MATHS

BOOKS - ARIHANT MATHS (HINGLISH)

THREE DIMENSIONAL GEOMETRY

Frequently Asked Questions

1. Find the acute angle which the line with direction -cosines $< \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{6}}, n >$ makes with positive direction of z-axis.

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2. Find the direction-cosines of the line joining the points (-2,4,-5) and (1,2,3).

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3. If α, β, γ are direction-angles of a line, prove that

(i) $\cos 2\alpha + \cos 2\beta + \cos 2\gamma + 1 = 0.$

(ii) $\cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1.$

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4. The x-coordinates of a point on t line joining the points $Q(2, 2, 1) and R(5, 1, -2) is 4.$ Find its z-coordinate.

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5. Show that the points $A(1, -2, -8), B(5, 0, -2)$ and $C(11, 3, 7)$ are collinear, and find the ratio in which B divides AC.

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6. Find the acute angle between the lines whose direction-ratios are :

$< 1, 1, 2 > \text{ and } < -3, -4, 1 >$.

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7. Find the angle between the lines whose direction cosines are given by the equations $3l + m + 5n = 0, 6mm - 2nl + 5l = 0$

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8. Find the length of the projection of the line segment joining the points P(3,-1,2) and Q(2,4,-1) on the line with direction rations $< -1, 2, -2 >$.

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9. Find the area of the traingle ABC whose vertices are :

$A(1, 2, 4); B(-2, 1, 2)$ and $C(2, 4, -3)$.

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10. A line makes angles $\alpha, \beta, \gamma$and $\delta$with the diagonals of a cube, prove that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta = \frac{4}{3}$

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11. Find the shortest distance between the lines:

$\vec{r} = \hat{i} + 2\hat{j} - 3\hat{k} + \lambda\left(3\hat{i} - 4\hat{j} - \hat{k}\right)$

and $\vec{r} = 2\hat{i} - \hat{j} + \hat{k} + \mu\left(\hat{i} + \hat{j} + 5\hat{k}\right)$.

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12. Find the distance between the lines L_1 and L_2 given by :

$\overrightarrow{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$

and $\overrightarrow{r} = 2\hat{i} + 3\hat{j} - 5\hat{k} + \mu\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$.

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13. Show that the two line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-4}{5} = \frac{y-1}{2} = z$ intersect. Find also the point of intersection of these lines.

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14. Show that the lines $\frac{x+3}{-3} = \frac{y-1}{1} = \frac{z-5}{5}$ and $\frac{x+1}{-1} = \frac{y-2}{2} = \frac{z-5}{5}$ and

are coplanar. Also, find the equation of the plane containing these lines.

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15. Find whether the lines :

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

$$\vec{r} = \left(2\hat{i} - \hat{j}\right) + \mu\left(\hat{i} + \hat{j} - \hat{k}\right)$$

intersect or not. If intersecting, Find their point of intersection.

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16. Find the shortest distance and the vector equation of the line of shortest distance between the lines given by:

$\vec{r} = \left(3\hat{i} + 8\hat{j} + 3\hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + \hat{k}\right)$ and

$\vec{r} = \left(-3\hat{i} - 7\hat{j} + 6\hat{k}\right) + \mu\left(-3\hat{i} + 2\hat{j} + 4\hat{k}\right)$.

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17. Find the equation of the plane with intercepts 2, 3 and 4 on the x, y and z-axis respectively.

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18. 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.

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19. Find the vector equation of a plane passing through the point having position vector $2\hat{i} + \hat{j} + \hat{k}$ and perpendicular to the vector :

$4\hat{i} - 2\hat{j} + 3\hat{k}$.

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20. Find the vector equation of the plane which is at a distance of $\frac{6}{\sqrt{29}}$ from the origin and its normal vector from the origin is $2\hat{i} - 3\hat{j} + 4\hat{k}$. Also find its cartesian form.

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21. Find the direction cosines of the unit vector perpendicular to the plane $\rightarrow r6\hat{i} - 3\dot{\hat{j}} - 2\hat{k} + 1 = 0$ passing through the origin.

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22. Find the angle between the planes $2x + y - 2z = 5$ and $3x - 6y - 2z = 7$. Using vector method.

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23. Find the equation of the plane passing through the points A(1,-1,2) and B(2,-2,2) and perpendicular to the plane $6x - 2y + 2z = 9.$

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24. Find the equationfo the plane through points (2,1,0),(3,-2,-2), and (3,1,7).

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25. Find the equation of the plane determined by the points A(3, 1, 2), B(5, 2, 4) and C(1, 1, 6) and hence find the distance between the plane and the point P(6, 5, 9).

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26. Find the equation of the plane passing through the line of intersection of the planes $\rightarrow r\hat{i} + \dot{\hat{j}} + \hat{k} = 1$and $\rightarrow r2\hat{i} + \dot{3}\hat{j} - \hat{k} + 4 = 0$and parallel to x-axis.

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27. Find the equation of the plane through the line of intersection of :

$\overrightarrow{r}.\left(2\hat{i} - 3\hat{j} + 4\hat{k}\right) = 1 \text{ and } \overrightarrow{r}.\left(\hat{i} - \hat{j}\right) + 4 = 0$

and perpendicular to the plane $\overrightarrow{r}.\left(2\hat{i} - \hat{j} + \hat{k}\right) + 8 = 0.$

hence, find whether the plane thus obtained contains the line:

x - 1 = 2y - 4 = 3z - 12.

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28. Find the equation of the plane which contains the line of intersection of the planes:

$\vec{r}.\left(\hat{i}-2\hat{j}+3\hat{k}\right)-4=0$ and

$\vec{r}.\left(-2\hat{i}+\hat{j}+\hat{k}\right)+5=0$ and whose intercept on x-axis is equal to that of y-axis.

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29. Find the vector equation of the plane that contains the line $\vec{r}=\left(\hat{i}+\hat{j}\right)+\lambda\left(\hat{i}+2\hat{j}-\hat{k}\right)$ and the point (-1, 3,-4). Also , find the length of the perpendicular from the point (2,1,4) to the plane, thus botained.

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30. Find the vector and cartesian equations of the plane passing through the points (2,2,-1), (3,4,2) and (7,06) also find the vector equation of a plane passing through (4,3,1) and parallel to the plane obtained above.

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31. From the point $P(1, 2, 4)$ a perpendicular is drawn on the plane $2x + y - 2z + 3 = 0$. Find the equation the length and the coordinates of the foot of perpendicular.

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32. Find the co-ordinates of the point P, where the line through A (3,-4,-5) and B(2,-3,1) crosses the plane passing through three points L (2,2,1) , M(3,0,1) and N(4,-1,0). Also , find the ratio in which P divides the line segment AB.

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33. Find the distance of the point (1,-2,3) from the plane x - y + z = 5, measured parallel to the line :

$$\frac{x}{2} = \frac{y}{3} = \frac{z}{-6}.$$

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34. Find the co-ordinates of the foot of the perpendicular and the perpendicular distance of the point (1,3,4) from the plane 2x -y + z + 3 = 0. Find also, the image of the point in the plane.

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35. Find the equation of a plane which meets the axes in $A, BandC,$ given that the centroid of the triangle ABC is the point (α, β, γ)

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36. Find the vector equation of the point determined by the points A (3,-1,2), B (5, 2, 4) and C (-1, -1, 6) Hence, find the distance of the plane, thus obtained, from the origin.

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37. Show that the plane whose vector equation is $\vec{r}\hat{i} + 2\dot{\hat{j}} = \hat{k} = 3$ contains the line whose vector equation is $\vec{r}\hat{i} \dot{+} \hat{j} + \lambda\left(2\hat{i} + \hat{j} + 4\hat{k}\right).$

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38. Find the angle between the line:

$\vec{r} = \left(\hat{i} - \hat{j} + \hat{k}\right) + \lambda\left(2\hat{i} - \hat{j} + 3\hat{k}\right)$ and the plane $\vec{r}\,.\left(2\hat{i} + \hat{j} - \hat{k}\right) = 4.$

Also, find the whether the line is parallel to the plane or not.

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39. Find the point of intersection of the line :

$\vec{r} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) + \lambda\left(2\hat{i} + \hat{j} + 2\hat{k}\right)$ and the plane $\vec{r}\,.\left(2\hat{i} - 6\hat{j} + 3\hat{k}\right)$ + 5 = 0.

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40. Show that the lines whose vector equation is $\vec{r} = \left(\hat{i} + \hat{j}\right) + \lambda\left(2\hat{i} + \hat{j} + 4\hat{k}\right)$ is parallel to the plane whose vector equation is $\vec{r}.\left(\hat{i}+2\hat{j}-\hat{k}\right)=3$, and find the distance between them. Also, state whether the line lies in the plane.

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41. Find the distance from the point (3,4,5) to the point, where the line:

$$\frac{x-3}{1}=\frac{y-4}{2}=\frac{z-5}{2}$$

meets the plane x + y + z = 2.

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42. Find the angle between the plane 2x + 3y - 5z = 10 and the line passing through the points (2,3,-1) and (1,2,1).

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43. State when the line $\vec{r} \cdot \vec{a} + \lambda \vec{b}$ is parallel to the plane $\vec{r} \cdot \vec{n} = ..$ Show that the line $\vec{r} = \hat{i} + \hat{j} + \lambda\left(2\hat{i} + \hat{j} + 4\hat{k}\right)$ is parallel to the plane $\vec{r} \cdot -2\hat{i} + \hat{k} = 5.$ Also, find the distance between the line and the plane.

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44. Find the equation to the plane through the line $\frac{x-\alpha}{l} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$ and parallel to the line $\frac{x}{l'} = \frac{y}{m'} = \frac{z}{n'}.$

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45. If lines : $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect, then find the value of 'k' and hence find the equation of the plane containing these lines.

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46. Find the equation of the plane parallel to the line $\frac{x-2}{1} = \frac{y-1}{3} = \frac{z-3}{2}$, which contains the point (5, 2, -1) and passes through the origin.

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47. Find the equation of the plane containing the line. :

$$\frac{x-1}{2} = \frac{y-2}{-1} = \frac{z-3}{4}$$

and perpendicular to the plane x + 2y + z - 2 = 0 .

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48. Find the vector equation of a line passing through the point (2,3,2) and parallel to the line :

$$\overrightarrow{r} = \left(-2\hat{i} + 3\hat{j}\right) + \lambda\left(2\hat{i} - 3\hat{j} + 6\hat{k}\right).$$

Also, find the distnace between these two lines.

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49. 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.

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50. Find the equation of the plane through the line :

$$\frac{x-1}{3} = \frac{y-4}{2} = \frac{z-4}{-2}$$

and parallel to the line :

$$\frac{x+1}{2} = \frac{y-1}{4} = \frac{z+2}{1}.$$

Hence, find the shortest distance between the lines.

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51. Show that the lines of intersection of the planes :

x + 2y + 3z = 8 and 2x + 4y + 4z = 11

is coplanar with the line $\frac{x+1}{1}+\frac{y+1}{2}=\frac{z+1}{3}$

Also, find the equation of the plane containing them.

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Example

1. Find the vector equation of the line which passes through the point (3,4,5) and is parallel the vector $2\hat{i}+2\hat{j}-3\hat{k}$.

A. $\vec{r}=\left(3\hat{i}+4\hat{j}+5\hat{k}\right)+\lambda\left(2\hat{i}-2\hat{j}-3\hat{k}\right)$

B. $\vec{r}=\left(3\hat{i}+4\hat{j}+5\hat{k}\right)+\lambda\left(2\hat{i}+2\hat{j}-3\hat{k}\right)$

C. $\vec{r}=\left(3\hat{i}-4\hat{j}+5\hat{k}\right)+\lambda\left(2\hat{i}+2\hat{j}-3\hat{k}\right)$

D. $\vec{r}=\left(3\hat{i}+4\hat{j}+5\hat{k}\right)+\lambda\left(5\hat{i}+2\hat{j}-3\hat{k}\right)$

Answer: B

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2. Find the direction-cosines of the line:

$$\frac{x-1}{2} = -y = \frac{z+1}{2}.$$

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3. Find the vector of the line joining (1,2,3) and (-3, 4,3) and show that it is perpendicular to the z-axis.

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4. Find the vector equation of the line through (4,3, -1) and parallel to the line :

$\overrightarrow{r} = \left(2\hat{i} - \hat{j} + 3\hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + 4\hat{k}\right).$

A. $\overrightarrow{r} = \left(4\hat{i} + 3\hat{j} + \hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + 4\hat{k}\right)$

B. $\overrightarrow{r} = \left(4\hat{i} + 3\hat{j} - \hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + 4\hat{k}\right)$

C. $\overrightarrow{r} = \left(4\hat{i} - 3\hat{j} - \hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + 4\hat{k}\right)$

D. $\overrightarrow{r} = \left(4\hat{i} + 3\hat{j} - \hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} - 4\hat{k}\right)$

Answer: B

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5. Find the angle between the following pair of lines :

$\overrightarrow{r} = \hat{i} + \hat{j} - \hat{k} + \lambda\left(\hat{i} - 3\hat{j} + 2\hat{k}\right)$ and

$\overrightarrow{r} = 2\hat{i} - \hat{j} + \mu\left(3\hat{i} + \hat{j} - 2\hat{k}\right).$

A. $\pi + \cos^{-1}\left(\frac{2}{7}\right)$

B. $\cos^{-1}\left(\frac{3}{7}\right)$

C. $\cos^{-1}\left(\frac{2}{7}\right)$

D. $\pi - \cos^{-1}\left(\frac{2}{7}\right)$

Answer: D

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6. Find the angle between the following pair of lines

$$\frac{x-2}{2} = \frac{y-1}{7} = \frac{z+3}{-3} \text{ and } \frac{x-2}{-1} = \frac{2y-8}{4} = \frac{z+5}{4}$$

and check whether the lines are parallel or perpendicular .

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7. Find the points on the line $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$ at a distance of 5 units from the point $P(1, 3, 3,)\cdot$

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8. Find the equations of the line passing through the point (-1,3,-2) and perpendicular to each of the lines $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$ and $\frac{x+2}{-3}=\frac{y-1}{2}=\frac{z+1}{5}$

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9. If $\hat{i}+\hat{j}+\hat{k}, 2\hat{i}+5\hat{j}, 3\hat{i}+2\hat{j}-3\hat{k}$ and $\hat{i}-6\hat{j}-\hat{k}$ respectively are the position vectors of points A, B , C and D, then find the angle between the straight lines AB and CD. Find whether $\overline{AB}$ and $\overline{CD}$ are collinear or not.

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10. Find the value of $'\lambda'$ so the lines:

$\frac{1-x}{3}=\frac{7y-14}{\lambda}=\frac{z-3}{2}$ and $\frac{7-7x}{3\lambda}=\frac{y-5}{1}=\frac{6-z}{5}$

are at right angles. Also, find whether the lines are ntersecting or not .

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11. Find the length of the perpendicular from point (3,4,5) on the line $\frac{x-2}{2}=\frac{y-3}{5}=\frac{z-1}{3}$.

A. $\frac{\sqrt{34}}{4}$

B. $\frac{\sqrt{34}}{2}$

C. $\frac{\sqrt{32}}{2}$

D. $\frac{\sqrt{37}}{2}$

Answer: B

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12. Find the coordinates of the foot of perpendicular drawn from the point $A(1, 8, 4)$ to the line joining the points $B(0, -1, 3)$ and $C(2-3, -1)$.

A. $\left(\frac{5}{3}, \frac{-2}{3}, \frac{19}{3}\right)$

B. $\left(\frac{5}{3}, \frac{2}{3}, \frac{19}{3}\right)$

C. $\left(\frac{-5}{3}, \frac{2}{3}, \frac{19}{3}\right)$

D. $\left(\frac{-5}{3}, \frac{2}{3}, \frac{17}{3}\right)$

Answer: C

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13. Find the vector equation of the line parallel to the line :

$$\frac{x-1}{5} = \frac{3-y}{2} = \frac{z+1}{4}$$

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14. Find the equations of the perpendicular drawn from the point P(2,4,-1) to the line:

$$\frac{x+5}{1}=\frac{y+3}{4}=\frac{z-6}{-9}.$$

Also, write down the co-ordinates of the foot of the perpendicular from P to the line.

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15. Find the image of the point $(1, 6, 3)$ in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$. Also, write the equation of the line joining the given point and its image and find length of the segment joining the given point and its image.

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16. Find the co-ordinates of the foot of perpendicular and the length of the perpendicular drawn from the point P (5,4,2) to the line :

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

Also, find the image of P in this line.

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17. Find the vector and cartesan equation of the plane passing through the poin (1,2,-4) and parallel to the lines.

$$\vec{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$$

and $\vec{r} = \hat{i} - 3\hat{j} + 5\hat{k} + \mu\left(\hat{i} + \hat{j} - \hat{k}\right)$.

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18. Find the vector and cartesian forms of the equation of the plane containing two lines :

$\overrightarrow{r} = (i) + 2\hat{j} - 4\hat{k} + \lambda\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$

and $\overrightarrow{r} = 3\hat{j} - 5\hat{k} + \mu\left(-2\hat{i} + 3\hat{j} + 8\hat{k}\right)$.

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Exercise 11 A Short Answer Type Questions

1. (A) If a line makes angle $90^\circ, 135^\circ, 45^\circ$ with the x , y and z respectively, find its direction-cosines.

(b) If a line has direction-ratio $<$ 2, -1, -2, $>$, determine its direction-cosines.

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2. (A) find the direction-cosines of the lines joining the points :

(-1, -1, -1) and (2,3,4)

(b) Find the direction ratios and direction cosines of the vector joining the points (4,7,2) and (5,11,-4).

(c) Find the direction cosines of a line segment joining the points A (2,5,7) and B (3,2,9) .

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3. Find the length of the projection of the line segment joining (3,4,5) and (4,6,3) on the straight line) :

$$\frac{x-4}{2} = \frac{y-5}{3} = \frac{z-6}{6}$$

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4. Show that the following points are collinear :

(1,2,7) : (2,6,3) : (3,10,-1).

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5. Find the acute angle between the lines whose direction-ratios are :

$< 2, 3, 6 >$ and $< 1, 2, -2, >$.

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6. Find the obtuse angle between two lines whose direction-ratios are :

$< 3, -6, 2 >$ and $< 1, -2, -2 >$.

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7. Find the angle between the lines whose direction ratios are a, b, c and $b-c, c-a, a-b$.

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Exercise 11 A Long Answer Type Questions I

1. Find the direction cosines of the sides of the triangle whose vertices are (3, 5, -4), (-1, 1, 1) and (-5, -5, -2).

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2. Check if lines with direction-cosines :

$$< \frac{12}{13}, -\frac{3}{13}, -\frac{4}{13} >, < \frac{4}{13}, \frac{12}{13}, \frac{3}{13} >, < \frac{3}{13}, \frac{4}{13}, \frac{12}{13} >$$

are mutually perpendicular .

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3. Find the angle between the lines whose direction-cosines are given by :

(i) l + m + n = 0, $l^2 + m^2 - n^2 = 0$

(ii) 2l - m + 2n = 0 , mn + nl + lm = 0 ,

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4. Find the ate area of the triangle whose vertices are :

A (1,2,3) , B (2,-1,4) and C (4,5,-1).

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5. Show that the line thorugh the points (4,7,8) and (2,3,4) $isparal \leq l \rightarrow thel \in ethroughthep \oint s(-1, -2, 1)$ and $(1, 2, 5)$

.

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6. Show that the line joining the origin to the point $(2, 1, 1)$ is perpendicular to the line determined by the points $(3, 5, -1)$ and $(4, 3, -1)$.

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7. Determine the value of k so that the line joining points $A(k, 1, -1)$ and $B(2, 0, 2k)$ is perpendicular to the line joining the points $C(4, 2k, 1)$ and $D(2, 3, 2)$.

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8. Show that the angle between any two diagonals of a cube is $\cos^{-1}\left(\frac{1}{3}\right)$.

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Exercise 11 A Long Answer Type Questions Ii

1. Find the the projection of the line segment joining the points :

(I) (2,-3,0) (0,4,5) on the line with direction cosines $< \frac{2}{7}, \frac{3}{7}, \frac{-6}{7} >$

(ii) (1,2,3), (4,3,1) on the line with direction-ratios $< 3, -6, 2 >$.

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2. If the edges of a rectangular parallelepiped are a,b, c, prove that the angles between the four diagonals are given by $\cos^{-1}\left(\frac{\pm a^2 \pm b^2 \pm c^2}{a^2 + b^2 + c^2}\right)$.

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Exercise 11 B Short Answer Type Questions

1. Show that the three lines with direction cosines $\frac{12}{13}, \frac{-3}{13}, \frac{-4}{13}; \frac{4}{13}, \frac{12}{13}, \frac{3}{13}; \frac{3}{13}, \frac{-4}{13}, \frac{12}{13}$ are mutually perpendicular.

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2. Express the following equation of the lines into vector form :

$$\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$$

and $\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$

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3. Find the cartesian as well as the vector equation of the line passing through :

(i) (-2, 4, -5) and parallel to the line :

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

(ii) (0,-1,4) and parallel to the straight line :

$$\frac{-x-2}{1}=\frac{y+3}{7}-\frac{2z-6}{3}.$$

(iii) (-1, 2,3) and parallel to the line :

$$\frac{x-3}{2}=\frac{y+1}{3}=\frac{z-1}{6}$$

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4. (A) The cartesian equations of a line are :

$(i)\frac{x-5}{3}=\frac{y+4}{7}=\frac{z-6}{2}$

(ii) $\frac{x+3}{2}=\frac{y-5}{4}=\frac{z+6}{2}$. Find the vector equations of the lines.

(b) find the vector equation of the line passing through the point A (1,2, - 1) and parallel to the line :

5 x - 25 = 14 - 7y = 35 z.

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5. (A) find the equation of a line parallel to x-axis and passing through the origin.

(b) Find the direction-cosines of a line parallel to the line :

$$\frac{2x-5}{4}=\frac{y+4}{3}=\frac{6-z}{6}.$$

(c) Write the direction-cosines of a line parallel to the line :

$$\frac{3-x}{3}=\frac{y+2}{-2}=\frac{z+2}{6}.$$

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6. (A) Find the vector and cartesian equations of the line through the point (5,2,-4) and which is parallel to the vector 3 $\hat{i}+2\hat{j}-8\hat{k}$.

(b) Find the equation of a line passing through the point P(2, -1, 3) and perpendicular to the lines :

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

and $\vec{r}=\left(2\hat{i}-\hat{j}-3\hat{k}\right)+\mu\left(\hat{i}+2\hat{j}+2\hat{k}\right)$.

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7. Find the equation of the line in vector and in cartesian form that passes through the point with position vector $2\hat{i}-\hat{j}+4\hat{k}$ and is in the direction $\hat{i}+2\hat{j}-\hat{k}$.

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8. Find the vector equation of the line passing thought the points $(-1, 0, 2) and (3, 4, 6)$.

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9. Find the vector and cartesian equations of the line that passes through :

(i) the origin and (5, -2, 3)

(ii) the points (1,2,3) and (2,-1,4)

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10. (A) Find the equation of a st. line through (-1,2,3) and equally inclined to the axea.

(b) Find the equation of a line parallel to x-axis and passing through the origin.

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11. Find the angle between the pairs of lines with direction-ratios :

(i) $< 5, -12, 13 >, < -3, 4, 5 >$

(ii) $< a, b, c >, < b, -c, c-a, a-b >$

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12. The angle between a line with direction ratios proportional to $2, 2, 1$ and a line joining $(3, 1, 4)$ and $(7, 2, 12)$ is

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13. Find the angle between the following pairs of lines :

(i) $\overrightarrow{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda\left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$.

$\overrightarrow{r} = 5\hat{j} - 2\hat{k} + \mu\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right)$

(ii) $\overrightarrow{r} = 3\hat{i} + \hat{j} - 2\hat{k} + \lambda\left(\hat{i} - \hat{j} - 2\hat{k}\right)$.

$\overrightarrow{r} = \left(2\hat{i} - \hat{j} - 56\hat{k}\right) + \mu\left(3\hat{i} - 5\hat{j} - 4\hat{k}\right)$

(iii) $\dfrac{x-2}{2} = \dfrac{y-1}{5} = \dfrac{z+3}{-3}$

and $\dfrac{x+2}{-1} = \dfrac{y-4}{8} = \dfrac{z-5}{4}$

(iv) $\dfrac{x-4}{3} = \dfrac{y+1}{4} = \dfrac{z-6}{5}$ and $\dfrac{x-5}{1} = \dfrac{2y+5}{-2} = \dfrac{z-3}{1}$

(v) $\dfrac{5-x}{3} = \dfrac{y+3}{-4}, z = 7$ and $x = \dfrac{1-y}{2} = \dfrac{z-6}{2}$

(vi) $\dfrac{x+3}{3} = \dfrac{y-1}{5} = \dfrac{z+3}{4}$ and $\dfrac{x+1}{1} = \dfrac{y-4}{1} = \dfrac{z-5}{2}$.

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14. Show that the lines :

(i) $\frac{x-5}{7}=\frac{y+2}{-5}=\frac{z}{1}$ and $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$

(ii) $\frac{x-3}{2}=\frac{y+1}{-3}=\frac{z-2}{4}$ and $\frac{x+2}{2}=\frac{y-4}{4}=\frac{z+5}{2}$

are perpendicular to each other .

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15. (i) Find the value of 'p' so that the lines :

$$l_1 : \frac{1-x}{3}=\frac{7y-14}{2p}=\frac{z-3}{2} \text{ and } l_2 : \frac{7-7x}{3p}=\frac{y-5}{1}=\frac{6-z}{5}$$

are at right angles.

Also, find the equations of the line passing through (3,2, -4) and parallel to line l_1.

(ii) Find 'k' so that the lines :

$$\frac{x-3}{2}=\frac{y+1}{3}=\frac{z-2}{2k} \text{ and } \frac{x+2}{1}=\frac{4-y}{k}=\frac{z+5}{1}$$

are perpendicular to each other.

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16. Show that the line through the points :

(a) (1, -1, 2), (3,4,-2) is perpendicular to the line through the points (0,3,2) and (3, 5,6)

(b) (4,7,8) , (2,3,4) is parallel to the line through the points (-1, -2, 1) and (1,2,5) .

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Exercise 11 B Long Answer Type Questions I

1. The Cartesian equations of a line are $3x+1=6y-2=1-z$, finding the fixed point through which it passes, its direction ratios and also its vector equation.

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2. The points A(4, 5, 10), B(2, 3, 4) and C (1, 2,-1) are three vertices of a parallelogram ABCD. Find the vector equations of the sides AB and BC and also find the coordinates of point D.

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3. Write the equation of a line , parallel to the line $\frac{x-2}{-3}=\frac{y+3}{2}=(z+3)$ and passing through the point (1,2,3).

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4. Find the equation of the line perpendicular to the lines :

$\overrightarrow{r}=\left(3\hat{i}+2\hat{j}-4\hat{k}\right)+\lambda\left(\hat{i}+2\hat{j}-2\hat{k}\right)$

and $\overrightarrow{r}=\left(5\hat{j}-2\hat{k}+\mu\left(3\hat{i}+2\hat{j}+6\hat{k}\right)\right.$ and passing through the point (1,1,1) .

5. (i) Find the equations of the straight line passing through the point (2,3,-1) and is perpendicular to the lines :

$$\frac{x-2}{2}=\frac{y+1}{1}=\frac{z-3}{-3} \text{ and } \frac{x-3}{1}=\frac{y+2}{1}=\frac{z-1}{1}.$$

(ii) Find the equation of the line which intersects the lines :

$$\frac{x+2}{1}=\frac{y-3}{2}=\frac{z+1}{4} \text{ and } \frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$$

Perpendicular and passes through the point (1,1,1) .

6. Find the equation in vector and cartesian form of the line passing through the point :

(2,-1, 3) and perpendicular to the lines :

$\vec{r}=\left(\hat{i}+\hat{j}-\hat{k}\right)+\lambda\left(2\hat{i}-2\hat{j}+\hat{k}\right)$ and

$\vec{r}=\left(2\hat{i}-\hat{j}-3\hat{k}\right)+\mu\left(\hat{i}+2\hat{j}+2\hat{k}\right).$

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7. Prove that the points A (1,2,3) , B (4,0,4), C (-2,4,2) and (7,-2,5) and collinear.

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8. Show that the following points whose position vectors are given are collinear :

(i) 5 $\hat{i}+5\hat{k}, 2\hat{i}+\hat{j}+3\hat{k}$ and $-4\hat{i}+3\hat{j}-\hat{k}$

(ii) $-2\hat{i}+3\hat{j}+5\hat{k}, \hat{i}+2\hat{j}+3\hat{k}$ and $7\hat{i}-\hat{k}$.

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9. Find the points on the line through the points A (1,2,3) and B (5,8 ,15) at a distance of 14 units from the mid-point of AB.

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10. Show that the line joining the origin to the point $(2, 1, 1)$ is perpendicular to the line determined by the points $(3, 5, -1)$ and $(4, 3, -1)$.

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Exercise 11 B Long Answer Type Questions Ii

1. (i) Find the vector and cartesian equation of the line passing through the point (1,2,-4) and perpendicular to the two lines :

$$\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7} \text{ and } \frac{x-15}{3} = \frac{y-19}{8} = \frac{z-5}{-5}.$$

(ii) Find the vector and cartesian equations of the line passing through the point (2,1,3) and perpendicular to the lines :

$$\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3} \text{ and } \frac{x}{-3} = \frac{y}{2} = \frac{z}{5}.$$

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2. (i) Find the vector equation of a line passing through a point with position vector $2\hat{i} - \hat{j} + \hat{k}$ and parallel to the line joining the points with position vectors $-\hat{i} + 4\hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 2\hat{k}$. Also, find the cartesian equivalent of the equation.

(ii) Find the vector equation of a line passing through the point with position vector $\hat{i} - 2\hat{j} - 3\hat{k}$ and parallel to the line joining the points with position vectors $\hat{i} - \hat{j} + 4\hat{k}$ and $2\hat{i} + \hat{j} + 2\hat{k}$. Also, find the cartesian form of the equation.

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Exercise 11 C Long Answer Type Questions I

1. Find the distance of the point (1,-2,3) from the line joining the points (-1,2,5) and (2,3,4).

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2. Find the distance of the point (1,2,3) from the cor-ordinate axes.

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3. Find the distance of (-1,2,5) from the plane passing through the point (3,4,5)and whose direction-ratios are $< 2, \ -3, 6 >$.

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4. 2/ Find the perpendicular distance of the point (1, 0, 0) from the line $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$ Also, and the coordinates of the

foot of the perpendicular and the equation of the perpendicular.

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5. (a) Find the length of the perpendicular from the point (1,2,3) to the line :

$$\frac{x-6}{3}=\frac{y-7}{2}=\frac{z-7}{-2}.$$

(b) Find the perpendicular distance from the point (1,2,3) to the line :

$$\vec{r}=6\hat{i}+7\hat{j}+7\hat{k}+\lambda\left(3\hat{i}+2\hat{j}-2\hat{k}\right).$$

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6. (a) Find the foot of the perpendicular from the point (i) (2, -1,5) on the line :

$$\frac{x-11}{10}=\frac{y+2}{-5}=\frac{z+8}{11}$$

(ii) (0,2,3) on the line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$.

(b) Also, find the length of perpendicular in part (ii).

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7. Find the coordinates of the foot of the perpendicular drawn from point $A(1, 0, 3)$ to the join of points $B(4, 7, 1) and C(3, 5, 3)\cdot$

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8. $A91, 0, 4), B(0, -11, 3), C(2, -3, 1)$ are three points and D is the foot of perpendicular from A to BC. Find the coordinates of D.

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9. Find the perpendicular distance of an angular point of a cube from a diagona which does not pass through that angular point.

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Exercise 11 C Long Answer Type Questions Ii

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

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2. Let the point P (5,9,3) lie on the top of Qutub Minar , Delhi. Find the image of the point on the line :

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}.$$

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3. Find the foot of the perpendicular from the point (1,2,3) to the line joining the points (6,7,7) and (9,9,5) .

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4. Find the length and the foot of the perpendicular drawn from the point $(2, -1, 5)$ to the line $\frac{x-11}{10} = \frac{y+2}{-4} = \frac{x+8}{11}$

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5. Find the equation of the perpendicular drawn from (2,4,-1) to the line $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{3}$.

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6. 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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7. Find the equation of the perpendicular from point $(3, -1, 11)$ to line $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$. Also, find the coordinates of foot of perpendicular and the length of perpendicular.

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8. A line passing through the point A with position vector $\vec{a} = 4\hat{i} + 2\hat{j} + 2\hat{k}$ is parallel to the vector $\vec{b} = 2\hat{i} + 3\hat{j} + 6\hat{k}$. Find the length of the perpendicular drawn on this line from a point P with position vector $\vec{r_1} = \hat{i} + 2\hat{j} + 3\hat{k}$.

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Exercise 11 D Long Answer Type Questions I

1. Find the shortest distance between the following (1-4) lines whose vector equations are :

1. $\overrightarrow{r}=\hat{i}+\hat{j}+\lambda\left(2\hat{i}-\hat{j}+\hat{k}\right)$

and $\overrightarrow{r}=2\hat{i}+\hat{j}-\hat{k}+\mu\left(3\hat{i}-5\hat{j}+2\hat{k}\right)$.

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2. Find the shortest distance between the lines:

$(i)\overrightarrow{r}=3\hat{i}+8\hat{j}+3\hat{k}+\lambda\left(3\hat{i}-\hat{j}+\hat{k}\right)$

$\text{and }\overrightarrow{r}=-3\hat{i}-7\hat{j}+6\hat{k}+\mu\left(-3\hat{i}+2\hat{j}+4\hat{k}\right)$

(ii) $\left(\hat{i}-\hat{j}+2\hat{k}\right)+\lambda\left(-2\hat{i}+\hat{j}+3\hat{k}\right)$

$\text{and }\left(2\hat{i}+3\hat{j}-\hat{k}\right)+\mu\left(3\hat{i}-2\hat{j}+2\hat{k}\right)$.

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

and $\vec{r} = \left(4\hat{i} + 5\hat{j} + 6\hat{k}\right) + \mu\left(2\hat{i} + 3\hat{j} + \hat{k}\right)$.

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3. Find the shortest distance between the lines:

$(i)\ \vec{r} = 6\hat{i} + 2\hat{j} + 2\hat{k} + \lambda\left(\hat{i} - 2\hat{j} + 2\hat{k}\right)$

$\text{and } \vec{r} = -4\hat{i} - \hat{k} + \mu\left(3\hat{i} - 2\hat{j} - 2\hat{k}\right)$

(ii) $\vec{r} = \left(4\hat{i} - \hat{j}\right) + \lambda\left(\hat{i} + 2\hat{j} - 3\hat{k}\right)$

$\text{and } \vec{r} = \left(\hat{i} - \hat{j} + 2\hat{k}\right) + \mu\left(2\hat{i} + 4\hat{j} - 5\hat{k}\right)$

(iii) $\vec{r} = \left(\hat{i} + 2\hat{j} - 4\hat{k}\right) + \lambda\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$

and $\vec{r} = \left(3\hat{i} + 3\hat{j} + 5\hat{k}\right) + \mu\left(-2\hat{i} + 3\hat{j} + 6\hat{k}\right)$

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4. Find the shortest distance between the following (1-4) lines whose vector equations are :

(i) $\vec{r} = (\lambda - 1)\hat{i} + (\lambda - 1)\hat{j} - (1 + \lambda)\hat{k}$

and $\vec{r} = (1 - \mu)\hat{i} + (2\mu - 1)\hat{j} + (\mu + 2)\hat{k}$

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

and $\vec{r} = 2(1 + \mu)\hat{i} - (1 - \mu)\hat{j} + (-1 + 2\mu)\hat{k}$.

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5. Consider the equations of the straight lines given by :

$L_1 : \vec{r} = \left(\hat{i} + 2\hat{j} + \hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right)$

$L_2 : \vec{r} = \left(2\hat{i} - \hat{j} - \hat{k}\right) + \mu\left(2\hat{i} + \hat{j} + 2\hat{k}\right)$.

If $\vec{a_1} = \hat{i} + 2\hat{j} + \hat{k}$, $\quad \vec{b_1} = \hat{i} - \hat{j} + \hat{k}$,

$\vec{a_2} = 2\hat{i} - \hat{j} - \hat{k}$, $\vec{b_2} = 2\hat{i} + \hat{j} + 2\hat{k}$, then find :

(i) $\vec{a_2} - \vec{a_1}$ $\qquad$ $(ii)\,\vec{b_2} - \vec{b_1}$

(iii) $\vec{b_1} \times \vec{b_2}$ $\qquad$ $(iv)\,\vec{a_1} \times \vec{a_2}$

(v) $\left(\vec{b_1} \times \vec{b_2}\right) . \left(\vec{a_1} \times \vec{a_2}\right)$

(vi) the shortest distance between L_1 and L_2 .

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6. Find the shortest distance between the following (6 -7) lines whose vector equations are :

$(i)\overrightarrow{r}=(1-t)\hat{i}+(t-2)\hat{j}+(3-2t)\hat{k}$

and $\overrightarrow{r}=(s+1)\hat{i}+(2s-1)\hat{j}-(2s+1)\hat{k}$

(ii) $\overrightarrow{r}=(3-t)\hat{i}+(4+2t)\hat{j}+(t-2)\hat{k}$

and $\overrightarrow{r}=(1+s)\hat{i}+(3s-7)\hat{j}+(2s-2)\hat{k}.$

where t and s are scalars.

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7. Find the shortest distance between the following lines whose vector equations are :

(i) $\overrightarrow{r}=(8+3\lambda)\hat{i}-(9+16\lambda)\hat{j}+(10+7\lambda)\hat{k}$

and $\overrightarrow{r}=15\hat{i}+29\hat{j}+5\hat{k}+\mu\left(3\hat{i}+8\hat{j}-5\hat{k}\right)$

(ii) $\vec{r} = 3\hat{i} - 15\hat{j} + 9\hat{k} + \lambda\left(2\hat{i} - 7\hat{j} + 5\hat{k}\right)$

and $\vec{r} = (2\mu - 1)\hat{i} + (1 + \mu)\hat{j} + (9 - 3\mu)\hat{k}$.

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8. Find the S.D. between the lines :

(i) $\frac{x}{2} = \frac{y}{-3} = \frac{z}{1}$ and $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+4}{2}$

(ii) $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{2}$ and $\frac{x+1}{3} = \frac{y-1}{2} = \frac{z-1}{5}$

(iii) $\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$

(iv) $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$.

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9. Determine whether or not the following pairs of lines intersect :

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

and $\vec{r} = \left(\hat{i} - \hat{j} - \hat{k}\right) + \mu\left(\hat{i} + 2\hat{j} - 2\hat{k}\right)$.

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10. Determine whether or not the following pairs of lines intersect

:

$\overrightarrow{r} = (2\lambda + 1)\hat{i} - (\lambda + 1)\hat{j} + (\lambda + 1)\hat{k}.$

and $\overrightarrow{r} = (3\mu + 2)\hat{i} - (5\mu + 5)\hat{j} + (2\mu - 1)\hat{k}.$

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11. Determine whether or not the following pairs of lines intersect :

$\frac{x-1}{2} = \frac{y+1}{3} = z, \frac{x+1}{5} = \frac{y-2}{1} = \frac{z-2}{0}.$

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12. Prove that the lines : $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and

$\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ are coplanar.

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Exercise 11 D Long Answer Type Questions Ii

1. Find the shortest distance and the equation of the shortest distance between the following two lines :

$\overrightarrow{r} = \left(-\hat{i} + \hat{j} + 9\hat{k}\right) + \lambda\left(2\hat{i} + \hat{j} - 3\hat{k}\right)$

and $\overrightarrow{r} = \left(3\hat{i} - 15\hat{j} + 9\hat{k}\right) + \mu\left(2\hat{i} - 7\hat{j} + 5\hat{k}\right)$.

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2. Find the shortest distance and the vector equation of the line of shortest distance between the lines given by :

$(i)\ \overrightarrow{r} = \left(-4\hat{i} + 4\hat{j} + \hat{k}\right) + \lambda\left(\hat{i} + \hat{j} - \hat{k}\right)$

and $\overrightarrow{r} = \left(-3\hat{i} - 8\hat{j} - 3\hat{k}\right) + \mu\left(2\hat{i} + 3\hat{j} + 3\hat{k}\right)$

$(ii)\ \overrightarrow{r} = \left(-\hat{i} + 5\hat{j}\right) + \lambda\left(-\hat{i} + \hat{j} + \hat{k}\right)$

and $\overrightarrow{r} = \left(-\hat{i} - 3\hat{j} + 2\hat{k}\right) + \mu\left(3\hat{i} + 2\hat{j} + \hat{k}\right)$.

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3. Write the vector equations of the following lines and hence determine the distance between them $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z+4}{6} and \frac{x-3}{4}=\frac{y-3}{6}=\frac{z+5}{12}$

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4. Show that the lines : $\frac{x+1}{3}=\frac{y+3}{5}=\frac{z+5}{7}$

and $\frac{x-2}{1}=\frac{y-4}{3}=\frac{z-6}{5}$

intersect each other. Also, find the their point of intersection.

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5. Show that the lines :

$\overrightarrow{r}=3\hat{i}+2\hat{j}-4\hat{k}+\lambda\left(\hat{i}+2\hat{j}+2\hat{k}\right)$

and $\vec{r} = 5\hat{i} - 2\hat{j} + \mu\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right)$

(ii) $\vec{r} = \left(\hat{i} + \hat{j} - \hat{k}\right) + \lambda\left(3\hat{i} - \hat{j}\right)$.

and $\vec{r} = \left(4\hat{i} - \hat{k}\right) + \mu\left(2\hat{i} + 3\hat{k}\right)$

are intersecting. Hence, find their point of intersection.

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6. Show that the lines :

(a) $\frac{x-1}{3} = \frac{y+1}{5}$ and $\frac{x-2}{4} = \frac{y-1}{3} = \frac{z+1}{-2}$

(b) $\vec{r} = \left(\hat{i} + \hat{j}\right) + \lambda\left(2\hat{i} - \hat{k}\right)$

and $\vec{r} = \left(2\hat{i} - \hat{j}\right) + \mu\left(\hat{i} + \hat{k} - \hat{k}\right)$ do not intersect.

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7. Find the shortest distance between the lines

$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} and \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$.

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8. 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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9. 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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10. Find the equations of the lines joining the following pair of vertices and then find its shortest distance between the lines :

(i) (0,0,0), (1,0,2) (ii) (1,3,0), (0,3,0).

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Exercise 11 E Short Answer Type Questions

1. Find the vector equation of a plane which is at a distance of 7 units from the origin and which is normal to the vector $3\hat{i} + 5\hat{j} - 6\hat{k}$.

(ii) Find the vector equation of a plane , which is at a distance of 5 units from the origin and its normal vector is

2 $\hat{i} - 3\hat{j} + 6\hat{k}$.

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2. Find the vector equation of the line through the origin, which is perpendicular to the plane $\vec{r} . \left(\hat{i} - 2\hat{j} + \hat{k}\right)$ = 3 .

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3. Find the distance of the point (2,3,4) from the plane :

$\vec{r}.\left(3\hat{i} - 6\hat{j} + 2\hat{k}\right) = -11.$

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4. (i) Find the distance from (1,2,3) to the plane 2x + 3y - z + 2 = 0 .

Find the length of perpendicular drawn from the origin to the plane 2x - 3y + 6z + 21 = 0.

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5. Find the angle between the planes :

(i) 3 x - 6y - 2z = 7 2x + y - 2z = 5

(ii) 4 x + 8y + z = 8 and y + z = 4

(iii) 2 x - y + z =6 and x + y + 2z = 7 .

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6. Angle between the planes:

(i) $\overrightarrow{r}.\left(\hat{i}-2\hat{j}-\hat{k}\right)=1$ and $\overrightarrow{r}.\left(3\hat{i}-6\hat{j}+2\hat{k}\right)$ = 0

(ii) $\overrightarrow{r}.\left(2\hat{i}+2\hat{j}-3\hat{k}\right)=5$ and $\overrightarrow{r}.\left(3\hat{i}-3\hat{j}+5\hat{k}\right)=3$

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7. (i) The position vectors of two points A and B are $3\hat{i}+\hat{j}+2\hat{k}$ and $\hat{i}-2\hat{j}-4\hat{k}$ respectively. Find the vector equation of the plane passing throug B and perpendicular to $\overrightarrow{AB}$.

(ii) Find the vector equation of the plane through the point (2,0, -1) and perpendicular to the line joining the two points (1,2,3,) and (3, -1, 6).

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8. Find the equation of the plane passing through the point $(1, 2, 1)$ and perpendicular to the line joining the points $(1, 4, 2) and (2, 3, 5)$. find also the perpendicular distance of the origin from this plane.

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9. Find the vector and Cartesian equations of the plane which passes through the point (5,2-4) and perpendicular to the line with direction ratios 2,3,-1.

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10. Find the vector and cartesian equation of the plane :

(i) that passes through the point (5,2,-4) and perpendicular to the line with direction-ratios $< 2, 3, -1 >$

(ii) that passes through the point (1,0, -2) and the normal to the plane is $\hat{i} + \hat{j} - \hat{k}$

(iii) that passes through the point (1,4,6) and the normal vector to the plane is $\hat{i} - 2\hat{j} + \hat{k}$.

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11. Find the length of the perpendicular from the point (2,3,7) to the plane 3 x - y - z = 7 . Also , find the co-ordinates of the foot of the perpendicular .

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12. In the following, find the distance of each of the given points from the corresponding given planes :

Point	Plane
(i) (0,0,0)	$2x - y + 2z + 1 = 0$
$(ii)(3, -2, 1)$	$2x - y + 2z + 3 = 0$
$(iii)(-6, 0, 0)$	$2x - 3y + 6z - 2 = 0$
$(iv)(2, 3, -5)$	$x + 2y - 2z = 9.$

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13. In the following, determine the direction-cosines of the normal to the plane and the distance from the origin :

(i) z = 2 (ii) 5y + 8 = 0.

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14. If the points $(1, 1, p)$ and $(3, 0, 1)$ be equidistant from the plane $\rightarrow r3\hat{i} + 4\hat{j} - 12\hat{k} + 13 = 0$, then find the value of p.

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15. In the following cases, find the co-ordinates of the foot of the perpendicular drawn from the origin to the plane :

(i) $2x + 3y + 4z - 12 = 0$

(ii) $3y + 4z - 6 = 0$

(iii) $x + y + z = 1$

(iv) $5y + 8 = 0$.

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

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17. (i) Find the vector equation of the line passing through (1,2,3) and parallel to the planes :

$\vec{r}.\left(\hat{i}-\hat{j}+2\hat{k}\right)=5$ and $\vec{r}.\left(3\hat{i}+\hat{j}+\hat{k}\right)$ = 6 .

(ii) Find the vector equation of the straight line passing through (1,2,3) and perpendicular to the plane :

$\vec{r}.\left(\hat{i}+2\hat{j}-5\hat{k}\right)+9=0.$

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18. (i) Find the equations of the plane passing through (a,b,c) and parallel to the plane $\vec{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=2.$

(ii) Find the vector equation of the plane through the point $\hat{i}+\hat{j}+\hat{k}$ and parallel to the plane $\vec{r}.\left(2\hat{i}-\hat{j}+2\hat{k}\right)=5.$

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19. Find the vector and catesian equations of the plane containing the lines :

$\overrightarrow{r} = 2\hat{i} + \hat{j} - 3\hat{k} + \lambda\left(\hat{i} + 2\hat{j} + 5\hat{k}\right)$

and $\overrightarrow{r} = 3\hat{i} + 3\hat{j} - 7\hat{k} + \mu\left(3\hat{i} - 2\hat{j} + 5\hat{k}\right)$.

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20. Find the angle between the lines

$x - 2y + z = 0 = x + 2y - 2z and x + 2y + z = 0 = 3x + 9y + 5z.$

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21. Show that the line 3x - 2y + 5 = 0 , y + 3z - 15 = 0 and

$\frac{x-1}{5} = \frac{y+5}{-3} = \frac{z}{1}$ are perpendicular to each other .

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22. Find the equations of the line passing through the point (1, -2, 3) and parallel to the planes :

$x - y + 2z = 5$ and $3x + 2y - z = 6$.

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23. Find the equation of the plane which bisects the line segment joining the points (-1, 2, 3) and (3, -5, 6) at right angles.

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Exercise 11 E Long Answer Type Questions I

1. (A) Find the equation of the plane through the intersection of the plane :

$3x - y + 2z - 4 = 0$ and $x + y + z - 2 = 0$

and the point (2,2,1).

(b) Find the vector equation of the plane through the intersection of the planes :

$\vec{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=6$ and $\vec{r}.\left(2\hat{i}+3\hat{j}+4\hat{k}\right)=-5$ at the point. (1,1,1).

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2. Find the vector equation of the following planes in cartesian form :

$$\vec{r}=\hat{i}-\hat{j}+\lambda\left(\hat{i}+\hat{j}+\hat{k}\right)+\mu\left(\hat{i}-2\hat{j}+3\hat{k}\right).$$

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3. Find the equations of the plane that passes through three points (1,1,0),(1,2,1),(-2,2,-1).

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4. Find the equations of the faces of the tetrahedron whose vertices are the points:

(0,0,0) , (0,3,0) , (2,1,0) , (1,1,2).

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5. (i) Find the distance of the point P (6,5,9) from the plane determined by the points A (3,-1,2) B (5,2,4) and C (-1,-1,6).

(ii) Find the distance between the point (7,2,4) and the plane determined by the points.

A (2,5,-3) B (-2,-3,5) and C (5,3,-3,) .

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6. (i) Find the equation of the plane through the points (2,-3,1) and (5,2,-1) and perpendicular to the plane x -2y + 4z = 10 .

(ii) Find the vector equation of the plane through the points (2,1,-1) and (-1,3,4) and perpendicular to the plane x - 2y + 4z = 10.

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7. Find the Cartesian equation of the plane passing through the points $A(0, 0, 0)$ and $b(3, -1, 2)$ and parallel to the line $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$

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8. (a) show that the following four points are coplanar :

(i) (4,5,1), (0,-1,-1) ,(3,9,4) and (-4,4,4)

(ii) (0,-1,0), (2 , 1 , -1) , (1,1,1) and (3,3,0).

(b) Show that the four points : (0,-1,-1), (4,5,1), (3,9,4) and (-4,4,4) are coplanar.

Also,find the equation of the plane containing them .

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9. The foot of the perpendicular drawn from the origin to a plane is (2, -3, -4). Find the equation of the plane.

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10. (I) Find the foot and length of the perpendicular from the point (3,4,5) to the plane :

$2x - 5y + 3z = 39$.

(ii) Find the length and the foot of the perpendicular from the point (7,14,5) to the plane $2x + 4y - z = 2$.

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11. find the coordinates of point where the line through (3,-4,-5) and (2,-3,1) crosses the plane $2x + y + z = 7$.

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12. If x co-ordinate of a point on the line joining points (2,2,1) and (5,1,-2) is 4, then its z co-ordinate will be

A. 1

B. -1

C. 2

D. -2

Answer: B

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13. (i) Find the equation of the plane passing through the intersection of the planes :

2x - 7y + 4z = 3 and 3x - 5y + 4z + 11 = 0 and the point (-2, 1,3).

(ii) Find the equation of plane through the intersection of planes :

3x - y + 2z - 4 = 0 and x + y + z - 2 = 0 and the point (2,2,1) .

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14. (i) Find the vector equation of the plane through the intersection of the planes :

$\overrightarrow{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=6, \overrightarrow{r}.\left(2\hat{i}+3\hat{j}+4\hat{k}\right)=-5$

and the point (1,1,1).

(ii) Find the equation of the plane which contains the line of intersection of the planes :

$\overrightarrow{r}.\left(\hat{i}+2\hat{j}+3\hat{k}\right)-4=0. \overrightarrow{r}.\left(2\hat{i}+\hat{j}-\hat{k}\right)+5=0$

and which is perpendicular to the plane :

$\overrightarrow{r} . \left(5\hat{i} + 3\hat{j} - 6\hat{k}\right)$ + 8 = 0 .

(iii) Find the equation the plane passing through the intersection of the planes x + y + z = 6 and 2x + 3y + 4z + 5 = 0 and the point (1,1,1) .

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15. Find the equation of the plane through the line of intersection of the planes $x + y + z = 1$ and $2x + 3y + 4z = 5$ which is perpendicular to the plane $x - y + z = 0$

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16. Find the equation of a plane through the intersection of the planes :

$\vec{r}\left(2\hat{i}+\hat{j}+3\hat{k}\right)=7$ and $\vec{r}.\left(2\hat{i}+3\hat{j}+3\hat{k}\right)=9$

and passing through the point (2,1,3).

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17. Find the equation of the plane passing through the line of intersection of the planes $\vec{r}.\left(\hat{i}+3\hat{j}\right)-6=0$ and $\vec{r}.\left(3\hat{i}-\hat{j}-4\hat{k}\right)=0,$ whose perpendicular distance from the origin is unity.

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18. Find the equation of the plane passing through the line of intersection of the planes :

2x + y - z = 3 and 5x - 3y + 4z = 9

and parallel to the line $\dfrac{x-1}{2}=\dfrac{y-3}{4}=\dfrac{z-5}{5}$.

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19. Find the equation of the plane passing through the intersection of the planes $2x+3y-z+1=0 and x+y-2z+3=0$ and perpendicular to the plane $3x-y-2z-4=0.$

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20. (i) Find the equation of the plane passing through (1,-1,2) and perpendicular to the planes :

2 x + 3y - 2z = 5 , x + 2y - 3z = 8 .

(ii) find the equation of the plane passing through the point (1,1,-1) and perpendicular to each of the planes :

x + 2y + 3z - 7 = 0 and 2x - 3y + 4z = 0 .

(iii) Find the equation of the plane passing through the point

(-1,-1,2) and perpendicular to the planes :

3x + 2y - 3z = 1 and 5x - 4y + z = 5.

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Exercise 11 E Long Answer Type Questions Ii

1. (i) Find the distance of the point (-2,3,-4) from the line :

$$\frac{x+2}{3}=\frac{2y+3}{4}=\frac{3z+4}{5},$$

measured parallel to the plane $4x+12y-3z+1=0$.

(ii) Find the distance of the point $-2\hat{i}+3\hat{j}-4\hat{k}$ from the line :

$$\vec{r}=\hat{i}+2\hat{j}-\hat{k}+\lambda\left(\hat{i}+3\hat{j}-9\hat{k}\right)$$

measured parallel to the plane $x-y+2z-3=0$

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2. Find the ratio in which the line-segment joining the points :

(i) (2,1,5) and (3,4,3) is divided by the plane :

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

(ii) (1,2,3) and (-3,4,-5) is divided by the xy-plane

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3. Find the equation of the plane passing through the point $(1, 2, 1)$ and perpendicular to the line joining the points $(1, 4, 2) and (2, 3, 5)$. find also the perpendicular distance of the origin from this plane.

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4. Find the image of the point :

(i) (2,-3,2) in the plane 2x + y - 3z = 10

(ii) (1,2,3) in the plane $x + 2y + 4z = 38$

(iii) (2,-1,3) in the plane $3x - 2y - z = 9$.

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5. (i) Find the co-ordinates of foot of perpendicular drawn from the point (2,3,5) on the plane given by the equation :

$2x - 3y + 4z + 10 = 0$.

(ii) Find the distance between the point (2,3,-1) and foot of perpendicular drawn from (3,1,-1) to the plane $x - y + 3z = 10$.

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6. The foot of the perpendicular drawn from origin to a plane is (4,-2,5).

(a) How far is the plane from the origin ?

(b) Find a unit vector perpendicular to that plane.

(c) Obtain the equation of the plane in general form.

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7. Find the co-ordinates of the foot of the perpendicular Q drawn from P (3,2,1) so that plane 2x - y + z + 1 = 0. Also, find the distance PQ and the image of the point P treating this plane as a mirror.

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

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9. Find the distance of the point P (1,2,3) from its image in the plane x + 2y + 4z = 38.

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10. Find the coordinates of the point where the line through $(3, -4, -5)$ and (2-3,1) crosses the plane passing through the points (2,2,1),(3,0,1) and (4,-1,0).

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11. (i) A variable plane, which remains at a constant distance '3p' from the origin cuts the co-ordinate axes at A, B, C. Show that the locus of the centroid of the triangle ABC is :

$$\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{1}{p^2}.$$

(ii) A variable is at a constant distance 'p' from the origin and meets the axes in A, B, C respectively, then show that locus of the centroid of th triangle ABC is :

$$\frac{1}{x^2}+\frac{1}{y^2}+\frac{1}{z^2}=\frac{9}{p^2}.$$

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12. If a plane has intercepts a,b,c on axes and is at a distance of p units from the origin then prove that $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}=\frac{1}{p^2}$

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13. A variable plane passes through a fixed point (a,b,c) and meets the co-ordinate axes in A, B, C. Show that the locus of the point common to the planes through A, B, C parallel to the co-ordiante planes is $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=1.$

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14. A variable plane moves in such a way that the sum of the reciprocals of its intercepts on the three coordinate axes is constant. Show that the plane passes through a fixed point.

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15. Differentiate$e^{\tan x} \cos x$

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16. 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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17. In the following determine whether the given planes are parallel or perpendicular and in case they are neither, find the angles between them :

(i) $7x + 5y + 6z + 30 = 0$ and $3x - y - 10z + 4 = 0$

(ii) $2x + y + 3z - 2 = 0$ and $x - 2y + 5 = 0$

(iii) $2x - 2y + 4z + 5 = 0$ and $3x - 3y + 6z - 1 = 0$

(iv) $2x - y + 3z - 1 = 0$ and $2x - y + 3z + 3 = 0$

(v) $4x + 8y + z - 8 = 0$ and $y + z - 4 = 0$.

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Exercise 11 F Long Answer Type Questions I

1. Find the angle between the lines in which the planes :

$3x - 7y - 5z = 1, 5x - 13y + 3z + 2 = 0$

cut the plane $8x - 11y + 2z = 0$.

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2. (i) show that the line :

$\vec{r} = 2\hat{i} - 3\hat{j} + 5\hat{k} + \lambda\left(\hat{i} - \hat{j} + 2\hat{k}\right)$

lies in the plane $\vec{r}.\left(3\hat{i} + \hat{j} - \hat{k}\right) + 2 = 0.$

(ii) Show that the line :

$\vec{r} = \hat{i} + \hat{j} + \lambda\left(2\hat{i} + \hat{j} + 4\hat{k}\right)$

lies in the plane $\vec{r}.\left(\hat{i} + 2\hat{j} - \hat{k}\right) = 3.$

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3. Find the value of 'm' for which the line $\vec{r} = \left(\hat{i} + 2\hat{k}\right) + \lambda\left(2\hat{i} - m\hat{j} - 3\hat{k}\right)$ is parallel to the plane $\vec{r}.\left(m\hat{i} + 3\hat{j} + \hat{k}\right)$ = 4.

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4. Find the vector equationof the line passing through the point (3,1,2) and perpendicular to the plane $\vec{r}.\left(2\hat{i}-\hat{j}+\hat{k}=4\right.$. Find also the point of intersection of this line and the plane.

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5. Find the coordinates of the point where the line $\frac{\text{x}+1\backslash}{2}=\frac{\text{y}+2}{3}=\frac{\text{z}+3}{4}$ meets the plane $\text{x}+\text{y}+4\text{z}=6$.

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6. (i) Find the angle between the line :

$\left(2\hat{i}+3\hat{j}+4\hat{k}\right)+\lambda\left(2\hat{i}+3\hat{j}+4\hat{k}\right)$

and the plane : $\vec{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=5$.

(ii) Fiind the angle between the line joining (3,-4,-2)and (12,2,0) and the plane $\vec{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=4$

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7. (i) Find the angle between the line :

$\frac{x+1}{2}=\frac{y}{3}=\frac{z-3}{6}$ and the plane 10x + 12y - 11z = 3

(ii) Find the angle between the line :

$\frac{x+1}{2}=\frac{y-1}{2}=\frac{z-2}{4}$ and the plane 2x + y - 3z + 4 =0 .

(iii) Find the angle between the plane 2x + 4y - z = 8 and line $\frac{x-1}{2}=\frac{2-y}{7}=\frac{3z+6}{12}$

(iv) Find the angle between the line $\frac{x-1}{3}=\frac{3-y}{-1}=\frac{3z+1}{6}$ and the plane 3x - 5y + 2z = 10 .

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8. Find the distance of the points $(-1, -5, -10)$ form the point of intersection of the line $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}$ and plane $x-y+z=5$

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9. (i) Find the distance of the point (-1,-5,-10) from the point of intersection of the line $\vec{r} = \left(2\hat{i} - \hat{j} + 2\hat{k}\right) + \lambda\left(3\hat{i} + 4\hat{j} + 12\hat{k}\right)$ and the plane $\vec{r}.\left(\hat{i} - \hat{j} + \hat{k}\right) = 5$.

(ii) Find the distance of the point with position vector $-\hat{i} - 5\hat{j} - 10\hat{k}$ from the point of intersection of the line $\vec{r} = \left(2\hat{i} - \hat{j} + 2\hat{k}\right) + \lambda\left(3\hat{i} + 4\hat{j} + 12\hat{k}\right)$ and the plane $\vec{r}.\left(\hat{i} - \hat{j} + \hat{k}\right) = 5$.

(iii) Find the distance of the point (2,12, 5) from the point of intersection of the line .

$\vec{r} = 2\hat{i} - 4\hat{j} + 2\hat{k} + \lambda\left(3\hat{i} + 4\hat{j} + 12\hat{k}\right)$

and the plane $\vec{r}.\left(\hat{i} - 2\hat{j} + \hat{k}\right) = 0$.

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10. Find the distance between the point with position vector $\hat{i}-5\hat{j}-10\hat{k}$ and the point of intersection of the line $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}$ with the plane $x-y+z=5$.

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11. Find the vector and cartesian equation of the line passing through the point P (1,2,3) and parallel to the planes :

$\overrightarrow{r}.\left(\hat{i}-\hat{j}+2\hat{k}\right)=5.\ \overrightarrow{r}.\left(3\hat{i}+\hat{j}+\hat{k}\right)=6.$

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12. Find the vector equation of the line passing through (1, 2, 3) and perpendicular to the plane $\rightarrow r\hat{i}+2\dot{\hat{j}}-5\hat{k}+9=0$.

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13. Find the Cartesian equation of the plane passing through the points $A(0, 0, 0)$ and $b(3, -1, 2)$ and parallel to the line $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$

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14. 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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15. Find the equation of the plane containing the line. :

$$\frac{x+2}{2} = \frac{y+3}{3} = \frac{z-4}{-2}$$

and the point (0,6,0).

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16. Find the equation of the plane which contains two parallel to lines $\frac{x-4}{1}=\frac{y-3}{-4}=\frac{z-2}{5}$ and $\frac{x-3}{1}=\frac{y+2}{-4}=\frac{z}{5}$.

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17. Find the vector and cartesian equations of the plane containing the lines :

$\overrightarrow{r}=\hat{i}+2\hat{j}-4\hat{k}+\lambda\left(2\hat{i}+3\hat{j}+6\hat{k}\right)$ and

$\overrightarrow{r}=3\hat{i}+3\hat{j}-5\hat{k}+\mu\left(-2\hat{j}+3\hat{j}+8\hat{k}\right)$.

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18. Find the equation of the plane through the point (1,1,1) and perpendicular to the plane :

x - 2y + z = 2, 4x + 3y -z + 1 = 0 .

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19. The line draw from points (4,-1,2) to the points (-3,2,3)meets and a palne at right angle at the points (-10,5,4), then the equation of plane is

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20. (a) Find the length and the foot of the perpendicular from : P (1,1,2) to the plane $2x - 2y + 4z + 5 = 0$

(b) Find the co-ordinates of the foot of the perpendicular drawn from the origin to the plane $2x - 3y + 4z - 6 = 0$.

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21. Find the co-ordinates of the foot of the perpendicular from the point (2,3,7) to the plane 3x - y - z = 7 . Also find the length of the perpendicular.

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Exercise 11 F Long Answer Type Questions Ii

1. Find the equation of the plane containing the line: $\frac{x-1}{3}=\frac{y+2}{1}=\frac{z-3}{2}$ and perpendicular to the plane 2 x - y + 2z - 3 = 0.

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2. show that the line whose vectors equation is $\vec{r}=\left(2\hat{i}-2\hat{j}+3\hat{k}\right)+\lambda\left(\hat{i}-\hat{j}+4\hat{k}\right)$ is parallel to the plane whose vectors equation is $\vec{r}.\left(\hat{i}+5\hat{j}+\hat{k}\right)=5.$ Find also the distance between them.

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3. State when the line $\vec{r}=\vec{a}+\lambda\vec{b}$ is parallel to the plane $\vec{r}.\vec{n}=d.$ Show that the line $\vec{r}=\hat{i}+\hat{j}\lambda\left(3\hat{i}-\hat{j}+2\hat{k}\right)$ is parallel to the plane $\vec{r}.\left(2\hat{i}+\hat{k}\right)$ = 3. Also, find the distance between the line and the plane.

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4. Find the equations of the line through (-1,3,2) and perpendicular to the plane x + 2y + 2z = 3, the length of the perpendicular and co-ordinates of its foot.

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5. Find the vector equationof the line passing through the point (3,1,2) and perpendicular to the plane $\vec{r}.\left(2\hat{i}-\hat{j}+\hat{k}=4\right.$. Find also the point of intersection of this line and the plane.

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6. Find the vector equation of a line passing through the point with position vector $\left(2\hat{i}-3\hat{j}-5\hat{k}\right)$ and perpendicular to the plane $\vec{r}.\left(6\hat{i}-3\hat{j}-5\hat{k}\right)$ + 2 = 0. Also find the point of intersection of this line and the plane.

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7. Find the coordinates of the point, where the line $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{2}$ intersects the plane

$x - y + z - 5 = 0$. Also find the angle between the line and the plane.

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8. Find the length of the perpendicular from the point $(1, 2, 3)$ to the line $\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-7}{-2}$.

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9. Find the point , where the line joining the points (1,3,4) and (-3,5,2) intersects the plane $\vec{r}.\left(2\hat{i} + \hat{j} + \hat{k}\right) + 3 = 0.$

Is the point equidistant from the given points ?

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10. Find the co-ordinates of the point where the line joining the points (1,-2,3) and (2,-1,5) cuts the plane x - 2y + 3z = 19, Hence, find the distance of this point from the point (5,4,1).

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11. Find the equation fo the plane passing through the point (1,1,1) and containing the line :

$$\vec{r} = \left(-3\hat{i} + \hat{j} + 5\hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + 5\hat{k}\right).$$

Also , show that the plane contains the line :

$$\vec{r} = \left(-\hat{i} + 2\hat{j} + 5\hat{k}\right) + \lambda\left(\hat{i} - 2\hat{j} - 5\hat{k}\right).$$

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12. Find the equation of the plane passing through the point A (1,2,1) and perpendicular to the line joining the points P(1,4,2) and

Q(2,3,5) .

Also, Find also the perpendicular distance of the plane from te line

:

$$\frac{x+3}{2}=\frac{y-5}{-1}=\frac{z-7}{-1}.$$

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13. Find the vector equation of the plane passing through three points with position vectors $\hat{i}+\hat{j}-2\hat{k}, 2\hat{i}-\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$. Also find the co-ordinates of the point of intersection of this plane and the line $\vec{r}=3\hat{i}-\hat{j}-\hat{k}+\lambda\left(2\hat{i}-2\hat{j}+\hat{k}\right)$.

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Objective Type Questions A Multiple Choice Questions

1. Distance between two planes :

$2x + 3y + 4z = 5$ and $4x + 6y + 8z = 12$ is :

A. 2 units

B. 4 units

C. 8 units

D. $\frac{1}{29}$ units.

Answer: D

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2. The planes $2x - y + 4z = 3$ and $5x - 2.5y + 10z = 6$ are :

A. perpendicular

B. parallel

C. intersect along y - axis

D. passes through $\left(0, 0, \frac{5}{4}\right)$.

Answer: B

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3. The co-ordinates of the foot of the perpendicular drawn from the point (2,5,7) on the x-axis are given by :

A. (2,0,0)

B. (0,5,0)

C. (0,0,7)

D. (0,5,7)

Answer: A

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4. If α, β, γ are the angles that a line makes with the positive direction of x, y, z axis, respectively, then the direction-cosines of the line are :

A. $< \sin \ \alpha, \sin \beta, \sin \gamma >$

B. $< \cos \alpha, \cos \beta, \cos \gamma >$

C. $< \tan \alpha, \tan \beta, \tan \gamma >$

D. $< \cos^2 \alpha, \cos^2 \beta, \cos^2 \gamma >$.

Answer: B

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5. The distance of the point P(a,b,c)` from the x-axis is

A. $\sqrt{a^2 + c^2}$

B. $\sqrt{a^2 + b^2}$

C. $\sqrt{b^2 + c^2}$

D. $b^2 + c^2$

Answer: C

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6. If the direction cosines of a line are k, k and k, then :

A. k $>$ 0

B. 0 $<$ k $<$ 1

C. k = 1

D. $k = \frac{1}{\sqrt{3}} \text{ or } -\frac{1}{\sqrt{3}}.$

Answer: D

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7. reflection of the point (α, β, γ) in the XY-plane is :

A. $(\alpha, \beta, 0)$

B. $(0, 0, \gamma)$

C. $(- \alpha, - \beta, \gamma)$

D. $(\alpha, \beta, - \gamma)$.

Answer: D

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8. What is the distance (in units) between the two planes

$3x + 5y + 7z = 3$ and $9x + 15y + 21z = 9$?

A. 0

B. 3

C. $\dfrac{6}{\sqrt{83}}$

D. 6

Answer: A

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9. the equation of the line in vector form passing through the point (-1,3,5) and parallel to line $\dfrac{x-3}{2} = \dfrac{y-4}{3}, z = 2$ is

A. $\overrightarrow{r} = \left(-\hat{i} + 3\hat{j} + 5\hat{k}\right) + \lambda\left(2\hat{i} + 3\hat{j} + \hat{k}\right)$

B. $\overrightarrow{r} = \left(-\hat{i} + 3\hat{j} + 5\hat{k}\right) + \lambda\left(2\hat{i} + 3\hat{j}\right)$

C. $\overrightarrow{r} = \left(2\hat{i} + 3\hat{j} - 2\hat{k}\right) + \lambda\left(-\hat{i} + 3\hat{j} + 5\hat{k}\right)$

D. $\overrightarrow{r} = \left(2\hat{i} + 3\hat{j}\right) + \lambda\left(-\hat{i} + 3\hat{j} + 5\hat{k}\right)$

Answer: B

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10. Direction-ratios of normal to plane which is parallel to the plane 3x + y - z = 11 are ,

A. $< 3, 1, -1 >$

B. $< 0, 1, 1 >$

C. $< -3, 1, -1, >$

D. $< 1, 1, 0 >$

Answer: A

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11. The relation between direction-cosines l, m and n of a line is :

A. $l^2 + m^2 + n^2 = 1$

B. $l^2 + m^2 + n^2 = -1$

C. $l^2 + m^2 + n^2 = 0$

D. $l^2 + m^2 = n^2$.

Answer: A

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12. The direction cosines of x-axis are (A) 0,0,1 (B) 1,0,0 (C) 0,1,0 (D) 0,1,1

A. $< 1, 0, 0 >$

B. $< 0, 1, 0 >$

C. $< 0, 0, 1 >$

D. None of these.

Answer: A

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13. What are the direction cosines of Z-axis?

A. $< 1, 0, 0 >$

B. $< 0, 1, 0 >$

C. $< 0, 0, 1 >$

D. None of these.

Answer: C

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14. If the line $\vec{r}=\left(-2\hat{i}+3\hat{j}+4\hat{k}\right)+\lambda\left(-\hat{k}\hat{i}+2\hat{j}+\hat{k}\right)$ is parallel to the plane $\vec{r}.\left(2\hat{i}+3\hat{j}-4\hat{k}\right)+7=0,$ then the value of k is :

A. 0

B. 1

C. -1

D. -2

Answer: B

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15. Distance between plane 3x + 4y - 20 = 0 and point (0,0,-7) is :

A. 4 units

B. 3 units

C. 2 units

D. 1 unit

Answer: A

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16. If a line makes an angle of $\frac{\pi}{4}$ with each of Y and Z-axes , then the angle which it makes with X-axis is

A. $\frac{3\pi}{2}$

B. $\frac{\pi}{2}$

C. $\frac{\pi}{2}$

D. $\frac{3\pi}{2}$

Answer: C

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17. If a line makes angles α, β, γ with the positive direction of coordinate axes, then write the value of $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$.

A. -1

B. 2

C. 1

D. -2

Answer: B

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18. If a line makes angles $\frac{\pi}{2}, \frac{3\pi}{4}$ and $\frac{\pi}{4}$ with x,y,z axis respectively, then direction cosines of this line are :

A. $\pm$ (1,1,1)

B. $\pm\left(0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

C. $\pm\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$

D. $\pm\left(0, -\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

Answer: D

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19. If direction-cosines of two lines are proportional to 4,3,2 and 1, -2, 1, then the angle between the lines is :

A. 90°

B. 60°

C. 45°

D. None of these.

Answer: A

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20. The direction consines of a line equally inclined with the co-ordinate axes are

A. $< 1, 1, 1 >$

B. $< \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} >$

C. $< \pm\frac{1}{3}, \pm\frac{1}{3}, \pm\frac{1}{3} >$

D. $< \pm\frac{1}{\sqrt{3}}, \pm\frac{1}{\sqrt{3}}, \pm\frac{1}{\sqrt{3}}, >$

Answer: D

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21. The line $\frac{x-1}{2}=\frac{y-2}{4}=\frac{z-3}{4}$ meets the plane $2x+3y-z=14$ in the point

A. (3,5,7(

B. (5,7,3)

C. (6,5,3)

D. (2,5,7)

Answer: A

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22. Direction-ratios of line given by :

$\frac{x-1}{3}=\frac{2y+6}{10}=\frac{1-z}{-7}$ are ,

A. $< 3, 10, \ -7 >$

B. $< 3, \ -5, 7 >$

C. $< 3, 5, 7 >$

D. $< 3, 5, \ -7 >$,

Answer: C

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23. Find the distance of the plane $3x \quad 4y + 12z = 3$ from the origin.

A. $\frac{3}{13}$

B. $\frac{13}{3}$

C. -2

D. 3

Answer: A

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24. Find the angle between the pair of lines $\frac{x+3}{3}=\frac{y-1}{5}=\frac{z+3}{4}$ and $\frac{x+1}{1}=\frac{y-4}{1}=\frac{z-5}{2}$.

A. $\cos^{-1}\left(\frac{8\sqrt{3}}{15}\right)$

B. $\cos^{-1}\left(\frac{5\sqrt{7}}{15}\right)$

C. $\cos^{-1}\left(\frac{15}{8\sqrt{3}}\right)$

D. $\cos^{-1}\left(\frac{3\sqrt{8}}{15}\right)$

Answer: A

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25. If the lines $\frac{x-1}{-3}=\frac{x-2}{2k}=\frac{z-3}{2}$ and $\frac{x-1}{3k}=\frac{y-1}{1}=\frac{z-6}{-5}$ are perpendicular to each other, then the value of k is ,

A. $-\frac{1}{7}$

B. $-\frac{1}{10}$

C. $\frac{7}{10}$

D. $-\frac{10}{7}$

Answer: D

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26. The direction-cosines of te vector $\overrightarrow{a}=\hat{i}-\hat{j}-2\hat{k}$ are ,

A. $<1, -1, -2>$

B. $\left(\frac{1}{\sqrt{6}}, -\frac{1}{\sqrt{6}}, \frac{-2}{\sqrt{6}}\right)$

C. $\left(\frac{1}{4}, -\frac{1}{4}, \frac{-2}{4}\right)$

D. $\left(\sqrt{\frac{1}{6}}, -\sqrt{\frac{1}{6}}, -\sqrt{\frac{2}{6}}\right)$.

Answer: B

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27. The angle between the vector $\vec{r} = 4\hat{i} + 8\hat{j} + \hat{k}$ makes with the x-axis is :

A. $\cos^{-1}\left(\frac{13}{9}\right)$

B. $\cos^{-1}\left(\frac{13}{3}\right)$

C. $\cos^{-1}\left(\frac{\sqrt{13}}{4}\right)$

D. $\cos^{-1}\left(\frac{4}{9}\right)$

Answer: D

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28. The length of perpendicular from the origin to the plane :

$\vec{r}.\left(3\hat{i}-12\hat{j}-4\hat{k}\right)+39=0$ is ,

A. 19

B. 3

C. 13

D. 12

Answer: B

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29. The angle between the lines whose direction-ratios are :

$< 2, 1, 2 >$ and $< 4, 8, 1 >$ is :

A. $\cos^{-1}\left(\frac{3}{2}\right)$

B. $\cos^{-1}\left(\frac{2}{3}\right)$

C. $\cos^{-1}\left(\frac{10}{3}\right)$

D. $\cos^{-1}\left(\frac{1}{3}\right)$

Answer: B

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30. Distance between the point (0,1,7) and the plane 3x + 4y + 1 = 0 is :

A. 1 unit

B. 2 units

C. 3 units

D. 4 units

Answer: A

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Objective Type Questions B Fill In The Blanks

1. Direction-cosines of x-axis are, ...

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2. Direction-cosines of y-axis are ....

Watch Video Solution

3. Direction-cosines of z-axis are ....

Watch Video Solution

4. If a line makess angle $90^\circ, 60^\circ$, and theta with x, y and z-axis respectively, then acute θ = ...

Watch Video Solution

5. The direction-cosines of the vector - $2\hat{i} + \hat{j} - 5\hat{k}$ are ....

Watch Video Solution

6. The point (1,2,7) , (2,6,3) , (3,10,-1) are ....

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7. If the lines $\frac{1-x}{3}=\frac{7y-14}{2\lambda}=\frac{z-3}{2}$ and $\frac{7-7x}{3\lambda}=\frac{y-5}{1}=\frac{6-z}{5}$ are at right angle, then the value of λ is

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8. Write the sum of intercepts cut off by the plane $\vec{r}\left(2\hat{i}+\hat{j}-\hat{k}\right)-5=0$ on the three axis

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9. If α, β, γ are direction angles of a line , then $\cos 2\alpha, \cos 2\beta + \cos 2\gamma =$

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10. The equation of the plane with intercepts, 2,5 and 4 on the x,y and z axis respectively is ....

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Objective Type Questions C True False Questions

1. If α, β, γ are direction angles of a line , then $\cos 2\alpha, \cos 2\beta + \cos 2\gamma =$

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2. The direction-cosines of the vector $\hat{i} + 2\hat{j} + 3\hat{k}$ are $< \frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}} >$

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3. Find the distance of the plane $2x - 2y + 4z = 6$ from the origin.

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4. angle between two planes :

2x + y - 2z = 5 and 3x - 6y - 2z = 7 is $\sin^{-1}\left(\frac{4}{21}\right)$

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5. The intercepts cut off by the plane 7x+ y - z = 5 are $\frac{5}{7}, \ -5,$ 5.

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6. State Whether TRUE or FALSE:

Angle between the planes :

$\overrightarrow{r}.\left(\hat{i}-2\hat{j}-2\hat{k}\right)=1$ and $\overrightarrow{r}.\left(3\hat{i}-6\hat{j}+2\hat{k}\right)=0$ is $\cos^{-1}\left(\frac{11}{21}\right)$.

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7. The point of interesection of the line x = y = z with the plane x + 2y + 3z = 6 is (1,1,-1).

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Objective Type Questions D Very Short Answer Type Questions

1. If a line makes angles $90o$, $135o$, $45o$ with the x, y and z-axes respectively, find its direction cosines.

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2. If a line has direction-cosines $< \frac{-9}{11}, \frac{6}{11}, \frac{-2}{11} >$, then what are its direction-ratios?

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3. Write the direction-cosines of the line joining the points (1, 0, 0) and (0, 1, 1).

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4. If α, β, γ be angles which a straighat line makes with the positive direction of the axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is equal to (A) 4 (B) 1 (C) 2 (D) 3

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5. The ratio in which the line joining the points $(a, b, c) and (- a, - c, - b)$ is divided by the xy-plane is $a : b$ b. $b : c$ c. $c : a$ d. $c : b$

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6. If a line makes angle 90° and 60° respectively with positively direction of x and y axes, find the angle which it makes with the positive direction of z -axis.

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7. Find the direction-cosines of the line

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

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8. Write the vector equation of the line :

$$\frac{x-5}{3}=\frac{y+4}{7}=\frac{6-z}{2}.$$

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9. The cartesian equations of line is :

$$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}.$$

Write the vector equation.

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10. Find the vector equation of the line which passes through the point (3,4,5) and is parallel the vector $2\hat{i}+2\hat{j}-3\hat{k}$.

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11. Find the length of the perpendicular drawn from the point P (3, -4, 5) on the z-axis.

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12. The equation of a line given by $\frac{4-x}{3}=\frac{y+3}{3}=\frac{z+2}{6}$. Write the direction cosines of a line parallel to this line.

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13. Find the cartesian equation of the line which passes through the point $(-2, 4, -5)$ and parallel and line are $(3, 5, 6)$. So, the equation of line is,

$$\frac{x-(-2)}{3}=\frac{y-4}{5}=\frac{z-(-5)}{6}.$$

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14. Find the acute angle between the plane :

$\vec{r}.\left(\hat{i}-2\hat{j}-2\hat{k}\right)=1 \text{ and } \vec{r}.\left(3\hat{i}-6\hat{j}+2\hat{k}\right)$ = 0 `

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15. Write the equation of the plane passing through (a , b , c) and parallel to xy-plane

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16. Write the intercept cut off by the plane $2x+y-z=5$ on x-axis.

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17. Find the vector equation of a plane which is at a distance of 5 units from the origin and whose normal vector is $2\hat{i} - \hat{j} + 2\hat{k}$.

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18. Find the vector equations of the plane whose cartesian form of equation is $5x - 7x + 2z = 3$.

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19. Find the cartesian equation of the plane $\overrightarrow{r} . \left(2\hat{i} + 3\hat{j} - 4\hat{k}\right) = 1$.

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20. What are the direction-cosines of the normal to the plane 3x + 2y - 3z = 8 ?

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21. Find the direction-cosines of the perpendicular from the origin to the plane $\overrightarrow{r}.\left(\hat{i}+2\hat{j}-2\hat{k}\right)$ = 18 .

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22. Find the the distance of a point (2,5, -3) from the plane $\overrightarrow{r}.\left(6\hat{i}-3\hat{j}+2\hat{k}\right)=4.$

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23. Find the value of 'k' for which the plane :

3x - 6y - 2z = 7 and 2x + y - kz = 3

are perpendicular to each other.

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24. Write the vector equation fo the line passing through the point (1,-2,-3) and normal to the plane $\vec{r} . \left(2\hat{i} + \hat{j} + 2\hat{k}\right)$ = 5 .

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25. Write the equation of a plane which is at a distance of $5\sqrt{3}$ units from origin and the normal to which is equally inclined to coordinate axes.

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Ncert File Exercise 11 1

1. If a line makes angles $90o, \quad 135o, \quad 45o$ with the x, y and z-axes respectively, find its direction cosines.

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2. Find the direction cosines of a line which makes equal angles with the coordinate axes.

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3. If a line has direction ratios `-18,-12,-4 then what are its direction cosines?

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4. Show that the points $(2, 3, 4), (-1, -2, 1), (5, 8, 7)$ are collinear.

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5. Find the direction cosines of the sides of the triangle whose vertices are (3, 5, -4), (-1, 1, 1) and (-5, -5, -2).

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Ncert File Exercise 11 2

1. Show that the three lines with direction cosines $\frac{12}{13}, \frac{-3}{13}, \frac{-4}{13}, \frac{4}{13}, \frac{12}{13}, \frac{3}{13}; \frac{3}{13}, \frac{-4}{13}, \frac{12}{13}$ are mutually perpendicular.

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2. Show that the line through the points $(1, -1, 2)$ and $(3, 4-2)$ is perpendicular to the line through the points $(0, 3, 2)$ and $(3, 5, 6)$.

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3. Show that the line through the points $(4, 7, 8), (2, 3, 4)$is parallel to the line through the points $(1, 2, 1)$,$(1, 2, 5)$.

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

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5. Find the equation of the line in vector and in cartesian form that passes through the point with position vector $2\hat{i} - \hat{j} + 4\hat{k}$ and is in the direction $\hat{i} + 2\hat{j} - \hat{k}$.

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6. Find the cartesian equation of the line which passes through the point $(-2, 4, -5)$ and parallel and line are $(3, 5, 6)$. So, the equation of line is,

$$\frac{x-(-2)}{3} = \frac{y-4}{5} = \frac{z-(-5)}{6}.$$

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7. The vector equationm of the line $\frac{x-5}{3} = \frac{y+4}{7} = \frac{z-6}{2}$ is

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8. Find the vector and Cartesiasn equation of the line that passes through the origin and (5,-2,3).

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9. Find the vector and the cartesian equations of the line that passes through the point (3, -2 , - 5), (3, -2, 6) .

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10. Find the angle between the following pairs of lines :

(i) $\overrightarrow{r}=2\hat{i}-5\hat{j}+\hat{k}+\lambda\left(3\hat{i}+2\hat{j}+6\hat{k}\right)$ and

$\overrightarrow{r}=7\hat{i}-6\hat{k}+\mu\left(\hat{i}+2\hat{j}+2\hat{k}\right)$

(ii) $\overrightarrow{r}=3\hat{i}+\hat{j}-2\hat{k}+\lambda\left(\hat{i}-\hat{j}-2\hat{k}\right)$ and

$\overrightarrow{r}=2\hat{i}-\hat{j}-56\hat{k}+\mu\left(3\hat{i}-5\hat{j}-4\hat{k}\right)$.

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11. Find the angle between the following pair of lines ,

(i) $\dfrac{x-2}{2} = \dfrac{y+3}{5} = \dfrac{z+3}{-3}$ and $\dfrac{x+2}{-1} = \dfrac{y-4}{8} = \dfrac{z-5}{4}$

(ii) $\dfrac{x}{2} = \dfrac{y}{2} = \dfrac{z}{1}$ and $\dfrac{x-5}{4} = \dfrac{y-2}{1} = \dfrac{z-3}{8}$.

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12. Find the values p so that line $\dfrac{1-x}{3} = \dfrac{7y-14}{2p} = \dfrac{z-3}{2} and \dfrac{7-7x}{3p} = \dfrac{y-5}{1} = \dfrac{6-z}{5}$ are at right angles.

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13. Show that the lines $\dfrac{x+5}{7} = \dfrac{y+2}{-5} = \dfrac{z}{1}$ and $\dfrac{x}{1} = \dfrac{y}{2} = \dfrac{z}{3}$ are perpendicular to each other.

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14. Find the shortest distance betwee the lines :

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

$\vec{r} = 2\hat{i} - \hat{j} - hakt + \mu(2\hat{i} + \hat{j} + 2\hat{k})$.

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15. Find the shortest distance between the lines

$\frac{x+1}{7} = \frac{y+1}{-6}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$.

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16. Find the shortest distance between the lines whose vector equations are :

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

$\vec{r} = 4\hat{i} + 5\hat{j} + 6\hat{k} + \mu(2\hat{i} + 3\hat{j} + \hat{k})$.

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17. Find the shortest distance between the following lines whose vector equations are: $\overrightarrow{r} = (1-t)\hat{i} + (t-2)\hat{j} + (3-2t)\hat{k}$ and $\overrightarrow{r} = (s+1)\hat{i} + (2s-1)\hat{j} - (2s+1)\hat{k}$.

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Ncert File Exercise 11 3

1. In each of the following cases, determine the direction cosines of the normal to the plane and the distance from the origin .

a. z = 2

b. x + y + z = 1

c. 2x + 3y - z = 5

d. 5y + 8 = 0

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2. Find the vector equation of a plane which is at a distance of 7 units from the origin and normal to the vector $3\hat{i} + 5\hat{j} - 6\hat{k}$

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3. Find the Cartesian equation of the following planes :

a. $\vec{r}.\left(\hat{i} + \hat{j} - \hat{k}\right) = 2$

b. $\vec{r}.\left(2\hat{i} + 3\hat{j} - 4\hat{k}\right) = 1$

(c) $\vec{r}.\left[(s - 2t)\hat{i} + (3 - t)\hat{j} + (2s + t)\hat{k}\right]$ = 15

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4. In the following cases, find the coordinates of the foot of the perpendicular drawn from the origin.(a) $2x + 3y + 4z12 = 0$ (b)

$3y + 4z6 = 0$(c) $x + y + z = 1$ (d) $5y + 8 = 0$

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5. Find the vector and cartesian equations of the planes :

(a) that passes through the point (1,0,-2) and the normal to the plane is $\hat{i} + \hat{j} - \hat{k}$

(b) that passes through the point (1,4,6) and the normal vector of the plane is $\hat{i} - 2\hat{j} + \hat{k}$.

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6. Find the equations of the planes that passes through three points :

(a) (1,1-1) , (6,4,-5) (-4,-2,3)

(b) 1,1,0), (1,2,1) , (-2,2,-1).

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7. Find the intercepts cut off by the plane $2x + yz = 5$.

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8. Find the equation of the plane with intercept 3 on the y-axis and parallel to ZOX plane.

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9. Find the equation of the plane through the intersection of the planes $3x - y + 2z - 4 = 0$ and $x + y + z - 2 = 0$ and the point (2,2,1).

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10. Find the vector equation of the plane passing through the intersection of the planes

$\vec{r}.\left(2\hat{i}+2\hat{j}-3\hat{k}\right)=7, \vec{r}(r).\left(2\hat{i}+5\hat{j}+3\hat{k}\right)=9$

and through the point (2,1,3).

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11. Find the equation of the plane through the line of intersection of the planes $x+y+z=1$ and $2x+3y+4z=5$ which is perpendicular to the plane $x-y+z=0$

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12. Find the angle between the planes whose vector equations are $\vec{r}.\left(2\hat{i}+2\hat{j}-3\hat{k}\right)=5$ and $\vec{r}.\left(3\hat{i}-3\hat{j}+5\hat{k}\right)=3.$

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13. In the following cases, determine whether the given planes are parallel or perpendicular, and in case they are neither, find the angles between them :

(a) 7x + 5y + 6z + 30 = 0 and 3x - y - 10 z + 4 = 0

(b) 2x + y + 3z -2 = 0 and x - 2y + 5 = 0

(c) 2x - 2y + 4z + 5 = 0 and 3x - 3y + 6z - 1 = 0

(d) 2x - y + 4z + 5 = 0 and 2x - y + 3z + 3 = 0

(e) 4 x + 8y + z = 0 and y + z - 4 = 0

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14. In the following cases, find the distance of each of the given points from the corresponding given plane .

Point	Plane
$(a)(0, 0, 0)$	$3x - 4y + 12z = 3$
(b) (3,-2,1)	$2x - y + 2z + 3 = 0$
$(c)(2, 3, -5)$	$x + 2y - 2z = 9$
$(d)(-6, 0, 0)$	$2x - 3y + 6z - 2 = 0$

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Miscellaneous Exercise On Chapter 11

1. Show that the line joining the origin to the point $(2, 1, 1)$ is perpendicular to the line determined by the points $(3, 5, -1)$ and $(4, 3, -1)$.

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2. If l_1, m_1, n_1 and l_2, m_2, n_2 are the direction cosines of two mutually perpendicular lines, show that the direction cosines of the line perpendicular to both of these are $m_1n_2 - m_2n_1, n_1l_2 - n_2l_1, l_1m_2 - l_2m_1$.

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3. Find the angle between the lines whose direction ratios are a, b, c and $b - c, c - a, a - b.$

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4. Find the equation of a line parallel to x-axis and passing through the origin.

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5. If the coordinates of the points $A, B, C, Dbe91, 2, 3), (4, 5, 7), (- 4, 3, - 6)$ and $(2, 9, 2)$ respectively then find the angle between AB and CD.

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6. The value of so that $\frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-4}{2}$ and $\frac{x-1}{3k} = \frac{y-1}{1} = \frac{z-6}{-5}$ may be perpendicular is given by :

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7. Find the vector equation of the line passing through (1, 2, 3) and perpendicular to the plane $\rightarrow r\hat{i} + 2\dot{\hat{j}} - 5\hat{k} + 9 = 0$.

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8. Find the equation of the plane passing through (a,b,c) and paralle toteh plne $\overrightarrow{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=2.$

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9. Find the shortest distance between lines:

$\overrightarrow{r} = 6\hat{i} + 2\hat{j} + 2\hat{k} + \lambda\left(\hat{i} - 2\hat{j} + 2\hat{k}\right)$ and

$\overrightarrow{r} = -4\hat{i} - \hat{k} + \mu\left(3\hat{i} - 2\hat{j} - 2\hat{k}\right)$.

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10. Find the coordinates of the point where the line through (5, 1, 6) and (3, 4,1) crosses the YZ-plane.

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Revision Exercise

1. 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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2. Prove that the straight lines whose direction cosines are given by the relations $al+bm+cn=0$ and $fmn+gnl+hlm=0$ are

Perpendicular to each other if $\frac{f}{a}+\frac{g}{b}+\frac{h}{c}=0$, and

parallel if $a^2f^2+b^2g^2+c^2h^2-2bcgh-2cahf-2abfg=0$.

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3. Prove that the line joining the mid-points of the two sides of a triangle is parallel to the third side.

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4. Find the vector equation of the line passing through (1, 2, 3) and perpendicular to the plane $\rightarrow r\hat{i} + 2\hat{\dot{j}} - 5\hat{k} + 9 = 0$.

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5. Prove that the lines x=ay +b,z =cy +d and x=a'y +b' z =c'y +a'

are perpendicular if aa'+cc' +1=0

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6. Prove that the line joining the points $\overrightarrow{6a} - \overrightarrow{4b} + \overrightarrow{4c}$ and $\overrightarrow{-4c}$ and the line joining the points $\overrightarrow{-a} - \overrightarrow{2b} - \overrightarrow{3c}, \overrightarrow{a} + \overrightarrow{2b} - \overrightarrow{5c}$ intersect at $-\overrightarrow{4c}$.

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7. Find the vector equation o the line passing through (1,2,3) and parallel to the planes $\vec{r}.\left(\hat{i}+\hat{j}+2\hat{k}\right)=5$ and $\vec{r}.\left(3\hat{i}+\hat{j}+\hat{k}\right)=6$

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8. Find the vector equation of the line passing through the point $(1, \quad 2, \quad 4)$ 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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9. find the coordinates of point where the line through (3,-4,-5) and (2,-3,1) crosses the plane $2x+y+z=7$.

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10. Show that equation of the plane passing through a point having position vector $\vec{a}$ and parallel to $\vec{b}$ and $\vec{c}$ is $\vec{r} = \vec{a} + \lambda \vec{b} + \mu \vec{c}$.

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11. Find the distance of the point (2,3,4) from the plane $3x + 2y + 2z + 5 = 0$ measured parallel to the line $\frac{x+3}{3} = \frac{y-2}{6} = \frac{z}{2}$.

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12. Find the distance of the point with position vector $-\hat{i} - 5\hat{j} - 10\hat{k}$ from the point of intersection of the line $\vec{r} = \left(2\hat{i} - \hat{j} + 2\hat{k}\right) + \lambda\left(3\hat{i} + 4\hat{j} + 12\hat{k}\right)$ with the plane $\vec{r} \cdot \left(\hat{i} - \hat{j} + \hat{k}\right) = 5$.

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13. Find the point R, Where the line joining P (1,3,4) and Q (-3,5,2) cuts the plane $\overrightarrow{r}.\left(2\hat{i}-\hat{j}+\hat{k}\right)+3=0.$ is $\left|\overrightarrow{PR}\right|=\left|\overrightarrow{QR}\right|$?

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14. Find the equation of the plane passing through the line of intersection of the planes 2x + y - Z = 3,5x - 3y + 4z + 9 = 0 and parallel to the line $\frac{x-1}{2}=\frac{y-3}{4}=\frac{z-5}{5}$

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15. If from a point $P(a, b, c)$ perpendiculars $PAandPB$ are drawn to $YZandZX-planes$ find the vectors equation of the plane

OAB.

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16. If O be the origin and the coordinates of P be $(1, \quad 2, \quad 3)$, then find the equation of the plane passing through P and perpendicular to OP.

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17. Find the equation of the plane , which contains the line of intersection of the planes :

$\vec{r}.\left(\hat{i}+2\hat{j}+3\hat{k}\right)-4=0$ and $\vec{r}.\left(2\hat{i}+\hat{j}+\hat{k}\right)+5=0$ and which is perpendicular to the plane :

$\vec{r}.\left(5\hat{i}+3\hat{j}-6\hat{k}\right))+8=0$.

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18. Prove that the shortest distance between the diagonals of a rectangular parallelopiped whose coterminous sides are a, b, c and the edges not meeting it are

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19. A variable plane is at a constant distance p from the origin and meets the coordinate axes in A, B, C . Show that the locus of the centroid of the tehrahedron $OABCisx^{-2} + y^{-2} + z^{-2} = 16p^{-2}$.

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Check Your Understanding

1. Equation of XY-plane is

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2. If $\vec{A}$ makes an angle α, β and γ from x,y and z axis respectively then $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=$

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3. Write the direction-cosines of the vector $\hat{i}+2\hat{j}+3\hat{k}$.

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4. Write the vector equation of the following line: $\frac{x-5}{3}=\frac{y+4}{7}=\frac{6-z}{2}$

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5. Find the equation of a st. line through (-1,2,3) and equally inclined to the axes.

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6. Find the distance of the point (2,3,-5) from the plane $x + 2y - 2z = 9$.

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7. Find the distance of the plane $2x - 2y + 4z = 6$ from the origin.

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8. Find the intercepts cut off by the plane $2x + yz = 5$.

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9. Find the equation of the plane with intercept 3 on the y-axis and parallel to ZOX plane.

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10. What is the point of intersection of the line $x = y = z$ with the plane $x + 2y + 3z = 6$?

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Competition File

1. The line passing through the points $(5, 1, a)$ and $(3, b, 1)$ crosses the YZ-plane at the point $\left(0, \frac{17}{2}, -\frac{13}{2}\right)$. Then,

A. a = 8 , b = 2

B. a = 2 , b = 8

C. a = 4, b = 6

D. a = 6 , b = 4

Answer: D

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2. If the straight lines $\frac{x-1}{k} = \frac{y-2}{2} = \frac{z-3}{3}$ and $\frac{x-2}{3} = \frac{y-3}{k} = \frac{z-1}{2}$ intersect at a point, then the integer k is equal to

A. -2

B. -5

C. 5

D. 2

Answer: B

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3. Let the line $\frac{x-2}{3}=\frac{y-1}{-5}=\frac{z+2}{2}$ lie in the plane $x+3y-\alpha z+\beta=0$. Then, (α, β) equals

A. (-6,-17)

B. (5, -15)

C. (-5,5)

D. (6,-17)

Answer: A

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4. The projection of a vector on the three coordinate axes are $6, \ -3, 2$, respectively. The direction cosines of the vector are

A. $\frac{6}{5}, \ -\frac{3}{5}, \frac{2}{5}$

B. $\frac{6}{7}, \ -\frac{3}{7}, \frac{2}{7}$

C. $\frac{-6}{7}, \frac{-3}{7}, \frac{2}{7}$

D. 6 , - 3, 2

Answer: B

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5. A line AB in three-dimensional space makes angles 45° and 120° with the positive x-axis and the positive y-axis respectively. If AB makes an acute angle θ with the positive z-axis, then θ equals

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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6. If the angle between the line $x = \frac{y-1}{2} = (z-3)(\lambda)$ and the plane $x + 2y + 3z = 4 is \cos^{-1}\left(\sqrt{\frac{5}{14}}\right)$, then λ equals

A. $\frac{2}{3}$

B. $\frac{3}{2}$

C. $\frac{2}{5}$

D. $\frac{5}{3}$

Answer: A

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7. The length of the perpendicular drawn from the point $(3, -1, 11)$ to the line $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ is

A. $\sqrt{29}$

B. $\sqrt{33}$

C. $\sqrt{53}$

D. $\sqrt{65}$

Answer: C

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8. The distance of the point (1,-5,9) from the plane x-y+z = 5 measured along the line x = y = z is

A. $10\sqrt{3}$

B. $5\sqrt{3}$

C. $3\sqrt{10}$

D. $3\sqrt{5}$

Answer: A

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9. If the line $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-1}{4}$ and $\frac{x-3}{1}=\frac{y-k}{2}=\frac{z}{1}$ intersect, then k is equal to

A. -1

B. $\frac{2}{9}$

C. $\frac{9}{2}$

D. 0

Answer: C

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10. An equation of a plane parallel to the plane $x-2y+2z-5=0$ and at a unit distance from the origin is

A. x - 2y + 2z - 3 = 0

B. x - 2y + 2z + 1 = 0

C. x - 2y + 2z - 1 = 0

D. x - 2y + 2z + 5 = 0

Answer: A

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11. 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, if

A. exactly one value

B. exactly two values

C. exactly three values

D. any value.

Answer: B

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12. Distance between two parallel planes $2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is

A. $\frac{5}{2}$

B. $\frac{7}{2}$

C. $\frac{9}{2}$

D. $\frac{3}{2}$

Answer: B

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13. The image of the line $\frac{x-1}{3}=\frac{y-3}{1}=\frac{z-4}{-5}$ in the plane $2x-y+z+3=0$ is the line

A. $\frac{x+3}{-3}=\frac{y-5}{-1}=\frac{z+2}{5}$

B. $\frac{x-3}{3}=\frac{y+5}{1}=\frac{z-2}{-5}$

C. $\frac{x-3}{-3}=\frac{y+5}{-1}=\frac{z-2}{5}$

D. $\frac{x+3}{3}=\frac{y-5}{1}=\frac{z-2}{-5}$

Answer: D

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14. The angle between the lines whose direction cosines satisfy the equations $l+m+n=0$ and $l^2=m^2+n^2$ is

A. $\frac{\pi}{4}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{2}$

D. $\frac{\pi}{3}$

Answer: D

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15. The disatance of the point $(1, 0, 2)$ from the point of intersection of the line $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$ and the plane $x - y + z = 16$, is

A. $2\sqrt{14}$

B. 8

C. $3\sqrt{21}$

D. 13

Answer: D

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16. The equation of the plane containing the line $2x - 5y + z = 3, x + y + 4z = 5$ and parallel to the plane, $x + 3y + 6z = 1$ is

A. 2x + 6y + 12z = 13

B. x + 3y + 6z = -7

C. x + 3y + 6z = 7

D. 2x + 6y - 12z = -13 .

Answer: C

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17. If the line, $\frac{x-3}{2}=\frac{y+2}{-1}=\frac{z+4}{3}$ lies in the place, $lx+my-z=9$, then l^2+m^2 is equal to: (1) 26 (2) 18 (3) 5 (4) 2

A. 18

B. 5

C. 2

D. 26

Answer: C

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18. The distance of the point (1,-5,9) from the plane x-y+z = 5 measured along the line x = y = z is

A. $10\sqrt{3}$

B. $\frac{10}{\sqrt{3}}$

C. $\frac{20}{3}$

D. $3\sqrt{10}$

Answer: A

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19. If the image of the point P(1,-2,3) in the plane, 2x+3y-4z+22=0 mesured parallel to the line, $\frac{x}{1}=\frac{y}{4}=\frac{z}{5}$ is Q, then PQ is equal to

A. $\sqrt{42}$

B. $6\sqrt{5}$

C. $3\sqrt{5}$

D. $2\sqrt{42}$

Answer: D

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20. The distance of the point $(1, 3, -7)$ from the plane passing through the point $(1, -1, -1)$ having normal perpendicular to both the lines $\frac{x-1}{1} = \frac{y+2}{-2} = \frac{z-4}{3}$ and $\frac{x-2}{2} = \frac{y+1}{-1} = \frac{z+7}{-1}$ is

A. $\frac{5}{\sqrt{83}}$

B. $\frac{10}{\sqrt{74}}$

C. $\frac{20}{\sqrt{74}}$

D. $\frac{10}{\sqrt{83}}$

Answer: D

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21. If L_1 is the line of intersection of the planes $2x-2y+3z-2=0$, $x-y+z+1=0$ and L_2 is the line of the intersection of the planes $x+2y-z-3=0$, $3x-y+2z-1=0$ then the distance of the origin from the plane containing the lines L_1 and L_2 is

A. $\frac{1}{4\sqrt{2}}$

B. $\frac{1}{3\sqrt{2}}$

C. $\frac{1}{2\sqrt{2}}$

D. $-\frac{1}{\sqrt{2}}$

Answer: B

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22. The perpendicular distance from the origin to the plane containing the two lines, $\frac{x+2}{3}=\frac{y-2}{5}=\frac{z+5}{7}$ and $\frac{x-1}{1}=\frac{y-4}{4}=\frac{z+4}{7}$ is: (a) $11\sqrt{6}$ (b) $\frac{11}{\sqrt{6}}$ (c) 11 (d) $6\sqrt{11}$

A. $11\sqrt{6}$

B. $6\sqrt{11}$

C. 11

D. $\frac{11}{\sqrt{6}}$

Answer: D

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23. 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 :

A. $\cos^{-1}\left(\frac{19}{35}\right)$

B. $\cos^{-1}\left(\frac{9}{35}\right)$

C. $\cos^{-1}\left(\frac{17}{31}\right)$

D. $\cos^{-1}\left(\frac{7}{31}\right)$

Answer: A

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24. A plane passes through the point $(0, -1, 0)$ and $(0, 0, 1)$ and makes an angle of $\frac{\pi}{4}$ with the plane $y - z = 0$ then the point which satisfies the desired plane is

A. $(\sqrt{2}, -1, 4)$

B. $(\sqrt{2}, 1, 2)$

C. $(\sqrt{2}, 1, 4)$

D. $\left(\sqrt{2}, 2, 4\right)$

Answer: C

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25. Consider a plane $x+2y+3z=15$ and a line $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-2}{4}$ then find the distance of origin from point of intersection of line and plane.

A. $\frac{1}{2}$

B. $\frac{9}{2}$

C. $\frac{5}{2}$

D. 4

Answer: B

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Chapter Test 11

1. What is the distance (in units) between the two planes

$3x + 5y + 7z = 3$ and $9x + 15y + 21z = 9$?

A. 0

B. 3

C. $\frac{6}{83}$

D. 6

Answer: A

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2. The angle between the lines whose direction- ratios are $< 2, 1, 2 >$ and $< 4, 8, 1 >$ is :

A. $\cos^{-1}\left(\frac{3}{2}\right)$

B. $\cos^{-1}\left(\frac{2}{3}\right)$

C. $\cos^{-1}\left(\frac{10}{3}\right)$

D. $\cos^{-1}\left(\frac{1}{3}\right)$

Answer: B

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3. If as line has direction ratios 2, -1, -2, determine its direction cosines.

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4. Find the Cartesian equations of the following planes whose vector equations are: $\overrightarrow{r}.\left(\hat{i}+\hat{j}-\hat{k}\right)=2$

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5. Using vectors, find the area of the $\triangle ABC$, whose vertices are $A(1, 2, 3), B(2, -1, 4)$ and $C(4, 5, -1)$.

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6. Find the equations of the straight line passing through point (2,3,-1) and is perpendicular t $\frac{x-1}{2}=\frac{y+1}{1}=\frac{z-3}{-3}$ and $\frac{x-3}{1}=\frac{y+2}{1}=\frac{z-1}{1}$

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

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8. Find the equation of the plane passing through the point (1, 3, 2) and perpendicular to each of the planes : $x + 2y + 3z = 5 \text{ and } 3x + 3y + z = 0$

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9. Prove that if a plane has the intercepts a, b, c and is at a distance of p units from the origin, then $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} = \frac{1}{p^2}$.

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10. 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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11. 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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