VECTOR ALGEBRA

EXERCISE – 1: Basic Subjective Questions

Section–A (1 Mark Questions)

1. Find the values of x and y so that the vectors $2\hat{i}+3\hat{j}$ and $x\hat{i}+y\hat{j}$ are equal.

2. Find a unit vector parallel to the vector $-3\hat{i}+4\hat{j}$.

3. The magnitude of the vector $\vec{a}=3\hat{i}-6\hat{j}+2\hat{k}$ is.

4. Find the projection of the vector $\vec{a}=2\hat{i}+3\hat{j}+2\hat{k}$ on the vector $\vec{b}=\hat{i}+2\hat{j}+\hat{k}$.

5. If l,m and n are direction cosines of a given vector, then $l^2+m^2+n^2=$ ________.

Section–B (2 Marks Questions)

6. If the position vector $\vec{a}$ of a point $(12,n)$ is such that $|\vec{a}|=13$, find the value of n.

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

8. Find a vector in the direction of vector $\vec{a}=\hat{i}-2\hat{j}$ that has magnitude 7 units.

9. If a vector makes angles α,β,γ with OX, OY and OZ respectively, prove that $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=2$.

10. Find $(\vec{a}+3\vec{b})\cdot(2\vec{a}-\vec{b})$, if $\vec{a}=\hat{i}+\hat{j}+2\hat{k}$ and $\vec{b}=3\hat{i}+2\hat{j}-\hat{k}$.

11. For given vectors, $\vec{a}=2\hat{i}-\hat{j}+2\hat{k}$ and $\vec{b}=-\hat{i}+\hat{j}-\hat{k}$, find the unit vector in the direction of the vector $\vec{a}+\vec{b}$.

12. Find the magnitude of $\vec{a}$ given by $\vec{a}=(\hat{i}+3\hat{j}-2\hat{k})\times(-\hat{i}+3\hat{k})$.

13. Find a unit vector perpendicular to both the vectors $\hat{i}-2\hat{j}+3\hat{k}$ and $\hat{i}+2\hat{j}-\hat{k}$.

Section–C (3 Marks Questions)

14. Represent graphically
(i) A displacement of 40 km, 30° west of south,
(ii) 60 km, 40° east of north
(iii) 50 km south-east.

15. If two vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a}|=2, |\vec{b}|=1$ and $\vec{a}\cdot\vec{b}=1$, find $(3\vec{a}-5\vec{b})\cdot(2\vec{a}+7\vec{b})$.

16. Show that the points $A(2\hat{i}-\hat{j}+\hat{k})$, $B(\hat{i}-3\hat{j}-5\hat{k})$, $C(3\hat{i}-4\hat{j}-4\hat{k})$ are the vertices of a right angled triangle.

17. Find the angle 'θ' between the vectors $\vec{a}=\hat{i}+\hat{j}-\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}+\hat{k}$.

18. A vector $\overrightarrow{OP}$ is inclined to OX at 45° and OY at 60° Find the angle at which $\overrightarrow{OP}$ is inclined to OZ.

19. Show that the points $A(-2\hat{i}+3\hat{j}+5\hat{k}), B(\hat{i}+2\hat{j}+3\hat{k})$ and $C(7\hat{i}-\hat{k})$ are collinear.

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

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

22. Find $\vec{a}\cdot\vec{b}$ when
(i) $\vec{a}=2\hat{i}+2\hat{j}-\hat{k}$ and $\vec{b}=6\hat{i}-3\hat{j}+2\hat{k}$
(ii) $\vec{a}=(1,1,2)$ and $\vec{b}=(3,2,-1)$

23. Find the magnitude of two vectors $\vec{a}$ and $\vec{b}$, having the same magnitude and such that the angle between them is 60° and their scalar product is $\frac{1}{2}$.

24. Find the area of the parallelogram determined by the vectors $\hat{i}+2\hat{j}+3\hat{k}$ and $3\hat{i}-2\hat{j}+\hat{k}$.

Section–D (5 Marks Questions)

25. Find the value of p for which the vector $\vec{a}=3\hat{i}+2\hat{j}+9\hat{k}$ and $\vec{b}=\hat{i}+p\hat{j}+3\hat{k}$ are.
(i) Perpendicular
(ii) Parallel

26. Three vectors $\vec{a},\vec{b}$ and $\vec{c}$ satisfy the condition $\vec{a}+\vec{b}+\vec{c}=\vec{0}$. Evaluate the quantity $\mu=\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}$, if $|\vec{a}|=3, |\vec{b}|=4$ and $|\vec{c}|=2$.

27. Find the position vector of a point R which divides the line joining two points P and Q whose position vector are $\left(2\vec{a}+\vec{b}\right)$ and $\left(\vec{a}-3\vec{b}\right)$ externally in the ratio $1:2$.

Also, show that P is the mid point of the line segment RQ.

28. (i) Find a unit vector perpendicular to the plane ABC where A, B, C are the points $(3,-1,2),(1,-1,-3),(4,-3,1)$ respectively.

(ii) If $\vec{a}$ makes equal angles with $\hat{i},\hat{j}$ and $\hat{k}$ and has magnitude 3, then prove that the angle between $\vec{a}$ and each of $\hat{i},\hat{j}$ and $\hat{k}$ is $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$.

29. Find the components of a unit vector which is perpendicular to the vectors $\hat{i}+2\hat{j}-\hat{k}$ and $3\hat{i}-\hat{j}+2\hat{k}$.

30. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpendicular vectors of equal magnitudes, show that the vector $\vec{a}+\vec{b}+\vec{c}$ is equally inclined to $\vec{a}, \vec{b}$ and $\vec{c}$.

EXERCISE – 2: Basic Objective Questions

Section–A (Single Choice Questions)

1. If in a ΔABC, $A \equiv (0,0)$, $B \equiv (3, 3\sqrt{3})$, $C \equiv (-3\sqrt{3}, 3)$, then the vector of magnitude $2\sqrt{2}$ units directed along $\overrightarrow{AO}$, where O is the circumcentre of ΔABC, is

(a) $(1-\sqrt{3})\hat{i} + (1+\sqrt{3})\hat{j}$ (b) $(1+\sqrt{3})\hat{i} + (1+\sqrt{3})\hat{j}$

(c) $(1+\sqrt{3})\hat{i} + (\sqrt{3}-1)\hat{j}$ (d) None of these

2. If $\vec{a}, \vec{b}$ are vectors forming sides AB and BC of a regular hexagon ABCDEF, then the vector representing side CD is

(a) $\vec{a}+\vec{b}$ (b) $\vec{a}-\vec{b}$

(c) $\vec{b}-\vec{a}$ (d) $a(\vec{a}+\vec{b})$

3. If points $A(60\hat{i}+3\hat{j}), B(40\hat{i}-8\hat{j})$ and $C(a\hat{i}-52\hat{j})$ are collinear, then a is equal to

(a) 40 (b) –40

(c) 20 (d) –20

4. If G is the intersection of diagonals of a parallelogram ABCD and O is any point, then $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}+\overrightarrow{OD} =$

(a) $2\overrightarrow{OG}$ (b) $4\overrightarrow{OG}$

(c) $5\overrightarrow{OG}$ (d) $3\overrightarrow{OG}$

5. In a regular hexagon ABCDEF, $\overrightarrow{AB} = \vec{a}$, $\overrightarrow{BC} = \vec{b}$ and $\overrightarrow{CD} = \vec{c}$. Then $\overrightarrow{AE} =$

(a) $\vec{a}+\vec{b}+\vec{c}$ (b) $2\vec{a}+\vec{b}+\vec{c}$

(c) $\vec{b}+\vec{c}$ (d) $\vec{a}+2\vec{b}+2\vec{c}$

6. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are the position vectors of points A, B, C, D such that no there of them are collinear and $\vec{a}+\vec{c} = \vec{b}+\vec{d}$, then ABCD is a

(a) Rhombus (b) Rectangle

(c) Square (d) Parallelogram

7. Let G be the centroid of ΔABC. If $\overrightarrow{AB} = \vec{a}$, $\overrightarrow{AC} = \vec{b}$, then the vector $\overrightarrow{AG}$ in terms of $\vec{a}$ and $\vec{b}$ is

(a) $\frac{2}{3}(\vec{a}+\vec{b})$ (b) $\frac{1}{6}(\vec{a}+\vec{b})$

(c) $\frac{1}{3}(\vec{a}+\vec{b})$ (d) $\frac{1}{2}(\vec{a}+\vec{b})$

8. If ABCDEF is a regular hexagon, then $\overrightarrow{AD}+\overrightarrow{EB}+\overrightarrow{FC}$ equals

(a) $2\overrightarrow{AB}$ (b) $\vec{0}$

(c) $3\overrightarrow{AB}$ (d) $4\overrightarrow{AB}$

9. The position vectors of the points A, B, C are $2\hat{i}+\hat{j}-\hat{k}$, $3\hat{i}-2\hat{j}+\hat{k}$ and $\hat{i}+4\hat{j}-3\hat{k}$ respectively. These points

(a) Form an isosceles triangle

(b) Form a right triangle

(c) Are collinear

(d) Form a scalene triangle

10. If OACB is a parallelogram with $\overrightarrow{OC} = \vec{a}$ and $\overrightarrow{AB} = \vec{b}$, then $\overrightarrow{OA} =$

(a) $(\vec{a}+\vec{b})$ (b) $(\vec{a}-\vec{b})$

(c) $\frac{1}{2}(\vec{b}-\vec{a})$ (d) $\frac{1}{2}(\vec{a}-\vec{b})$

11. If $\vec{a}$ and $\vec{b}$ are two collinear vectors, then which of the following is incorrect

(a) $\vec{b} = \lambda\vec{a}$ for some scalar λ

(b) Both the vectors $\vec{a}$ and $\vec{b}$ have the same direction but different magnitudes.

(c) The respective components of $\vec{a}$ and $\vec{b}$ are proportional

(d) None of these

12. The vectors $\vec{a}$ and $\vec{b}$ satisfy the equation $2\vec{a}+\vec{b} = \vec{p}$ and $\vec{a}+2\vec{b} = \vec{q}$, where $\vec{p} = \hat{i}+\hat{j}$ and $\vec{q} = \hat{i}-\hat{j}$. If θ is the angle between $\vec{a}$ and $\vec{b}$, then

(a) $\cos\theta = \frac{4}{5}$ (b) $\sin\theta = \frac{1}{\sqrt{2}}$

(c) $\cos\theta = -\frac{4}{5}$ (d) $\cos\theta = -\frac{3}{5}$

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

(a) $\frac{\pi}{6}$ (b) $\frac{2\pi}{3}$

(c) $\frac{5\pi}{3}$ (d) $\frac{\pi}{3}$

14. $(\cos\alpha\cos\beta)\hat{i} + (\cos\alpha\sin\beta)\hat{j} + (\sin\alpha)\hat{k}$ is a

(a) Null vector (b) Unit vector

(c) Constant vector (d) None of these

15. If the vectors $\hat{i}-2x\hat{j}+3y\hat{k}$ and $\hat{i}+2x\hat{j}-3y\hat{k}$ are perpendicular, then the locus of (x,y) is

(a) A circle (b) An ellipse
(c) A hyperbola (d) None of these

16. The length of the longer diagonal of the parallelogram constructed on $5\vec{a}+2\vec{b}$ and $\vec{a}-3\vec{b}$, if it is given that $|\vec{a}|=2\sqrt{2}, |\vec{b}|=3$ and angle between $\vec{a}$ and $\vec{b}$ is $\pi/4$, is

(a) 15 (b) $\sqrt{113}$
(c) $\sqrt{593}$ (d) $\sqrt{369}$

17. If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$, then $\vec{a}\cdot\vec{b}\ge 0$ holds only when

(a) $0<\theta<\frac{\pi}{2}$ (b) $0\le\theta\le\frac{\pi}{2}$
(c) $0<\theta<\pi$ (d) $0\le\theta\le\pi$

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

(a) 300 (b) 325
(c) 275 (d) 225

19. If $\vec{a}=\hat{i}+\hat{j}-\hat{k}, \vec{b}=-\hat{i}+2\hat{j}+2\hat{k}$ and $\vec{c}=-\hat{i}+2\hat{j}-\hat{k},$ then a unit vector normal to the vectors $\vec{a}+\vec{b}$ and $\vec{b}-\vec{c}$ is

(a) $\hat{i}$ (b) $\hat{j}$
(c) $\hat{k}$ (d) None of these

20. If $|\vec{a}\times\vec{b}|=4, |\vec{a}\cdot\vec{b}|=2,$ then $|\vec{a}|^2|\vec{b}|^2=$

(a) 6 (b) 2
(c) 20 (d) 8

21. The value of $(\vec{a}\times\vec{b})^2$ is

(a) $|\vec{a}|^2+|\vec{b}|^2-(\vec{a}\cdot\vec{b})^2$ (b) $|\vec{a}|^2|\vec{b}|^2-(\vec{a}\cdot\vec{b})^2$
(c) $|\vec{a}|^2+|\vec{b}|^2-2(\vec{a}\cdot\vec{b})^2$ (d) $|\vec{a}|^2+|\vec{b}|^2-\vec{a}\cdot\vec{b}$

22. If θ is the angle between any two vectors $\vec{a}$ and $\vec{b}$, then $|\vec{a}\cdot\vec{b}|=|\vec{a}\times\vec{b}|$ when θ is equal to

(a) 0 (b) $\pi/4$
(c) $\pi/2$ (d) π

Section–B (Assertion & Reason Type Questions)

23. **Assertion:** Let $P(\vec{a}), Q(\vec{b})$ and $R(\vec{c})$ be three points such that $2\vec{a}+3\vec{b}-5\vec{c}=0$. Then the vector area of the ΔPQR is a null vector.

Reason: Three collinear points form a triangle with zero area.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

24. Let $\vec{u}$ and $\vec{v}$ be unit vectors inclined at an angle θ such that for some vector $\vec{w}, \vec{w}+\vec{w}\times\vec{u}=\vec{v}$.

Assertion: $\vec{u}\cdot\vec{w}=\cos\theta$.

Reason: $|\vec{u}\times\vec{v}|=\sin\theta$.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

25. If $\vec{a},\vec{b},\vec{c}$ are unit vectors such that $\vec{a}+\vec{b}+\vec{c}=0$ then $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}=-\frac{3}{2}$.

Reason: $(\vec{x}+\vec{y})^2=|\vec{x}|^2+|\vec{y}|^2+2(\vec{x}\cdot\vec{y})$.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

26. **Assertion:** If $\vec{a}\times\vec{b}=\vec{c}\times\vec{d}$ and $\vec{a}\times\vec{c}=\vec{b}\times\vec{d}$, then $\vec{a}-\vec{d}$ is perpendicular to $\vec{b}-\vec{c}$.

Reason: If $\vec{P}$ and $\vec{Q}$ are perpendicular then $\vec{P}.\vec{Q}=0$.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

27. Let the vectors $\overrightarrow{PQ}, \overrightarrow{QR}, \overrightarrow{RS}, \overrightarrow{ST}, \overrightarrow{TU}$ and $\overrightarrow{UP}$ represent the sides of a regular hexagon.

Assertion: $\overrightarrow{PQ} \times \left(\overrightarrow{RS} + \overrightarrow{ST}\right) \neq \vec{0}$

Reason: $\overrightarrow{PQ} \times \overrightarrow{RS} = \vec{0}$ and $\overrightarrow{PQ} \times \overrightarrow{ST} \neq \vec{0}$

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.

(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

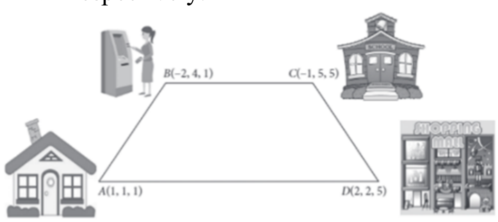
(c) Assertion is correct, reason is incorrect

(d) Assertion is incorrect, reason is correct.

Section–C (Case Study Questions)

Case Study–1

28. Ritika starts from his house to shopping mall. Instead to going to the mall directly, she first goes to a ATM, from there to her daughter's school and then reaches the mall. In the diagram, A, B, C and D represent the coordinates of house, ATM, school and mall respectively.



Based on the above information, answer the following questions.

(i) Distance between house (A) and ATM (B) ?

(a) 3 units (b) $3\sqrt{2}$ units

(c) $\sqrt{2}$ units (d) $4\sqrt{2}$ units

(ii) Distance between ATM (B) and school (C) is ?

(a) $\sqrt{2}$ units (b) $2\sqrt{2}$ units

(c) $3\sqrt{2}$ units (d) $4\sqrt{2}$ units

(iii) Distance between school (C) and shopping mall (D) is ?

(a) $3\sqrt{2}$ units (b) $5\sqrt{2}$ units

(c) $7\sqrt{2}$ units (d) $10\sqrt{2}$ units

(iv) What is the total distance travelled by Ritika ?

(a) $4\sqrt{2}$ units (b) $6\sqrt{2}$ units

(c) $8\sqrt{2}$ units (d) $9\sqrt{2}$ units

Case Study–2

29. A building is to be constructed in the form of a triangular pyramid, ABCD as shown in the figure.

Let its angular points are A(0, 1, 2), B(3, 0, 1), C(4, 3, 6) and D(2, 3, 2) and G be the point intersection of the medians of ΔBCD.

Base on the above information, answer the following questions.

(i) The coordinates of point G are ?

(a) (3,0,3) (b) (3,2,3)

(c) (0,3,3) (d) (3,3,2)

(ii) The length of vector $\overrightarrow{AG}$ is ?

(a) $\sqrt{17}$ units (b) $\sqrt{11}$ units

(c) $\sqrt{13}$ units (d) $\sqrt{19}$ units

(iii) Area of ΔABC (in sq. units) is ?

(a) $\sqrt{10}$ (b) $2\sqrt{10}$

(c) $3\sqrt{10}$ (d) $5\sqrt{10}$

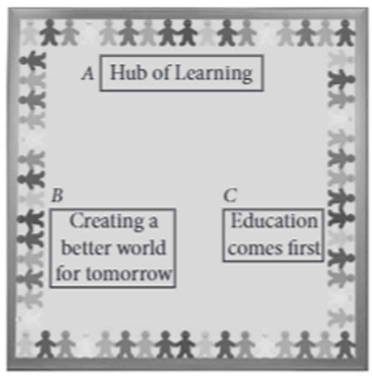
(iv) The sum of length of $\overrightarrow{AB}$ and $\overrightarrow{AC}$ is ?

(a) 5 units (b) 9.32 units

(c) 10 units (d) 11 units

Case Study–3

30. There slogans on chart papers are to be placed on a school bulletin board at the points A, B and C displaying A (Hub of Learning); B (creating a better world for tomorrow) and C (Education comes first). The coordinates of these points are (1, 4, 2), (3, -3, -2) and (-2, 2, 6) respectively.



Based on the above information, answer the following questions.

(i) Let $\vec{a}, \vec{b}$ and $\vec{c}$ be the position vectors of points A, B and C respectively, then $\vec{a}+\vec{b}+\vec{c}$ is equal to ?

(a) $2\hat{i}+3\hat{j}+6\hat{k}$ (b) $3\hat{i}-3\hat{j}-6\hat{k}$

(c) $2\hat{i}+8\hat{j}+3\hat{k}$ (d) $2\left(7\hat{i}+8\hat{j}+3\hat{k}\right)$

(ii) Which of the following is not true ?

(a) $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CA}=\vec{0}$ (b) $\overrightarrow{AB}+\overrightarrow{BC}-\overrightarrow{AC}=\vec{0}$

(c) $\overrightarrow{AB}+\overrightarrow{BC}-\overrightarrow{CA}=\vec{0}$ (d) $\overrightarrow{AB}-\overrightarrow{CB}+\overrightarrow{CA}=\vec{0}$

(iii) Area of ΔABC is ?

(a) 19 sq. units (b) $\sqrt{1937}$ sq. units

(c) $\frac{1}{2}\sqrt{1937}$ sq. units (d) $\sqrt{1837}$ sq. units

(iv) Suppose. If the given slogans are to be placed on a straight line, then the value of $\left|\vec{a}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}\right|$ will be equal to ?

(a) –1 (b) –2

(c) 2 (d) 0

EXERCISE – 3: Previous Year Questions

1. Find a vector $\vec{a}$ of magnitude $5\sqrt{2}$, making an angle of $\frac{\pi}{4}$ with x-axis, $\frac{\pi}{2}$ with y-axis and an acute angle θ with z-axis. **(AI 2014)**

2. If a unit vector $\vec{a}$ makes angle $\frac{\pi}{3}$ with $\hat{i}$, $\frac{\pi}{4}$ with $\hat{j}$ and an acute angle θ with $\hat{k}$, then find the value of θ. **(Delhi 2013)**

3. Find the magnitude of the vector $\vec{a} = 3\hat{i} - 2\hat{j} - 6\hat{k}$. **(AI 2011C)**

4. Find the sum of the vectors $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = -2\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{c} = \hat{i} - 6\hat{j} - 7\hat{k}$. **(Delhi 2012)**

5. Find the sum of the following vectors: $\vec{a} = \vec{i} - 3\vec{k}, \vec{b} = 2\vec{j} - \vec{k}, \vec{c} = 2\vec{i} - 3\vec{j} + 2\vec{k}$. **(Delhi 2012)**

6. Find the sum of the following vectors: $\vec{a} = \hat{i} - 2\hat{j}, \vec{b} = 2\hat{i} - 3\hat{j}, \vec{c} = 2\hat{i} + 3\hat{k}$ **(Delhi 2012)**

7. If A, B and C are the vertices of a triangle ABC, then what is the value of $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA}$. **(Delhi 2011C)**

8. Find the position vector of a point which divides the join of points with position vectors $\vec{a} - 2\vec{b}$ and $2\vec{a} + \vec{b}$ externally in the ration 2 : 1. **(Delhi 2016)**

9. Write the position vector of the point which divides the join of points with position vectors $3\vec{a} - 2\vec{b}$ and $2\vec{a} + 3\vec{b}$ in the ration 2 : 1. **(AI 2016)**

10. Find the unit vector in the direction of the sum of the vectors $2\hat{i} + 3\hat{j} - \hat{k}$ and $4\hat{i} - 3\hat{j} + 2\hat{k}$. **(Foreign 2015)**

11. Find a vector in the direction of $\vec{a} = \hat{i} - 2\hat{j}$ that has magnitude 7 units. **(Delhi 2015C)**

12. Write the direction ratios of the vector $3\vec{a} + 2\vec{b}$ where $\vec{a} = \hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = 2\hat{i} - 4\hat{j} + 5\hat{k}$. **(AI 2015C)**

13. Find the value of 'p' for which the vectors $3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\hat{i} - 2p\hat{j} + 3\hat{k}$ are parallel. **(AI 2014)**

14. Find a vector in the direction of vector $2\hat{i} - 3\hat{j} + 6\hat{k}$ which has magnitude 21 units. **(Foreign 2014)**

15. Write the a unit vector in the direction of vector $\overrightarrow{PQ}$, where P and Q are the points (1, 3, 0) and (4, 5, 6) respectively. **(Foreign 2014)**

16. If $\vec{a} = x\hat{i} + 2\hat{j} - z\hat{k}$ and $\vec{b} = 3\hat{i} - y\hat{j} + \hat{k}$ are two equal vectors, then write the value of $x + y + z$. **(Delhi 2013)**

17. Find a unit vector parallel to the sum of the vector $\hat{i} + \hat{j} + \hat{k}$ and $\hat{2} - 3\hat{j} + 5\hat{k}$. **(Delhi 2012C)**

18. Write the direction cosines of the vector $-2\hat{i} + \hat{j} - 5\hat{k}$. **(Delhi 2011)**

19. For what value of 'a', the vectors $2\hat{i} - 3\hat{j} + 4\hat{k}$ and $a\hat{i} + 6\hat{j} - 8\hat{k}$ are collinear. **(Delhi 2011)**

20. Write a unit vector in the direction of the vector $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$. **(AI 2011)**

21. The two vectors $\hat{j} + \hat{k}$ and $3\hat{i} - \hat{j} + 4\hat{k}$ represent the two sides AB and AC, respectively of a ΔABC. Find the length of the median through A. **(Delhi 2016, Foreign 2015)**

22. Find a vector of magnitude 5 units and parallel to the resultant of the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$. **(Delhi 2011)**

23. Write the number of vectors of unit length perpendicular to both the vectors $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. **(AI 2016)**

24. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then write the value of $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$. **(Foreign 2016)**

25. If $\left|\vec{a} \times \vec{b}\right|^2 + \left|\vec{a}.\vec{b}\right|^2 = 400$ and $|\vec{a}| = 5$ then write the value of $|\vec{b}|$. **(Foreign 2016)**

26. If $\vec{a} = 7\hat{i} + \hat{j} - 4\hat{k}$ and $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$, then find the projection of $\vec{a}$ and $\vec{b}$. **(Delhi 2015, 2013C)**

27. If $\hat{a}, \hat{b}$ and $\hat{c}$ are mutually perpendicular unit vectors, then find the value of $\left|2\hat{a} + \hat{b} + \hat{c}\right|$. **(AI 2015)**

28. Write a unit vector perpendicular to both the vectors $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}$. **(AI 2015)**

29. Find the area of a parallelogram whose adjacent sides are represented by the vectors $2\hat{i}-3\hat{k}$ and $4\hat{j}+2\hat{k}$. **(Foreign 2015)**

30. If $\vec{a}$ and $\vec{b}$ are unit vectors, then what is the angle between $\vec{a}$ and $\vec{b}$ so that $\sqrt{2}\vec{a}-\vec{b}$ is a unit vector. **(Delhi 2015C)**

31. If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a}+\vec{b}$ is also a unit vector, then find the angle between $\vec{a}$ and $\vec{b}$. **(Delhi 2014)**

32. If vectors $\vec{a}$ and $\vec{b}$ are such that, $|\vec{a}|=3, |\vec{b}|=\frac{2}{3}$ and $\vec{a}\times\vec{b}$ is a unit vector, then write the angle between $\vec{a}$ and $\vec{b}$. **(Delhi 2014)**

33. If $\vec{a}$ and $\vec{b}$ are perpendicular vectors, $|\vec{a}+\vec{b}|=13$ and $|\vec{a}|=5$, find the value of $|\vec{b}|$. **(AI 2014)**

34. Write the projection of the vector $\hat{i}+\hat{j}+\hat{k}$ along the vector $\hat{j}$. **(Foreign 2014)**

35. Write the value of $\hat{i}\times(\hat{j}+\hat{k})+\hat{j}\times(\hat{k}+\hat{i})+\hat{k}\times(\hat{i}+\hat{j})$. **(Foreign 2014)**

36. Write the value of cosine of the angle which the vector $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ makes with y-axis. **(Delhi 2014C)**

37. If $|\vec{a}|=8, |\vec{b}|=3$ and $|\vec{a}\times\vec{b}|=12$, find the angle between $\vec{a}$ and $\vec{b}$. **(Delhi 2014C)**

38. Find the angle between x-axis and the vector $\hat{i}+\hat{j}+\hat{k}$. **(Delhi 2014)**

39. Find $|\vec{x}|$, if for a unit vector $\vec{a}$, $(\vec{x}-\vec{a}).(\vec{x}+\vec{a})=15$. **(AI 2013)**

40. Write the value of λ so that the vectors $\vec{a}=2\hat{i}+\lambda\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-2\hat{j}+3\hat{k}$ are perpendicular to each other. **(Delhi 2013C, 2008, AI 2012C)**

41. Write the projection of $\vec{b}+\vec{c}$ on $\vec{a}$, where $\vec{a}=2\hat{i}-2\hat{j}+\hat{k}, \vec{b}=\hat{i}+2\hat{j}-2\hat{k}$ and $\vec{c}=2\hat{i}-\hat{j}+4\hat{k}$. **(AI 2013C, Delhi 2007)**

42. 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. **(Delhi 2012)**

43. Write the value of $(\hat{i}\times\hat{j}).\hat{k}+\hat{i}.\hat{k}$. **(AI 2012)**

44. Write the value of $(\hat{k}\times\hat{j}).\hat{i}+\hat{j}.\hat{k}$. **(AI 2012)**

45. Write the value of $(\hat{k}\times\hat{i}).\hat{j}+\hat{i}.\hat{k}$. **(AI 2012)**

46. Write the angle between two vector $\vec{a}$ and $\vec{b}$ with magnitudes $\sqrt{3}$ and2 respectively having $\vec{a}.\vec{b}=\sqrt{6}$. **(AI 2011)**

47. Write the projection of the vector $\hat{i}-\hat{j}$ on the vector $\hat{i}+\hat{j}$. **(AI 2011)**

48. If $|\vec{a}|=\sqrt{3}, |\vec{b}|=2$ and angle between $\vec{a}$ and $\vec{b}$ is $60°$, find $\vec{a}.\vec{b}$. **(Delhi 2011C)**

49. The two adjacent sides of a parallelogram are $2\hat{i}-4\hat{j}-5\hat{k}$ and $2\hat{i}+2\hat{j}+3\hat{k}$. Find the two unit vectors parallel to its diagonals. Using the diagonal vectors, find the area of the parallelogram. **(AI 2016)**

50. If $\vec{a}\times\vec{b}=\vec{c}\times\vec{d}$ and $\vec{a}\times\vec{c}=\vec{b}\times\vec{d}$, show that $\vec{a}-\vec{d}$ is parallel to $\vec{b}-\vec{c}$, where $\vec{a}\neq\vec{d}$ and $\vec{b}\neq\vec{c}$. **(Foreign 2016)**

51. If $\vec{r}=x\hat{i}+y\hat{j}+z\hat{k}$, find $(\vec{r}\times\hat{i}).(\vec{r}\times\hat{j})+xy$. **(Delhi 2015)**

52. If $\vec{a}=\hat{i}+2\hat{j}+\hat{k}$, $\vec{b}=2\hat{i}+\hat{j}$ and $\vec{c}=3\hat{i}-4\hat{j}-5\hat{k}$, then find a unit vector perpendicular to both of the vectors $(\vec{a}-\vec{b})$ and $(\vec{c}-\vec{b})$. **(AI 2015)**

53. Vector $\vec{a}, \vec{b}$ and $\vec{c}$ are such that $\vec{a}+\vec{b}+\vec{c}=\vec{0}$ and $|\vec{a}|=3, |\vec{b}|=5$ and $|\vec{c}|=7$. Find the angle between $\vec{a}$ and $\vec{b}$. **(Delhi 2014, AI 2008)**

54. The scalar product of the vector $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ with a unit vector along the sum of vectors $\vec{b}=2\hat{i}+4\hat{j}-5\hat{k}$ and $\vec{c}=\lambda\hat{i}+2\hat{j}+3\hat{k}$ is equal toone. Find the value of λ and hence find the unit vector along $\vec{b}+\vec{c}$. **(AI 2014)**

55. Find a unit vector perpendicular to both of the vectors $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ where $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}+2\hat{j}+3\hat{k}$. **(Foreign 2014)**

56. If $\vec{a}=2\hat{i}-3\hat{j}+\hat{k}, \vec{b}=-\hat{i}+\hat{k}, \vec{c}=2\hat{j}-\hat{k}$ are three vectors, find the area of the parallelogram having diagonals $(\vec{a}+\vec{b})$ and $(\vec{b}+\vec{c})$. **(Delhi 2014C)**

57. Find the vector $\vec{p}$ which is perpendicular to both $\vec{\alpha}=4\hat{i}+5\hat{j}-\hat{k}$ and $\beta=4\hat{i}+5\hat{j}-\hat{k}$ and $\vec{p}.\vec{q}=21$, where $\vec{q}=3\hat{i}+\hat{j}-\hat{k}$. **(AI 2014C)**

58. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}+\vec{b}|=|\vec{a}|$, then prove that vector $2\vec{a}+\vec{b}$ is perpendicular to vector $\vec{b}$. **(Delhi 2013)**

59. If $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{b}=\hat{j}-\hat{k}$, find a vector $\vec{c}$, such that $\vec{a}\times\vec{c}=\vec{b}$ and $\vec{a}.\vec{c}=3$. **(Delhi 2013)**

60. Using vectors, find the area of the triangle ABC with vertices $A(1, 2, 3)$, $B(2,-1,4)$ and $C(4, 5,-1)$. **(Delhi 2013, AI 2013)**

61. If $\vec{a}=\hat{i}-\hat{j}+7\hat{k}$ and $\vec{b}=5\hat{i}-\hat{j}+\lambda\hat{k}$, then find the value of λ, so that $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ are perpendicular vectors. **(AI 2013)**

62. If $\vec{a},\vec{b},\vec{c}$ are three mutually perpendicular vectors of the same magnitude, prove that $\vec{a}+\vec{b}+\vec{c}$ is equally inclined with the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$. **(Delhi 2013C)**

63. Dot product of a vector with vectors $\hat{i}-\hat{j}+\hat{k}$, $2\hat{i}+\hat{j}-3\hat{k}$ and $\hat{i}+\hat{j}+\hat{k}$ are respectively 4, 0 and 2. Find the vector. **(Delhi 2013C)**

64. Find the values of λ for which the angle of a vector with vectors and are between the vectors $\vec{a}=2\lambda^2\hat{i}+4\lambda\hat{j}+\hat{k}$ and $\vec{b}=7\hat{i}-2\hat{j}+\lambda\hat{k}$ is obtuse. **(AI 2013C)**

65. If $\vec{a}=3\hat{i}-\hat{j}$ and $\vec{b}=2\hat{i}+\hat{j}-3\hat{k}$ then express $\vec{b}$ in the form $\vec{b}=\vec{b}_1+\vec{b}_2$ where $\vec{b}_1 \parallel \vec{a}$ and $\vec{b}_2 \perp \vec{a}$. **(AI 2013C)**

66. If $\vec{a},\vec{b},\vec{c}$ are three vectors such that $|\vec{a}|=5, |\vec{b}|=12$ and $|\vec{c}|=13$ and $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, find the value of $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}$. **(Delhi 2012)**

67. If the sum of two unit vectors $\hat{a}$ and $\hat{b}$ is a unit vector, show that the magnitude of their difference is $\sqrt{3}$. **(Delhi 2012C)**

68. If two vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a}|=2, |\vec{b}|=1$ and $\vec{a}.\vec{b}=1$, then find the value of $(3\vec{a}-5\vec{b}).(2\vec{a}+7\vec{b})$. **(Delhi 2011)**

69. Find λ, if the vectors $\vec{a}=\hat{i}+3\hat{j}+\hat{k}$, $\vec{b}=2\hat{i}-\hat{j}-\hat{k}$ and $\vec{c}=\lambda\hat{j}+3\hat{k}$ are coplanar. **(Delhi 2015)**

70. Find $\vec{a}.(\vec{b}\times\vec{c})$, if $\vec{a}=2\hat{i}+\hat{j}+3\hat{k}$, $\vec{b}=-\hat{i}+2\hat{j}+\hat{k}$ and $\vec{c}=3\hat{i}+\hat{j}+2\hat{k}$. **(Delhi 2015)**

71. Show that the vectors $\vec{a},\vec{b}$ and $\vec{c}$ are coplanar if $\vec{a}+\vec{b}$, $\vec{b}+\vec{c}$ and $\vec{c}+\vec{a}$ are coplanar. **(Delhi 2016)**

72. Find the value of λ so that the four points A, B, and C and D with position vectors $4\hat{i}+5\hat{j}+\hat{k}$, $-\hat{j}-\hat{k}, 3\hat{i}+\lambda\hat{j}+4\hat{k}$ and $-4\hat{i}+4\hat{j}+4\hat{k}$ respectively are coplanar. **(Delhi 2015C)**

73. Prove that, for any three vectors $\vec{a},\vec{b},\vec{c}$
$$\left[\vec{a}+\vec{b}\;\; \vec{b}+\vec{c}\;\; \vec{c}+\vec{a}\right]=2\left[\vec{a}\;\vec{b}\;\vec{c}\right].$$
(Delhi 2014)

74. Show that the vectors $\vec{a},\vec{b},\vec{c}$ are coplanar if and only if $\vec{a}+\vec{b}$, $\vec{b}+\vec{c}$ and $\vec{c}+\vec{a}$ are coplanar. **(Foreign 2014)**

75. X and Y are two points with position vectors $3\vec{a}+\vec{b}$ and $\vec{a}-3\vec{b}$ respectively. Write the position vector of a point Z which divides the line segment XY in the ratio 2 : 1 externally. **(AI 2019)**

76. Find the magnitude of each of the two vectors $\vec{a}$ and $\vec{b}$, having the same magnitude such that the angle between them is 60° and their scalar product is $\frac{9}{2}$. **(2018)**

77. If the sum of two unit vectors is a unit vector, prove that the magnitude of their difference is $\sqrt{3}$. **(Delhi 2019)**

78. Let $\vec{a}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{b}=3\hat{i}-\hat{j}+2\hat{k}$ be two vectors. Show that the vectors $(\vec{a}+\vec{b})$ and $(\vec{a}-\vec{b})$ are perpendicular to each other. **(AI 2019)**

79. If θ is the agle between two vectors $\hat{i}-2\hat{j}+3\hat{k}$ and $3\hat{i}-2\hat{j}+\hat{k}$, find $\sin\theta$. **(2018)**

80. If $\hat{i}+\hat{j}+\hat{k}, 2\hat{i}+5\hat{j}, 3\hat{i}+2\hat{j}-3\hat{k}$ and $\hat{i}-6\hat{j}-\hat{k}$ respectively are the position vectors of points A, B, C and D, then the angle between the straight lines AB and CD. Find whether $\overrightarrow{AB}$ and $\overrightarrow{CD}$ are collinear or not. **(Delhi 2019)**

81. Let $\vec{a}=4\hat{i}+5\hat{j}-\hat{k}, \vec{b}=\hat{i}-4\hat{j}+5\hat{k}$ and $\vec{c}=3\hat{i}+\hat{j}-\hat{k}$. find a vector $\vec{d}$ which is perpendicular to both $\vec{c}$ and $\vec{b}$ and $\vec{d}\cdot\vec{a}=21$ **(2018)**

82. If $\vec{a}=2\hat{i}+3\hat{j}+\hat{k}, \vec{b}=\hat{i}-2\hat{j}+\hat{k}$ and $\vec{c}=-3\hat{i}+\hat{j}+2\hat{k}$. Find $[\vec{a}\vec{b}\vec{c}]$. **(Delhi 2019)**

83. Find the value of x, for which the four points $A(x, -1,-1)$, B(4,5,1),C(3,9,4) and D(–4,4,4) are coplanar. **(AI 2019)**

84. State true or false

If $\hat{i},\hat{j},\hat{k}$ are unit vectors along three mutually perpendicular directions, then $\hat{i}\cdot\hat{k}=0$. **(AI 2020, Delhi 2020)**

85. ABCD is a rhombus whose diagonals intersect at E. Then $\overrightarrow{EA}+\overrightarrow{EB}+\overrightarrow{EC}+\overrightarrow{ED}$ equals _____. **(AI 2020, Delhi 2020)**

86. If $\vec{a}=\hat{i}+2\hat{j}+3\hat{k}$ and $\vec{b}=2\hat{i}+4\hat{j}-5\hat{k}$ represent two adjacent sides of parallelogram, find unit vectors parallel to the diagonals of the parallelogram. **(AI 2020, Delhi 2020)**

87. using vectors, find the area of the triangle ABC with vertices A(1,2,3), B(2,–1,4) and C(4,5,–1). **(AI 2020, Delhi 2020)**

88. The value of p for which $p(\hat{i}+\hat{j}+\hat{k})$ is a unit vector is ____. **(AI 2020)**

89. The area of the parallelogram whose diagonals are $2\hat{i}$ and $-3\hat{k}$ is square units. **(AI 2020)**

90. The value of λ for which the vectors $2\hat{i}-\lambda\hat{j}+\hat{k}$ and $i+2\hat{j}-\hat{k}$ are orthogonal is _____. **(AI 2020)**

Answer Key

EXERCISE-1:

Basic Subjective Questions

1. $x=2, y=3$ **2.** $\vec{a}=-\frac{3}{5}\hat{i}+\frac{4}{5}\hat{j}$ **3.** 7.

4. $\frac{5}{3}\sqrt{6}$ **5.** 1 **6.** $n=\pm 5$

7. $0\hat{i}-4\hat{j}-\hat{k}$ **8.** $\frac{7}{\sqrt{5}}\hat{i}-\frac{14}{\sqrt{5}}\hat{j}$ **10.** -15

11. $\frac{1}{\sqrt{2}}\hat{i}+\frac{1}{\sqrt{2}}\hat{k}$ **12.** $\sqrt{91}$ **13.** $\frac{1}{\sqrt{3}}\left(-\hat{i}+\hat{j}+\hat{k}\right)$

15. 0 **17.** $\theta=\cos^{-1}\left(\frac{-1}{3}\right)$ **18.** $60°$ or $120°$

20. 50 **21.** $\left(-\frac{1}{3},-\frac{2}{3},\frac{2}{3}\right)$ **22.** (i) 4 (ii) 3

23. $|\vec{a}|=|\vec{b}|=1$ **24.** $8\sqrt{3}$ sq. units

25. $p=\frac{2}{3}$ **26.** $\mu=-\frac{29}{2}$ **27.** $2\vec{a}+\vec{b}$

28. (i) $\frac{1}{\sqrt{165}}\left(-10\hat{i}-7\hat{j}+4\hat{k}\right)$

29. $\frac{-3}{\sqrt{83}}\hat{i},\frac{5}{\sqrt{83}}\hat{j},\frac{7}{\sqrt{83}}\hat{k}$

EXERCISE-2:

Basic Objective Questions

1. (a) **2.** (c) **3.** (b) **4.** (b) **5.** (c)

6. (d) **7.** (c) **8.** (d) **9.** (a) **10.** (d)

11. (b) **12.** (c) **13.** (d) **14.** (b) **15.** (b)

16. (c) **17.** (b) **18.** (a) **19.** (a) **20.** (c)

21. (b) **22.** (b) **23.** (a) **24.** (b) **25.** (a)

26. (d) **27.** (c)

28. (i) (b) **(ii)** (c) **(iii)** (a) **(iv)** (d)

29. (i) (b) **(ii)** (b) **(iii)** (c) **(iv)** (b)

30. (i) (a) **(ii)** (c) **(iii)** (c) **(iv)** (d)

EXERCISE-3:

Previous Year Questions

1. $\vec{a} = 5\left(\hat{i} + \hat{k}\right)$ **2.** $\theta = \frac{\pi}{3}$ **3.** 7

4. $-4\hat{j} - \hat{k}$ **5.** $3\hat{i} - \hat{j} - 2\hat{k}$

6. $5\hat{i} - 5\hat{j} + 3\hat{k}$ **7.** 0 **8.** $3\vec{a} + 4\vec{b}$

9. $\frac{7}{3}\vec{a} + \frac{4}{3}\vec{b}$ **10.** $\frac{6}{\sqrt{37}}\hat{i} + \frac{1}{\sqrt{37}}\hat{k}$

11. $\frac{7}{\sqrt{5}}\left(\hat{i} - 2\hat{j}\right)$ **12.** 7, –5, 4 **13.** $p = -\frac{1}{3}$

14. $6\hat{i} - 9\hat{j} + 18\hat{k}$ **15.** $\frac{3\hat{i} + 2\hat{j} + 6\hat{k}}{7}$ **16.** 0

17. $\pm\frac{1}{7}\left(3\hat{i} - 2\hat{j} + 6\hat{k}\right)$ **18.** $\left(\frac{-2}{\sqrt{30}}, \frac{1}{\sqrt{30}}, \frac{-5}{\sqrt{30}}\right)$

19. $a = -4$ **20.** $\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}$ **21.** $\frac{\sqrt{34}}{2}$

22. $\frac{5\left(3\hat{i} + \hat{j}\right)}{\sqrt{10}}$ **23.** $\pm\left(\frac{-1}{3}\hat{i} - \frac{2}{3}\hat{j} + \frac{2}{3}\hat{k}\right)$

24. $\frac{-3}{2}$ **25.** 4 **26.** $\frac{8}{7}$ **27.** $\sqrt{6}$

28. $\frac{1}{\sqrt{2}}\left(-\hat{i} + \hat{j}\right)$ **29.** $4\sqrt{14}$ sq. units **30.** $\theta = \frac{\pi}{4}$

31. 120° **32.** $\frac{\pi}{6}$ **33.** $\left|\vec{b}\right| = 12$ **34.** 1

35. $\vec{0}$ **36.** $\frac{1}{\sqrt{3}}$ **37.** $\frac{\pi}{6}$ **38.** $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

39. $\left|\vec{x}\right| = 4$ **40.** $\frac{5}{2}$ **41.** 2 **42.** $\lambda = 5$ **43.** 1

44. –1 **45.** 1 **46.** $\frac{\pi}{4}$ **47.** 0 **48.** $\sqrt{3}$

49. $2\sqrt{101}$ sq. units **51.** 0 **52.** $\frac{1}{\sqrt{2}}\left(-\hat{j} + \hat{k}\right)$

53. $\theta = \frac{\pi}{3}$ **54.** $\frac{1}{7}\left(3\hat{i} + 6\hat{j} - 2\hat{k}\right)$ **55.** $\pm\frac{\left(\hat{i} - 2\hat{j} + \hat{k}\right)}{\sqrt{6}}$

56. $\frac{\sqrt{21}}{2}$ **57.** $\vec{p} = 7\hat{i} - 7\hat{j} - 7\hat{k}$ **60.** $\frac{1}{2}\sqrt{274}$

59. $\vec{c} = \frac{5}{3}\hat{i} + \frac{2}{3}\hat{j} + \frac{2}{3}\hat{k}$ **61.** ±5 **63.** $\vec{r} = 2\hat{i} - \hat{j} + k$

64. $0 < \lambda < \frac{1}{2}$ **65.** $b_1 = \frac{3}{2}\hat{i} - \frac{1}{2}\hat{j}, b_2 = \frac{1}{2}\hat{i} + \frac{3}{2}\hat{j} - 3\hat{k}$

66. –169 **68.** 0 **69.** 7 **70.** –10

72. 9 **75.** $-\vec{a} - 7\vec{b}$ **76.** $\left|\vec{a}\right| = \left|\vec{b}\right| = 3$

79. $\frac{2\sqrt{6}}{7}$ **81.** $\vec{d} = \frac{-1}{3}\hat{i} + \frac{16}{3}\hat{j} + \frac{13}{3}\hat{k}$

82. –30 **83.** $x = 0$ **84.** true **85.** 0

86. $\vec{c} = \frac{3\hat{i} + 6\hat{j} - 2\hat{k}}{7}$ and $\vec{d} = \frac{-\hat{i} - 2\hat{i} + 8\hat{k}}{\sqrt{69}}$

87. $\frac{1}{2}\sqrt{274}$ sq. units **88.** $p = \frac{1}{\sqrt{3}}$

89. 3 sq. units **90.** $\lambda = \frac{1}{2}$