MATHS

BOOKS - CENGAGE

THREE-DIMENSIONAL GEOMETRY

Illustration

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

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

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3. If $\cos^{-1} x > \sin^{-1} x$, then find the range of x

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4. A line passes through the points $(6, -7, -1) and (2, -3, 1)$. Find te direction cosines off the line if the line makes an acute angle with the positive direction of the x-axis.

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

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

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

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8. 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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9. Write the direction ratios of a line parallel to AB: $\frac{2x-1}{2} = \frac{4-y}{7} = \frac{x-1}{2}$

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10. A mirror and a source of light are situated at the origin O and at a point on $OX,$ respectively. A ray of light from the source strikes the mirror and is reflected. If the direction ratios of the normal to the plane are $1, -1, 1,$ then find the DCs of the reflected ray.

A. 1/3,2/3,2/3

B. -1/3,2/3,2/3

C. -1/3,-2/3,-2/3

D. -1/3,-2/3,2/3

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11. Projection of a line on axis are $-3, 4, -12.$ Find length of line segment and direction cosines.

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12. The Cartesian equations of a line are $6x - 2 = 3y + 1 = 2z - 2.$

Find its direction ratios and also find a vector equation of the line.

A. (1,2,3), r=(1/3)i^-(1/3)j^+k^+

B.

C.

D.

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

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

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

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

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

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17. Find the points where line $\frac{x-1}{2}=\frac{y+2}{-1}=\frac{z}{1}$ intersects xy, yz and zx planes.

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

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

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20. If

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

are two lines, then find the equation of acute angle bisector of two lines.

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

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

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

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24. Find the angle between the following pair 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 $\overrightarrow{r} = 7\hat{i} - 6\hat{k} + \mu\left(\hat{i} + 2\hat{j} + 2\hat{k}$

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

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25. Find the values of p so that the lines

$\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{z-3}{2}$ and $\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ are at right angles.

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

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

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

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

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

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32. Find the shortest distance between the lines $\vec{r} = \left(\hat{i} + 2\hat{j} + \hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right)$ and

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

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33. If the straighat lines $x = 1 + s, y = -3 - \lambda s, z = 1 + \lambda s$ and $x = \frac{t}{2}, y = 1 + t, z = 2 - t$ with parameters s and t respectively, are coplanar, then λ equals (A) $-\frac{1}{2}$ (B) -1 (C) -2 (D) 0

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34. Find the equation of a line which passes through the point $(1, 1, 1)$ and intersects the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} and \frac{x+2}{1} = \frac{y-3}{2} = \frac{z+1}{4}$.

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

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

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37. Find the distance of the plane $2x - y - 2z - 9 = 0$ from the origin.

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

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

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40. If O is the origin and the coordinates of P be (1,2,-3) , then find the equation of the plane passing through P and perpendicular to OP.

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

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42. Find the equation of the plane passing through $A(2, 2, \,-1), B(3, 4, \quad 2) andC(7, 0, 6)\cdot$ Also find a unit vector perpendicular to this plane.

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

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44. 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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45. Prove that the plane $\vec{r}\cdot\left(\hat{i}+2\hat{j}-\hat{k}\right)=3$ contains the line $\vec{r}=\hat{i}+\hat{j}+\lambda\left(2\hat{i}+\hat{j}+4\hat{k}\right)$.

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

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

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

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

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

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

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

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

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54. Find the point of intersection of line passing through $(0, 0, 1)$ and the intersection lines $x + 2y + z = 1, -x + y - 2z and x + y = 2, x + z = 2$ with the xy plane.

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

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

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57. Find the equation of the plane containing line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and point $(0, 7, -7)$.

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

$3x + 2y - 2z + 15 = 0.$

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

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

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

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

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

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65. The plane ax + by = 0 is rotated about its line of intersection with the plane z = 0 through an angle α. Prove that the equation of the plane in its new position is $ax+by \pm \left(\sqrt{a^2+b^2}\tan\alpha\right)z=0$

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

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

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

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70. Find the image of the line $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-3}{4}$ in the plane $3x - 3y + 10z - 26 = 0$.

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

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73. Find the equation of the sphere passing through (0, 0, 0), (1, 0, 0) and (0, 0, 1).

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

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75. Find the equation of the sphere which passes through $(1, 0, 0), (0, 1, 0) and (0, 0, 1)$ and whose centre lies on the plane $3x - y + z = 2.$

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

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

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

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

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

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

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

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Exercise 3.1

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

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2. Find the distance of the point $P(a, b, c)$ from the x-axis.

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

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

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

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

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6. A line makes angles α, β, γ with the coordinates axes . If $\alpha + \beta = 90^{\circ}$ then γ is equal to

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

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

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

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10. Find the angel between any two diagonals of a cube.

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11. Direction ratios of two lines are $a, b, cand1/bc, 1/ca, 1/ab$. Then the lines are ______.

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12. Find the angle between the lines whose direction cosines are connected by the relations $l+m+n=0and2/m+2nl-mn=0.$

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Exercise 3.2

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

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

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3. Find the vector equation of the line passing through the point $(2, \ - 1, \ - 1)$ which is parallel to the line $6x - 2 = 3y + 1 = 2z - 2.$

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

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5. Find the equation of the line passing through the intersection $(-1, 2, 3)$ and perpendicular to the lines $\frac{x-1}{2} = \frac{y-2}{-3} = \frac{z-3}{4} and \frac{x-4}{5} = \frac{y-1}{2} = z \cdot$ and also through the point $(2, 1, -2) \cdot$

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6. The straight line $\frac{x-3}{3} = \frac{y-2}{1} = \frac{z-1}{0}$ is Parallel to x-axis Parallel to the y-axis Parallel to the z-axis Perpendicular to the z-axis

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7. Find the acute angle between the following lines.

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

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8. If the lines $\frac{x-1}{-3}=\frac{y-2}{2k}=\frac{z-3}{2}$ and $\frac{x-1}{3k}=\frac{y-1}{1}=\frac{z-6}{-5}$ are perpendicular , find the value of k .

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

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

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

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12. Find the shortest distance between the two lines whose vector equations are given by: $\vec{r} = (1+\lambda)\hat{i} + (2-\lambda)\hat{j} + (-1+\lambda)\hat{k}$ and $\vec{r} = 2(1+\mu)\hat{i}(1-\mu)\hat{j} + ($

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

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

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15. Let l_1 and l_2 be the two skew lines. If P, Q are two distinct points on l_1 and R, S are two distinct points on l_2, then prove that PR cannot be parallel to QS.

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Exercise 3.3

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

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

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3. Find the distance of the point $(-1, -5, -10)$ from 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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4. Find the equation of the plane passing through the point (-1,3,2) and perpendicular to each of the planes x+2y+3z=5 and 3x+3y+z=0.

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

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

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

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

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

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11. Find the equation of the plane which passes through the point $(12, 3)$ and which is at the maxixum distance from the point $(-1, 0, 2)$.

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12. The direction ratios of the line, given by the planes $x - y + z - 5 = 0, x - 3y - 6 = 0$are

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

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14. Find the equation of a plane which passes through the point $(1, 2, 3)$ and which is equally inclined to the planes

$x - 2y + 2z - 3 = 0 and 8x - 4y + z - 7 = 0.$

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

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16. Find the equation of the plane through the points $(23, 1) and (4, -5, 3)$ and parallel to the x-axis.

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17. Find the distance of the point $\vec{a}$ from the plane $\vec{r} \cdot \hat{n} = d$ measured parallel to the line $\vec{r} = \vec{b} + t\vec{c}.$

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

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19. 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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Exercise 3.4

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

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

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

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

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

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Exercise (Subjective)

1. about to only mathematics

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2. Find the equation of the plane containing the line $\frac{y}{b} + \frac{z}{c} = 1, x = 0,$ and parallel to the line $\frac{x}{a} - \frac{z}{c}1, y = 0.$

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

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

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5. about to only mathematics

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

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

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8. A line passes through the two points $A(2,-3,-1)$ and $B(8,-1,2)$. The coordinates of point on this line nearer to the origin and at a distance of 14 units from is

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

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

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11. Let a plane $ax + by + cz + 1 = 0, wherea, b, c$ are parameters, make an angle 60^0 with the line $x = y = z, 45^0$ with the line $x = y - z = 0$

andθ with the plane $x = 0$. The distance of the plane from point $(2, 1, 1)$ is 3 units. Find the value of θ and the equation of the plane.

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

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13. If $f(x) = 2x - 1, g(x) = \frac{x+1}{2}$, show that $fog = gof = x$

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14. If $f(x) = 1 + x, g(x) = 2x - 2$, show that $fog = gof$

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

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

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SUBJECTIVE TYPE

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

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Exercise (Single)

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

A. points

B. planes

C. curves

D. pair of straight lines

Answer: b

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2. The line $\frac{x-2}{3} = \frac{y+1}{2} = \frac{z-1}{1}$ intersects the curve $xy = c^{I2}, z = 0$ if c is equal to a. ± 1 b. $\pm 1/3$ c. $\pm\sqrt{5}$ d. none of these

A. $\neq 1$

B. $\pm 1/3$

C. $\pm \sqrt{5}$

D. none of these

Answer: c

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

A. the line is parallel to the plane

B. the line is parpendicular to the plane

C. the line lies in the plane

D. none of these

Answer: a

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4. The length of the perpendicular from the origin to the plane passing through the points $\vec{a}$ and containing the line $\vec{r} = \vec{b} + \lambda \vec{c}$ is

A. $\dfrac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right|}$

B. $\dfrac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c}\right|}$

C. $\dfrac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right|}$

D. $\dfrac{\left[\vec{a}\,\vec{b}\,\vec{c}\right]}{\left|\vec{c} \times \vec{a} + \vec{a} \times \vec{b}\right|}$

Answer: c

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

A. $2/\sqrt{3}$

B. $\sqrt{14/3}$

C. $16/\sqrt{3}$

D. $5/\sqrt{3}$

Answer: B

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

A. $2x + y = 5$

B. $2x - y = 5$

C. $2x + z = 5$

D. $2x - z = 5$

Answer: c

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7. A unit vector parallel to the intersection of the planes $\overrightarrow{r}.\left(\hat{i} - \hat{j} + \hat{k}\right) = 5$ and $\overrightarrow{r}.\left(2\hat{i} + \hat{j} - 3\hat{k}\right) = 4$ is

A. $\dfrac{2\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{38}}$

B. $\dfrac{2\hat{i} - 5\hat{j} + 3\hat{k}}{\sqrt{38}}$

C. $\dfrac{-2\hat{i} - 5\hat{j} - 3\hat{k}}{\sqrt{38}}$

D. $\dfrac{-2\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{38}}$

Answer: C

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

A. $\sqrt{2/7}$

B. $1/7$

C. $\sqrt{6}$

D. none

Answer: a

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9. For the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$, which one of the following is correct? a. it lies in the plane $x - 2y + z = 0$ b. it is same as line

$\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ c. it passes through $(2, 3, 5)$ d. it is parallel t the plane $x - 2y + z - 6 = 0$

A. It lies in the plane $x - 2y + z = 0$

B. It is same as line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$

C. It passes through (2,3,5)

D. It is parallel to the plane $x - 2y + z - 6 = 0$

Answer: c

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

A. -2

B. 8

C. -18

D. 11

Answer: A

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

A. $\frac{q}{\hat{i}.\overrightarrow{n}}$

B. $\frac{\hat{i}.\overrightarrow{n}}{q}$

C. $\frac{\hat{i}.\overrightarrow{n}}{q}$

D. $\frac{q}{\left|\overrightarrow{n}\right|}$

Answer: a

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12. Equation of a line in the plane $\pi \equiv 2x - y + z - 4 = 0$ which is perpendicular to the line l whse equation is $\frac{x-2}{1} = \frac{y-2}{-1} = \frac{z-3}{-2}$ and which passes through the point of intersection of $l and \pi$ is a. $\frac{x-2}{1} = \frac{y-1}{5} = \frac{z-1}{-1}$ b. $\frac{x-1}{3} = \frac{y-3}{5} = \frac{z-5}{-1}$ c. $\frac{x+2}{2} = \frac{y+1}{-1} = \frac{z+1}{1}$ d. $\frac{x-2}{2} = \frac{y-1}{-1} = \frac{z-1}{1}$

A. $\frac{x-2}{1} = \frac{y-1}{5} = \frac{z-1}{-1}$

B. $\frac{x-1}{3} = \frac{y-3}{5} = \frac{z-1}{-5}$

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

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

Answer: B

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13. If the foot of the perpendicular from the origin to plane is $P(a, b, c)$, the equation of the plane is a. $\frac{x}{a} = \frac{y}{b} = \frac{z}{c} = 3$ b. $ax + by + cz = 3$ c. $ax + by + cz = a^{I2} + b^2 + c^2$ d. $ax + by + cz = a + b + c$

A. $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 3$

B. $ax + by + cz = 3$

C. $ax + by + cz = a^2 + b^2 + c^2$

D. $ax + by + cz = a + b + c$

Answer: c

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

A. $4x + 3y + 5z = 25$

B. $4x + 3y + 5z = 50$

C. $3x + 4y + 5z = 49$

D. $x+7y+5z=2$

Answer: b

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

A. $\frac{1}{2}$

B. 2

C. 1

D. $\lambda \varepsilon R-\{0\}$

Answer: b

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16. Let $A(1, 1, 1), B(23, 5) and C(-1, 0, 2)$ be three points, then equation of a plane parallel to the plane ABC which is at distance is a. $2x - 3y + z + 2\sqrt{14} = 0$ b. $2x - 3y + z - \sqrt{14} = 0$ c. $2x - 3y + z + 2 = 0$ d. $2x - 3y + z - 2 = 0$

A. $2x - 3y + z + 2\sqrt{14} = 0$

B. $2x - 3y + z - 2\sqrt{14} = 0$

C. $2x - 3y + z + 2 = 0$

D. $2x - 3y + z - 2 = 0$

Answer: a

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17. The point on the line $\frac{x-2}{1} = \frac{y+3}{-2} = \frac{z+5}{-2}$ at a distance of 6 from the point $(2, -3, -5)$ is a. $(3, -5, -3)$ b. $(4, -7, -9)$ c.

$0, 2, \ -1$ d. none of these

A. (3,-5,-3)

B. (4,-7,-9)

C. (0,2,-1)

D. (-3,5,3)

Answer: b

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

A. (-3,2,1)

B. (1,2,2,)

C. (4,5,3)

D. none of these

Answer: D

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19. about to only mathematics

A. parallel lines

B. coplanar lines

C. coincident lines

D. concurrent lines

Answer: d

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

A. 2

B. $\sqrt{\frac{271}{53}}$

C. $\sqrt{\frac{472}{31}}$

D. $\sqrt{\frac{474}{35}}$

Answer: d

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

A. 3

B. 4

C. 7

D. 9

Answer: c

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

A. 0

B. $a^2+b^2+c^2$

C. $\frac{2}{3}(a^2+b^2+c^2)$

D. none of these

Answer: a

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

A. $V \leq \frac{9}{2}$

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

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

D. none of these

Answer: b

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24. If lines $x = y = zandx = \frac{y}{2} = \frac{z}{3}$ and third line passing through $(1, 1, 1)$ form a triangle of area $\sqrt{6}$ units, then the point of intersection of third line with the second line will be a. $(1, 2, 3)$ b. $2, 4, 6$ c. $\frac{4}{3}, \frac{6}{3}, \frac{12}{3}$

d. none of these

A. (1,2,3)

B. (2,4,6)

C. $\left(\frac{4}{3}, \frac{8}{3}, \frac{12}{3}\right)$

D. none of these

Answer: b

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25. Find the point of intersection of line passing through $(0, 0, 1)$ and the intersection lines $x + 2y + z = 1, \; -x + y - 2z and x + y = 2, x + z = 2$ with the xy plane.

A. $\left(\frac{5}{3}, -\frac{1}{3}, 0\right)$

B. (1,1,0)

C. $\left(\frac{2}{3}, -\frac{1}{3}, 0\right)$

D. $\left(-\frac{5}{3}, \frac{1}{3}, 0\right)$

Answer: a

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

A. $\sqrt{14}$

B. $\sqrt{7}$

C. $\sqrt{2}$

D. none of these

Answer: c

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27. Distance of point $P\left(\vec{P}\right)$ from the plane $\vec{r}\cdot\vec{n}=0$ is

A. $\left|\vec{p}\cdot\vec{n}\right|$

B. $\dfrac{\left|\vec{p}\times\vec{n}\right|}{\left|\vec{n}\right|}$

C. $\dfrac{\left|\vec{p}\cdot\vec{n}\right|}{\left|\vec{n}\right|}$

D. none of these

Answer: c

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28. The reflection of the point $\vec{a}$ in the plane $\vec{r}\cdot\vec{n}=q$ is (A) $\vec{a}+\dfrac{\vec{q}-\vec{a}\cdot\vec{n}}{\left|\vec{n}\right|}$ (B) $\vec{a}+2\left(\dfrac{\vec{q}-\vec{a}\cdot\vec{n}}{\left|\vec{n}\right|^2}\right)\vec{n}$ (C) $\vec{a}+\dfrac{2\left(\vec{q}+\vec{a}\cdot\vec{n}\right)}{\left|\vec{n}\right|}$ (D) none of these

A. $\vec{a}+\dfrac{\left(\vec{q}-\vec{a}\,.\,\vec{n}\right)}{\left|\vec{n}\right|}$

B. $\vec{a}+2\left(\dfrac{\left(\vec{q}-\vec{a}\,.\,\vec{n}\right)}{\left|\vec{n}\right|^2}\right)\vec{n}$

C. $\vec{a}+\dfrac{2\left(\vec{q}-\vec{a}\,.\,\vec{n}\right)}{\left|\vec{n}\right|}\vec{n}$

D. none of these

Answer: b

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29. The angle θ between the line $\vec{r}=\vec{a}+\lambda\vec{b}$ and the plane $\vec{r}\,.\,\hat{n}=d$ is given by

A. $\vec{b}\,.\,\vec{n}=0,\ \vec{a}\,.\,\vec{n}=q$

B. $\vec{b}\,.\,\vec{n}\neq 0,\ \vec{a}\,.\,\vec{n}\neq q$

C. $\vec{b}\,.\,\vec{n}=0,\ \vec{a}\,.\,\vec{n}\neq q$

D. $\vec{b}\,.\,\vec{n}\neq 0,\ \vec{a}\,.\,\vec{n}\neq q$

Answer: c

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

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

B. $\frac{\pi}{4}$

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

D. $\frac{\pi}{6}$

Answer: c

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

A. $1:5$

B. $1:10$

C. $3:5$

D. $3:10$

Answer: d

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32. then image of the point $(-1, 3, 4)$ in the plane $x-2y=0$

A. $\left(-\frac{17}{3}, \frac{19}{3}, 4\right)$

B. (15,11,4)

C. $\left(-\frac{17}{3}, \frac{19}{3}, 1\right)$

D. $\left(\frac{9}{5}, -\frac{13}{5}, 4\right)$

Answer: d

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33. The perpendicular distance between the line $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda\left(\hat{i} - \hat{j} + 4\hat{k}\right)$ and the plane $\vec{r}.\left(\hat{i}\middle|5\hat{j}\middle|\hat{k}\right) = 5$ is :

A. $\frac{10}{3\sqrt{3}}$

B. $\frac{10}{9}$

C. $\frac{10}{3}$

D. $\frac{3}{10}$

Answer: a

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

A. $\frac{1}{2}$

B. 1

C. $\frac{1}{\sqrt{2}}$

D. $\frac{1}{\sqrt{3}}$

Answer: d

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

A. 4

B. 5

C. 6

D. 7

Answer: d

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36. If the angle θ between the line $\frac{x+1}{1}=\frac{y-1}{2}=\frac{z-2}{2}$ and the plane $2x-y+\sqrt{pz}+4=0$ is such that $\sin\theta=\frac{1}{3}$, then the values of p is (A) 0 (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) none of these`

A. $\frac{-3}{5}$

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

C. $\frac{-4}{3}$

D. $\frac{3}{4}$

Answer: b

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

A. $x - y - z = 1$

B. $x - 2y - z = 1$

C. $x - y - 2z = 1$

D. $2x - y - z = 1$

Answer: d

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38. If a plane cuts off intercepts $OA = a, OB = b, OC = c$ from the coordinate axes 9where $'O'$ is the origin). then the area of the triangle ABC is equal to

A. $\frac{1}{2}(ab+bc+ac)$

B. $\frac{1}{2}abc$

C. $\frac{1}{2}\left(a^2b^2+b^2c^2+c^2a^2\right)^{1/2}$

D. $\frac{1}{2}(a+b+c)^2$

Answer: c

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

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

B. $\frac{1}{5}$

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

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

Answer: c

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

A. 39

B. 26

C. $41\frac{4}{13}$

D. 13

Answer: d

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41. A tetrahedron has vertices $O(0, 0, 0), A(1, 2, 1), B(2, 1, 3), and C(-1, 1, 2)$, then angle between face $OAB and ABC$ will be a. $\cos^{-1}\left(\frac{17}{31}\right)$ b. 30^0 c. 90^0 d. $\cos^{-1}\left(\frac{19}{35}\right)$

A. $\cos^{-1}\left(\frac{17}{31}\right)$

B. 30°

C. 90°

D. $\cos^{-1}\left(\frac{19}{35}\right)$

Answer: d

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42. The radius of the circle in which the sphere $x^{I2} + y^2 + z^2 + 2z - 2y - 4z - 19 = 0$ is cut by the plane $x + 2y + 2z + 7 = 0$ is a. 2 b. 3 c. 4 d. 1

A. 2

B. 3

C. 4

D. 1

Answer: b

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43. The lines $\frac{x-2}{1}=\frac{y-3}{2}=\frac{z-4}{-k} and =\frac{x-1}{k}=\frac{y-4}{2}=\frac{z-5}{1}$ are coplanar if a. $k=1 \text{ or } -1$ b. $k=0 \text{ or } -3$ c. $k=3 \text{ or } -3$ d. $k=0 \text{ or } -1$

A. k=1 or -1

B. k=0 or -3

C. k=3 or -3

D. k=0 or -1

Answer: b

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44. The point of intersection of the lines $\frac{x-5}{3}=\frac{y-7}{-1}=\frac{z+2}{1} and =\frac{x+3}{-36}=\frac{y-3}{2}=\frac{z-6}{4}$ is a. $\left(21, \frac{5}{3}, \frac{10}{3}\right)$ b. $(2, 10, 4)$ c. $(-3, 3, 6)$ d. $(5, 7, -2)$

A. $\left(21, \frac{5}{3}, \frac{10}{3}\right)$

B. (2,10,4)

C. (-3,3,6)

D. (5,7,-2)

Answer: a

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

A. $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}+\frac{1}{a'^2}+\frac{1}{b'^2}+\frac{1}{c'^2}=0$

B. $\frac{1}{a^2}-\frac{1}{b^2}-\frac{1}{c^2}-\frac{1}{a'^2}-\frac{1}{b'^2}-\frac{1}{c'^2}=0$

C. $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}-\frac{1}{a'^2}-\frac{1}{b'^2}-\frac{1}{c'^2}=0$

D. $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}+\frac{1}{a'^2}+\frac{1}{b'^2}+\frac{1}{c'^2}=0$

Answer: c

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46. Find the equation of a plane which passes through the point (3, 2, 0) and contains the line $\frac{x-3}{1}=\frac{y-6}{5}=\frac{z-4}{4}$

A. $x - y + z = 1$

B. $x + y + z = 5$

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

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

Answer: a

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

A. $< 1, \sqrt{2}, 1 >$

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

C. $< 1, 1, 2 >$

D. $< \sqrt{2}, 1, 1 >$

Answer: b

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48. The centre of the circle given by $\vec{r}.\left(\hat{i}+2\hat{j}+2\hat{k}\right)=15 \text{ and } |\vec{r}-\left(\hat{j}+2\hat{k}\right)=4$ is

A. (0,1,2)

B. (1,3,4)

C. (-1,3,4)

D. none of these

Answer: b

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

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

A. $cz = mxy$

B. $xy = cmz$

C. $cy = mxz$

D. none of these

Answer: c

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50. Distance of the point $P\left(\vec{c}\right)$ from the line $\vec{r} = \vec{a} + \lambda \vec{b}$ is

A. $\left|\left(\vec{a} = \vec{p}\right) + \frac{\left(\left(\vec{p} - \vec{a}\right).\vec{b}\right)\vec{b}}{\left|\vec{b}\right|^2}\right|$

B. $\left|\left(\vec{b} - \vec{p}\right) + \frac{\left(\left(\vec{p} - \vec{a}\right).\vec{b}\right)\vec{b}}{\left|\vec{b}\right|^2}\right|$

C. $\left|\left(\vec{a}-\vec{p}\right)+\frac{\left(\left(\vec{p}-\vec{a}\right).\vec{b}\right)\vec{b}}{\left|\vec{b}\right|^2}\right|$

D. none of these

Answer: c

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

A. $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=0$

B. $\frac{x}{a}+\frac{y}{b}-\frac{z}{c}=0$

C. $\frac{x}{a}-\frac{y}{b}-\frac{z}{c}=0$

D. $\frac{x}{a}-\frac{y}{b}+\frac{z}{c}=0$

Answer: b

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52. The plane $\vec{r} \cdot \vec{n} = q$ will cotain the line $\vec{r} = \vec{a} + \lambda \vec{b}$ if

A. $\vec{b} . \vec{n} \neq 0, \vec{a} . \vec{n} \neq q$

B. $\vec{b} . \vec{n} = 0, \vec{a} . \vec{n} \neq q$

C. $\vec{b} . \vec{n} = 0, \vec{a} . \vec{n} = q$

D. $\vec{b} . \vec{n} \neq 0, \vec{a} . \vec{n} = q$

Answer: c

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

A. $\vec{s} = \dfrac{\left(q - \vec{p} . \vec{n}\right)\vec{n}}{\left|\vec{n}\right|^2}$

B. $\vec{s} = \vec{p} + \frac{\left(q - \vec{p} \cdot \vec{n}\right)\vec{n}}{\left|\vec{n}\right|^2}$

C. $\vec{s} = \vec{p} - \frac{\left(\vec{p} \cdot \vec{n}\right)\vec{n}}{\left|\vec{n}\right|^2}$

D. $\vec{s} = \vec{p} - \frac{\left(q - \vec{p} \cdot \vec{n}\right)\vec{n}}{\left|\vec{n}\right|^2}$

Answer: b

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54. The angle between $\hat{i}$ and line of the intersection of the plane $\vec{r} \cdot \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) = 0$ and $\vec{r} \cdot \left(3\hat{i} + 3\hat{j} + \hat{k}\right) = 0$ is

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

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

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

D. none of these

Answer: d

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

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

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

C. $\frac{x-7}{3}=\frac{y-2}{5}=\frac{z-4}{-1}$

D. none of these

Answer: c

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

A. $\left[\vec{n}_2\vec{n}_3\vec{n}_4\right]\left(\vec{r}.\vec{n}_1 - q_1\right) = \left[\vec{n}_1\vec{n}_3\vec{n}_4\right]\left(\vec{r}.\vec{n}_2 - q_2\right)$

B. $\left[\vec{n}_1\vec{n}_2\vec{n}_3\right]\left(\vec{r}.\vec{n}_4 - q_4\right) = \left[\vec{n}_4\vec{n}_3\vec{n}_1\right]\left(\vec{r}.\vec{n}_2 - q_2\right)$

C. $\left[\vec{n}_4\vec{n}_3\vec{n}_1\right]\left(\vec{r}.\vec{n}_4 - q_4\right) = \left[\vec{n}_1\vec{n}_2\vec{n}_3\right]\left(\vec{r}.\vec{n}_2 - q_2\right)$

D. none of these

Answer: a

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57. Consider triangle AOB in the $x - y$ plane, where $A \equiv (1, 0, 0), B \equiv (0, 2, 0) and O \equiv (0, 0, 0)$. The new position of O, when triangle is rotated about side AB by 90^0 can be

A. $\left(\frac{4}{5}, \frac{3}{5}, \frac{2}{\sqrt{5}}\right)$

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

C. $\left(\frac{4}{5}, \frac{2}{5}, \frac{2}{\sqrt{5}}\right)$

D. $\left(\frac{4}{5}, \frac{2}{5}, \frac{1}{\sqrt{5}}\right)$

Answer: c

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58. Let $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = 2\hat{i} - \hat{k}$. Then the point of intersection of the lines $\vec{r} \times \vec{a} = \vec{b} \times \vec{a}$ and $\vec{r} \times \vec{b} = \vec{a} \times \vec{b}$ is

A. (3,-1,1)

B. (3,1,-1)

C. (-3,1,1)

D. (-3,-1,-1)

Answer: b

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59. The co-ordinates of the point P on the line $\overrightarrow{r}=\left(\hat{i}+\hat{j}+\hat{k}\right)+\lambda\left(-\hat{i}+\hat{j}-\hat{k}\right)$ which is nearest to the origin is

A. $\left(\frac{2}{3}\frac{4}{3},\frac{2}{3}\right)$

B. $\left(-\frac{2}{3}-\frac{4}{3},\frac{2}{3}\right)$

C. $\left(\frac{2}{3}\frac{4}{3},-\frac{2}{3}\right)$

D. none of these

Answer: a

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

A. 13:12 internally

B. 12:25 externally

C. 13:25 internally

D. 37:25 internally

Answer: B

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61. Which of the following are equation for the plane passing through the points $P(1, 1, -1), Q(3, 0, 2)$ and $(-2, 1, 0)$?

A. $\left(2\hat{i} - 3\hat{j} + 3\hat{k}\right).\left((x+2)\hat{i} + (y-1)\hat{j} + z\hat{k}\right) = 0$

B. $x = 3 - t, y = -11t, z = 2 - 3t$

C. $(x+2) + 11(y-1) = 3z$

D. $\left(2\hat{i} - \hat{j} + 3\hat{k}\right) \times \left(-3\hat{i} + \hat{j}\right).\left((x+2)\hat{i} + (y-1)\hat{j} + z\hat{k}\right) = 0$

Answer: d

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62. Given $\overrightarrow{\alpha} = 3\hat{i} + \hat{j} + 2\hat{k} and \overrightarrow{\beta} = \hat{i} - 2\hat{j} - 4\hat{k}$ are the position vectors of the points $A and B$. Then the distance of the point $\hat{i} + \hat{j} + \hat{k}$ from the plane passing through B and perpendicular to AB is a. 5 b. 10 c. 15 d. 20

A. 5

B. 10

C. 15

D. 20

Answer: a

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63. $L_1 and L_2$ and two lines whose vector equations are

$L_1 : \overrightarrow{r} = \lambda\left(\left(\cos\theta + \sqrt{3}\right)\hat{i}\left(\sqrt{2}\sin\theta\right)\hat{j} + \left(\cos\theta - \sqrt{3}\right)\hat{k}\right)$

$L_2 : \vec{r} = \mu\left(a\hat{i} + b\hat{j} + c\hat{k}\right)$, where $\lambda and \mu$ are scalars and α is the acute angel between $L_1 and L_2$. If the angel α is independent of θ, then the value of α is a. $\frac{\pi}{6}$ b. $\frac{\pi}{4}$ c. $\frac{\pi}{3}$ d. $\frac{\pi}{2}$

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

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

Answer: a

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64. The shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1} and \frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$ is

A. $\sqrt{30}$

B. $2\sqrt{30}$

C. $5\sqrt{30}$

D. $3\sqrt{30}$

Answer: d

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65. The line through $\hat{i}+3\hat{j}+2\hat{k}$ and perpendicular to the lines $\vec{r}=\left(\hat{i}+2\hat{j}-\hat{k}\right)+\lambda\left(2\hat{i}+\hat{j}+\hat{k}\right)$ and $\vec{r}=\left(2\hat{i}+6\hat{j}+\hat{k}\right)+\mu\left(\hat{i}+2\hat{j}+3\hat{k}\right)$ is

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

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

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

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

Answer: b

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66. The line through of the plane passing through the lines $\frac{x-4}{1} = \frac{y-3}{1} = \frac{z-2}{2}$ and $\frac{x-3}{1} = \frac{y-2}{-4} = \frac{z}{5}$ is

A. $11x - y - 3z = 35$

B. $11x + y - 3z = 35$

C. $11x - y + 3z = 35$

D. none of these

Answer: d

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

A. meet in a point

B. have a line in common

C. form a triangular prism

D. none of these

Answer: b

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

A. $(ab'-a'b)x+(bc'-b'c)y+(ad'-a'd)=0$

B. $(ab'-a'b)x+(bc'-b'c)y+(ad'-a'd)z=0$

C. $(ab'-a'b)y+(bc'-b'c)z+(ad'-a'd)=0$

D. none of these

Answer: c

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

A. $3x + 4y + 5z = 9$

B. $3x + 4y - 5z = -9$

C. $3x + 4y - 5z = 9$

D. none of these

Answer: b

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70. Value of λ such that the line $\frac{x-1}{2} = \frac{y-1}{3} = \frac{z-1}{\lambda}$ is $\perp$ to normal to the plane $\vec{r}.\left(2\vec{i} + 3\vec{j} + 4\vec{k}\right) = 0$ is

A. $-\frac{13}{4}$

B. $-\frac{17}{4}$

C. 4

D. none of these

Answer: a

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71. The equation of the plane passing through the intersection of $x+2y+3x+4=0$ and $4x+3y+2z+1=0$ and the origin $(0.0, 0)$ is

A. $x+y+z=0$

B. $3x+2y+z+1=0$

C. $2x+3y+z=0$

D. $3x+2y+z=0$

Answer: a

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

A. $x - 4y + 6z = 106$

B. $x - 8y + 13z = 103$

C. $x - 4y + 6z = 110$

D. $x - 8y + 13z = 19 = 105$

Answer: a

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73. The vector equation of the plane passing through the origin and the line of intersection of the planes $\vec{r}.\vec{a} = \lambda$ and $\vec{r}.\vec{b} = \mu$ is

A. $\overrightarrow{r}.\left(\lambda\overrightarrow{a}-\mu\overrightarrow{b}\right)=0$

B. $\overrightarrow{r}.\left(\lambda\overrightarrow{b}-\mu\overrightarrow{a}\right)=0$

C. $\overrightarrow{r}.\left(\lambda\overrightarrow{a}+\mu\overrightarrow{b}\right)=0$

D. $\overrightarrow{r}.\left(\lambda\overrightarrow{b}+\mu\overrightarrow{a}\right)=0$

Answer: b

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74. The two lines $\overrightarrow{r}=\overrightarrow{a}+\overrightarrow{\lambda}\left(\overrightarrow{b}\times\overrightarrow{c}\right)$ and $\overrightarrow{r}=\overrightarrow{b}+\mu\left(\overrightarrow{c}\times\overrightarrow{a}\right)$ intersect at a point where $\overrightarrow{\lambda}$ and μ are scalars then

A. $\overrightarrow{a}\times\overrightarrow{c}=\overrightarrow{b}\times\overrightarrow{c}$

B. $\overrightarrow{a}.\overrightarrow{c}=\overrightarrow{b}.\overrightarrow{c}$

C. $\overrightarrow{b}\times\overrightarrow{a}=\overrightarrow{c}\times\overrightarrow{a}$

D. none of these

Answer: b

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75. The projection of the line $\frac{x+1}{-1}=\frac{y}{2}=\frac{z-1}{3}$ on the plane $x-2y+z=6$ is the line of intersection of this plane with the plane a. $2x+y+2=0$ b. $3x+y-z=2$ c. $2x-3y+8z=3$ d. none of these

A. $2x+y+2=0$

B. $3x+y-z=2$

C. $2x-3y+8z=3$

D. none of these

Answer: a

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76. The direction cosines of a line satisfy the relations $\lambda(l+m)=n$ and $mn+nl+lm=0$. The value of λ, for which the two lines are perpendicular to each other, is

A. 1

B. 2

C. $1/2$

D. none of these

Answer: b

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77. The line through the points $(-2, a)$ and $(9, 3)$has slope $\frac{-1}{2}$. Find the value of a.

A. $\left(-\frac{9}{2}, 9, 9\right)$

B. $\left(\frac{9}{2}, 9, 9\right)$

C. $\left(9, -\frac{9}{2}, 9\right)$

D. $\left(9, \frac{9}{2}, 9\right)$

Answer: a

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78. Find the angle between the lines whose direction cosines are given by the equations $3l + m + 5n = 0$ and $6mn - 2nl + 5lm = 0$

A. parallel

B. perpendicular

C. inclined at $\cos(-1)\left(\frac{1}{6}\right)$

D. none of these

Answer: c

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79. A sphere of constant radius $2k$ passes through the origin and meets the axes in $A, B, andC.$ The locus of a centroid of the tetrahedron $OABC$ is a. $x^2 + y^2 + z^2 = 4k^2$ b. $x^2 + y^2 + z^2 = k^2$ c. $2\left(k^2 + y^2 + z\right)^2 = k^2$ d. none of these

A. $x^2 + y^2 + z^2 = k^2$

B. $x^2 + y^2 + z^2 = k^2$

C. $2(k^2 + y^2 + z)^2 = k^2$

D. none of these

Answer: b

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

A. $\frac{1}{2}\sqrt{a^2 + b^2 + c^2}$

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

C. $a^2 + b^2 + c^2$

D. $\frac{1}{2}(a^2 + b^2 + c^2)$

Answer: a

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

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

A. They meet at a point

B. They form a triangular prism

C. They pass through a line

D. They are at equal distance from the origin

Answer: c

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82. Find the equation of a straight line in the plane $\vec{r}\,.\,\vec{n}=d$ which is parallel to $\vec{r}\,.\,\vec{n}=d\left(\text{where }\ \vec{n}\,.\,\vec{b}=0\right)$.

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

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

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

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

Answer: a

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83. What is the equation of the plane which passes through the z-axis and is perpendicular to the line $\frac{x-a}{\cos\theta}=\frac{y+2}{\sin\theta}=\frac{z-3}{0}$?

A. $x+y\tan\theta=0$

B. $y+x\tan\theta=0$

C. $x \cos \theta - y \sin \theta = 0$

D. $x \sin \theta - y \cos \theta = 0$

Answer: a

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

A. $< (1/\sqrt{2}), (1/\sqrt{2}), 0 >$

B. $< (1/2), (\sqrt{3}/2), 0 >$

C. $< 0, 0, 1 >$

D. $< (2/3), (2/3), (1/3) >$

Answer: a

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85. For what value (s) of a will the two points $(1, a, 1) and (-3, 0, a)$ lie on opposite sides of the plane $3x + 4y - 12z + 13 = 0$? a. $a \succ 1 \text{ or } a > 1/3$ b. $a = 0$ only c. `0

A. $a < -1 \text{ or } a > 1/3$

B. a=0 only

C. $0 < a < 1$

D. $-1 < a < 1$

Answer: a

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86. If the plane $\frac{x}{2} + \frac{y}{3} + \frac{z}{6} = 1$ cuts the axes of coordinates at points, $A, B, \text{ and } C$, then find the area of the triangle ABC

A. 18 sq unit

B. 36 sq unit

C. $3\sqrt{14}$ sq unit

D. $2\sqrt{14}$ sq unit

Answer: c

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Exercise (Multiple)

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

A. $\cos\theta\cos\phi = \frac{1}{\sqrt{14}}, \tan\phi = 2, \tan\theta = \frac{\sqrt{5}}{3}$

B. $\sin\theta\sin\phi = \frac{2}{\sqrt{14}}, \tan\phi = 2, \tan\theta = \frac{\sqrt{5}}{3}$

C. $\tan\phi = 2, \cos\theta\cos\phi = \frac{1}{\sqrt{14}}, \tan\theta = \frac{\sqrt{5}}{3}$

D. $\tan\theta = \frac{\sqrt{5}}{3}, \cos\theta\cos\phi = \frac{1}{\sqrt{14}}, \tan\phi = 2$

Answer: B

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

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3. If the planes $\vec{r}.\left(\hat{i} + \hat{j} + \hat{k}\right) = q_1, \vec{r}.\left(\hat{i} + 2a\hat{j} + \hat{k}\right) = q_2$ and $\vec{r}.\left(a\hat{i} + a^2\hat{j} + \hat{k}\right) =$

intersect in a line, then the value of a is

A. 1

B. $1/2$

C. 2

D. 0

Answer: a, b

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

A. (2,-3,1)

B. (1,2,3)

C. $(0, 5/3, 5/2)$

D. (3,-2,2)

Answer: a, b

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5. Let $P=0$ be the equation of a plane passing through the line of intersection of the planes $2x-y=0and3z-y=0$ and perpendicular to the plane $4x+5y-3z=8$. Then the points which lie on the plane $P=0$ is/are a. $(0, 9, 17)$ b. $(1/7, 21/9)$ c. $(1, 3, -4)$ d. $(1/2, 1, 1/3)$

A. (0,9,17)

B. $(1/7, 2, 1/9)$

C. (1,3,-4)

D. $(1/2, 1, 1/3)$

Answer: a, d

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

B. $\frac{x+(1/2)}{1}=\frac{y-1}{-2}=\frac{z-(1/2)}{1}$

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

D. $\frac{x+1}{1}=\frac{y-2}{-2}=\frac{z=0}{1}$

Answer: b, c, d

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7. Consider the planes $3x-6y+2z+5=0and4x-12+3z=3.$ The plane $67x-162y+47z+44=0$ bisects the angel between the given planes which a. contains origin b. is acute c. is obtuse d. none of these

A. contains origin

B. is acute

C. is obtuse

D. none of these

Answer: a, b

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

A. $\lambda=-1$

B. $\lambda=2$

C. $\lambda=-3$

D. $\lambda=0$

Answer: a,d

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

A. $y = 0$

B. $x = 0$

C. $x + y = 0$

D. $x + z = 0$

Answer: a, c

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

A. $z + x = 0$

B. $z - y = 0$

C. $x + y + z = 0$

D. $z - x = 0$

Answer: a, d

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

A. $14x - 5y - 7z = 0$

B. $2x + 7y - z = 0$

C. $3x - 4y - z = 0$

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

Answer: a, b

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

A. $\frac{x-1}{1}=\frac{y}{-1}=\frac{z-5}{-1}$

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

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

D. none of these

Answer: a, c

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

A. $x+y-z=0$

B. $y + x = 6$

C. $y + z = 0$

D. $y + z = -3$

Answer: b, c

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14. A rod of length 2 units whose one end is $(1, 0, -1)$ and other end touches the plane $x - 2y = 2Z + 4 = 0,$ then a. the rod sweeps the figure whose volume is $b. \pi c.$ d. cubic units. e. the area of the region which the rod traces on the plane is $f. g.2\pi h.$ i. j. the length of projection of the rod on the plane is $k. l. \sqrt{m.3n.} \odot p.$ q. units. r. the centre of the region which the rod traces on the plane is $s. t. \left(u. v. w\frac{.2}{x}.3y. z. , aa\frac{.2}{b}b.3cc. dd. , -ee\frac{.5}{f}f.3gg. hh. ii. \right)\dot{j}j.$ kk.

A. the rod sweeps the figure whose volume is π cubic units.

B. the area of the region which the rod traces on the plane is 2π.

C. the length of projection of the rod on the plane is $\sqrt{3}$ units.

D. the centre of the region which the rod traces on the plane is $\left(\frac{2}{3}, \frac{2}{3}, \frac{-5}{3}\right)$

Answer: b

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15. Find the angle between the line $\frac{x-2}{3} = \frac{y-1}{-1} = \frac{z-3}{2}$ and the plane $3x + 4y + z + 5 = 0$.

A. The volume of the bounded figure by points R and the planes is $\left(10/3\sqrt{3}\right)\pi$ cube units.

B. The area of the curved surface formed by the set of points R is $\left(20\pi/\sqrt{6}\right)$ sq. units.

C. The volume of the bounded figure by the set of points R and the planes is $\left(20\pi/\sqrt{6}\right)$ cubic units.

D. The area of the curved surface formed by the set of points R is

$(10/\sqrt{3})\pi$ sq. units.

Answer: b,c

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16. The equation of the line throgh the point $\vec{a}$ parallel to the plane $\vec{r}\,.\,\vec{n}$=q and $perpendic\underline{a}r \rightarrow thel \in e$vecr=vecb+tvecc$is(A)$ vecr=veca+lamda (vecnxxvecc)(B)(vecr-veca)xx(vecnxxvecc)=0(C) vecr=vecb+lamda(vecnxxvecc)` (D) none of these

A. $\vec{r} = \vec{a} + \lambda\left(\vec{n} \times \vec{c}\right)$

B. $\left(\vec{r} - \vec{a}\right) \times \left(\vec{n} \times \vec{c}\right) = 0$

C. $\vec{r} = \vec{b} + \lambda\left(\vec{n} \times \vec{c}\right)$

D. none of these

Answer: a, d

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A. $\frac{x+1}{1}=\frac{y-2}{-2}=\frac{z-0}{1}$

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

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

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

Answer: a,b,c

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Exercise (Reasoning Questions)

1. Statement 1 : Lines $\vec{r}=\hat{i}-\hat{j}+\lambda\left(\hat{i}+\hat{j}-\hat{k}\right)$ and $\vec{r}=2\hat{i}-\hat{j}+\mu\left(\hat{i}+\hat{j}-\hat{k}\right)$ do not intersect.

Statement 2 : Skew lines never intersect.

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: b

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2. If $f(x) = 2x + 1$ and $g(x) = \frac{x}{2}$, then find $(fog(x)) - (gof(x))$

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

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: d

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4. Statement 1: A plane passes through the point $A(2, 1, -3)$. If distance of this plane from origin is maximum, then its equation is $2x + y - 3z = 14$. Statement 2: If the plane passing through the point $A\left(\vec{a}\right)$ is at maximum distance from origin, then normal to the plane is vector $\vec{a}$.

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: b

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5. Statement 1: Line $\dfrac{x-1}{1}=\dfrac{y-0}{2}=\dfrac{z2}{-1}$ lies in the plane $2x-3y-4z-10=0$. Statement 2: if line $\overrightarrow{r}=\overrightarrow{a}+\lambda\overrightarrow{b}$ lies in the plane $\overrightarrow{r}\dot{\overrightarrow{c}}=n(where n$ is scalar$\Big)$, $then \overrightarrow{b}\dot{\overrightarrow{c}}=0.$

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: c

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6. Statement 1: Let θ be the angle between the line $\dfrac{x-2}{2}=\dfrac{y-1}{-3}=\dfrac{z+2}{-2}$ and the plane $x+y-z=5$. Then

$\theta = \sin^{-1}(1/\sqrt{51})$. Statement 2: The angle between a straight line and a plane is the complement of the angle between the line and the normal to the plane.

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: c

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

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: b

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

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: c

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

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: b

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

Statement 2: The given lines are perpendicular.

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: d

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Exercise (Comprehension)

1. Given four points $A(2, 1, 0), B(1, 0, 1), C(3, 0, 1)$ and $D(0, 0, 2)$. Point D lies on a line L orthogonal to the plane determined by the points A, B and C.

The equation of the plane ABC is

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

B. $y + z - 1 = 0$

C. $x + z - 1 = 0$

D. $2y + z - 1 = 0$

Answer: b

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2. Given four points $A(2, 1, 0), B(1, 0, 1), C(3, 0, 1)$ and $D(0, 0, 2)$.

Point D lies on a line L orthogonal to the plane determined by the points A, B and C.

The equation of the line L is

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

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

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

D. none

Answer: c

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3. Given four points $A(2, 1, 0), B(1, 0, 1), C(3, 0, 1)$ and $D(0, 0, 2)$. Point D lies on a line L orthogonal to the plane determined by the points A, B and C.

A. $\sqrt{2}$

B. $1/2$

C. 2

D. $1/\sqrt{2}$

Answer: d

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4. A ray of light comes light comes along the line L = 0 and strikes the plane mirror kept along the plane P = 0 at B. $A(2, 1, 6)$ is a point on the line L = 0 whose image about P = 0 is A'. It is given that L = 0 is $\frac{x-2}{3} = \frac{y-1}{4} = \frac{z-6}{5}$ and $P = 0$ is $x + y - 2z = 3$.

The coordinates of A' are

A. $(6, 5, 2)$

B. $(6, 5, -2)$

C. $(6, -5, 2)$

D. none of these

Answer: b

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5. A ray of light comes light comes along the line L = 0 and strikes the plane mirror kept along the plane P = 0 at B. $A(2, 1, 6)$ is a point on the line L = 0 whose image about P = 0 is A'. It is given that L = 0 is $\frac{x-2}{3} = \frac{y-1}{4} = \frac{z-6}{5}$ and $P = 0$ is $x + y - 2z = 3$. The coordinates of B are

A. $(5, 10, 6)$

B. $(10, 15, 11)$

C. $(-10, -15, -14)$

D. none of these

Answer: c

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6. A ray of light comes light comes along the line L = 0 and strikes the plane mirror kept along the plane P = 0 at B. $A(2, 1, 6)$ is a point on the line L = 0 whose image about P = 0 is A'. It is given that L = 0 is $\frac{x-2}{3} = \frac{y-1}{4} = \frac{z-6}{5}$ and $P = 0$ is $x + y - 2z = 3$.

If $L_1 = 0$ is the reflected ray, then its equation is

A. $\frac{x+10}{4} = \frac{y-5}{4} = \frac{z+2}{3}$

B. $\frac{x+10}{3} = \frac{y+15}{5} = \frac{z+14}{5}$

C. $\frac{x+10}{4} = \frac{y+15}{5} = \frac{z+14}{3}$

D. none of these

Answer: c

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7. for what values of p and q the system of equations $2x + py + 6z = 8x + 2y + qz = 5, x + y + 3z = 4$ has

(i) no solutions

(ii) a unique solution

(iii) infinitely many solution.

A. $p = 2, q \neq 3.$

B. $p \neq 2, q \neq 3$

C. $p \neq 2, q = 3$

D. $p = 2, q = 3$

Answer: b

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8. for what values of p and q the system of equations $2x + py + 6z = 8x + 2y + qz = 5, x + y + 3z = 4$ has

(i) no solutions

(ii) a unique solution

(iii) infinitely many solution.

A. $p = 2, q \neq 3.$

B. $p \neq 2, q \neq 3$

C. $p \neq 2, q = 3$

D. $p = 2, q = 3$

Answer: c

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9. for what values of p and q the system of equations $2x + py + 6z = 8x + 2y + qz = 5, x + y + 3z = 4$ has

(i) no solutions

(ii) a unique solution

(iii) infinitely many solution.

A. $p = 2, q \in 3$

B. $p \in 2, q \in 3$

C. $p \neq 2, q = 3$

D. $p = 2, q = 3$

Answer: b

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10. Consider a plane $x + y - z = 1$ and point $A(1, 2, -3)$. A line L has the equation $x = 1 + 3r, y = 2 - r$ and $z = 3 + 4r$.

The coordinate of a point B of line L such that AB is parallel to the plane is

A. $(10, -1, 15)$

B. $(-5, 4, -5)$

C. $(4, 1, 7)$

D. $(-8, 5, -9)$

Answer: d

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11. Consider a plane $x + y - z = 1$ and point $A(1, 2, -3)$. A line L has the equation $x = 1 + 3r, y = 2 - r$ and $z = 3 + 4r$. the equation of plane containing line Land point A has the equation x − 3 y + 5 = 0 x + 3 y − 7 = 0 3 x − y − 1 = 0 3 x + y − 5 = 0

A. $x - 3y + 5 = 0$

B. $x + 3y - 7 = 0$

C. $3x - y - 1 = 0$

D. $3x + y - 5 = 0$

Answer: b

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12. Find the direction cosines of the vector joining the points $A(1, 2, -3)$ and $B(-1, -2, 3)$ directed from A to B.

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Exercise (Matrix)

1. Find the angle between the vectors $\vec{a} = 3\hat{i} + 4\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + 3\hat{j} - \hat{k}$

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2. Prove that the vectors $\vec{a} = 3\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = \hat{i} - \hat{k}$ are perpendicular.

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3. Find the shortest distance between the lines whose vector equations are $\vec{r} = \left(4\hat{i} - \hat{j}\right) + \lambda\left(\hat{i} + 2\hat{j} - 3\hat{k}\right)$ and $\vec{r} = \left(\hat{i} - \hat{j} + 2\hat{k}\right) + \mu\left(\hat{i} + 4\hat{j} - 5\hat{k}\right)$

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4. Prove that the vectors $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j}$ are perpendicular.

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5. Match the following Column I to Column II

Column I	Column II
a. Image of the point (3, 5, 7) in the plane $2x + y + z = -18$ is	p. $(-1, -1, -1)$
b. The point of intersection of the line $\frac{x-2}{-3} = \frac{y-1}{-2} = \frac{z-3}{2}$ and the plane $2x + y - z = 3$ is	q. $(-21, -7, -5)$
c. The foot of the perpendicular from the point (1, 1, 2) to the plane $2x - 2y + 4z + 5 = 0$ is	r. $\left(\frac{5}{2}, \frac{2}{3}, \frac{8}{3}\right)$
d. The intersection point of the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-4}{5} = \frac{y-1}{2} = z$ is	s. $\left(-\frac{1}{12}, \frac{25}{12}, \frac{-2}{12}\right)$

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Exercise (Numerical)

1. Find the number of sphere of radius r touching the coordinate axes.

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

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

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

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5. Let A_1, A_2, A_3, A_4 be the areas of the triangular faces of a tetrahedron, and h_1, h_2, h_3, h_4 be the corresponding altitudes of the tetrahedron. If the volume of tetrahedron is $\frac{1}{6}$ cubic units, then find the minimum value of $(A_1+A_2+A_3+A_4)(h_1+h_2+h_3+h_4)$ (in cubic units).

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A. 4

B. 2

C. 6

D. 8

Answer: C

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8. The plane denoted by $P_1 : 4x + 7y + 4z + 81 = 0$ is rotated through a right angle about its line of intersection with the plane $P_2 : 5x + 3y + 10z = 25$. If the plane in its new position is denoted by P, and the distance of this plane from the origin is d, then find the value of $[k/2]$ (where $[\cdot]$ represents greatest integer less than or equal to k).

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9. 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 $4x + 12y - 3z + 1 = 0$.

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JEE Previous Year

1. (i) Find the equation of the plane passing through the points $(2, 1, 0), (5, 0, 1) and (4, 11)\cdot$ (ii) If P s the point $(2, 1, 6)$, then the find the point Q such that PQ is perpendicular to the plane in (i) and the midpoint of PQ lies on it.

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

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

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6. The value of k such that $\frac{x-4}{1}=\frac{y-2}{1}=\frac{z-k}{2}$ lies in the plane $2x-4y=z=7$ is a. 7 b. -7 c. no real value d. 4

A. 7

B. -7

C. no real value

D. 4

Answer: a

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

A. $3/2$

B. $9/2$

C. $-2/9$

D. $-3/2$

Answer: b

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A. 3

B. 1

C. $1/3$

D. 9

Answer: d

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9. A plane passes through (1,-2,1) and is perpendicualr to two planes $2x - 2y + z = 0$ and $x - y + 2z = 4$, then the distance of the plane from the point (1,2,2) is

A. 0

B. 1

C. $\sqrt{2}$

D. $2\sqrt{2}$

Answer: d

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

A. $1/4$

B. $-1/4$

C. $1/8$

D. $-1/8$

Answer: a

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

B. $3x + 2y - 2z = 0$

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

D. $5x + 2y - 4z = 0$

Answer: c

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12. If the distance of the point $P(1, -2, 1)$ from the plane $x + 2y - 2z = \alpha, where\alpha > 0, is5,$ then the foot of the perpendicular from P to the place is a. $\left(\frac{8}{3}, \frac{4}{3}, -\frac{7}{3}\right)$ b. $\left(\frac{4}{3}, -\frac{4}{3}, \frac{1}{3}\right)$ c. $\left(\frac{1}{3}, \frac{2}{3}, \frac{10}{3}\right)$ d. $\left(\frac{2}{3}, -\frac{1}{3}, -\frac{5}{3}\right)$

A. $\left(\frac{8}{3}, \frac{4}{3}, -\frac{7}{3}\right)$

B. $\left(\frac{4}{3}, -\frac{4}{3}, \frac{1}{3}\right)$

C. $\left(\frac{1}{3}, \frac{2}{3}, \frac{10}{3}\right)$

D. $\left(\frac{2}{3}, -\frac{1}{3}, \frac{5}{2}\right)$

Answer: a

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A. $\frac{1}{\sqrt{2}}$

B. $\sqrt{2}$

C. 2

D. $2\sqrt{2}$

Answer: a

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14. about to only mathematics

A. $\frac{x}{5}=\frac{y-1}{8}=\frac{z-2}{-13}$

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

C. $\frac{x}{4}=\frac{y-1}{3}=\frac{z-2}{-7}$

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

Answer: d

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

A. 1

B. 2

C. 3

D. 4

Answer: a, d

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16. about to only mathematics

A. $\left(\frac{7}{3}, \frac{7}{3}, \frac{5}{3}\right)$

B. $(-1, -1, 0)$

C. $(1, 1, 1)$

D. $\left(\frac{7}{9}, \frac{7}{9}, \frac{8}{9}\right)$

Answer: b, d

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17. In R^3 let L be straight line passing through the origin. Suppose that all the points on L are at a constant distance from the two planes $P_1 : x + 2y - z + 1 = 0$ and $P_2 : 2x - y + z - 1 = 0$ Let M be the locus of the feet of the perpendiculars drawn from the points on L to the plane P_1 . which of the following points lie (s) on M?

A. $\left(0, -\frac{5}{9}, -\frac{2}{3}\right)$

B. $\left(-\frac{1}{6}, -\frac{1}{3}, \frac{1}{6}\right)$

C. $\left(-\frac{5}{6}, 0, \frac{1}{6}\right)$

D. $\left(-\frac{1}{3}, 0, \frac{2}{3}\right)$

Answer: a, b

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18. In R_3, consider the planes $P_1 : y = 0$ and $P_2 : x + z = 1$. $Let P_3$ be a plane , different from P_1 and P_2 , which passes through the interesection of P_1 and P_2I fhte distance of the (0,1,0) from p_3 is 1 and the distance of a point (α, β, γ) from P_3 is 2, then which of the following relations is (are) true ?

A. $2\alpha + \beta + 2\gamma + 2 = 0$

B. $2\alpha - \beta + 2\gamma + 4 = 0$

C. $2\alpha + \beta - 2\gamma - 10 = 0$

D. $2\alpha - \beta + 2\gamma - 8 = 0$

Answer: b, d

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

A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: d

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A. Both the statements are true, and Statement 2 is the correct explanation for Statement 1.

B. Both the Statements are true, but Statement 2 is not the correct explanation for Statement 1.

C. Statement 1 is true and Statement 2 is false.

D. Statement 1 is false and Statement 2 is true.

Answer: d

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21. Consider the line $L1: \frac{x+1}{3} = \frac{y+2}{1} = \frac{z+1}{2}, L2: \frac{x-2}{1} = \frac{y+2}{2} = \frac{z-3}{3}$

A. $\frac{-\hat{i}+7\hat{j}+7\hat{k}}{\sqrt{99}}$

B. $\dfrac{-\hat{i}-7\hat{j}+5\hat{k}}{5\sqrt{3}}$

C. $\dfrac{-\hat{i}+7\hat{j}+5\hat{k}}{5\sqrt{3}}$

D. $\dfrac{7\hat{i}-7\hat{j}-\hat{k}}{\sqrt{99}}$

Answer: b

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

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23. If $f(x)=3x-2$ and $g(x)=2x+a$ and if $fog=gof$, then find the value of a

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24. Consider the linear equations $ax + by + cz = 0, bx + cy + az = 0$ and $cx + ay + bz = 0.$

Match the conditions/expressions in Column I with statements in Column II.

Column I	Column II
a. $a + b + c \neq 0$ and $a^2 + b^2 + c^2 = ab + bc + ca$	p. The equations represent planes meeting only at a single point.
b. $a + b + c = 0$ and $a^2 + b^2 + c^2 \neq ab + bc + ca$	q. The equations represent the line $x = y = z$.
c. $a + b + c \neq 0$ and $a^2 + b^2 + c^2 \neq ab + bc + ca$	r. The equations represent identical planes.
d. $a + b + c = 0$ and $a^2 + b^2 + c^2 = ab + bc + ca$	s. The equations represent the whole of the three-dimensional space.

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25. Let $f: R \to R: f(x) = x^2$ and $g: R \to R: g(x) = (x + 1)$. Show that $(gof) \neq (fog)$.

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26. If the distance between the plane Ax 2y + z = d and the plane containing the lines 2 1x = 3 2y = 4 3z and 3 2x = 4 3y = 5 4z is 6 , then |d| is

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