MATHS

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APPLICATIONS OF VECTOR ALGEBRA

Worked Examples

1. Cosine formula:

With usual notations in any triangle ABC

Prove that : $\cos A = \frac{b^2+c^2-a^2}{2bc}$.

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2. Projection formula:

Prove that $a = b\cos C + c\cos B$.

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3. Sine formula:

With usual notation in a ΔABC

Prove that $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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4. Prove by vector methods.

$\cos(A - B) = \cos A \cos B + \sin A \sin B.$

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5. Prove that $\sin(A + B) = \sin A \cos B + \cos A \sin B.$

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6. Prove that twice the area of a parallelogram is equal in the area of another parallelogram formed by taking as its adjacent sides of the diagonals of the former parallelogram.

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7. Show that the diameter of a sphere subtends a right angle at a point on the circumference.

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8. (Apollonius theorem): If D is the midpoint of the side BC of a triangle ABC, then show by vector method that

$$\left|\overrightarrow{AB}\right|^2 + \left|\overrightarrow{AC}\right|^2 = 2\left(\left|\overrightarrow{AD}\right|^2 + \left|\overrightarrow{BD}\right|^2\right).$$

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9. A particle acted on forces $\overrightarrow{F}_1 = 3\hat{i} - \hat{j} + 3\hat{k}$ and $\overrightarrow{F}_2 = 2\hat{i} + 3\hat{j} - 4\hat{k}$, is displaced from the point $(3, -2, -1)$ to the point $(1, 5, -2)$. Find the total work done by the forces.

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10. A particle is acted upon by the forces $\overrightarrow{F}_1 = \hat{i} + 2\hat{j} + 3\hat{k}, \overrightarrow{F}_2 = 2\hat{i} + \hat{j} - 3\hat{k}, \overrightarrow{F}_3 = 3\hat{i} - 4\hat{j} + 2\hat{k}$, is displaced from the point $(-2, 1, 3)$ to the point $(1, \lambda, -2)$. If the total work done by the forces is 8. Find the value of λ .

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11. Find the magnitude and direction cosines of the torque about the point $(3, 1, -2)$ of a force $3\hat{i} + 2\hat{j} + \hat{k}$ whose line of action passes through that $(1, 2, -1)$

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12. If $\vec{a} = 3\hat{i} + 2\hat{j} - \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{c} = 4\hat{i} + 3\hat{j} - \hat{k}$ Find $\vec{a} \cdot \left(\vec{b} \times \vec{c}\right)$.

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13. Find the volume of the parallelepiped whose coterminus edges are given by the vectors $\hat{i} + 2\hat{j} + 3\hat{k}$, $2\hat{i} - \hat{j} - \hat{k}$ and $3\hat{i} + 4\hat{j} + 2\hat{k}$

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14. Show that the vectors $2\hat{i} - 3\hat{j} + \hat{k}$, $-4\hat{i} - \hat{j} + 3\hat{k}$ and $-2\hat{i} - 4\hat{j} + 4\hat{k}$ are coplanar.

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15. If $3\hat{i} + 6\hat{j} + 2\hat{k}$, $\hat{i} - 2\hat{j} + 3\hat{k}$ and $5\hat{i} + 2\hat{j} + m\hat{k}$ are coplanar.

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16. If $\vec{a}, \vec{b}, \vec{c}$ are three given vectors show that

$$\left[\vec{a}+\vec{b}+\vec{c}, \vec{b}+\vec{c}, \vec{a}+\vec{b}+\vec{c}\right]=0.$$

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17. Show that for any three vectors $\vec{a}, \vec{b}$ and $\vec{c}\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right]=2\left[\vec{a}, \vec{b}, \vec{c}\right].$

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18. Show that the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ are coplanar if $\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}$ are coplanar.

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19. Show that $\left[\vec{b}, \vec{c}, \vec{d}\right]\vec{a} - \left[\vec{a}, \vec{c}, \vec{d}\right]\vec{b} + \left[\vec{a}, \vec{b}, \vec{d}\right]\vec{c} - \left[\vec{a}, \vec{b}, \vec{c}\right]\vec{d} = 0$

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20. For any four vectors $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ (all non coplanar) any vector can be written as a linear combination of other three vectors.

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21. If $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}, \vec{b} = \hat{i} + \hat{j} + 2\hat{k}, \vec{c} = 3\hat{i} - \hat{j} + \hat{k}$ Find $\left(\vec{a} \times \vec{b}\right)\vec{c}$ and $\vec{a}\left(\vec{b} \times \vec{c}\right)$ Are they equal?

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22. Find the vector equation and cartesian equation of the line through the point (1, 2, -2) and in parallel to $\left(3\hat{i} - 4\hat{j} + 5\hat{k}\right)$.

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23. Given the vector equation of a line as $\overrightarrow{r} = \left(2\hat{i} - \hat{j} + 3\hat{k}\right) + t\left(\hat{i} - \hat{j} - \hat{k}\right)$ find the direction cosines of the line. Find also the equation of the line in non parametric form and in cartesian form.

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24. Find vector and cartesian equation of the line passing through (2, -2, -3) and is parallel to $\frac{x-1}{5} = \frac{y+3}{2} = \frac{z-1}{-2}$.

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25. Find the vector and cartesian equation of the line through points (2, 1, -3) and (-2, 3, -2) Find also where does the line meets yz plane.

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26. Find the angle between the straight line $\frac{x-1}{2}=\frac{y-3}{2}=z$ with co-ordinates axes.

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27. Find the angle between the straight line $\vec{r}=3\hat{i}-\hat{j}+2\hat{k}+t\left(2\hat{i}-\hat{j}-2\hat{k}\right)$ and the line joining the points (2, -1, 3) (-1, -2, 4).

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28. Find tha angle between the lines

$$\frac{x-20}{1}=\frac{y+15}{2}=\frac{z-3}{-2} \text{ and}$$
$$\frac{x+5}{6}=\frac{y+3}{3}=\frac{z-16}{6}$$

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29. Show that the line joining the points A(2, 3, 1) and B(4, 6, 2) is perpendicular to the line joining the points C(6, -2, -9) and D(4, -1, -8).

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30. Show that the lines $\frac{x-3}{2}=\frac{y-5}{-1}=\frac{z+7}{4}$ and $\frac{x-15}{4}=\frac{y+12}{-2}=\frac{z-8}{8}$ are parallel.

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31. Find the point of intersection of the lines $\frac{x-1}{3}=\frac{y-1}{-1}=z+2$' and (x-4)/(2)=y=(z+1)/(3)`.

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32. Find the equation of a straight line passing through the point of intersection of the straight line $\vec{r}=\left(2\hat{i}+4\hat{j}-3\hat{k}\right)+t\left(\hat{i}+2\hat{j}+4\hat{k}\right)$ and $\frac{x-1}{2}=\frac{y-3}{3}=\frac{z+1}{2}$ and perpendicular to both the straight lines.

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33. Show that the lines

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

$\vec{r}=\left(\hat{i}+\hat{j}+\hat{k}\right)+s\left(7\hat{i}+6\hat{j}+7\hat{k}\right)$ are skew lines and find the shortest distance between them.

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34. Show that the lines $\frac{x-3}{1}=\frac{y-5}{-2}=\frac{z-7}{1}$ and $\frac{x-1}{7}=\frac{y-1}{6}=\frac{z-1}{7}$ are skew lines and find the shortest distance between them.

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35. Determine whether the lines

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

$\vec{r}=\left(2\hat{i}+\hat{j}-\hat{k}\right)+s\left(\hat{i}+2\hat{j}-\hat{k}\right)$ are parallel. Find the shortest distance between them.

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36. Find the shortest distance between the lines $\frac{x-6}{3}=\frac{y-7}{-1}=\frac{z-4}{1}$ and $\vec{r}=-9\hat{i}+2\hat{k}+t\left(-3\hat{i}+2\hat{j}+4\hat{k}\right)$

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37. Find the coordinates of the foot of the perpendicular from the point (5, 2, -8) to the straight line $\overrightarrow{r} = 2\hat{i} - \hat{j} + 2\hat{k} + t\left(\hat{i} + 3\hat{j} - \hat{k}\right)$. Find also the shortest distance from the point to this straight line.

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38. Find the vector and cartesian form of the equation of the plane which is at distance of 6 units from the origin and perpendicular to $2\hat{i} + 3\hat{j} - 6\hat{k}$.

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39. If the cartesian equation of the plane $2x - y + 2z = 3$ find the vector equation of the plane in standard form.

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40. Find the direction cosines and length of the perpendicular from hte origin to the plane $\overrightarrow{r}\cdot\left(12\hat{i}-4\hat{j}-3\hat{k}\right)=7.$

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41. Find the vector and cartesian equation of the plane through the point whose position vector is $2\hat{i}-3\hat{j}+\hat{k}$ and normal to the vector $3\hat{i}-2\hat{j}-\hat{k}.$

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42. Find the unit normal vectors to the plane $2x+y-2z=5.$

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43. Find the non parametric form of vector equation and the cartesian equation of the plane passing through the point (-1, 2, -3) and parallel to the lines

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

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44. Find the vector parametric , non parametric and Cartesian equation of the plane passing through the points (2, 1, -1) and (1, -1, 2) and parallel to the line $\frac{x-10}{2} = \frac{y+7}{3} = \frac{z-3}{4}$.

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45. Check whether the line $\frac{x-1}{4} = \frac{y+2}{5} = \frac{z-7}{6}$ lines in the plane $3x + 2y + z = 6$.

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46. Show that the lines

$\vec{r} = (-2\hat{i} - 4\hat{j} - 6\hat{k}) + t(\hat{i} + 4\hat{j} + 7\hat{k})$

$\overrightarrow{r} = \left(\hat{i} + 3\hat{j} + 5\hat{k}\right) + s\left(3\hat{i} + 5\hat{j} + 7\hat{k}\right)$ are coplanar. Find the equation of such plane in non parametric form and in cartesian form.

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47. Find the acute angle between the planes $\overrightarrow{r}\left(2\hat{i} - 3\hat{j} + 5\hat{k}\right) = 1 \text{ and } \overrightarrow{r}\left(\hat{i} - \hat{j} - \hat{k}\right) = 7.$

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48. Find the acute angle between the planes $2x - 3y + 5z = 1 \text{ and } x - y - z = 7.$

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49. Find the angle between the line $\overrightarrow{r} = \left(2\hat{i} - \hat{j} + 2\hat{k}\right) + t\left(\hat{i} + \hat{j} - \hat{k}\right)$ and the plane $2x + y - 2z = 5$.

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50. Find the perpendicular distance of the point (2, -3, 3) from the plane $\vec{r}\cdot\left(\hat{i}-2\hat{j}-2\hat{k}\right)=8.$

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51. Find the distance of the point (2, 3, -2) from the point of intersection of the straight line passing through the points A(3, 0, 1) and B(6, 4, 3) with the plane $x+y-z=7.$

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52. Find the distance between the parallel planes $x-2y-2z=3$ and $2x-4y-4z=7.$

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53. Find the distance between the planes

$\vec{r}\cdot\left(\hat{i}-2\hat{j}-2\hat{k}\right)=7$ and $\vec{r}\cdot\left(5\hat{i}-10\hat{j}-10\hat{k}\right)=15.$

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54. Find the equation of the plane passing through the line of intersection of the plane $\vec{r}\cdot\left(2\hat{i}+3\hat{j}-4\hat{k}\right)+1=0$ and $\vec{r}\cdot\left(\hat{i}-\hat{j}+3\hat{k}\right)=3$ and through the point (1, 1, -1).

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55. Find the equation of the plane passing through the intersection of the planes $\vec{r}\cdot\left(2\hat{i}+3\hat{j}\right)=1$ and $3x-4y+3z=8$ and is perpendicular to the plane $x+2y-z+6=0.$

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56. Find the equation of the plane through the intersection of the line $2x + 3y = 1$ and $\overrightarrow{r} \cdot \left(3\hat{i} - 4\hat{j} + 3\hat{k}\right) = 8$ and is parallel to the line $\frac{x-1}{1} = \frac{y-3}{2} = \frac{z+1}{-1}$.

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57. Find the images of the point (1, 2, 3) in the plane $x + 2y + 4z = 38$.

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58. Find the coordinates of the points where the straight line $\overrightarrow{r} = \left(\hat{i} - 2\hat{j} - 2\hat{k}\right) + t\left(4\hat{i} + 3\hat{j} + 2\hat{k}\right)$ intersects the plane $x - 2y + 3z + 9 = 0$.

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Solution To Exercise 6 1

1. Prove by vertor metord thtat if a line is drawn frome the centre of a circle of a circle to the midpoint of a chord then the line is perpendicular to the chord

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2. Prove by vector method that median to the base of an isoscels triangle is perpendicular to the base.

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3. Prove by vector method that an angle in a semi-circle is a right angle.

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4. Prove by vector method that the diagonals of a rhombus bisect each other at right angles.

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5. Using vector method, prove that if the diagonals of a parallelogram are equal, then it is a rectangle.

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6. Prove by vector method that the area of the quadrilateral ABCD having diagonals AC and is $\frac{1}{2}\left|\overline{AC}\times\overline{BD}\right|$

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7. Prove by vector method that the parallelograms on the same base and between the same parallels are equal in area.

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8. If G is the centroid of a ΔABC, Prove that (area of ΔGAB) $=$ (area of ΔGBC) $=$ (are

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9. Using vector method, prove $\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$.

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10. Prove by vector method that $\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$.

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11. A particle acted on by constant forces $8\hat{i} + 2\hat{j} - 6\hat{k}$ and $6\hat{i} + 2\hat{j} - 2\hat{k}$ is displaced from the point $(1, 2, 3)$ to the point $(5, 4, 1)$.

Find the total work done by the forces.

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12. Forces of magnitude $5\sqrt{2}$ and $10\sqrt{2}$ units acting in the directions $3\hat{i}+4\hat{j}+5k$ and $10\hat{j}+6\hat{j}-8\hat{k}$, respectively, act on a particle which is displaced from the point with position vector $4\hat{i}-3\hat{j}-2\hat{k}$ to the with position vector $6\hat{i}+\hat{j}-3\hat{k}$. Find the work done by the forces.

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13. Find the magnidude and direction cosines of the torque of a force represented by $3\hat{i}+4\hat{j}-5\hat{k}$ about the point with position vector $2\hat{i}-3\hat{j}+4\hat{k}$ acting through a point whose position vector is $4\hat{i}+2\hat{j}-3\hat{k}$.

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14. Find the torque of the resultant of the three forces represented by $-3\hat{i}+6\hat{j}-3\hat{k}, 4\hat{i}-10\hat{j}+12\hat{k}$ and $4\hat{i}+7\hat{j}$ acting at the point with position vector $8\hat{i} - 6\hat{j} - 4\hat{k}$, about the point with position vector $18\hat{i} + 3\hat{j} - 9\hat{k}$.

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Solution To Exercise 6 2

1. If $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} - 2\hat{k}$, $\vec{c} = 3\hat{i} + 2\hat{j} + \hat{k}$, find $\vec{a} \cdot \left(\vec{b} \times \vec{c}\right)$.

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2. Find the volume of the parallelepiped whose coterminous edges are represented by the vector $-6\hat{i} + 14\hat{j} + 10\hat{k}$, $14\hat{i} - 10\hat{j} - 6\hat{k}$, and $2\hat{i} + 4\hat{j} - 2\hat{k}$.

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3. The volume of the parallelepiped whose coterminus edges are $7\hat{i}+\lambda\hat{j}-3\hat{k}, \hat{i}+2\hat{j}-\hat{k}-3\hat{i}+7\hat{j}+5\hat{k}$ is 90 cubic units. Find the value of λ.

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4. If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors represented by concurrent edges of a parallelepiped of volume 4 cubic units, find the value of $\left(\vec{a}+\vec{b}\right)\cdot\left(\vec{b}\times\vec{c}\right)+\left(\vec{b}+\vec{c}\right)\cdot\left(\vec{c}\times\vec{a}\right)+\left(\vec{c}+\vec{a}\right)\cdot\left(\vec{a}\times$

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5. Find the altitude of a parallelepiped determined by the vectors $\vec{a}=-2\hat{i}+5\hat{j}+3\hat{k}\quad\vec{b}=\hat{i}+3\hat{j}-2\hat{k}$ and $\vec{c}=-3\hat{i}+\hat{j}+4\hat{k}$ if the base is taken as the parallelogram determined by $\vec{b}$ and $\vec{c}$.

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6. Determine whether the three vectors $2\hat{i}+3\hat{j}+\hat{k}, \hat{i}-2\hat{j}+2\hat{k}$ and $3\hat{i}+\hat{j}+3\hat{k}$ are coplanar.

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7. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}$ and $\vec{c}=c_1\hat{i}+c_2\hat{j}+c_3\hat{k}$. If $c_1=1$ and $c_2=2$, find c_3 which makes $\vec{a}, \vec{b}$ and $\vec{c}$ coplanar.

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8. If $\vec{a}=\hat{i}-\hat{k}, \vec{b}=x\hat{i}+\hat{j}+(1-x)\hat{k}, \vec{c}=y\hat{i}+x\hat{j}+(1+x-y)\hat{k}$ show that $\left[\vec{a}, \vec{b}, \vec{c}\right]$ depends on neither .x nor y.

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9. If the vectors $a\hat{i}+a\hat{j}+c\hat{k}, \hat{i}+\hat{j}$andchat(i)+chat(j)+bhat(k)` are coplanar, prove that c is the geometric mean of a and b .

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10. Let $\vec{a}, \vec{b}, \vec{c}$ be three non-zero vectors such that $\vec{c}$ is a unit vector perpendicular to both $\vec{a}$ and $\vec{c}$. If the angle between $\vec{a}$ and $\vec{c}$ is $\frac{\pi}{6}$, show that $\left[\vec{a}, \vec{b}, \vec{c}\right]^2 = \frac{1}{4}\left|\vec{a}\right|^2\left|\vec{b}\right|^2$.

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Solution To Exercise 6 3

1. If $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}, \vec{b} = 2\hat{i} + \hat{j} - 2\hat{k}, \vec{c} = 3\hat{i} + 2\hat{j} + \hat{k},$ find $\left(\vec{a} \times \vec{b}\right) \times \vec{c}$

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2. If $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}, \vec{b} = 2\hat{i} + \hat{j} - 2\hat{k}, \vec{c} = 3\hat{i} + 2\hat{j} + \hat{k},$ find $\vec{a} \times \left(\vec{b} \times \vec{c}\right)$

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3. For any vector $\vec{a}$, prove that $\hat{i}\times\left(\vec{a}\times\vec{i}\right)+\hat{j}\times\left(\vec{a}\times\vec{j}\right)+\hat{k}\times\left(\vec{a}\times\hat{k}\right)=2\vec{a}$

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4. prove that $\left[\vec{a}-\vec{b},\vec{b}-\vec{c}\vec{c}-\vec{a}\right]=0$

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5. If $\vec{a}=2\hat{i}+3\hat{j}-\hat{k},\ \vec{b}=3\hat{i}+5\hat{j}+2\hat{k},\ \vec{c}=-\hat{i}-2\hat{j}+3\hat{k},$ verify that $\left(\vec{a}\times\vec{b}\right)\times\vec{c}=\left(\vec{a}\cdot\vec{c}\right)\vec{b}-\left(\vec{b}\cdot\vec{c}\right)\vec{a}$

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6. If $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{b} = 3\hat{i} + 5\hat{j} + 2\hat{k}$, $\vec{c} = -\hat{i} - 2\hat{j} + 3\hat{k}$, verify that $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \left(\vec{a} \cdot \vec{c}\right)\vec{b} - \left(\vec{a} \cdot \vec{b}\right)\vec{c}$

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7. If $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} - 4\hat{k}$, $\vec{c} = \hat{i} + \hat{j} + \hat{k}$, then find the value of $\left(\vec{a} \times \vec{b}\right) \cdot \left(\vec{a} \times \vec{c}\right)$.

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8. If $\vec{a}, \vec{b}, \vec{c}$ are coplanar vectors, show that $\left(\vec{a} \times \vec{b}\right) \times \left(\vec{c} \times \vec{d}\right) = \vec{0}$

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9. If $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{c} = 3\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{a} \times \left(\vec{b} \times \vec{c}\right.$

, find the value of l, m, n.

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10. If $\widehat{a}, \hat{b}, \hat{c}$ are three unit vectors such that $\hat{b}$ and $\hat{c}$ are non-parallel and $\widehat{a} \times \left(\hat{b} \times \hat{c}\right) = \frac{1}{2}\hat{b}, \quad \text{find the angle between } \overrightarrow{a} \text{ and } \overrightarrow{c}.$

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Solution To Exercise 6 4

1. Find the non-parametric form of vector equation and Cartesian equations of the straight line passing through the point with position vector $4\hat{i} + 3\hat{j} - 7\hat{k}$ and parallel to the vector $2\hat{i} - 6\hat{j} + 7\hat{k}$.

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2. Find the parametric form of vector equation and Cartesian equtions of the straight line passing through the point $(-2, 3, 4)$ and parallel to the straight line $\frac{x-1}{-4} = \frac{y+3}{5} = \frac{8-z}{-6}$

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3. Find the point where the straight line passes through $(6, 7, 4)$ and $(8, 4, 9)$ cut the xz and yz planes.

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4. Find the direction cosines of the straight line passing through the points $(5, 6, 7)$ and $(7, 9, 13)$. Also, find the parametric form of vector equation and Cartesian equtions of the straight line passing through two given points.

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5. Find the angle between the following lines.

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

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

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6. Find the acute angle between the following lines.

$$\frac{x+4}{3} = \frac{y-7}{4} = \frac{z+5}{5}, \vec{r} = 4\hat{k} + t\left(2\hat{i} + \hat{j} + \hat{k}\right)$$

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7. Find the acute angle between the following lines.

$2x = 3y = -z$ and $6x = -y = -4z$

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8. The vertices of ΔABC are $A(7, 2, 1), B(6, 0, 3),$ and $C(4, 2, 4)$. Find $\angle ABC$.

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9. If the straight line joining the points $(2, 1, 4)$ and $(a-1, 4, -1)$ is parallel to the line joining the points $(0, 2, b-1)$ and $(5, 3, -2)$, find the values of a and b.

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10. If the straight lines $\frac{x-5}{5m} = \frac{2-y}{5} = \frac{1-z}{-1}$ and $x = \frac{2y+1}{4m} = \frac{1-z}{-3}$ are perpendicular to each other, find the value of m.

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

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Solution To Exercise 6 5

1. Find the parametric form of vector equation and Cartesian equations of a straight line passing through $(5, 2, 8)$and is perpendicular to the straight lines

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2. Show that the lines $\overrightarrow{r} = \left(6\hat{i} + \hat{j} + 2\hat{k}\right) + s\left(\hat{i} + 2\hat{j} - 3\hat{k}\right)$ and $\overrightarrow{r} = \left(3\hat{i} + 2\hat{j} - 2\hat{k}\right) + t\left(2\hat{i}\right.$ are skew lines and hence find the shortest distance between them.

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3. 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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4. Show that the lines $\frac{x-3}{3}=\frac{y-3}{-1}, z-1=0$ and $\frac{x-6}{2}=\frac{z-1}{3}, y-2=0$ intersect.

Also find the point of intersection.'

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5. Show that the straight lines $x+1=2y=-12z$ and $x=y+2=6z-6$ are skew and hence find the shortest distance between them.

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6. Find the parametric form of vector eqution of the straight line passing through $(-1, 2, 1)$ and paralle to the straight line $\vec{r}=\left(2\hat{i}+3\hat{j}-\hat{k}\right)+t\left(\hat{i}-2\hat{j}+\hat{k}\right)$ and lines find the shortest distance between the lines.

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7. Find the foot of the perpendicular drawn from the point $(5, 4, 2)$ to the line $\frac{x+1}{2} = \frac{y-3}{3} = \frac{z-1}{-1}$. Also, find the eqution of the perpendicular.

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Solution To Exercise 6 6

1. Find a parametric form of vector equation of a plane which is at a distance of 7 units from the origin having3,-4,5 as direction ratios of a normal to it .

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2. Find the direction cosines of the normal to the plane 12x + 3y - 4z = 65. Also, find the non-parametric form of vector equation of a plane and the length of the perpendicular to the plane from the origin.

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3. Find the vector and Cartesian equations of the plane passing through the point with position vector $2\hat{i} + 6\hat{j} + 3\hat{k}$ and normal to the vector $\hat{i} + 3\hat{j} + 5\hat{k}$.

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4. A plane passes through the point $(1, 1, 2)$ - and the normal to the plane of magnitude $3\sqrt{3}$ makes equal acute angles with the coordinate axes. Find the equation of the plane.

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5. Find the intercept cut off by the plane $\vec{r} = \left(6\hat{i} + 4\hat{j} - 3\hat{k}\right) = 12$ on the coordinate axes.

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6. If a plane meets the coordinate axes at A,B,C such that the centroid of the triangle ABC is the point (u, v, w), find the eqution of the plane.

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Solution To Exercise 6 7

1. Find the non-parametric form of vector equation, and Cartesian eqution of the plane passing through the point $(2, 3, 6)$ and parallel to the straight lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-3}{1}$ and $\frac{x+3}{2} = \frac{y-3}{-5} = \frac{z+1}{-3}$.

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2. Find the parametric form of vector equation, and Cartesian equations of the plane passing through the points $(2, 2, 1), (9, 3, 6)$ and perpendicular to the plane 2x + 6y + 6z = 9.

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3. Find the parametric form vector eqution and Cartesian equations of the plane passing through the points $(2, 2, 1), (1, -2, 3)$ and parallel to the straight line passing through the points $(2, 1, -3)$ and $(-1, 5, -8)$.

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4. Find the non-parametric form of vector equation and Cartesian equation of the plane passing through the point $(1, -2, 4)$ and perpendicular to the plane x + 2y - 3z = 11 and parallel to the line $\frac{x+7}{3} = \frac{y+3}{-1} = \frac{z}{1}$.

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5. Find the parametric form of vector equation, and Cartesian equations of the plane containing the line $\vec{r} = \left(\hat{i} - \hat{j} + 3\hat{k}\right) + t\left(2\hat{i} - \hat{j} + 4\hat{k}\right)$

and perpendicular to plane $\vec{r} \cdot \left(\hat{i} + 2\hat{j} + \hat{k}\right) = 8$.

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6. Find the parametric vector, non-parametric vector and Cartesian form of the equations of the plane passing through the three non-collinear points `(3,6,-2),(-1,-2,6)and(6,4,-2).

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7. Find the non-parametric form of vector equation, and Cartesian equations of the plane $\vec{r} = \left(6\hat{i} - \hat{j} + \hat{k}\right) + s\left(-\hat{i} + 2\hat{j} + \hat{k}\right) + t\left(-5\hat{j} - 4\hat{j} - 5\hat{k}\right)$

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Solution To Exercise 6 8

1. Show that the straight lines $\vec{r} = \left(5\hat{i} + 7\hat{j} - 3\hat{k}\right) + s\left(4\hat{i} + 4\hat{j} - 5\hat{k}\right)$ and $\vec{r} = \left(8\hat{i} + 4\hat{j} + 5\hat{k}\right) + t($

are coplanar. Find the vector equation of the plane in which they lie.

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2. Show that the lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{3}$ and $\frac{x-1}{-3} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar. Also, find the plane containing these lines.

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3. If the straight lines $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{m^2}$ and $\frac{x-3}{1} = \frac{y-2}{m^2} = \frac{z-1}{2}$ are coplanar, find the distinct real values of m.

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4. If the straight lines $\frac{x-1}{2}=\frac{y+1}{\lambda}=\frac{z}{2}$ and $\frac{x+1}{5}=\frac{y+1}{2}=\frac{z}{\lambda}$ are coplanar, find λ and equations of the planes containing theses two lines.

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Solution To Exercise 6 9

1. Find the equation of the plane passing through the line of intersection of the planes $\vec{r}\cdot\left(2\hat{i}-7\hat{j}+4\hat{k}\right)=3$ and $3x-5y+4z+11=0,$ and the point $(-$

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2. Find the equation of the plane passing thruogh the line of intersection of the planes x +2y + 3z = 2 and x - y + z= 3 , and at a distance $\frac{2}{\sqrt{3}}$ from point $(3, 1, -1)$.

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3. Find the angle between the line $\overrightarrow{r} = \left(2\hat{i} - \hat{j} + 2\hat{k}\right) + t\left(\hat{i} + 2\hat{j} - 2\hat{k}\right)$ and the plane $\overrightarrow{r} \cdot \left(6\hat{i} + 3\hat{j} + 2\hat{k}\right) = 8.$

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

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5. Find the equation of the plane which passes through the point $(3, 4, -1)$ and is parallel to the plane 2x - 3y + 5z + 7 = 0. Also, find the distance between the two planes.

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6. Find the length of the perpendicular from the point $(1, -2, 3)$ to the plane x - y + z = 5.

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7. Find the point intersection of the line $x - 1 = \frac{y}{2} = z + 1$ with the plane $2x - y + 2z = 2$. Also, find the angle between the line and the plane.

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8. Find the coordinates of the foot of the perpendicular and length of the perpendicular from the point $(4, 3, 2)$ to the plane x + 2y + 3z = 2.

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Solution To Exercise 6 10

1. If $\vec{a}$ and $\vec{b}$ are parallel vector, then $\left[\vec{a} \quad \vec{b} \quad \vec{c}\right]$ is equal to

A. 2

B. -1

C. 1

D. 0

Answer: D

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2. If a vector $\vec{\alpha}$ lies in the plane of $\vec{\beta}$ and $\vec{\gamma}$, then

A. $\left[\vec{\alpha}, \vec{\beta}, \vec{\gamma}\right] = 1$

B. $\left[\vec{\alpha}, \vec{\beta}, \vec{\gamma}\right] = 1$

C. $\left[\vec{\alpha}, \vec{\beta}, \vec{\gamma}\right] = 0$

D. $\left[\vec{\alpha}, \vec{\beta}, \vec{\gamma}\right] = 2$

Answer: C

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3. If $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{c} = \vec{c} \cdot \vec{a} = 0$, then the value of $\left[\vec{a}, \vec{b}, \vec{c}\right]$ is :

A. $\left|\vec{a}\right|\left|\vec{b}\right|\left|\vec{c}\right|$

B. $\frac{1}{3}\left|\vec{a}\right|\left|\vec{b}\right|\left|\vec{c}\right|$

C. 1

D. -1

Answer: A

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4. If $\vec{a}, \vec{b}, \vec{c}$ are three unit vectors such that $\vec{a}$ is perpendicular to $\vec{b}$, and is parallel to $\vec{c}$ then $\vec{a} \times \left(\vec{b} \times \vec{c}\right)$ is equal to

A. $\vec{a}$

B. $\vec{b}$

C. $\vec{c}$

D. $\vec{0}$

Answer: B

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5. If $\left[\vec{a}, \vec{b}, \vec{c}\right] = 1,$ then the value of

$$\frac{\vec{a} \cdot \left(\vec{b} \times \vec{c}\right)}{\left(\vec{c} \times \vec{a}\right) \cdot \vec{b}} + \frac{\vec{b} \cdot \left(\vec{c} \times \vec{a}\right)}{\left(\vec{a} \times \vec{b}\right) \cdot \vec{c}} + \frac{\vec{c} \cdot \left(\vec{a} \times \vec{b}\right)}{\left(\vec{c} \times \vec{b}\right) \cdot \vec{a}}$$ is

A. 1

B. -1

C. 2

D. 3

Answer: A

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6. The volume of the parallelepiped with its edges represented by the vectors $\hat{i}+\hat{j}, \hat{i}+2\hat{j}, \hat{i}+\hat{j}+\pi\hat{k}$ is

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

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

C. π

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

Answer: C

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7. If $\vec{a}$ and $\vec{b}$ are unit vectors such that $\left[\vec{a}, \vec{b}, \vec{a}\times\vec{b}\right]=\frac{1}{4}$, then the angle between $\vec{a}$ and $\vec{b}$ is :

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

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

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

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

Answer: A

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8. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = \hat{i} + \hat{j}, \vec{c} = \vec{i}$ and $\left(\vec{a} \times \vec{b}\right)\Big) \times \vec{c} = \lambda \vec{a} + \mu \vec{b}$ then the value of $\lambda + \mu$ is.______

A. 0

B. 1

C. 6

D. 3

Answer: A

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9. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar, non-zero vectors such that $\left[\vec{a}, \vec{b}, \vec{c}\right] = 3$, then $\left\{\left[\vec{a} \times \vec{b}, \vec{b} \times \vec{c}, \vec{c} \times \vec{a}\right]\right\}^2$ is equal to

A. 81

B. 9

C. 27

D. 18

Answer: A

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10. If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors such that $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \dfrac{b + c}{\sqrt{2}}$, then the angle between $\vec{a}$ and $\vec{b}$ is

A. $\dfrac{\pi}{2}$

B. $\frac{3\pi}{4}$

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

D. π

Answer: B

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11. If the volume of the parallelpiped with $\vec{a} \times \vec{b}, \vec{b} \times \vec{c}, \vec{c} \times \vec{c} \times \vec{a}$ as coterminous edges is 8 cubic units, then the volume of the parallelepiped with $\left(\vec{a} \times \vec{b}\right) \times \left(\vec{b} \times \vec{c}\right), \left(\vec{b} \times \vec{c}\right) \times \left(\vec{c} \times \vec{a}\right)$ and $\left(\vec{c} \times \vec{a}\right) \times \left(\vec{a}\right.$ as coterminous edges is,

A. 8 cubic units

B. 512 cubic units

C. 64 cubic units

D. 24 cubic units

Answer: C

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12. Consider the vectors, $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ such that $\left(\vec{a} \times \vec{b}\right) \times \left(\vec{c} \times \vec{d}\right) = \vec{0}$ Let P_1 and P_2 be the planes determined by the pairs of vectors, $\vec{a}, \vec{b}$ and $\vec{c}, \vec{d}$ respectively. Then the angle between P_1 and P_2 is

A. 0°

B. 45°

C. 60°

D. 90°

Answer: A

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13. If $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \left(\vec{a} \times \vec{b}\right) \times \vec{c}$, where $\vec{a}, \vec{b}\,\vec{c}$ are any three vectors such that $\vec{b} \cdot \vec{c} \neq 0$ and $\vec{a} \cdot \vec{b} \neq 0$, then $\vec{a}$ and $\vec{c}$ are

A. perpendicular

B. parallel

C. inclined at an angle $\frac{\pi}{3}$

D. inclined at an angle $\frac{\pi}{6}$

Answer: B

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14. If $\bar{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\bar{b} = \hat{i} + 2\hat{j} - 5\hat{j}$, $\bar{c} = 3\hat{i} + 5\hat{j} - \hat{k}$, then a vector perpendicular to $\bar{a}$ and lies in the plane containing $\bar{b}$ and $\bar{c}$ is............

A. $-17\hat{i} + 21\hat{j} - 97\hat{k}$

B. $17\hat{i} + 21\hat{j} - 123\hat{k}$

C. $-17\hat{i}-21\hat{j}+97\hat{k}$

D. $-17\hat{i}-21\hat{j}-97\hat{k}$

Answer: D

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15. The angle between the lines $\frac{x-2}{3}=\frac{y+1}{-2}, z=2$ and $\frac{x-1}{1}=\frac{2y+3}{3}, \frac{z+5}{2}$ is

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

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

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

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

Answer: D

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16. If the line $\frac{x-2}{3}=\frac{y-1}{-5}=\frac{z+2}{2}$ lies in the plane $x+3y-az+\beta=0$ then (

is

A. (-5, 5)

B. (-6, 7)

C. (5, -5)

D. (6, -7)

Answer: B

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17. The angle between the line $\vec{r}=\left(\hat{i}+2\hat{j}-3\hat{k}\right)+t\left(2\hat{i}+\hat{j}-2\hat{k}\right)$ and the plane $\vec{r}\cdot\left(\hat{i}+\hat{j}\right)+4=0$ is :

A. 0°

B. 30°

C. 45°

D. 90°

Answer: C

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18. The coordinates of the point where the line $\vec{r} = \left(6\hat{i} - \hat{j} - 3\hat{k}\right) + t\left(-\hat{i} + 4\hat{k}\right)$ meets the plane $\vec{r} \cdot \left(\hat{i} + \hat{j} - \hat{k}\right) = 3$ are:

A. (2, 1, 0)

B. (7, -1, -7)

C. (1, 2, -6)

D. (5, -1, 1)

Answer: D

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19. Distance from the origin to the plane $3x - 6y + 2z + 7 = 0$ is

A. 0

B. 1

C. 2

D. 3

Answer: B

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20. The distance between the planes $x + 2y + 3z + 7 = 0$ and $2x + 4y + 6z + 7 = 0$ is

A. $\frac{\sqrt{7}}{2\sqrt{2}}$

B. $\frac{7}{2}$

C. $\frac{\sqrt{7}}{2}$

D. $\frac{7}{2\sqrt{2}}$

Answer: A

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21. If direction cosines of a line are $\frac{1}{c}, \frac{1}{c}, \frac{1}{c}, \quad \text{then.}$

A. $c = \pm 3$

B. $c = \pm \sqrt{3}$

C. $c > 0$

D. $0 < c < 1$

Answer: B

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22. The vector equation $\vec{r} = \left(\hat{i} - 2\hat{j} - \hat{k}\right) + t\left(6\hat{j} - \hat{k}\right)$ represents a straight line passing through the points

A. (0, 6, -1) and (1, -2, -1)

B. (0, 6, -1) and (-1, -4, -2)

C. (1, -2, -1) and (1, 4, -2)

D. (1, -2, 1) and (0, -6, 1)

Answer: C

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23. If the distance of the point $(1, 1, 1)$ from the origin is half of its distance from the plane x + y + z + k = 0, then the value of k are

A. ± 3

B. ± 6

C. $-3, 9$

D. 3, -9

Answer: D

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24. If the planes $\overrightarrow{r}\cdot\left(2\hat{i}-\lambda\hat{j}+\hat{k}\right)=3$ and $\overrightarrow{r}\cdot\left(4\hat{i}+\hat{j}-\mu\hat{k}\right)=5$ are parallel, then the value of λ and μ are:

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

B. $-\frac{1}{2}, 2$

C. $-\frac{1}{2}, \ -2$

D. $\frac{1}{2}, 2$

Answer: C

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25. If the length of the perpendicular from the origin to the plane $2x + 3y + \lambda z = 1, \lambda > 0$ is $\frac{1}{5}$ then the value of is λ is

A. $2\sqrt{3}$

B. $3\sqrt{2}$

C. 0

D. 1

Answer: A

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Problems For Practice Choose The Correct Answer

1. If $\vec{a} + \vec{b} + \vec{c} = 0, \left|\vec{a}\right| = 3, \left|\vec{b}\right| = 5, \left|\vec{c}\right| = 7$ then the angle between $\vec{a}$ and $\vec{b}$ is :

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

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

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

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

Answer: D

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2. If $\widehat{a}$ and $\hat{b}$ are unit vectors inclined at angle θ then $\frac{1}{2}\left|\widehat{a}+\hat{b}\right|$ is

A. $\sin\frac{\theta}{2}$

B. $\cos 2\theta$

C. $\cos\frac{\theta}{2}$

D. $\cos 2\theta$

Answer: C

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3. If $\vec{a}, \vec{b}, \vec{c}$ are three mutually perpendicular unit vectors then $\left|\vec{a} + \vec{b} + \vec{c}\right|$ is

A. $\frac{1}{3}$

B. $\sqrt{3}$

C. 3

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

Answer: B

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4. If $\left|\vec{a} \times \vec{b}\right| = \vec{a} - \vec{b}$ then the angle between $\vec{a}$ and $\vec{b}$ is :

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

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

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

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

Answer: A

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5. If $\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right]=8$ then $\left[\vec{a}, \vec{b}, \vec{c}\right]$ is

A. 4

B. 2

C. 1

D. 16

Answer: A

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6. If the area of the parallelogram having diagonals $\vec{a}=3\hat{i}+\hat{j}-2\hat{k}, \vec{b}=\hat{i}-3\hat{j}+4\hat{k}$ is :

A. $5\sqrt{3}$ sq. units

B. $15\sqrt{3}$ sq. units

C. $5\sqrt{13}$ sq. units

D. 3 sq. units

Answer: A

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7. If $\overrightarrow{a} = 2\hat{i} + \hat{j} - \hat{k}, \overrightarrow{b} = -\hat{i} + 2\hat{j} + \hat{k}, \overrightarrow{c} = -\hat{i} + 2\hat{j} - \hat{k}$ then the unit vector perpendicular to both $\overrightarrow{a} + \overrightarrow{b}$ and $\overrightarrow{b} + \overrightarrow{c}$ is :

A. $\hat{i}$

B. $\hat{j}$

C. $\hat{k}$

D. $\dfrac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$

Answer: C

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8. The force $\vec{F} = 2\hat{i} + 2\hat{j} - 2\hat{k}$ acting at the point $\hat{i} - 2\hat{j} + \hat{k}$ is displaced to a unit distance in z axis direction. The magnitude of workdone is :

A. 4 units

B. 6 units

C. 2 units

D. 10 units

Answer: C

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9. If $\left|\vec{a}\right| = 5\left|\vec{b}\right| = 4$ and $\left|\vec{a} + \vec{b}\right| = 1$ then $\left|\vec{a} - \vec{b}\right| = ?$

A. 5

B. 6

C. 7

D. 8

Answer: C

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10. The projectionof $\hat{i} - \hat{j}$ on z axis:

A. 1

B. 2

C. 3

D. 0

Answer: D

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11. Given $\vec{a} \cdot \vec{c} = 4, \vec{a} \cdot \vec{d} = 3, \vec{b} \cdot \vec{c} = 2, \vec{b} \cdot \vec{d} = 3$. Then value of $\left(\vec{a} \times \vec{b}\right) \cdot \left(\vec{c} \times \vec{d}\right)$ is :

A. 4

B. 6

C. 18

D. 2

Answer: B

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12. The vector $\overrightarrow{AB} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\overrightarrow{BC} = -\hat{i} - 2\hat{k}$ are adjacent sides of a parallelogram ABCD the angle between the diagonals is :

A. $\dfrac{\pi}{4}$

B. $\dfrac{\pi}{3}$

C. $\dfrac{2\pi}{3}$

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

Answer: A

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13. If the angle between the lines having direction ratios $(\alpha, 3, 5)$ and (2, -1, 2) is $\frac{\pi}{4}$ then α is:

A. 4

B. 3

C. 2

D. 1

Answer: A

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14. Let a, b, c be distinct non negative numbers. The vectors $a\hat{i}+a\hat{j}+c\hat{k},\ \hat{i}+\hat{k}$ and $c\hat{i}+c\hat{j}+b\hat{k}$ lie in a plane then c is :

A. AM of a and b

B. GM of a and b

C. HM of a and b

D. None of these

Answer: B

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15. $\hat{i}\cdot\left(\hat{j}\times\hat{k}\right)+\hat{j}\left(\hat{k}\times\hat{i}\right)+\hat{k}\left(\hat{i}\times\hat{j}\right)$ is :

A. -3

B. 0

C. 1

D. 3

Answer: D

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16. If $\overrightarrow{a}$ is any vector then the value of $\Sigma\left(\overrightarrow{a} \times \overrightarrow{i}\right)^2$ is :

A. a^2

B. $2a^2$

C. $3a^2$

D. $4a^2$

Answer: B

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17. If $(1-p)\hat{i} + 2(1+p)\hat{j} + (3+p)\hat{k}$ and $3\hat{i} + \hat{j}$ are at right angle to each other then value of p is :

A. -5

B. 3

C. 5

D. 3

Answer: C

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18. $\left[\vec{a}, \vec{a}+\vec{b}, \vec{a}+\vec{b}+\vec{c}\right]$ is :

A. $\left[\vec{a}\vec{b}\vec{c}\right]$

B. 0

C. $2\left[\vec{a}, \vec{b}, \vec{c}\right]$

D. $\left[\vec{a}, \vec{b}, \vec{c}\right]^2$

Answer: A

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19. The sum of the projection of $2\hat{i}+\hat{j}+2\hat{k}$ on the coordinate axis is :

A. -5

B. 5

C. 3

D. 4

Answer: B

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20. If $\vec{a}=\hat{i}-2\hat{j}+\hat{k}, \vec{b}=\hat{i}+2\hat{j}+3\hat{k}, \vec{c}=3\hat{i}+2\hat{j}+\hat{k}$ then the value of $\left[\vec{a}\times\vec{b}, \vec{b}\times\vec{c}, \vec{c}\times\vec{a}\right]$ is :

A. 765

B. 675

C. 576

D. 567

Answer: C

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21. $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$

$\vec{b} = \hat{i} - \hat{j} - m\hat{k}$

$\vec{c} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\left[\vec{a}, \vec{b}, \vec{c}\right] = 8$ then m is :

A. $\sqrt{29}$

B. -4

C. 1

D. 2

Answer: D

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22. The work done by the force $\overrightarrow{F} = 2\hat{i} - 3\hat{j} + 2\hat{k}$ in moving a particle from (3, 4, 5) to (1, 2, 3) is :

A. $\sqrt{29}$

B. -4

C. 1

D. 2

Answer: D

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23. The area of the triangle formed by the points where position vector are $3\hat{i} + \hat{j}, 5\hat{i} + 2\hat{j} + \hat{k}$ and $\hat{i} - 2\hat{j} + 3\hat{k}$ is :

A. $\sqrt{29}$

B. -4

C. 1

D. 2

Answer: A

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24. $\vec{a} = \hat{i} - \hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{c} = \lambda\hat{i} - \hat{j} + \lambda\hat{k}$ are coplanar then λ is :

A. $\sqrt{29}$

B. -4

C. 1

D. 2

Answer: C

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25. If the equations $2x - \lambda y + 5z = 7$ and $\lambda x - 8y - 10z + 14 = 0$ represent the same plane then λ is :

A. $\sqrt{29}$

B. -4

C. 1

D. 2

Answer: B

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26. Find the odd one out in the following :

A. $\vec{a} + \vec{b}$

B. $\vec{a} \times \vec{b}$

C. $\vec{a} \times \left(\vec{b} \times \vec{c}\right)$

D. $\left[\vec{a}, \vec{b}, \vec{c}\right]$

Answer: D

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27. Find the correct statement in the following given four points A, B, C, D are coplanar only of the following condition is satisfied.

A. $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = 0$

B. $\left[\overrightarrow{AB}, \overrightarrow{AC}, \overrightarrow{AD}\right] = 0$

C. $\overrightarrow{AB} \times \overrightarrow{CD} = 0$

D. $\overrightarrow{AB} \cdot \overrightarrow{CD} = 0$

Answer: B

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28. If $\overrightarrow{a}$ and $\overrightarrow{b}$ lie in one plane and $\overrightarrow{c}$ and $\overrightarrow{d}$ lie on another plane and if the planes are parallel which one of the following is true.

A. A) $\left(\vec{a} \times \vec{b}\right) \cdot \left(\vec{c} \times \vec{d}\right) = 0$

B. $\left(\vec{a} \times \vec{c}\right) \cdot \left(\vec{b} \times \vec{d}\right) = 0$

C. $\left(\vec{a} \times \vec{b}\right) \times \left(\vec{c} \times \vec{d}\right) = 0$

D. $\left(\vec{a} \times \vec{c}\right) \times \left(\vec{c} \times \vec{d}\right) = 0$

Answer: C

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29. If $\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \vec{a} \times \left(\vec{b} \times \vec{c}\right)$ and $\vec{b}$ perpendicular to $\vec{c}$ then which is true ?

A. a) $\vec{a}$ and $\vec{b}$ are parallel or $\vec{c} = 0$

B. b) $\vec{a}$ and $\vec{b}$ are perpendicular or $\vec{c} = 0$

C. c) $\vec{c} = 0$

D. d) $\vec{a} = 0$

Answer: B

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30. Find which one is not correct statement.

A. Two straight lines are said to be skew lines if the lines are neither parallel nor intersecting

B. Vector product is not commutative

C. Scalar triple product is half of the volume of the parallelopiped

D. $\left[\vec{a}, \vec{b}, \vec{c}\right] = 0$

Answer: C

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31. Identify correct pair from the following.

(i) $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \left(\vec{a} \cdot \vec{b}\right)\vec{c} - \left(\vec{a} \cdot \vec{c}\right)\vec{b}$

(ii) Projection of $\vec{a}$ on $\vec{b}$ is $\dfrac{\vec{a} \cdot \vec{b}}{\left|\vec{a}\right|}$

(iii) $\left[\hat{i}+2\hat{j}, \hat{j}+2\hat{k}, \hat{k}+2\hat{j}\right]=9$

(iv) If $\vec{r}=\vec{a}+t\,\vec{b}$ and $\vec{r}=\vec{c}+s\vec{d}$ are two skew lines then shortest distance between the lines is $\dfrac{\vec{c}-\vec{a}\quad\vec{b}\quad\vec{d}}{\left|\vec{b}\times\vec{d}\right|}$

A. (i) and (ii) are correct

B. (iii) and (iv) are correct

C. (i) and (iii) are correct

D. (ii) and (iv) are correct

Answer: B

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Problems For Practice Answer The Following Questions

1. Prove that the sum of the squares of the squares of tha diagonals of a parallelogram is equal to tha sum of the squares of its sides. `

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2. Show that $\left(\vec{a} \times \vec{b}\right) \cdot \left(\vec{c} \times \vec{d}\right) + \left(\vec{b} \times \vec{c}\right) \cdot \left(\vec{a} \times \vec{d}\right) + \left(\vec{c} \times \vec{a}\right) \cdot \left(\vec{b} \times$

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3. Find the vector and cartesian equation of the line through the point (3, -4, -2) and parallel to the vector $9\hat{i} + 6\hat{j} + 2\hat{k}$.

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4. Find the vector and cartesian equation of the line joining the points (1, -2, 1) and (0, -2, 3).

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5. Find the angle between the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-4}{6}$ and $\vec{r} = \left(-\hat{i} - 2\hat{j} + 4\hat{k}\right) + t\left(\hat{j} + 2\hat{k}\right)$.

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6. Find the distance between the parallel lines $\vec{r} = \left(\hat{i} - \hat{j}\right) + t\left(2\hat{i} - \hat{j} + \hat{k}\right)$ and $\vec{r} = \left(2\hat{i} + \hat{j} - \hat{k}\right) + s\left(2\hat{i} - \hat{j} + \hat{k}\right)$

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7. Show that the lines $\vec{r} = \left(\hat{i} - \hat{j}\right) + t\left(2\hat{i} + \hat{k}\right)$ and $\vec{r} = \left(2\hat{i} - \hat{j}\right) + s\left(\hat{i} + \hat{j} - \hat{k}\right)$ are skew lines and find the distance between them .

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

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9. Find the vector and cartesian equation of the plane passing through (2, -1, -3) and parallel to the line $\frac{x-5}{3} = \frac{y+1}{2} = \frac{z-3}{-4}$ and $\frac{x+10}{2} = \frac{y-10}{3} = \frac{z-2}{2}$

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10. Find the vector and cartesian equation of the plane passing through (2, -1, -3) and $\perp r$ to the planes $3x + 2y - 4z = 1$ and $2x + 3y + 2z = 7$.

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11. Find the Vector and Cartesian equation of the plane containing the line $\frac{x-2}{2} = \frac{y-2}{3} = \frac{z-1}{3}$ and parallel to the line $\frac{x+1}{3} = \frac{y-1}{2} = \frac{z+1}{1}$

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12. Find the vector cartesian equation of the plane passing through the points (1, -2, 3) and (-1, 2, -1) and is parallel to the line $\vec{r} = \left(2\hat{i} - \hat{j} + \hat{k}\right) + t\left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)$

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13. Find the vector and certesian equation of the plane through the points (1, 2, 3) and (2, 3, 1) and perpendicular to the plane $\vec{r} \cdot \left(3\hat{i} - 2\hat{j} + 4\hat{k}\right) = 5.$

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14. Find the equation of the plane passing through the points (3, 4, 2), (2, -2, -1) and (7, 0, 1).

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15. Find the equation of the plane passingthrough the intersection of the planes $3x - 5y + 4z + 10 = 0$ and $2x - 8y + 4z - 3 = 0$ and perpendicular to the plane $3x - y - 2z - 4 = 0$.

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16. Find the distance between the parallel planes $\vec{r} \cdot \left(-\hat{i} - \hat{j} + \hat{k}\right) = 3, \vec{r} \cdot \left(\hat{i} + \hat{j} - \hat{k}\right) = 5.$

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17. Find the coordinates of the point where the line $\vec{r} = (\hat{i} + 2\hat{j} - 5\hat{k}) + t(2\hat{i} - 3\hat{j} + 4\hat{k})$ meets the plane $\vec{r} \cdot (2\vec{i} + 4\vec{j} - \vec{k}) = 3$.

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18. The value of $[\hat{i} + \hat{j}, \hat{j} + \hat{k}, \hat{k} + \hat{i}]$ is equal to :

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19. If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$ prove that $\vec{a}$ and $\vec{b}$ are perpendicular.

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20. Find the shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $\vec{r} = (-3\vec{i} - 7\hat{j} + 6\vec{k}) + t(-3\vec{i} +$

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21. Show that the lines $\vec{r}=\left(4\vec{i}+5\vec{j}+6\vec{k}\right)+t\left(2\vec{i}+3\vec{j}+4\vec{k}\right)$ and $\vec{r}=\left(2\vec{i}+3\vec{j}+\right.$

are coplanar. Find the equation of the plane in which they lie.

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