3\hat{i} + \hat{j} + 5\hat{k}\right)\cdot$ Then the value of $\mu$ for which the vector $\overrightarrow{P}Q$ is parallel to the plane $x - 4y + 3z = 1$ is a. 1/4 b. -1/4 c. 1/8 d. -1/8

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**200.** If the two lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-m}{2} = z$ intersect at a point, find the value of m.

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**201.** Statement 1: A plane passes through the point $A(2, 1, -3)\cdot$ If distance of this plane from origin is maximum, then its equation is $2x + y - 3z = 14.$ Statement 2: If the plane passing through the point

$A\left(\vec{a}\right)$ is at maximum distance from origin, then normal to the plane is vector $\vec{a}$.

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**202.** If the distance between the plane $Ax - 2y + z = d.$ and the plane containing the lies $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{4-3}{4} = \frac{z-4}{5}$ is $\sqrt{6}$, then $|d|$ is

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**203.** Prove that the volume of tetrahedron bounded by the planes $\vec{r}\, m\hat{j} + n\hat{k} = 0, \vec{r}\, n\hat{k} + l\hat{i} = 0, \vec{r}\, l\hat{i} + m\hat{j} = 0, \vec{r}\, l\hat{i} + m\hat{j} + n\hat{k} = \pi s \frac{2p}{3ln}$

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**204.** If a variable plane forms a tetrahedron of constant volume $64k^3$ with the co-ordinate planes, then the locus of the centroid of the tetrahedron is:

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**205.** Prove that for all values of $\lambda and \mu$ , the planes $\frac{2x}{a}+\frac{y}{b}+\frac{2z}{c}-1+\lambda\left(\frac{x}{a}-\frac{2y}{b}-\frac{z}{c}-2\right)=0$ and $\frac{4x}{a}+\frac{3y}{b}-5+\mu\left(\frac{5y}{b}-\frac{4z}{c}+3\right)=0$ intersect on the same line.

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**206.** If $P$ is any point on the plane $lx+my+nz=pandQ$ is a point on the line $OP$ such that $OP\dot{O}Q=p^2$ , then find the locus of the point $Q$.

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**207.** A variable plane $lx + my + nz = p(wherel, m, n$ are direction cosines of normal) intersects the coordinate axes at points$A, BandC$ , respectively. Show that the foot of the normal on the plane from the origin is the orthocenter of triangle $ABC$ and hence find the coordinate of the circumcentre of triangle $ABC$.

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**208.** Find the sum of the vectors $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = -2\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{c} = \hat{i} - 6\hat{j} - 7\hat{k}$

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**209.** Let a plane $ax + by + cz + 1 = 0, wherea, b, c$ are parameters, make an angle $60^0$ with the line $x = y = z, 45^0$ with the line $x = y - z = 0$ and$\theta$ with the plane $x = 0$. The distance of the plane from point $(2, 1, 1)$ is 3 units. Find the value of $\theta$ and the equation of the plane.

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**210.** Let $x - y\sin\alpha - zs \in \beta = 0, xs \in \alpha = zs \in \gamma - y = 0 and x\sin\beta + y\sin\gamma -$ be the equations of the planes such that $\alpha + \beta + \gamma = \pi/2 (where \alpha, \beta and \gamma \ne 0)$. Then show that there is a common line of intersection of the three given planes.

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**211.** The position vectors of the four angular points of a tetrahedron OABC are $(0, 0, 0)$; $(0, 0, 2)$, $(0, 4, 0)$ and $(6, 0, 0)$ respectively. A point P inside the tetrahedron is at the same distance $r$ from the four plane faces of the tetrahedron. Find the value of $r$

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212. Find the distance of the point $(-2, 3, \backslash \quad -4)$ from the line $\frac{x+2}{3} = \frac{2y+3}{4} = \frac{3z+4}{5}$ measured parallel to the plane $4x + 12y - 3z + 1 = 0.$

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213. The plane $4x + 7y + 4z + 81 = 0$ is rotated through a right angle about its line of intersection with the plane $5x + 3y + 10z = 25.$ The equation of the plane in its new position is a. $x - 4y + 6z = 106$ b. $x - 8y + 13z = 103$ c. $x - 4y + 6z = 110$ d. $x - 8y + 13z = 105$

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214. If $(a, b, c)$ is a point on the plane $3x + 2y + z = 7,$ then find the least value ofvector method. $a^2 + b^2 + c^2,$ using vector method.

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**215.** Let the equation of the plane containing the line $x-y-z-4=0=x+y+2z-4$ and is parallel to the line of intersection of the planes $2x+3y+z=1$ and $x+3y+2z=2$ be $x+Ay+Bz+C=0$ Compute the value of $|A+B+C|$.

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**216.** Let $a_1, a_2, , a_{10}$ be in A.P. and $h_1, h_2, h_{10}$ be in H.P. If $a_1 = h_1 = 2 and a_{10} = h_{10} = 3, then a_4 h_7$ is

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**217.** If the angle between the plane $x-3y+2z=1$ and the line $\frac{x-1}{2}=\frac{y-1}{1}=\frac{z-1}{-3} is \theta,$ then the find the value of $\cos ec\theta$.

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218. The length of projection of the line segment joining the points $(1, 0, -1) and (-1, 2, 2)$ on the plane $x+3y-5z=6$ is equal to a. $2$ b. $\sqrt{\frac{271}{53}}$ c. $\sqrt{\frac{472}{31}}$ d. $\sqrt{\frac{474}{35}}$

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219. Find the equation of a plane passing through (1, 1, 1) and parallel to the lines $L_1$ and $L_2$ direction ratios (1, 0,-1) and (1,-1, 0) respectively. Find the volume of the tetrahedron formed by origin and the points where this plane intersects the coordinate axes.

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220. Find the equation of the plane passing through the points $(2, 1, 0)$, $(5, 0, 1)$ and $(4, 1, 1)$ If P is the point $(2, 1, 6)$ then find point Q such that PQ is perpendicular to the above plane and the mid point of PQ lies on it.

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**221.** For the line $\frac{x-1}{1}=\frac{y-2}{2}=\frac{z-3}{3}$, which one of the following is incorrect? a. it lies in the plane $x-2y+z=0$ b. it is same as line $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$ c. it passes through $(2, 3, 5)$ d. it is parallel t the plane $x-2y+z-6=0$

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**222.** The value of $m$ for which straight lein $3x-2y+z+3=0=4x-3y+4z+1$ is parallel to the plane $2x-y+mz-2=0$ is a. $-2$ b. $8$ c. $-18$ d. $11$

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**223.** Let the equations of a line and plane be $\frac{x+3}{2}=\frac{y-4}{3}=\frac{z+5}{2}and4x-2y-z=1,$ respectively, then a. the line is parallel to the plane b. the line is perpendicular to the plane c. the line lies in the plane d. none of these

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**224.** The length of the perpendicular form the origin to the plane passing through the point $a$ and containing the line $\vec{r} = \vec{b} + \lambda \vec{c}$ is a. $\frac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{a}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}\right|}$ b. $\frac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{a}\times\vec{b}+\vec{b}\times\vec{c}\right|}$ c. $\frac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{b}\times\vec{c}+\vec{c}\times\vec{a}\right|}$ d. $\frac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{c}\times\vec{a}+\vec{a}\times\vec{b}\right|}$

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**225.** In a three-dimensional $xyz$ space , the equation $x^2 - 5x + 6 = 0$ represents a. Points b. planes c. curves d. pair of straight lines

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**226.** The line $\frac{x-2}{3} = \frac{y+1}{2} = \frac{z-1}{-1}$ intersects the curve $xy = c^2, z = 0$ if $c$ is equal to a. $\pm 1$ b. $\pm 1/3$ c. $\pm \sqrt{5}$ d. none of these

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**227.** A unit vector parallel to the intersection of the planes $\vec{r}\,\hat{i} - \dot{\hat{j}} + \hat{k} = 5 and \vec{r}\, 2\hat{i} + \dot{\hat{j}} - 3\hat{k} = 4$ a. $\frac{2\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{38}}$ b. $\frac{-2\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{38}}$ c. $\frac{2\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{38}}$ d. $\frac{-2\hat{i} - 5\hat{j} - 3\hat{k}}{\sqrt{38}}$

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**228.** Let $L_1$ be the line $\vec{r}_1 = 2\hat{i} + \hat{j} - \hat{k} + \lambda\left(i + 2\hat{k}\right)$ and let $L_2$ be the line $\vec{r}_2 = 3\hat{i} + \hat{j} + \mu\left(i + \hat{j} - \hat{k}\right)$ . Let $\pi$ be the plane which contains the line $L_1$ and is parallel to $L_2\cdot$ The distance of the plane $\pi$ from the origin is a. $\sqrt{6}$ b. $1/7$ c. $\sqrt{2/7}$ d. none of these

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**229.** The distance of point $A(-2,3,1)$ from the line $PQ$ through $P(-3,5,2)$, which makes equal angles with the axes is a. $2/\sqrt{3}$ b. $14/\sqrt{3}$ c. $16/\sqrt{3}$ d. $5/\sqrt{3}$

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**230.** The Cartesian equation of the plane $\vec{r}=(1+\lambda-\mu)\hat{i}+(2-\lambda)\hat{j}+(3-2\lambda+2\mu)\hat{k}$ is a. $2x+y=5$ b. $2x-y=5$ c. $2x+z=5$ d. $2x-z=5$

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**231.** Statement 1: there exists a unique sphere which passes through the three non-collinear points and which has the least radius. Statement 2: The centre of such a sphere lies on the plane determined by the given three points.

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**232.** Statement 1: There exist two points on the $\frac{x-1}{1}=\frac{y}{-1}=\frac{z+2}{2}$ which are at a distance of 2 units from point $(1, 2, -4)$. Statement 2: Perpendicular distance of point $(1, 2, -4)$ form the line $\frac{x-1}{1}=\frac{y}{-1}=\frac{z+2}{2}$ is 1 unit.

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**233.** Statement 1: The shortest distance between the lines $\frac{x}{-3}=\frac{y-1}{1}=\frac{z+1}{-1} and \frac{x-2}{1}=\frac{y-3}{2}=\left(\frac{z+(13/7)}{-1}\right)$ is zero.

Statement 2: The given lines are perpendicular.

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**234.** Find the number of sphere of radius $r$ touching the coordinate axes.

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**235.** Find the distance of the z-axis from the image of the point $M(2-3, 3)$ in the plane $x-2y-z+1=0.$

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**236.** A line with direction cosines proportional to $1, \ -5, and -2$ meets lines $x=y+5=z+1 and x+5=3y=2z\cdot$ The coordinates of each of the points of the intersection are given by a. $(2, \ -3, 1)$ b. $(1, 2, 3)$ c. $(0, 5/3, 5/2)$ d. $(3, \ -2, 2)$

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**237.** If the planes $\vec{r}\hat{i}+\dot{\hat{j}}+\hat{k}=q_1, \vec{r}\hat{i}+2a\dot{\hat{j}}+\hat{k}=q_2 and \vec{r}a\hat{i}+a^2\dot{\hat{j}}+\hat{k}=q_3$ intersect in a line, then the value of $a$ is a. $1$ b. $1/2$ c. $2$ d. $0$

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**238.** The equation of a line passing through the point $\vec{a}$ parallel to the plane $\vec{r}\dot{\vec{n}}=q$ and perpendicular to the line $\vec{r}=\vec{b}+t\vec{c}$ is a. $\vec{r}=\vec{a}+\lambda\left(\vec{n}\times\vec{c}\right)$ b. $\left(\vec{r}-\vec{a}\right)\times\left(\vec{n}\times\vec{c}\right)$ c. $\vec{r}=\vec{b}+\lambda\left(\vec{n}\times\vec{c}\right)$ d. none of these

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**239.** A straight line $L$ on the xy-plane bisects the angle between $OXandOY\cdot$ What are the direction cosines of $L?$ a. $\langle(1/\sqrt{2}),(1/\sqrt{2}),0\rangle$ b. $\langle(1/2),(\sqrt{3}/2),0\rangle$ c. $\langle 0,0,1\rangle$ d. $\left\langle\begin{matrix}2/3\\2/3\\1/3\end{matrix}\right\rangle$

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**240.** Each question has four choices a, b, c, and d, out of which only one is correct. Each question contains STATEMENT 1 and STATEMENT 2. Both the statements are TRUE and statement 2 is the correct explanation for Statement 1. Both the statements are TRUE but Statement 2 is NOT the correct explanation for Statement 1. Statement 1 is TRUE and Statement 2 is FALSE. Statement 1 is FALSE and Statement 2 is TRUE. Statement 1: Vector $\vec{c} = 5\hat{i} + 7\hat{j} + 2\hat{k}$ is along the bisector of angel between $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k} and \vec{b} = -8\hat{i} + \hat{j} - 4\hat{k}$. Statement 2: $\vec{c}$ is equally inclined to $\vec{a}\, and\, \vec{b}$.

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**241.** The equation of the line $x + y + z - 1 = 0,\ 4x + y - 2z + 2 = 0$ written in the symmetrical form is

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**242.** The equation of two straight lines are $\frac{x-1}{2} = \frac{y+3}{1} = \frac{z-2}{-3} and \frac{x-2}{1} = \frac{y-1}{-3} = \frac{z+3}{2}$. Statement 1: the given lines are coplanar. Statement 2: The equations $2x_1 - y_1 = 1,\ x_1 + 3y_1 = 4 and 3x - 1 + 2y_1 = 5$ are consistent.

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**243.** Statement 1: Lines $\overrightarrow{r} = \hat{i} + \hat{j} - \hat{k} + \lambda\left(3\hat{i} - \hat{j}\right) and \overrightarrow{r} = 4\hat{i} - \hat{k} + \mu\left(2\hat{i} + \ + 3\hat{k}\right)$ intersect. Statement 2: $\overrightarrow{b} \times \overrightarrow{d} = 0$ , then lines $\overrightarrow{r} = \overrightarrow{a} + \lambda \overrightarrow{b}\,and\,\overrightarrow{r} = \overrightarrow{c} + \lambda \overrightarrow{d}$ do not intersect.

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**244.** Statement 1: Line $\frac{x-1}{1} = \frac{y-0}{2} = \frac{z2}{-1}$ lies in the plane $2x - 3y - 4z - 10 = 0$. Statement 2: if line $\overrightarrow{r} = \overrightarrow{a} + \lambda \overrightarrow{b}$ lies in the plane $\overrightarrow{r}\dot{\overrightarrow{c}} = n\left(wheren \text{ is scalar}\right), then \overrightarrow{b}\dot{\overrightarrow{c}} = 0.$

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**245.** What is the equation of the plane which passes through the z-axis and is perpendicular to the line $\frac{x-a}{\cos\theta} = \frac{y+2}{\sin\theta} = \frac{z-3}{0}$? (A) $x + y\tan\theta = 0$ (B) $y + x\tan\theta = 0$ (C) $x\cos\theta - y\sin\theta = 0$ (D) $x\sin\theta - y\cos\theta = 0$

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**246.** Statement 1: let $A\left(\vec{i}+\vec{j}+\vec{k}\right)andB\left(\vec{i}-\vec{j}+\vec{k}\right)$ be two points. Then point $P\left(2\vec{i}+3\vec{j}+\vec{k}\right)$ lies exterior to the sphere with $AB$ as its diameter. Statement 2: If $AandB$ are any two points and $P$ is a point in space such that $\vec{P}A\dot{\vec{P}}B>0$, then point $P$ lies exterior to the sphere with $AB$ as its diameter.

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**247.** Statement 1: Let $\theta$ be the angle between the line $\frac{x-2}{2}=\frac{y-1}{-3}=\frac{z+2}{-2}$ and the plane $x+y-z=5.$ Then $\theta=\sin^{-1}\left(1/\sqrt{51}\right)\cdot$ Statement 2: The angle between a straight line and a plane is the complement of the angle between the line and the normal to the plane.

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**248.** If the volume of tetrahedron $ABCD$ is 1 cubic units, where $A(0, 1, 2), B(-1, 2, 1) and C(1, 2, 1)$, then the locus of point $D$ is a. $x + y - z = 3$ b. $y + z = 6$ c. $y + z = 0$ d. $y + z = -3$

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**249.** The equation of the plane which is equally inclined to the lines $\frac{x-1}{2} = \frac{y}{-2} = \frac{z+2}{-1} and = \frac{x+3}{8} = \frac{y-4}{1} = \frac{z}{-4}$ and passing through the origin is/are a. $14x - 5y - 7z = 0$ b. $2x + 7y - z = 0$ c. $3x - 4y - z = 0$ d. $x + 2y - 5z = 0$

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**250.** Which of the following lines lie on the plane $x + 2y - z + 4 = 0$? a. $\frac{x-1}{1} = \frac{y}{-1} = \frac{z-5}{1}$ b. $x - y + z = 2x + y - z = 0$ c. $\hat{r} = 2\hat{i} - \hat{j} + 4\hat{k} + \lambda\left(3\hat{i} + \hat{j} + 5\hat{k}\right)$ d. none of these

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**251.** The equations of the plane which passes through $(0, 0, 0)$ and which is equally inclined to the planes $x - y + z - 3 = 0 and x + y = z + 4 = 0$ is/are a. $y = 0$ b. $x = 0$ c. $x + y = 0$ d. $x + z = 0$

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**252.** The x-y plane is rotated about its line of intersection with the y-z plane by $45^0$ , then the equation of the new plane is/are a. $z + x = 0$ b. $z - y = 0$ c. $x + y + z = 0$ d. $z - x = 0$

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**253.** Consider the planes $3x - 6y + 2z + 5 = 0 and 4x - 12 + 3z = 3$. The plane $67x - 162y + 47z + 44 = 0$ bisects the angel between the given planes which a. contains origin b. is acute c. is obtuse d. none of these

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**254.** A variable plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ at a unit distance from origin cuts the coordinate axes at $A, B$ and $C$. Centroid $(x, y, z)$ satisfies the equation $\frac{1}{x^2}+\frac{1}{y^2}+\frac{1}{z^2}=K$. The value of $K$ is (A) $9$ (B) $3$ (C) $\frac{1}{9}$ (D) $\frac{1}{3}$

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**255.** Let $P=0$ be the equation of a plane passing through the line of intersection of the planes $2x-y=0 and 3z-y=0$ and perpendicular to the plane $4x+5y-3z=8$. Then the points which lie on the plane $P=0$ is/are a. $(0, 9, 17)$ b. $(1/7, 21/9)$ c. $(1, 3, -4)$ d. $(1/2, 1, 1/3)$

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**257.** A point $P$ moves on a plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1.$ A plane through $P$ and perpendicular to $OP$ meets the coordinate axes at $A, BandC\cdot$ If the planes through $A, BandC$ parallel to the planes $x=0, y=0andz=0,$ respectively, intersect at $Q,$ find the locus of $Q\cdot$

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**258.** If the planes $x-cy-bz=0, cx-y+az=0andbx+ay-z=0$ pass through a straight line, then find the value of $a^2+b^2+c^2+2abc\cdot$

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**259.** Find the equation of the plane through the points $(1, 0, -1), (3, 2, 2)$ and parallel to the line $\frac{x-1}{1}=\frac{y-1}{-2}=\frac{z-2}{3}.$

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**260.** A variable plane passes through a fixed point $(\alpha, \beta, \gamma)$ and meets the axes at $A, B, andC\cdot$ show that the locus of the point of intersection of the planes through $A, BandC$ parallel to the coordinate planes is $\alpha x^{-1} + \beta y^{-1} + \gamma z^{-1} = 1.$

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**261.** Show that the straight lines whose direction cosines are given by the equations $al + bm + cn = 0$ and $ul^2 + zm^2 = vn^2 + wn^2 = 0$ are parallel or perpendicular as $\frac{a^2}{u} + \frac{b^2}{v} + \frac{c^2}{w} = 0$ or $a^2(v + w) + b^2(w + u) + c^2(u + v) = 0$

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**262.** The perpendicular distance of a corner of uni cube from a diagonal not passing through it is

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**263.** If the direction cosines of a variable line in two adjacent points be $l, M, n$ and $l+\delta l, m+\delta m+n+\delta n$ the small angle $\delta\theta$as between the two positions is given by

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**264.** The image of the point $(-1, 3, 4)$ in the plane $x-2y=0$ is a. $\left(-\frac{17}{3}, -\frac{19}{3}, 4\right)$ b. $(15, 11, 4)$ c. $\left(-\frac{17}{3}, -\frac{19}{3}, 1\right)$ d. $\left(\frac{9}{5}, \frac{-13}{5}, 4\right)$

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**265.** The ratio in which the plane $\vec{r}\vec{i}-2\dot{\vec{j}}+3\vec{k}=17$ divides the line joining the points $-2\vec{i}+4\vec{j}+7\vec{k}and3\vec{i}-5\vec{j}+8\vec{k}$ is a. $1:5$ b. $1:10$ c. $3:5$ d. $3:10$

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**266.** Let $L$ be the line of intersection of the planes $2x + 3y + z = 1 and x + 3y + 2z = 2$. If $L$ makes an angle $\alpha$ with the positive x-axis, then $\cos \alpha$ equals a. $\frac{1}{2}$ b. $1$ c. $\frac{1}{\sqrt{2}}$ d. $\frac{1}{\sqrt{3}}$

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**267.** The distance between the line $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda\left(\hat{i} - \hat{j} + 4\hat{k}\right)$ and the plane $\vec{r}\,\hat{i} + 5\hat{j} + \hat{k} = 5$ is a. $\frac{10}{3\sqrt{3}}$ b. $\frac{10}{9}$ c. $\frac{10}{3}$ d. $\frac{3}{10}$

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**268.** If angle $\theta$ bertween the line $\frac{x+1}{1} = \frac{y-1}{2} = \frac{z-2}{2}$ and the plane $2x - y + \sqrt{\lambda}z + 4 = 0$ is such that $s \int h\eta = 1/3,$ the value of $\lambda$ is a. $-\frac{3}{5}$ b. $\frac{5}{3}$ c. $-\frac{4}{3}$ d. $\frac{3}{4}$

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**269.** The length of the perpendicular drawn from $(1, 2, 3)$ to the line $\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-7}{-2}$ is a. $4$ b. $5$ c. $6$ d. $7$

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**270.** A plane makes intercepts $OA, OBandOC$ whose measurements are $a, b$ and $c$ on the $OX, OYandOZ$ axes. The area of triangle $ABC$ is a. $\frac{1}{2}(ab+bc+ca)$ b. $\frac{1}{2}abc(a+b+c)$ c. $\frac{1}{2}\left(a^2b^2+b^2c^2+c^2a^2\right)^{1/2}$ d. $\frac{1}{2}(a+b+c)^2$

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**271.** The intersection of the spheres $x^2+y^2+z^2+7x-2y-z=13andx^2+y^2+z^2-3x+3y+4z=8$ is the same as the intersection of one of the spheres and the plane a. $x-y-z=1$ b. $x-2y-z=1$ c. $x-y-2z=1$ d. $2x-y-z=1$

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**272.** The shortest distance from the plane $12x + 4y + 3z = 327$ to the sphere $x^2 + y^2 + z^2 + 4x - 2y - 6z = 155$ is a. $39$ b. $26$ c. $41 - \frac{4}{13}$ d. $13$

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**273.** A line makes an angel $\theta$ with each of the x-and z-axes. If the angel $\beta$, which it makes with the y-axis, is such that $\sin^2\beta = 3\sin^2\theta$,then $\cos^2\theta$ equals a. $\frac{2}{3}$ b. $\frac{1}{5}$ c. $\frac{3}{5}$ d. $\frac{2}{5}$

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**274.** Find the equation of a straight line in the plane $\vec{r} \cdot \vec{n} = d$ which is parallel to $\vec{r} = \vec{a} + \lambda\vec{b}$ and passes through the foot of the perpendicular drawn from point $P\left(\vec{a}\right) \to \vec{r}\dot{\vec{n}} = d\left(where \vec{n}\dot{\vec{b}} = 0\right)$. a. $\vec{r} = \vec{a} + \left(\frac{d - \vec{a}\cdot\vec{n}}{n^2}\right)n + \lambda\vec{b}$ b.

$\vec{r} = \vec{a} + \left(\frac{d - \vec{a} \cdot \vec{n}}{n}\right)n + \lambda \vec{b}$ c.

$\vec{r} = \vec{a} + \left(\frac{\vec{a} \cdot \vec{n} - d}{n^2}\right)n + \lambda \vec{b}$ d.

$\vec{r} = \vec{a} + \left(\frac{\vec{a} \cdot \vec{n} - d}{n}\right)n + \lambda \vec{b}$

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**275.** What is the nature of the intersection of the set of planes $x + ay + (b + c)z + d = 0, x + by + (a + a)z + d = 0 and x + cy + (a + $

a. they meet at a point b. the form a triangular prism c. the pass through a line d. they are at equal distance from the origin

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**276.** Let $P_1$ denote the equation of a plane to which the vector $\left(\hat{i} + \hat{j}\right)$ is normal and which contais the line whose equation is $\vec{r} = \hat{i} + \hat{j} + \hat{k} + \lambda\left(\hat{i} - \hat{j} - \hat{k}\right) and P_2$ denote the equation of the plane containing the line $L$ and a point with position vector $\hat{j}$. Which of the following holds good? a. The equation of $P_1$ is x+y=2. b. The equation of $P_2$ is $\overrightarrow{r}.(i-2j+k)=2$ c. The acute angle between $P_1$ and $P_2$ is $\cot^{-1}\sqrt{3}$ d. The angle between plane $P_2$ and the line L is $\tan^{-1}\sqrt{3}$

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**277.** Let $PM$ be the perpendicular from the point $P(1, 2, 3)$ to the $x-y$ plane. If $\overrightarrow{O}P$ makes an angle $\theta$ with the positive direction of the $z-$ axis and$\overrightarrow{O}M$ makes an angle $\phi$ with the positive direction of $x-$ axis, $whereO$ is the origin and $\theta and \phi$ are acute angels, then a. $\cos\theta\cos\phi=1/\sqrt{14}$ b. $\sin\theta\sin\phi=2/\sqrt{14}$ c. $\tan\phi=2$ d. $\tan\theta=\sqrt{5}/3$

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**278.** If the plane $\frac{x}{2}+\frac{y}{3}+\frac{z}{6}=1$ cuts the axes of coordinates at points, $A, B, andC$ , then find the area of the triangle $ABC$. a. $18sq$. unit b. $36sq$. unit c. $3\sqrt{14}sq$. unit d. $2\sqrt{14}sq$. unit

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279. For what value (s) of a will the two points $(1, a, 1)$ and $(-3, 0, a)$ lie on opposite sides of the plane $3x + 4y - 12z + 13 = 0$?

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## Question Bank

1. The equation of the plane which has the property that the point $Q(5, 4, 5)$ is the reflection of point $P(1, 2, 3)$ through that plane, is $ax + by + cz = d$ where $a, b, c, d \in N$. Find the least value of $(a + b + c + d)$.

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2. If the angle between the plane $x - 3y + 2z = 1$ and the line $x - \frac{1}{2} = y - \frac{1}{1} = z - \frac{1}{-3}$ is $\theta$, then the value of $\cos ec\theta$ is

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**3.** The intersection of the planes $2x - y - 3z = 8$ and $x + 2y - 4z = 14$ is the line $L$. The value of $a$ ' for which the line $L$ is perpendicular to the line through $(a, 2, 2)$ and $(6, 11, \ -1$ is

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**4.** $ABC$ is a triangle and $A = (235)\dot{B} = ( -1, 3, 2)andC = (\lambda, 5, \mu)\cdot$ If the median through $A$ is equally inclined to the axes, then find the value of $\lambda and \mu\cdot$

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**5.** Let $Q$ be the foot of perpendicular from the origin to the plane $4x - 3y + z + 13 = 0$ and $R$ be a point $( -1, 1, \ -6)$ on the plane. The length $QR$ is

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6. If direction ratios of the normal of the plane which contains the lines $\frac{x-2}{3} = \frac{y-4}{2} = \frac{z-1}{1}$ and $\frac{x-6}{3} = \frac{y+2}{2} = \frac{z-2}{1}$ are $(a, 1, -26)$, then $a$ is equal to

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7. If the planes $\overrightarrow{r}.\left(\hat{i}+\hat{j}+\hat{k}\right) = q_1, \overrightarrow{r}.\left(\hat{i}+2a\hat{j}+\hat{k}\right) = q_2$ and $\overrightarrow{r}.\left(a\hat{i}+a^2\hat{j}+\hat{k}\right) =$ intersect in a line, then the value of $a$ is

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8. Find the shortest distance between the z-axis and the line, $x+y+2z-3=0, 2x+3y+4z-4=0.$

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**9.** If the plane $2x - 3y + 6z - 11 = 0$ makes an angle $\sin^{-1}(\lambda)$ with $x$ - axis, then $\lambda$ is equal to

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**10.** The vector $\overline{A}B = 3\hat{i} + 4\hat{k}$ and $ove \rightarrow owAC = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle $ABC$. The length of the median through $A$ is

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**11.** The distance of the point $(-1, -5, -10)$ from the point of intersection of the line $\frac{x-2}{2} = \frac{y+1}{4} = \frac{z-2}{12}$ and the plane $x - y + z = 5$ is

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**12.** Consider two lines in space as $L_1 : \overrightarrow{r}_1 = \hat{j} + 2\hat{k} + \lambda\left(3\hat{i} - \hat{j} - \hat{k}\right)$ and $L_2 : \overrightarrow{r}_2 = 4\hat{i} + 3\hat{j} + 6\hat{k} + \mu\left(\hat{i} + 2\hat{k}\right)$. If the shortest distance between these lines is $\sqrt{d}$ then $d$ equals

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