MATHS

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Vector Algebra -I

Work Example

1. Represent graphically the displacement of

(i) $45km30^\circ$ east of north,

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2. Represent graphically the displacement of

(ii) 70 km 25° south of west.

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3. In a triangle ABC, if D and E are mid points of sides AB and AC respectively. Show that $\overrightarrow{BE} + \overrightarrow{DC} = \frac{3}{2}\overrightarrow{BC}$.

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4. If P and Q are two points with position vectors $4\vec{i} - 3\vec{j}$ and $2\vec{i} + 5\vec{j}$. Find the position vectors of the points which divide the line joining the points. P and Q in the ration 2:3internally and externally.

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5. Find the unit vector in the direction of the vector $\vec{i} - 2\vec{j} + 3\vec{k}$.

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6. Find the direction ratios and direction cosines of the vectors

(i) $4\vec{i} + 2\vec{j} - 3\vec{k}$,

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7. Find the direction ratios and direction cosines of the vectors

(ii) $\vec{i} + \vec{j} + \vec{k}$.

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8.

(i) Find the direction cosines of the vectors $10\vec{i} - 3\vec{j} - 4\vec{k}$.

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9.

(ii) Find the direction cosines of the vector $\vec{A}\,B$if $\vec{A}$ =(1,-2,3) and $\vec{B}$ =(2,1,-2).

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10.

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

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11. Show that the points whose position vectors are $\vec{i} - 2\vec{j} + 3\vec{k}$, $2\vec{i} + 3\vec{j} - 4\vec{k}$, and $-7\vec{j} + 10\vec{k}$ are collinear.

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12. Find the unit vector parallel to $\vec{a} - \vec{b} + 2\vec{c}$ Where $\vec{a} = 2\vec{i} - \vec{j} + 3\vec{k}$, $\vec{b} = 2\vec{i} + 3\vec{j} + \vec{k}, \vec{c} = \vec{i} - 2\vec{j} + 3\vec{k}$.

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13. Show that the points whose position vectors are $4\vec{i}+5\vec{j}+6\vec{k}$, $5\vec{i}+6\vec{j}+4\vec{k}$, and $6\vec{i}+4\vec{j}+5\vec{k}$ form an equilateral triangle.

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14. Show that the points whose position vectors are $4\vec{i}+5\vec{j}+\vec{k}$, $-\vec{j}-\vec{k}$, and $3\vec{i}+9\vec{j}+4\vec{k}$ and $-4\vec{i}+4\vec{j}+4\vec{k}$ are co planar.

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15. If $\vec{a}=3\vec{i}-4\vec{j}+3\vec{k}$, $\vec{b}=2\vec{i}-\vec{j}+k$,find $\vec{a}.\vec{b}$ [OR] If $\vec{a}$ and $\vec{b}$ are vectors given by (3,-4,3)and (2,-1,1) respectively find $\vec{a}.\vec{b}$.

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16. Given that $\vec{a}=\vec{i}-\vec{j}-\vec{k},\vec{b}=2\vec{i}-\vec{j}+\vec{k}$, find $\left(2\vec{a}+3\vec{b}\right).\left(\vec{a}-2\vec{b}\right)$.

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17. Given that $\vec{a} = 5\vec{i} + 3\vec{j} + 4\vec{k}, \vec{b} = 3\vec{i} - 2\vec{j} - \vec{k}$, vecc=4veci-3vecj+mveck$sucht\hat{}$veca$\grave{}$is perpendicular to (b+c) find m.

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18. If $\left|\vec{a} + \vec{b}\right|^2 - \left|\vec{a} - \vec{b}\right|^2 = 4$.Show that $\vec{a}$ and $\vec{b}$ are coincident, if $\vec{a}$ and $\vec{b}$ are unit vectors.

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19. Find the value of m if $m\vec{i} + 2\vec{j} + 3\vec{k}$ and $2\vec{i} - 6\vec{j} - 3\vec{k}$ are perpendicular.

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20. Find the angle between the vectors $3\vec{i} - 4\vec{j} + \vec{k}$ and $\vec{i} - 3\vec{j} + 4\vec{k}$.

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21. Find the Projection of $\vec{a} = 2\vec{i} + \vec{j} + 2\vec{k}$ on $\vec{b} = 5\vec{i} - \vec{j} + 3\vec{k}$.

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22. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a} + 2\vec{b} + \vec{c} = \vec{0}$ and $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 4, \left|\vec{c}\right| = 7$, find the angle between $\vec{a}$ and $\vec{b}$.

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23. Show that the points $3\vec{i} + 4\vec{j} + 2\vec{k}$, $9\vec{i} + \vec{j} + 4\vec{k}$, and $6\vec{i} - \vec{j} - 10\vec{k}$ form a right angled triangle.

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24. If $\vec{a} = 5\vec{i} - 2\vec{j} + 3\vec{k}, \vec{b} = 2\vec{i} + \vec{j} - \vec{k}$ find $\vec{a} X \vec{b}$.

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25. Find the unit vector perpendicular to both vectors $2\vec{i} + \vec{j} + 2\vec{k}$ and $3\vec{i} + 4vej + 5\vec{k}$ .Find also angle between the given vector.

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26. If $\vec{a} = 3\vec{i} - 2\vec{j} + \vec{k}$ and $\vec{b} = 6\vec{i} - 2\vec{j} + 4\vec{k}$,show that $\vec{a} X \vec{b}$ and $\vec{a}$ are perpendicular.

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27. Verify $\sin^2\theta + \cos^2\theta = 1$by find θ , the angle between the vectors $4\vec{i} - 2\vec{j} - \vec{k}$ and $2\vec{i} + 3\vec{j} + 3\vec{k}$

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28. Find the area of parallelogram two of whose adjacent sides are $3\vec{i} + 4\vec{j} + \vec{k}$ and $\vec{I} + \vec{j} - 2\vec{k}$.

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29. Show that the points(3,-1,7) (9,-3,-3)(6,-2,2) are collinear sing vector products.

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30. Find the area of triangle ABC given that vertices are A(2,1,-2) B(1,4,2) and C(3,-1,-1).

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Solution To Exercise 8 1

1. Represent graphically the displacement of (i) 45 km 30° north of east.

(ii) 80 km, 60° south of west

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2. Represent graphically the displacement of (i) 45 km 30° north of east.

(ii) 80 km, 60° south of west

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3. Prove that the relation R defined on the set V of all vectors by $\vec{a} R \vec{b}$ if $\vec{a} = \vec{b}$, is an equivalence relation on V.

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4. Let $\vec{a}$ and $\vec{b}$ be the position vectors of the points A and B. Prove that the position vectors of the points which trisects the line segment AB are

$\frac{\vec{a}+2\vec{b}}{3}$ and $\frac{\vec{b}+2\vec{a}}{3}$.

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5. If D and E, are the midpoints of the sides AB and AC of a triangle ABC, prove that $\overrightarrow{BE}+\overrightarrow{DC}=\frac{3}{2}\overrightarrow{BC}$.

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6. Prove that line segment joining the midpoints of two sides of a triangle is parallel to the third side whose length is half of the length of the third side.

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7. Prove that the line segments joining the midpoints of the adjacent sides of a quadrilateral form a parallelogram.

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8. If $\vec{a}$ and $\vec{b}$ represent a side and a diagonal of a parallelogram, find the other sides and the other diagonal.

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9. If $\vec{PQ} + \vec{OQ} = \vec{QO} + \vec{OR}$, prove that the points P,Q,R are collinear.

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10. If D is the midpoint of the side BC of a triangle ABC, prove that vec(AB)+vec(AC)=2vec(AD)

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11. If G is the centroid of a triangle ABC, prove that $\vec{GA} + \vec{GB} + \vec{GC} = \vec{0}$.

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12. Let A, B, and C be the vertices of a triangle. Let D, E, and F be the midpoints of the sides BC, CA, and AB respectively. Show that $\overrightarrow{AD} + \overrightarrow{BE} + \overrightarrow{CF} = \overrightarrow{0}$.

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13. If ABCD is a quadrilateral and E and F are the midpoints of AC and BD respectively, then prove that $\overrightarrow{AB} + \overrightarrow{AD} + \overrightarrow{CB} + \overrightarrow{CD} = 4\overrightarrow{EF}$.

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Solution To Exercise 8 2

1. Verify whether the ratios are direction cosines of some vector or not.

$\frac{1}{5}, \frac{3}{5}, \frac{4}{5}$

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2. Verify whether the ratios are direction cosines of some vector or not.

$\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{2}$

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3. Verify whether the ratios are direction cosines of some vector or not.

$\frac{4}{3}, 0, \frac{3}{4}$

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4. Find the direction cosines of a vector whose direction ratios are

(i) 1,2,3

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5. Find the direction cosines of a vector whose direction ratios are (i) 1,2,3, (ii) 3,-1,3 (iii) 0,0,7

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6. Find the direction cosines of a vector whose direction ratios are (i) 1,2,3, (ii) 3,-1,3 (iii) 0,0,7

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7. Find the direction cosines and direction ratios for the following vectors.

$3\hat{i} - 4\hat{j} + 8\hat{k}$

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8. Find the direction cosines and direction ratios for the following vectors.

$3\hat{i} + \hat{j} + \hat{k}$

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9. Find the direction cosines and direction ratios for the following vectors.

$\hat{j}$

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10. Find the direction cosines and direction ratios for the following vectors.

$5\hat{i} - 3\hat{j} - 48\hat{k}$

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11. Find the direction cosines and direction ratios for the following vectors.

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

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12. Find the direction cosines and direction ratios for the following vectors.

$\hat{i} - \hat{k}$

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13. A triangle is formed by joining the points (1,0,0), (0,1,0) and (0,0,1). Find the direction cosines of the medians.

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14. If $\frac{1}{2}, \frac{1}{\sqrt{2}}$ a are the direction cosines of some vector, then find a.

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15. If (a,a+b,a+b+c) is one set of direction ratios of the line joining (1,0,0) and (0,1,0), then find a set of values of a,b,c.

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16. Show that the vectors $2\hat{i}-\hat{j}+\hat{k}, 3\hat{i}-4\hat{j}-4\hat{k}, \hat{i}-3\hat{j}-5\hat{k}$ form a right angled triangle.

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17. Find the value of λ for which the vectors $\vec{a}=3\hat{i}+2\hat{j}+9\hat{k}$and $\vec{b}=\hat{i}+\lambda\hat{j}+3\hat{k}$ are parallel.

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18. Show that the vectors are coplanar

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

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19. Show that the following vectors are co-planar

(ii) $5\hat{i}+6\hat{j}+7\hat{k}, 7\hat{i}-8\hat{j}+9\hat{k}, -3\hat{i}+20\hat{j}+5\hat{k}.$

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20. Show that the points whose position vectors $4\hat{i}+5\hat{j}+\hat{k}, -\hat{j}-\hat{k}, 3\hat{i}+9\hat{j}+4\hat{k}$ and $-4\hat{i}+4\hat{j}+4\hat{k}$ are coplanar.

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21. If $\vec{a}=2\hat{i}+3\hat{j}-4\hat{k}, \vec{b}=3\hat{i}-4\hat{j}-5\hat{k},$ and $\vec{c}=-3\hat{i}+2\hat{j}+3\hat{k},$ find the magnitude and direction cosines of $\vec{a}+\vec{b}+\vec{c}$

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22. If $\vec{a} = 2\hat{i} + 3\hat{j} - 4\hat{k}, \vec{b} = 3\hat{i} - 4\hat{j} - 5\hat{k},$ and $\vec{c} = -3\hat{i} + 2\hat{j} + 3\hat{k},$ find the magnitude and direction cosines of $3\vec{a} - 2\vec{b} + 5\vec{c}$

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23. The position vectors of the vertices of a triangle are $\hat{i} + 2\hat{j} + 3\hat{k}, 3\hat{i} - 4\hat{j} + 5\hat{k}$ and $-2\hat{i} + 3\hat{j} - 7\hat{k}$. Find the perimeter of the triangle

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24. Find the unit vector parallel to $3\vec{a} - 2\vec{b} + 4\vec{c}$, if $\vec{a} = 3\hat{i} - \hat{j} - 4\hat{k}, \vec{b} = -2\hat{i} + 4\hat{j} - 3\hat{k}, \vec{c} = \hat{i} + 2$

.

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25. The position vectors $\vec{a}, \vec{b}, \vec{c}$ of three points satisfy the relation $2\vec{a} - 7\vec{b} + 5\vec{c} = \vec{0}$. Are these points collinear?

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26. The position vectors of the points P,Q,R,S are $\hat{i} + \hat{j} + \hat{k}, 2\hat{i} + 5\hat{j}, 3\hat{k} + 2\hat{j} - 3\hat{k}$, and $\hat{i} - 6\hat{j} - \hat{k}$ respectively. Prove that the line PQ and RS are parallel.

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27. Find $\vec{a} . \vec{b}$ when

$\vec{a} = 2\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = 6\hat{i} - 3\hat{j} + 2\hat{k}$

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Solution To Exercise 8 3

1. Find the value or values of m for which m $\left(\hat{i}+\hat{j}+\hat{k}\right)$ is a unit vector.

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2. Find $\vec{a}.\ \vec{b}$ when

$\vec{a}=\hat{i}-2\hat{j}+\hat{k} \quad \text{and} \quad \vec{b}=3\hat{i}-4\hat{j}-2\hat{k}$

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3. Find the value λ for which the vectors $\vec{a}$ and $\vec{b}$ are perpendicular, where

$\vec{a}=2\hat{i}+\lambda\hat{j}+\hat{k} \quad \text{and} \quad \vec{b}=\hat{i}-2\hat{j}+3\hat{k}$

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4. Find the value λ for which the vectors $\vec{a}$ and $\vec{b}$ are perpendicular, where

$\vec{a}=2\hat{i}+4\hat{j}-\hat{k} \quad \text{and} \quad \vec{b}=3\hat{i}-2\hat{j}+\lambda\hat{k}$

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5. If $\vec{a}$ and $\vec{b}$ are two vectors such that $\left|\vec{a}\right| = 10, \left|\vec{b}\right| = 15$ and $\vec{a}.\vec{b} = 75\sqrt{2}$, find the angle between $\vec{a}$ and $\vec{b}$.

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6. Find the angle between the vectors

$\hat{i} - \hat{j}$ and $\hat{j} - \hat{k}$.

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7. Find the angle between the vectors

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

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8. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a} + 2\vec{b} + \vec{c} = \vec{0}$ and $|\vec{a}| = 3, |\vec{b}| = 4, |\vec{c}| = 7$, find the angle between $\vec{a}$ and $\vec{b}$.

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9. Show that the vectors $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}, \vec{b} = 6\hat{i} + 2\hat{j} - 3\hat{k}$, and $\vec{c} = 3\hat{i} - 6\hat{j} + 2\hat{k}$, are mutually orthogonal.

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10. Show that the vectors $-\hat{i} - 2\hat{j} - 6\hat{k}, 2\hat{i} - \hat{j} + \hat{k}$ and $-\hat{i} + 3\hat{j} + 5\hat{k}$, form a right angled triangle.

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11. If $|\vec{a}| = 5, |\vec{b}| = 6, |\vec{c}| = 7$ and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, find $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$.

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12. Show that the points (2,-1,3), (4,3,1) and (3,1,2) are collinear.

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13. If $\vec{a}, \vec{b}$ are unit vectors and θ is the angle between them, show that $\sin\frac{\theta}{2} = \frac{1}{2}\left|\vec{a} - \vec{b}\right|$

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14. If $\vec{a}, \vec{b}$ are unit vectors and θ is the angle between them, show that $\cos\frac{\theta}{2} = \frac{1}{2}\left|\vec{a} + \vec{b}\right|$

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15. If $\vec{a}$, $\vec{b}$ are unit vectors and θ is the angle between them, show that

$$\tan\frac{\theta}{2}=\frac{\left|\vec{a}-\vec{b}\right|}{\left|\vec{a}+\vec{b}\right|}$$

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16. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ be three vectors such that $\left|\vec{a}\right|=3, \left|\vec{b}\right|=4, \left|\vec{c}\right|=5$ and each one of them being perpendicular to the sum of the other two , find $\left|\vec{a}+\vec{b}+\vec{c}\right|$.

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17. Find the projection of the vector $\hat{i}+3\hat{j}+7\hat{k}$ on the vector $2\hat{i}+6\hat{j}+3\hat{k}$.

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18. Find λ, when the projection of $\vec{a} = \lambda\hat{i} + \hat{j} + 4\hat{k}$ on $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$ is 4 units.

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19. Three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ are such that $|\vec{a}| = 2, |\vec{b}| = 3, |\vec{c}| = 4$, and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$.

Find $4\vec{a}.\vec{b} + 3\vec{b}.\vec{c} + 3\vec{c}.\vec{a}$.

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Solution To Exercise 8 4

1. Find the magnitude of $\vec{a} \times \vec{b}$ if $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + 5\hat{j} - 2\hat{k}$.

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2. Show that $\vec{a} \times \left(\vec{b} + \vec{c}\right) + \vec{b} \times \left(\vec{c} + \vec{a}\right) + \vec{c} \times \left(\vec{a} + \vec{b}\right) = \vec{0}$.

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3. Find the vectors of magnitude $10\sqrt{3}$ that are perpendicular to the plane which contains $\hat{i} + 2\hat{j} + \hat{k}$ and $\hat{i} + 3\hat{j} + 4\hat{k}$

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4. Find the unit vectors perpendicular to each of the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$,where $\vec{a} = \hat{i} + \hat{j} + \hat{k}$and $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$.

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5. Find the area of the parallelogram whose two adjacent sides are determined by the vectors $\hat{i} + 2\hat{j} + 3\hat{k}$ and $3\hat{i} - 2\hat{j} + \hat{k}$.

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6. Find the area of the triangle whose vertices are A (3,-1,2), B(1,-1,-3) and C(4,-3,1).

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7. If $\vec{a}, \vec{b}, \vec{c}$ are position vectors of the vertices A,B,C of a triangle ABC, show that the area of the triangle ABC is $\frac{1}{2}\left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right|$. Also deduce the condition for collinearity of the points A,B and C.

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8. For any vector $\vec{a}$ prove that $\left|\vec{a} \times \hat{i}\right|^2 + \left|\vec{a} \times \hat{j}\right|^2 + \left|\vec{a} \times \hat{k}\right|^2 = 2\left|\vec{a}\right|^2$.

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9. Let $\vec{a}, \vec{b}, \vec{c}$ be unit vectors such that $\vec{a} . \vec{b} = \vec{a} . \vec{c} = 0$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$. Prove that $\vec{a} = \pm \frac{2}{\sqrt{3}} \left(\vec{b} \times \vec{c} \right)$.

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10. Find the angle between the vectors $2\hat{i} + \hat{j} - \hat{k}$ and $\hat{i} + 2\hat{j} + \hat{k}$ using vector product.

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Solution To Exercise 8 5

1. The value of $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{DA} + \overrightarrow{CD}$is

A. $\overrightarrow{AD}$

B. $\overrightarrow{CA}$

C. 0

D. $-\overrightarrow{AD}$

Answer: C

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2. If $\overrightarrow{a} + 2\overrightarrow{b}$ and $3\overrightarrow{a} + m\overrightarrow{b}$ are parallel, then the value of m is

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3. The unit vector parallel to the resultant of the vectors $\hat{i} + \hat{j} - \hat{k}$ and $\hat{i} - 2\hat{j} + \hat{k}$is

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4. A vector $\overrightarrow{OP}$ makes 60° and 45° with the positive direction of the x and y axes respectively. Then the angle between $\overrightarrow{OP}$ and the z-axis is

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5. If $\overrightarrow{BA} = 3\hat{i} + 2\hat{j} + \hat{k}$ and the position vector of B is $\hat{i} + 3\hat{j} - \hat{k}$ then the position vector A is

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6. A vector makes equal angle with the positive direction of the coordinate axes. Then each angle is equal to

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7. The vectors $\vec{a} - \vec{b}, \vec{b} - \vec{c}, \vec{c} - \vec{a}$ are

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8. If ABCD is a parallelogram, then $\overrightarrow{AB} + \overrightarrow{AD} + \overrightarrow{CB} + \overrightarrow{CD}$ is equal to

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9. One of the diagonals of parallelogram ABCD with $\vec{a}$ and $\vec{b}$ as adjacent sides is $\vec{a} + \vec{b}$. The other diagonal $\overrightarrow{BD}$ is

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10. If $\vec{a}, \vec{b}$ are the position vectors A and B then which one of the following points whose position vector lies on AB, is

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11. If $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of three collinear points, then which of the following is true?

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12. If $\vec{r} = \frac{9\vec{a} + 7\vec{b}}{16}$ then the point P whose position vector $\vec{r}$ divides the line joining the points with position vectors $\vec{a}$ and $\vec{b}$ in the ratio

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13. If $\lambda\hat{i} + 2\lambda\hat{j} + 2\lambda\hat{k}$ is a unit vector,then the value of λ is

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14. Two vertices of a triangle have position vectors $3\hat{i} + 4\hat{j} - 4\hat{k}$ and $2\hat{i} + 3\hat{j} + 4\hat{k}$. If the position vector of the centroid is $\hat{i} + 2\hat{j} + 3\hat{k}$, then the position vector of the third vertex is

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15. If $\left|\vec{a} + \vec{b}\right| = 60, \left|\vec{a} - \vec{b}\right| = 40$ and $\left|\vec{b}\right| = 46$, then $\left|\vec{a}\right|$ is

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16. If $\vec{a}$ and $\vec{b}$ having same magnitude and angle between them is 60° and their scalar product is $\frac{1}{2}$ then $\left|\vec{a}\right|$ is

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17. The value of $\theta \in \left(0, \frac{\pi}{2}\right)$ for which the vectors $\vec{a} = (\sin\theta)\hat{i} + (\cos\theta)\hat{j}$ and $\hat{b} = \hat{i} - \sqrt{3}\hat{j} + 2\hat{k}$ are perpendicular, is equal to

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18. If $\left|\vec{a}\right| = 13, \left|\vec{b}\right| = 5$ and $\vec{a}.\ \vec{b} = 60$then $\left|\vec{a} \times \vec{b}\right|$ is

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19. Vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle $\theta = 120^\circ$. If $\left|\vec{a}\right| = 1, \left|\vec{b}\right| = 2$, then $\left[\left(\vec{a} + 3\vec{b}\right) \times \left(3\vec{a} - \vec{b}\right)\right]^2$ is equal to

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20. If $\vec{a}$ and $\vec{b}$ are two vectors of magnitude 2 and inclined at an angle 60°, then the angle between $\vec{a}$ and $\vec{a} + \vec{b}$ is

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21. If the projection of $5\hat{i} - \hat{j} - 3\hat{k}$ on the vector $\hat{i} + 3\hat{j} + \lambda\hat{k}$ is same as the projection of $\hat{i} + 3\hat{j} + \lambda\hat{k}$ on $5\hat{i} - \hat{j} - 3\hat{k}$ then $\lambda$is equal to.

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22. If (1,2,4) and (2,-3λ, -3) are the initial and terminal points of the vector $\hat{i} + 5\hat{j} - 7\hat{k}$, then value of λ is equal to

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23. If the points whose position vectors $10\hat{i}+3\hat{j}, 12\hat{i}-5\hat{j}$ and $a\hat{i}+11\hat{j}$ are collinear then a is equal to

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24. If $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=2\hat{i}+x\hat{j}+\hat{k}, \vec{c}=\hat{i}-\hat{j}+4\hat{k}$ and $\vec{a}.\left(\vec{b}\times\vec{c}\right)=70$, then x is equal to

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25. If $\vec{a}=\hat{i}+2\hat{j}+2\hat{k}, \left|\vec{b}\right|$ =5 and the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$, then the area of the triangle formed by these two vectors as two sides is

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Choose Correct Option

1. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are sides of triangle taken in order then $a \vec{+} b \vec{+} c \vec{}$ is:

A. perimeter

B. semi perimeter

C. Area of triangle

D. 0

Answer: D

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2. Let O be the origin . Let A and B be two points whose position vectors are $\vec{a}$ and $\vec{b}$ .Then the position vector of a point P which divides AB internally in the ratio l:m is:

A. $\frac{l\vec{a} + m\vec{b}}{l+m}$

B. $\frac{l\vec{b} + m\vec{a}}{l+m}$

C. $\frac{l\vec{a} - m\vec{b}}{l - m}$

D. $\frac{l\vec{b} - m\vec{a}}{l - m}$

Answer: B

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3. Let $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ be the position vector of any point and let α, β, γ be the direction angle of $\vec{r}$ then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is:

A. -2

B. 0

C. 2

D. 1

Answer: C

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4. If $m\left(\vec{i}+\vec{j}+\vec{k}\right)$ is a unit vector then value of m is:

A. $\pm\sqrt{3}$

B. $\pm\frac{1}{\sqrt{3}}$

C. ± 3

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

Answer: B

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5. A vector $\vec{OP}$ makes 60° each with positive direction of x and y axis then the angle between $\vec{OP}$ and z axis is:

A. 45°

B. 30°

C. 90°

D. 60°

Answer: A

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6. If $\vec{a} = \vec{i} - 2\vec{j} + \vec{k}, \vec{b} = 2\vec{i} - \vec{j} + 2\vec{k}, \vec{c} = 3\vec{i} + \vec{j} - \vec{k}$ be such that $\left(\frac{\vec{a}}{\lambda \vec{b}}\right)$ is perpendicular to c, the the value of λ is:

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

B. -1

C. 1

D. 0

Answer: D

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7. If O is the origin and A,B are the points (2,1,-3) and (1,1,1) respectively then the angle between $\vec{O}A$ and $\vec{O}B$ is:

A. 45°

B. 90°

C. 60°

D. 30°

Answer: B

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8. For any two vectors $\vec{a}$ and $\vec{b}$ $\left|\vec{a} X \vec{b}\right|^2 + \left|\vec{a} . \vec{b}\right|$ is:

A. $\left|\vec{a}\right|^2 . \left|\vec{b}\right|^2$

B. $\left|\vec{a}\right|^2 + \left|\vec{b}\right|^2$

C. $\left|\vec{a}\right|^2 - \left|\vec{b}\right|^2$

D. 0

Answer: A

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9. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three unit vectors satisfying $\vec{a} - \vec{b} - \sqrt{3}\vec{c} = 0$ then the angle between $\vec{a}$ and $\vec{c}$ is:

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

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

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

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

Answer: B

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10. Show that $\vec{a} \times \left(\vec{b} + \vec{c}\right) + \vec{b} \times \left(\vec{c} + \vec{a}\right) + \vec{c} \times \left(\vec{a} + \vec{b}\right) = \vec{0}$.

A. $2\left|\vec{a}\right|\left|\vec{b}\right|\left|\vec{c}\right|$

B. θ

C. 1

D. $\vec{a} + \vec{b} + \vec{c}$

Answer: B

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11. Two vertices of a triangle hence position vetors $2\vec{i} + 4\vec{j} - 5\vec{k}$ and $\vec{i} + 3\vec{j} - 3\vec{k}$ .If the position vector of the centroid is $\vec{j} + 2\vec{k}$,then the position vector of the third vertex is

A. $-3\vec{i} - 4\vec{j} + 14\vec{k}$

B. $3\vec{i} + 2\vec{j} - 14\vec{k}$

C. $-3\vec{i} + 2\vec{j} - 14\vec{k}$

D. $3\vec{i} - 2\vec{j} + 14\vec{k}$

Answer: A

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12. If $2\vec{a} + 6\vec{b}$ and $3\vec{a} + m\vec{b}$ are parallel then the vector of m is:

A. 3

B. 6

C. 9

D. 12

Answer: C

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13. Match the following

13.	$\lvert\cos\alpha\vec{i}+\cos\beta\vec{j}+\cos\gamma\vec{k}\rvert$ is: (Where α, β, γ are angles made by $\vec{r}$ with coordinates axes.)	(a) 0
14.	$\vec{j}\times\vec{j}=$	(b) 2
15.	$\vec{a}=2\vec{i}+\vec{j}+\vec{k}$ $\vec{b}=\vec{i}+2\vec{j}+2\vec{k}$ Then $\lvert\vec{a}\times\vec{b}\rvert$ is:	(c) 1
16.	The projection of $\vec{i}+2\vec{j}+\vec{k}$ on $2\vec{i}+\vec{j}+2\vec{k}$ is:	(d) $3\sqrt{2}$

A. 0

B. 2

C. 1

D. $3\sqrt{2}$

Answer: C

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14. Find the incorrect statement

A. The sum of the square of the direction cosines of $\vec{r}$ is 1.

B. The direction ratios of $3\vec{i} + 4\vec{k}$ are $\left(\frac{3}{5}, 0, \frac{4}{5}\right)$

C. If $\vec{a} . \vec{b} = 0$ then $\vec{a}$ and $\vec{b}$ are perpendicular vectors.

D. `(veca+vecb).(veca-vecb) =|veca|^(2)-|vecb|^(2).

Answer: C

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15. Find the incorrect statement

A. $\vec{a} . \left(\vec{b} + \vec{c}\right) = \vec{a} . \vec{b} + \vec{a} . \vec{c}$

B. If $\vec{a} . \vec{b} = 0 \Rightarrow \left|\vec{a}\right| = 0$ or $\left|\vec{b}\right| = 0$ or $\theta = \frac{\pi}{2}$

C. Vector product is commutative.

D. $\vec{a} X \vec{a} = 0$ for any vector $\vec{a}$.

Answer: C

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16. Find the correct statement

A. $\vec{a} X \vec{b} = \vec{b} X \vec{a}$

B. For any two non zero vectors $\vec{a}$ and $\vec{b}$ $\vec{a} X \vec{b} = 0 \Rightarrow \vec{a}$ and $\vec{b}$ are parallel.

C. If $\vec{AB} = \vec{i} - \vec{j} + 2\vec{k}$ and $\vec{OB} = 2\vec{i} + \vec{j} - \vec{k}$ then $\vec{OA} = \vec{i} + 2\vec{j} + 3\vec{k}$

D. $\vec{a} . \vec{b} = \left|\vec{a}\right|\left|\vec{b}\right| \sin\theta\hat{n}$

Answer: B

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17. Find the correct statement: Given $\vec{OA} = \vec{a}, \vec{OB} = \vec{b}$ and $\vec{OP} = \frac{3\vec{a} + 5\vec{b}}{8}$ implies that : P divides the line joining A nd B in the ratio:

A. 3:5 internally

B. 5:3 externally

C. 5:3 internally

D. 3:5 externally

Answer: C

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18. The vectors $\vec{a} - \vec{b}, \vec{b} - \vec{c}, \vec{c} - \vec{a}$ are

A. Parallel to each other

B. unit vectors

C. Mutually perpendicular vectors

D. co-planar vectors

Answer: D

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19. Find the odd man out.

A. $\left(\vec{b} X \vec{a}\right) = -\left(\vec{a} X \vec{b}\right)$

B. $\vec{i} . \vec{i} = 0$

C. Scalar product is commutative

D. $\vec{a} X \left(\vec{b} . \vec{c}\right)$ is not defined.

Answer: B

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20. Find which in suitable for the blank space given below: $\left|\vec{a}.\vec{b}\right|.....\left|\vec{a}\right|\left|\vec{b}\right|$

A. $\leq$

B. $\geq$

C. $=$

D. $>$

Answer: A

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21. Assertion If D is the midpoint of the side BC of a triangle ABC then $\vec{A}B+\vec{A}C=2\vec{A}D$.Reason: If $\vec{a}$ and $\vec{b}$ are two position vector of A and B , then the position vector of midpoint of AB in $\frac{\vec{a}+\vec{b}}{2}$

A. Assertion is direct application of Reason.

B. Assertion is not derived from Reason

C. Reason is true but Assertion is not True.

D. Assertion implies Reason.

Answer: A

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22. Assertion If G is the centroid of the triangle ABC then $\vec{G}A + \vec{G}B + \vec{G}C = 0$.Reason: If $\vec{a}$, $\vec{b}$, $\vec{c}$ are two p.v of A ,B ,C of $\triangle$ `$ABCthenthep.vofitscentroidis$(veca+vecb+vecc)/(3). $Also$

vecAB=vecb-veca`

A. Both Assertion and Reason are not correct.

B. Reason is correct, but Assertion is not correct.

C. Using Reason, Assertion can be proved.

D. Using Reason, Assertion cannot be proved.

Answer: C

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23. Find $\left(\vec{i}+\vec{j}\right).\left\{\left(\vec{j}+\vec{k}\right)X\left(\vec{k}+\vec{i}\right)\right\}$:

A. 2

B. 1

C. -2

D. -1

Answer: A

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24. If $\vec{a}+5\vec{b}$ and $4\vec{a}+m\vec{b}$ are parallel then m is :

A. 25

B. 20

C. 4

D. none of the above

Answer: B

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25. If the projection of $\vec{a}$ on $\vec{b}$ and projection of $\vec{b}$ on $\vec{a}$ are equal, then the angle between $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ is :

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

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

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

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

Answer: A

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26. If $60^\circ, 45^\circ, \alpha^\circ$ are the directional angles of a vector $\overrightarrow{O}P$ then α is

A. 0°

B. 30°

C. 60°

D. 45°

Answer: C

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27. If $aplha, \beta, \gamma$ are the directional angles of a vector then $\sin^2 aplha + \sin^2 \beta + \sin^2 \gamma$.

A. 2

B. -2

C. 1

D. 0

Answer: A

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28. If $\vec{r} = \frac{5\vec{a} - 3\vec{b}}{2}$, then the point P whose position vector $r$divides the line joining the points with position vectors $\rightarrow$ and $\vec{b}$ in the ratio:

A. 3:5 internally

B. 3:5 externally

C. 5:3 internally

D. 5:3 externally

Answer: B

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29. The Position vectors of A,B,C are $3\vec{i} + 2\vec{j} - \vec{k}, 2\vec{i} + 4\vec{j} + 5\vec{k}$ and veci+0vecj+5veck` then the

position vector of centroid is :

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

B. $2\vec{i} - 2\vec{j} - 3\vec{k}$

C. $2\vec{i} + 2\vec{j} + 3\vec{k}$

D. none of these

Answer: C

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30. The projection of $2\vec{i} - \vec{j} + 2\vec{k}$ on $\vec{i} + 2\vec{j} + 2\vec{k}$ is :

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

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

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

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

Answer: D

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31. If $\vec{a}, \vec{b}, \vec{c}$ are sides of triangle taken in order then $a \vec{+} b \vec{+} c$ is:

A. $\vec{0}$

B. 0

C. $2\left|\vec{a}\right|\left|\vec{b}\right|\left|\vec{c}\right|$

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

Answer: A

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32. If $\vec{a} = x\vec{i} + \vec{j} - \vec{k}, \vec{b} = \vec{i} - \vec{j} - \vec{k}, \vec{c} = \vec{i} - 2\vec{j} + 3\vec{k}$ and $\vec{a}.\ \vec{b}\ X\vec{c} = 7$ then x is :

A. 2

B. -2

C. 1

D. -1

Answer: B

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33. If the points where position vector $5\vec{i}+3\vec{j}, 2\vec{i}-\vec{j}$ and xveci+3vecj` are collinear then x is :

A. 5

B. 3

C. 3

D. 2

Answer: A

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34. If $\vec{a}$ and $\vec{b}$ are unit vector which are included at an angle of 360° then $\left|\left(3\vec{a}+2\vec{b}\right)X\left(2\vec{a}-\vec{b}\right)\right|$.

A. 7

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

C. 14

D. none of these

Answer: B

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35. If $\vec{a}$ and $\vec{b}$ are of equal magnitude and angle between them is 30° and their $\left|\vec{a}X\vec{b}\right| = \frac{1}{2}$ then $\left|\vec{a}\right|$ is:

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

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

C. 1

D. 0

Answer: C

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36. In a quadrilateral ABCD, $\overrightarrow{A}B + \overrightarrow{B}C + \overrightarrow{C}D$ is:

A. $\overrightarrow{D}A$

B. 0

C. 1

D. $\overrightarrow{A}D$

Answer: D

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37. If the vectors $2\vec{i}+\vec{j}-\vec{k}, \vec{i}+3\vec{j}-4\vec{k}$ and $-\vec{i}-4\vec{j}+\lambda\vec{k}$ form a triangle then λ is:

A. -4

B. 2

C. -3

D. 3

Answer: D

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38. (i) dot product of two vectors is not commutative

(ii) If $\vec{i}, \vec{j}, \vec{k}$ are unit vectors the $\left|\vec{i}+\vec{j}+\vec{k}\right|=\sqrt{3}$

(iii) $\left(\vec{a}, \vec{b}\right)X\vec{c}$ is not defined.

(iv)The magnitude of $2\vec{i}+\vec{j}-2\vec{k}$ is $\sqrt{3}$Find which pair of statements are correct.

A. (i) and (ii) are true

B. (i) and (iv) are true

C. (iii) and (iv) are true

D. (ii) and (iii) are true

Answer: D

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