Vector

Exercise-1

Marked questions may have for revision questions.

*** Marked Questions may have more than one correct option.**

OBJECTIVE QUESTIONS

Section (A): Addition and Subtraction laws of vectors, Position vector, Distance Formula, Section Formula, Direction Ratios & Direction cosines

A-1. Which of the following statement is correct -
(1) two unit vectors are parallel
(2) two unit vectors are equal
(3) two unit vectors are equal in magnitude
(4) two unit vectors are equal when they are parallel

A-2. Which of the following is a unit vector -
(1) i + j
(2) $\frac{(i+j+k)}{\sqrt{2}}$
(3) i + j + k
(4) $\frac{(i+j+k)}{\sqrt{3}}$

A-3. If $\vec{a} = 2\hat{i} + 5\hat{j}$ and $\vec{b} = 2\hat{i} - \hat{j}$, then unit vector in the direction of $\vec{a} + \vec{b}$ is -
(1) $\hat{i} + \hat{j}$
(2) $\sqrt{2}\,(\hat{i} + \hat{j})$
(3) $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$
(4) $\frac{\hat{i} - \hat{j}}{\sqrt{2}}$

A-4. The position vector of a point C with respect to B is $\hat{i} + \hat{j}$ and that of B with respect to A is $\hat{i} - \hat{j}$. The position vector of C with respect to A is -
(1) $2\hat{i}$
(2) $-2\hat{i}$
(3) $2\hat{j}$
(4) $-2\hat{j}$

A-5. Points $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$, $3\hat{i} - 4\hat{j} - 4\hat{k}$ are the vertices of a triangle, then the triangle is
(1) equilateral
(2) isosceles
(3) right angled
(4) obtuse angle triangle

A-6. If A, B,C, D be any four points and E and F be the middle points of AC and BD respectively, then $\overrightarrow{AB} + \overrightarrow{CB} + \overrightarrow{CD} + \overrightarrow{AD}$ is equal to-
(1) $3\overrightarrow{EF}$
(2) $3\overrightarrow{FE}$
(3) $4\overrightarrow{EF}$
(4) $4\overrightarrow{FE}$

A-7. If the position vectors of three consecutive vertices of any parallelogram are respectively $\hat{i} + \hat{j} + \hat{k}$, $+ 3\hat{j} + 5\hat{k}$, $7\hat{i} + 9\hat{j} + 11\hat{k}$ then the position vector of its fourth vertex is -
(1) $6(\hat{i} + \hat{j} + \hat{k})$
(2) $7(\hat{i} + \hat{j} + \hat{k})$
(3) $2\hat{j} - 4\hat{k}$
(4) $6\hat{i} + 8\hat{j} + 10\hat{k}$

A-8. The vectors $\hat{i} + 2\hat{j} + 3\hat{k}$, $2\hat{i} - \hat{j} + \hat{k}$ and $3\hat{i} + \hat{j} + 4\hat{k}$ are so placed that the end point of one vector is the starting point of the next vector. Then the vectors are :
(1) not coplanar
(2) coplanar but cannot form a triangle
(3) coplanar but can form a triangle
(4) coplanar & can form a right angled triangle

A-9. A,B,C are vertices of a ΔABC having position vectors 3i – j + 2k, $5\hat{i}+2\hat{j}+4\hat{k}$ and – $\hat{i}$ – $\hat{j}$ + 6 $\hat{k}$ respectively. D is point on side BC such that $\frac{BD}{DC}=\frac{2}{1}$ and E is the midpoint of side AC. If AD and BE intersect at point P, then PB : PE is equal to

(1) 1 : 4 (2) 2 : 3 (3) 3 : 2 (4) 4 : 1

A-10. The distance of the point (1, 2, 3) from x-axis is

(1) $\sqrt{13}$ (2) $\sqrt{5}$ (3) $\sqrt{10}$ (4) $\sqrt{14}$

A-11. If the distance of the point P(4, 3, 5) from the axis of y is λ unit, then the value of $5\lambda^2$ must be equal to

(1) 100 (2) 150 (3) 200 (4) 205

A-12. A point P lies on a line whose ends are A (1,2,3) and B(2,10,1). If z-coordinate of P is 7, then point P is-

(1) (–1, –14, 7) (2) (1, –14, 7) (3) (–1, 14, 7) (4) (1, 14, 7)

A-13. If the sum of the squares of the distances of a point from the three coordinate axes be 36, then its distance from the origin is

(1) 6 (2) $3\sqrt{2}$ (3) 2 (4) $6\sqrt{2}$

A-14. The vertices of a triangle are A (1, 1, 2), B(4, 3, 1) and C(2, 3, 5). A vector representing the internal bisector of the angle A is :

(1) $\hat{i}+\hat{j}+2\hat{k}$ (2) $2\hat{i}-2\hat{j}+\hat{k}$ (3) $2\hat{i}+2\hat{j}-\hat{k}$ (4) $2\hat{i}+2\hat{j}+\hat{k}$

A-15. The locus of a point P which moves such that $PA^2 - PB^2 = 2k^2$ where A and B are (3, 4, 5) and (– 1, 3, – 7) respectively is

(1) $8x + 2y + 24z - 9 + 2k^2 = 0$ (2) $8x + 2y + 24z - 2k^2 = 0$

(3) $8x + 2y + 24z + 9 + 2k^2 = 0$ (4) $8x - 2y + 24z - 2k^2 = 0$

A-16. If angles α, β, γ are made by a line with positive axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ equals

(1) 2 (2) 3 (3) 4 (4) 1

A-17. A line makes angles α, β, γ with the coordinate axes. If α + β= 90º, then γ =

(1) 0 (2) 90º (3) 180º (4) 60º

A-18. Direction cosines of the line equally inclined with axes are -

(1) 1,1,1 (2) $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$ (3) $\frac{1}{\sqrt{3}} + \frac{1}{\sqrt{3}}, + - \frac{1}{\sqrt{3}}$ (4) $-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}$

A-19. The coordinates of the points A, B, C, D are (4, α, 2), (5, −3, 2), (β, 1, 1) & (3, 3, −1). Line AB would be perpendicular to line CD when

(1) α = –1, β = –1 (2) α = 1, β = 2 (3) α = 2, β = 1 (4) α = 2, β = 2

A-20. If the edges of a rectangular parallelopiped are 3, 2, 1 then the angle between a pair of diagonals is given by

(1) $\cos^{-1}\frac{6}{7}$ (2) $\cos^{-1}\frac{3}{7}$ (3) $\cos^{-1}\frac{2}{7}$ (4) All of these

Section (B) : Dot Product, Projection of a line segement on other line, Cross Product

Vector

B-1. If θ be the angle between vectors $\hat{i} + 2\hat{j} + 3\hat{k}$ and $3\hat{i} + 2\hat{j} + \hat{k}$, then the value of sinθ is

(1) $\sqrt{\frac{6}{7}}$ (2) $\frac{2\sqrt{6}}{7}$ (3) $\frac{1}{7}$ (4) $2\sqrt{\frac{6}{7}}$

B-2. If $\vec{x}$ and $\vec{y}$ are two unit vectors and θ is the angle between them, then $\frac{1}{2}|\vec{x} - \vec{y}|$ is equal to -

(1) $\frac{\pi}{2}$ (2) 0 (3) $\left|\cos\frac{\theta}{2}\right|$ (4) $\left|\sin\frac{\theta}{2}\right|$

B-3. Angle between diagonals of a parallelogram whose side are represented by $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} - \hat{k}$ is

(1) $\cos^{-1}\left(\frac{1}{3}\right)$ (2) $\cos^{-1}\left(\frac{1}{2}\right)$ (3) $\cos^{-1}\left(\frac{4}{9}\right)$ (4) $\cos^{-1}\left(\frac{5}{9}\right)$

B-4. If $\vec{a} + \vec{b} + \vec{c} = 0$, $|\vec{a}| = 3, |\vec{b}| = 5, |\vec{c}| = 7$ then the angle between $\vec{a}$ and $\vec{b}$ is -

(1) $\frac{\pi}{6}$ (2) $\frac{2\pi}{3}$ (3) $\frac{5\pi}{3}$ (4) $\frac{\pi}{3}$

B-5. Let $\vec{a} = \hat{i}$ be a vector which makes an angle of 120º with a unit vector $\vec{b}$ in XY plane, then the unit vector $(\vec{a} + \vec{b})$ is -

(1) $-\frac{1}{2}\hat{i} + \frac{\sqrt{3}}{2}\hat{j}$ (2) $-\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}$ (3) $\frac{1}{2}\hat{i} + \frac{\sqrt{3}}{2}\hat{j}$ (4) $\frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}$

B-6. Let $\vec{a}, \vec{b}, \vec{c}$ be vectors of length 3, 4, 5 respectively. Let $\vec{a}$ be perpendicular to $\vec{b} + \vec{c}$, to $\vec{c} + \vec{a}$ and $\vec{c}$ to $\vec{a} + \vec{b}$. Then $|\vec{a} + \vec{b} + \vec{c}|$ is equal to :

(1) $2\sqrt{5}$ (2) $2\sqrt{2}$ (3) $10\sqrt{5}$ (4) $5\sqrt{2}$

B-7. If $|\vec{a}| = 5$, $|\vec{a} - \vec{b}| = 8$ and $|\vec{a} + \vec{b}| = 10$, then $|\vec{b}|$ is equal to :

(1) 1 (2) $\sqrt{57}$ (3) 3 (4) 4

B-8. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$ then $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$ is equal to

(1) 1 (2) 3 (3) $-\frac{3}{2}$ (4) $\frac{3}{2}$

B-9. The vertices of a triangle ABC are A (1, –2, 2), B (1, 4, 0) and C (–4, 1, 1) respectively. If M be the foot of perpendicular drawn from B on AC, then $\overrightarrow{BM}$ equals

(1) $\frac{10}{7}(-2\hat{i} - 3\hat{j} + \hat{k})$ (2) $10(-2\hat{i} - 3\hat{j} + \hat{k})$ (3) $2(\hat{i} + 3\hat{j} - \hat{k})$ (4) $-2\hat{i} - 3\hat{j} + \hat{k}$

B-10. If $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 3\hat{i} - 4\hat{j} + 2\hat{k}$ and $\vec{c} = \hat{i} - 2\hat{j} + 2\hat{k}$ then the projection of $\vec{a} + \vec{b}$ on $\vec{c}$ is -

(1) $\frac{17}{3}$ (2) $\frac{5}{3}$ (3) $\frac{4}{3}$ (4) $\frac{17}{\sqrt{43}}$

B-11. Let $\vec{b} = 4\hat{i} + 3\hat{j}$. Let $\vec{c}$ be a vector perpendicular to $\vec{b}$ and it lies in the XY-plane. A vector in the XY-plane having projections 1 and 2 along $\vec{b}$ and $\vec{c}$ is :

(1) $2\hat{i}+\hat{j}$ (2) $\hat{i}-2\hat{j}$ (3) $\frac{1}{5}(-2\hat{i}+11\hat{j})$ (4) $(-2\hat{i}+11\hat{j})$

B-12. If A (6, 3, 2), B (5, 1, 4), C (3, – 4, 7), D (0, 2, 5) are four points, then projection of CD on AB is

(1) $-\frac{13}{3}$ (2) $-\frac{13}{7}$ (3) $-\frac{3}{13}$ (4) $-\frac{7}{13}$

B-13. The length of the line segment whose projection on the coordinate axes are of magnitudes 12, 4, 3 is

(1) 13 (2) 17 (3) 19 (4) 21

B-14. Let $\vec{b} = 3\hat{j} + 4\hat{k}$, $\vec{a} = \hat{i} + \hat{j}$ and let $\vec{b}_1$ and $\vec{b}_2$ be component of vector $\vec{b}$ parallel and perpendicular to $\vec{a}$. If $\vec{b}_1 = \frac{3}{2}\hat{i} + \frac{3}{2}\hat{j}$, then $\vec{b}_2$ is equal to

(1) $-\frac{3}{2}\hat{i} + \frac{3}{2}\hat{j}$ (2) $\frac{3}{2}\hat{i} + \frac{3}{2}\hat{j} + 4\hat{k}$ (3) $-\frac{3}{2}\hat{i} + \frac{3}{2}\hat{j} + 4\hat{k}$ (4) $\frac{3}{2}\hat{i} + \frac{3}{2}\hat{j} - 4\hat{k}$

B-15. The vector $\frac{1}{3}\left(2\hat{i} - 2\hat{j} + \hat{k}\right)$ is:

(1) a unit vector (2) parallel to the vector $-\hat{i} + \hat{j} - \frac{1}{2}\hat{k}$

(3) perpendicular to the vector $3\hat{i} + 2\hat{j} - 2\hat{k}$ (4) all of these

B-16. The force determined by the vector $\vec{r}$ = (1, −8, −7) is resolved along three mutually perpendicular directions, one of which is in the direction of the vector $\vec{a} = 2\hat{i} + 2\hat{j} + \hat{k}$. Then the vector $\vec{r}$ component of the force along the vector $\vec{a}$ is

(1) $-\frac{14}{3}\hat{i} - \frac{14}{3}\hat{j} + \frac{7}{3}\hat{k}$ (2) $\frac{14}{3}\hat{i} - \frac{14}{3}\hat{j} - \frac{7}{3}\hat{k}$

(3) $-\frac{14}{3}\hat{i} + \frac{14}{3}\hat{j} - \frac{7}{3}\hat{k}$ (4) $-\frac{14}{3}\hat{i} - \frac{14}{3}\hat{j} - \frac{7}{3}\hat{k}$

B-17. If $\vec{u} = 2\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{v} = 6\hat{i} - 3\hat{j} + 2\hat{k}$ the unit vector perpendicular to $\vec{u}$ and $\vec{v}$ is -

(1) $\frac{\hat{i}-10\hat{j}-18\hat{k}}{\sqrt{425}}$ (2) $\frac{\hat{i}+10\hat{j}-18\hat{k}}{\sqrt{425}}$ (3) $\frac{\hat{i}+10\hat{j}+18\hat{k}}{\sqrt{425}}$ (4) $\frac{-\hat{i}+10\hat{j}-18\hat{k}}{\sqrt{425}}$

B-18. If the vector $\vec{b}$ is collinear with the vector $\vec{a} = \left(2\sqrt{2}, -1, 4\right)$ and $|\vec{b}|$ = 10, then :

(1) $\vec{a} \pm \vec{b} = 0$ (2) $\vec{a} \pm 2\vec{b} = 0$ (3) $2\vec{a} \pm \vec{b} = 0$ (4) $\vec{a} \pm 3\vec{b} = 0$

B-19. If $\hat{i} + 2\hat{j} + 3\hat{k}$ is parallel to sum of the vectors $3\hat{i} + \lambda\hat{j} + 2\hat{k}$ and $-2\hat{i} + 3\hat{j} + \hat{k}$, then λ equals -

(1) 1 (2) – 1 (3) 2 (4) – 2

B-20. The diagonals of a parallelogram are $\vec{d}_1 = 3\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{d}_2 = \hat{i} - 3\hat{j} + 4\hat{k}$. Its area is -

(1) $10\sqrt{3}$ (2) $5\sqrt{3}$ (3) 8 (4) 4

B-21. Twice of the area of the parallelogram constructed on the vectors $\vec{a} = \vec{p} + 2\vec{q}$ and $\vec{b} = 2\vec{p} + \vec{q}$, where $\vec{p}$ and $\vec{q}$ are unit vectors containing an angle of 30º, is :

(1) 2 (2) 3 (3) 6 (4) 5

B-22. If $(\vec{a} \times \vec{b})^2 + (\vec{a}.\vec{b})^2 = 144$ and $|\vec{a}| = 4$, then $|\vec{b}|$ equals

(1) 10 (2) 8 (3) 3 (4) 12

B-23. If the vector product of a constant vector $\overrightarrow{OA}$ with a variable vector $\overrightarrow{OB}$ in a fixed plane OAB be a constant vector, then locus of B is:

(1) a straight line perpendicular to $\overrightarrow{OA}$
(2) a circle with centre O radius equal to $|\overrightarrow{OA}|$
(3) a straight line parallel to $\overrightarrow{OA}$
(4) a circle with centre O radius equal to $|\overrightarrow{AB}|$

B-24. For a non zero vector $\vec{A}$ if the equations $\vec{A}.\vec{B} = \vec{A}.\vec{C}$ and $\vec{A} \times \vec{B} = \vec{A} \times \vec{C}$ hold simultaneously, then :

(1) $\vec{A}$ is perpendicular to $\vec{B} - \vec{C}$
(2) $\vec{A} = \vec{B}$
(3) $\vec{B} = \vec{C}$
(4) $\vec{C} = \vec{A}$

B-25. If $\vec{a} \times \vec{b} = \vec{c} \times \vec{d}$ and $\vec{a} \times \vec{c} = \vec{b} \times \vec{d}$, then the vectors $\vec{a} - \vec{d}$ and $\vec{b} - \vec{c}$ are:

(1) null vectors
(2) linearly independent
(3) perpendicular
(4) parallel

Section (C) : Straight Line in three dimensional geometry

C-1. Which of the following **doesnot** represent the equation of line passing through the points (2, 1, 3) and (–1, 3, 1).

(1) $\frac{x-2}{3} = \frac{y-1}{-2} = \frac{z-3}{2}$
(2) $\vec{r} = -\hat{i} + 3\hat{j} + \hat{k} + \lambda\left(3\hat{i} - 2\hat{j} + 2\hat{k}\right)$
(3) $\vec{r} = 8\hat{i} - 3\hat{j} + 7\hat{k} + \mu\left(3\hat{i} - 2\hat{j} + 2\hat{k}\right)$
(4) $\frac{x-5}{-3} = \frac{x+3}{2} = \frac{y-5}{-2}$

C-2. Coordinate of a point on the line $\frac{x-2}{1} = \frac{y+1}{2} = \frac{z-3}{-2}$. Which is at a distance of 6 unit from the point (2, –1, 3) is

(1) (–4, –3, 1) (2) (4, 3, 1) (3) (0, –5, 7) (4) (0, 5, –7)

C-3. The point of intersection of lines

L_1 : $(1+\lambda)\hat{i} + (2+2\lambda)\hat{j} + (3+3\lambda)\hat{k}$, $\lambda \in R$

L_2 : $(3+2\mu)\hat{i} + (4+2\mu)\hat{j} + (1-2\mu)\hat{k}$, $\mu \in R$ is

(1) (–1, 2, 3) (2) (1, 2, 3) (3) (–2, 3, 4) (4) (3, 4, –1)

C-4. The angle between lines 2x = 3y = – z and 6x = – y = – 4z is -

(1) 0º (2) 30º (3) 45º (4) 90º

C-5. The angle between the two straight lines $\vec{r} = 3\hat{i} - 2\hat{j} + 4\hat{k} + \lambda(-2\hat{i} + \hat{j} + 2\hat{k})$ and $\vec{r} = \hat{i} + 3\hat{j} - 2\hat{k} + \mu(3\hat{i} - 2\hat{j} + 6\hat{k})$ is

(1) $\cos^{-1}\left(\frac{4}{21}\right)$ (2) $\sin^{-1}\left(\frac{4}{21}\right)$ (3) $\cos^{-1}\left(\frac{5}{21}\right)$ (4) $\sin^{-1}\left(\frac{5}{21}\right)$

C-6. The length of perpendicular from (2, –1, 5) to the line $\frac{x-11}{10} = \frac{y+2}{-4} = \frac{z+8}{-11}$ and the coordinates of the foot are -

(1) $\sqrt{14}$, (1,2,–3) (2) $\sqrt{14}$, (1,–2,3) (3) $\sqrt{14}$, (1,2,3) (4) $2\sqrt{14}$ (1,2,3)

C-7. The foot of the perpendicular from (a, b, c) on the line x = y = z is the point (where 3r = a + b + c)

(1) (r, r, r) (2) (r, – r, r) (3) (–r, – r, r) (4) (r, r, – r)

C-8. Equation of the acute angle bisector of the angle between the lines $\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{1}$ & $\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{-1}$ is :

(1) $\frac{x-1}{2} = \frac{y-2}{2}$; z – 3 = 0 (2) $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$

(3) x – 1 = 0 ; $\frac{y-2}{1} = \frac{z-3}{1}$ (4) $\frac{x-1}{-1} = \frac{y-2}{2} = \frac{z-3}{3}$

C-9. Consider the lines $\frac{x}{2} = \frac{y}{3} = \frac{z}{5}$ and $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ the equation of the line which

(1) bisects the angle between the lines is $\frac{x}{3} = \frac{y}{3} = \frac{z}{8}$

(2) bisects the angle between the lines is $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$

(3) passes through origin and is perpendicular to the given lines is x = y = – z

(4) passes through origin and is parallel to the given lines is x = y = – z

C-10. If the lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$, $\frac{x-1}{3} = \frac{y-2}{-1} = \frac{z-3}{4}$ and $\frac{x+k}{3} = \frac{y-1}{2} = \frac{z-2}{h}$ are concurrent then

(1) h = – 2, k = – 6 (2) h = $\frac{1}{2}$, k = 2 (3) h = 6, k = 2 (4) h = 2, k = $\frac{1}{2}$

C-11. The shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$ is

(1) 0 (2) $\frac{1}{\sqrt{6}}$ (3) 4 (4) 12

C-12. The straight lines $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$ and $\frac{x-1}{2} = \frac{y-2}{2} = \frac{z-3}{-2}$ are

(1) parallel lines (2) intersecting at 60º

(3) skew lines (4) intersecting at right angle

Section (D) : Scalar Triple Product, Tetrahedron, Vector Triple Product, Vector Equations, Linear Independent and Linear dependent vectors

D-1. $|(\vec{a}\times\vec{b}).\vec{c}| = |\vec{a}||\vec{b}||\vec{c}|$, if
(1) $\vec{a}.\vec{b} = \vec{b}.\vec{c} = 0$ (2) $\vec{b}.\vec{c} = \vec{c}.\vec{a} = 0$ (3) $\vec{c}.\vec{a} = \vec{a}.\vec{b} = 0$ (4) $\vec{a}.\vec{b} = \vec{b}.\vec{c} = \vec{c}.\vec{a} = 0$

D-2. Given unit vectors $\hat{m}$, $\hat{n}$ and $\hat{p}$ such that $\left(\hat{m}\,\hat{\ }\,\hat{n}\right) = \hat{p}\ \hat{\ }(\hat{m} \times \hat{n}) = \alpha$, then the value of $\left[\hat{n}\ \ \hat{p}\ \ \hat{m}\right]$ in terms of α. is
(1) sin α (2) cos α (3) sin α cos α (4) $\sin_2 \alpha$

D-3. $\hat{i}.(\hat{j}\times\hat{k}) + \hat{j}.(\hat{i}\times\hat{k}) + \hat{k}.(\hat{i}\times\hat{j})$ is equal to
(1) 1 (2) 7 (3) 5 (4) 2

D-4. The value of $\left[\left(\vec{a}+2\vec{b}-\vec{c}\right)\left(\vec{a}-\vec{b}\right)\left(\vec{a}-\vec{b}-\vec{c}\right)\right]$ is equal to
(1) $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ (2) $2\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ (3) $3\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ (4) $4\left[\vec{a}\ \vec{b}\ \vec{c}\right]$

D-5. Let $\vec{r}$ be a vector perpendicular to $\vec{a} + \vec{b} + \vec{c}$, where $[\vec{a}\ \vec{b}\ \vec{c}] = 2$.
If $\vec{r} = \ell(\vec{b}\times\vec{c}) + m(\vec{c}\times\vec{a}) + n(\vec{a}\times\vec{b})$, then $(\ell + m + n)$ is equal to
(1) 2 (2) 1 (3) 0 (4) –1

D-6. Given $\vec{a} = x\hat{i} + y\hat{j} + 2\hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, $\vec{c} = \hat{i} + 2\hat{j}$; $(\vec{a}\ \hat{\ }\ \vec{b}) = \frac{\pi}{2}$, $\vec{a}.\vec{c} = 4$, then
(1) $[\vec{a}\ \ \vec{b}\ \ \vec{c}]^2 = |\vec{a}|$ (2) $[\vec{a}\ \ \vec{b}\ \ \vec{c}] = |\vec{a}|$ (3) $[\vec{a}\ \ \vec{b}\ \ \vec{c}] = 0$ (4) $[\vec{a}\ \ \vec{b}\ \ \vec{c}] = |\vec{a}|^2$

D-7. The volume of the parallelopiped constructed on the diagonals of the faces of the given rectangular parallelopiped is m times the volume of the given parallelopiped. Then m is equal to:
(1) 2 (2) 3 (3) 4 (4) 8

D-8. Let $\vec{a} = x\hat{i} + 12\hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} + 2x\hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{k}$. If the ordered set is left handed, then :
(1) x ∈ (2, ∞) (2) x ∈ (− ∞, − 3) (3) x ∈ (− 3, 2) (4) x ∈ {− 3, 2}

D-9. Vector of length 3 unit which is perpendicular to $\hat{i} + \hat{j} + \hat{k}$ and lies in the plane of $\hat{i} + \hat{j} + \hat{k}$ and $2\hat{i} - 3\hat{j}$, is
(1) $\frac{3}{\sqrt{6}}(\hat{i} - 2\hat{j} + \hat{k})$ (2) $\frac{3}{\sqrt{6}}(2\hat{i} - \hat{j} - \hat{k})$ (3) $\frac{3}{\sqrt{114}}(8\hat{i} - 7\hat{j} - \hat{k})$ (4) $\frac{3}{\sqrt{114}}(-7\hat{i} + 8\hat{j} - \hat{k})$

D-10. If $\vec{a} = \hat{i} - 2\hat{j} - 2\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + 3\hat{j} - \hat{k}$ then $\vec{a} \times (\vec{b} \times \vec{c})$ is equal to
(1) $-8\hat{i} - 3\hat{j} - \hat{k}$ (2) $20\hat{i} - 3\hat{j} - 7\hat{k}$ (3) $20\hat{i} + 3\hat{j} - 7\hat{k}$ (4) $8\hat{i} - 3\hat{j} + \hat{k}$

D-11. $(\vec{d} + \vec{a}).\left(\vec{a}\times(\vec{b}\times(\vec{c}\times\vec{d}))\right)$ simplifies to :

(1) $(\vec{b}.\vec{d})\ [\vec{a}\ \vec{c}\ \vec{d}]$ (2) $(\vec{b}.\vec{c})\ [\vec{a}\ \vec{b}\ \vec{d}]$ (3) $(\vec{b}\ .\ \vec{a})\ [\vec{a}\ \vec{b}\ \vec{d}]$ (4) $(\vec{b}.\vec{c})\ [\vec{a}\ \vec{c}\ \vec{d}]$

D-12. If $\vec{a}\times[\vec{a}\times(\vec{a}\times\vec{b})] = \lambda(\vec{a}\times\vec{b})\ (\vec{a}^2)$ then λ =

(1) 1 (2) –1 (3) 0 (4) 2

D-13. If $\vec{a}=\vec{b}+\vec{c}$, $\vec{b}\times\vec{d}=\vec{0}$ and $\vec{c}.\vec{d}$ = 0, then $\dfrac{\vec{d}\times(\vec{a}\times\vec{d})}{\vec{d}^2}$ is equal to

(1) $\vec{a}$ (2) $\vec{b}$ (3) $\vec{c}$ (4) $\vec{d}$

D-14. Vector $\vec{x}$ satisfying the relation $\vec{A}\ .\ \vec{x}=c$ and $\vec{A}\times\vec{x}=\vec{B}$ is

(1) $\dfrac{c\vec{A}-(\vec{A}\times\vec{B})}{|\vec{A}|}$ (2) $\dfrac{c\vec{A}-(\vec{A}\times\vec{B})}{|\vec{A}|^2}$ (3) $\dfrac{c\vec{A}+(\vec{A}\times\vec{B})}{|\vec{A}|^2}$ (4) $\dfrac{c\vec{A}-2(\vec{A}\times\vec{B})}{|\vec{A}|^2}$

D-15. $\vec{a}=\hat{i}-\hat{j}$; $\vec{b}=\hat{j}-\hat{k}$, $\vec{c}=\hat{k}-\hat{i}$. If $\vec{d}$ is a unit vector such that $\vec{a}.\vec{d}$ = 0 = $[\vec{b}\ \vec{c}\ \vec{d}]$ then $\vec{d}$ equals to

(1) ± $\dfrac{\hat{i}+\hat{j}+2\hat{k}}{\sqrt{6}}$ (2) ± $\dfrac{\hat{i}+\hat{j}-2\hat{k}}{\sqrt{3}}$ (3) ± $\dfrac{\hat{i}-\hat{j}-\hat{k}}{\sqrt{2}}$ (4) ± $\dfrac{\hat{i}+\hat{j}-2\hat{k}}{\sqrt{6}}$

D-16. The vectors $\vec{a}, \vec{b}, \vec{c}$ are of the same length and pairwise form equal angles. If $\vec{a}=\hat{i}+\hat{j}$ and $\vec{b}=\hat{j}+\hat{k}$ then vector may be :

(1) $\hat{i}+\hat{k}$ (2) $\hat{i}-\hat{k}$ (3) $\dfrac{\hat{i}-4\hat{j}-\hat{k}}{3}$ (4) $\dfrac{\hat{i}+4\hat{j}-\hat{k}}{3}$

Section (E) : Plane

E-1. The plane XOZ divides the join of (1, –1, 5) and (2, 3, 4) in the ratio λ : 1 then λ is

(1) 7 (2) 0 (3) $\dfrac{1}{3}$ (4) – $\dfrac{13}{2}$

E-2. Algebraic sum of intercepts made by the plane x + 3y – 4z+ 6 = 0 on the axes is

(1) 7 (2) 0 (3) $\dfrac{13}{2}$ (4) – $\dfrac{13}{2}$

E-3. If the plane x – 3y + 5z = d, passes through the point (1, 2, 4), then the intercept on x, y, z axes are

(1) 15, –5, 3 (2) 1, –5, 3 (3) –15, 5, –3 (4) 1, –6, 20

E-4. The equation of a plane which passes through (2, − 3, 1) & is normal to the line joining the points (3, 4, − 1) & (2, − 1, 5) is given by:

(1) x + 5y − 6z + 19 = 0 (2) x − 5y + 6z − 19 = 0
(3) x + 5y + 6z + 19 = 0 (4) x − 5y − 6z − 19 = 0

E-5. Angle between planes 2x – y + z = 6 and x + y + 2z = 7, is-

(1) $\dfrac{\pi}{4}$ (2) $\dfrac{\pi}{2}$ (3) $\dfrac{\pi}{3}$ (4) $\dfrac{\pi}{6}$

E-6. Cosine of the angle between the two planes 3x – 4y + 5z = 0 and 2x – y – 2z = 5 is

(1) $\frac{1}{2}$ (2) 0 (3) $\frac{1}{3}$ (4) $-\frac{1}{2}$

E-7. A plane is passing through (1, 2, 3) and is parallel to the plane $2x + 3y - 4z = 0$,then the equation of the plane is
(1) $2x + 3y + 4z = 4$ (2) $2x + 3y + 4z + 4 = 0$
(3) $2x - 3y + 4z + 4 = 0$ (4) $2x + 3y - 4z + 4 = 0$

E-8. The equation of the plane which passes through the points (2, 3, – 4) and (1, –1, 3) and parallel to x-axis is -
(1) $7y - 4z - 5 = 0$ (2) $4y - 7z - 5 = 0$ (3) $4y + 7z + 5 = 0$ (4) $7y + 4z - 5 = 0$

E-9. The equation of the plane passing through the point (1, − 3, − 2) and perpendicular to planes $x + 2y + 2z = 5$ and $3x + 3y + 2z = 8$, is
(1) $2x - 4y + 3z - 8 = 0$ (2) $2x - 4y - 3z + 8 = 0$
(3) $2x + 4y + 3z + 8 = 0$ (4) $3x - 4y - 3z + 8 = 0$

E-10. The locus represented by $xy + yz = 0$ is
(1) a pair of perpendicular lines (2) a pair of parallel lines
(3) a pair of parallel planes (4) a pair of perpendicular planes

E-11. A variable plane passes through a fixed point (1, 2, 3). The locus of the foot of the perpendicular drawn from origin to this plane is:
(1) $x^2 + y^2 + z^2 - x - 2y - 3z = 0$ (2) $x^2 + 2y^2 + 3z^2 - x - 2y - 3z = 0$
(3) $x^2 + 4y^2 + 9z^2 + x + 2y + 3 = 0$ (4) $x^2 + y^2 + z^2 + x + 2y + 3z = 0$

E-12. The distance between the parallel planes $\vec{r}\cdot(2\hat{i} - 3\hat{j} + 6\hat{k}) = 5$ and $\vec{r}\cdot(6\hat{i} - 9\hat{j} + 18\hat{k}) + 20 = 0$ is
(1) $\frac{5}{6}$ unit (2) 2 unit (3) $\frac{5}{3}$ unit (4) 3 unit

E-13. The reflection of the point (2, –1, 3) in the plane $3x - 2y - z = 9$ is :
(1) $\left(\frac{26}{7}, \frac{15}{7}, \frac{17}{7}\right)$ (2) $\left(\frac{26}{7}, \frac{-15}{7}, \frac{17}{7}\right)$ (3) $\left(\frac{15}{7}, \frac{26}{7}, \frac{-17}{7}\right)$ (4) $\left(\frac{26}{7}, \frac{17}{7}, \frac{-15}{7}\right)$

E-14. The volume of tetrahedron included between the plane $2x - 3y + 4z - 12 = 0$ and three co-ordinate planes is
(1) 0 (2) $\frac{1}{\sqrt{6}}$ (3) 4 (4) 12

E-15. Which of the following planes intersects the planes $x - y + 2z = 3$ and $4x + 3y - z = 1$ along the same line?
(1) $11x + 10y - 5z = 0$ (2) $7x + 7y - 4z = 0$
(3) $5x + 2y + z = 2$ (4) $7x - 7y - 4z = 0$

E-16. Equation of plane which passes through the point of intersection of lines $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-3}{2}$ and $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-3}{2}$ and at greatest distance from the point (0, 0, 0) is:
(1) $4x + 3y + 5z = 25$ (2) $4x + 3y + 5z = 50$ (3) $3x + 4y + 5z = 49$ (4) $x + 7y - 5z = 2$

E-17. The coordinates of the point where the line joining the points (2, –3 , 1), (3, – 4,– 5) cuts the plane 2x + y + z = 7, are

(1) (2, 1, 0) (2) (3, 2, 5) (3) (1,–2, 7) (4) (1, 2, 7)

E-18. The distance of the intersection point of the line $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$ and plane x – y + z = 5 from the point (–1,– 5, – 10), is

(1) 13 (2) 9 (3) 5 (4) 12

E-19. The distance of the point (1, -2, 3) from the plane $x - y + z = 5$ measured parallel to the line, $\frac{x}{2} = \frac{y}{3} = \frac{z}{-6}$, is:

(1) 1 (2) $\frac{6}{7}$ (3) $\frac{7}{6}$ (4) 2

E-20. The distance of the point P(3, 8, 2) from the line $\frac{x-1}{2} = \frac{y-3}{4} = \frac{z-2}{3}$ measured parallel to the plane 3x + 2y – 2z + 17 = 0 is

(1) 7 (2) 0 (3) $\frac{1}{3}$ (4) $-\frac{13}{2}$

E-21. The equation of image of the line $\frac{x-1}{9} = \frac{y-2}{-1} = \frac{z+3}{-3}$ in the plane 3x – 3y + 10z = 26 is

(1) $\frac{x-4}{9} = \frac{y+1}{-1} = \frac{z-7}{3}$ (2) $\frac{x-4}{9} = \frac{y+1}{-1} = \frac{z-7}{-3}$

(3) $\frac{x+4}{9} = \frac{y+1}{-1} = \frac{z-7}{-3}$ (4) $\frac{x-4}{9} = \frac{y-1}{1} = \frac{z-7}{-3}$

E-22. The equation of the line x + y + z – 1 = 0, 4x + y – 2z + 2 = 0 written in the symmetrical form is

(1) $\frac{x+1}{1} = \frac{y-2}{-2} = \frac{z-0}{1}$ (2) $\frac{x}{1} = \frac{y}{-2} = \frac{z-1}{1}$

(3) $\frac{x+1/2}{1} = \frac{y-1}{-2} = \frac{z-1/2}{1}$ (4) All of these

Exercise-2

Marked questions may have for revision questions.

PART - I : OBJECTIVE QUESTIONS

1. A vector $\vec{a}$ has components 2p and 1 with respect to a rectangular cartesian system. The system is rotated through a certain angle about the origin in the counterclockwise sense. If with respect to the new system $\vec{a}$, has components $p+1$ and 1, then

(1) p=0 (2) p=1 or p = $-\frac{1}{3}$ (3) p = -1 or p = $\frac{1}{3}$ (4) p = 1 or p = -1

2. Let $\vec{p}$ is the position vector of the orthocentre and $\vec{g}$ is the position vector of the centroid of the triangle ABC, where circumcentre is the origin. If $\vec{p}$ = K$\vec{g}$, then K is equal to :

(1) 2 (2) 3 (3) 6 (4) 5

Vector

3. If the vectors $\vec{a} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = -\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{c} = 4\hat{i} - 2\hat{j} - 6\hat{k}$ constitute the sides of a ΔABC. If length of the median bisecting the vector is λ, then λ^2

(1) 2 (2) 3 (3) 6 (4) 5

4. Four coplanar forces are applied at a point O. Each of them is equal to k and the angle between two consecutive forces equals 45º. Then the resultant has the magnitude equal to :

(1) $k\sqrt{2+2\sqrt{2}}$ (2) $k\sqrt{3+2\sqrt{2}}$ (3) $k\sqrt{4+2\sqrt{2}}$ (4) $k\sqrt{5+2\sqrt{2}}$

5. A point moves so that the sum of the squares of its distances from the six faces of a cube given by x = ± 1, y = ± 1, z = ± 1 is 10 units. The locus of the point is

(1) $x^2 + y^2 + z^2 = 1$ (2) $x^2 + y^2 + z^2 = 2$ (3) $x + y + z = 1$ (4) $x + y + z = 2$

6. The angle between the lines whose direction cosines are given by $\ell + m + n = 0$ and $\ell^2 + m^2 = n^2$ is

(1) 30º (2) 45º (3) 60º (4) 90º

7. The cosine of the angle between any two diagonals of a cube is -

(1) $\frac{1}{2}$ (2) $\frac{1}{3}$ (3) $\frac{1}{4}$ (4) $\frac{1}{5}$

8. If the unit vectors $\vec{e}_1$ and $\vec{e}_2$ are inclined at an angle 2θ and $|\vec{e}_1 - \vec{e}_2| < 1$, then for θ ∈ [0, π], θ may lie in the interval :

(1) $\left[0, \frac{\pi}{6}\right)$ (2) $\left[\frac{\pi}{6}, \frac{\pi}{2}\right]$ (3) $\left(\frac{5\pi}{6}, \pi\right]$ (4) $\left[\frac{\pi}{2}, \frac{5\pi}{6}\right]$

9. If $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, $\vec{c} = 3\hat{i} + \hat{j}$ and $\vec{a} + P\vec{b}$ is normal to $\vec{c}$, then P is equal

(1) 1 (2) 7 (3) 5 (4) 2

10. Let $\vec{u}, \vec{v}$ and $\vec{w}$ are vector such that $\vec{u} + \vec{v} + \vec{w} = \vec{0}$. If $|\vec{u}| = 3$, $|\vec{v}| = 4$, $|\vec{w}| = 5$ then $\sqrt{|\vec{u}.\vec{v} + \vec{v}.\vec{w} + \vec{w}.\vec{u}|}$ is

(1) 2 (2) 3 (3) 6 (4) 5

11. Given two vectors $\vec{a} = 2\hat{i} - 3\hat{j} + 6\hat{k}$, $\vec{b} = -2\hat{i} + 2\hat{j} - \hat{k}$ and $\lambda = \frac{\text{the projection of } \vec{a} \text{ on } \vec{b}}{\text{the projection of } \vec{b} \text{ on } \vec{a}}$, then the value of 3λ is

(1) 1 (2) 7 (3) 5 (4) 2

12. $(\vec{r}.\hat{i})(\hat{i}\times\vec{r}) + (\vec{r}.\hat{j})(\hat{j}\times\vec{r}) + (\vec{r}.\hat{k})(\hat{k}\times\vec{r})$ is equal to

(1) $\vec{0}$ (2) $\vec{r}$ (3) $2\vec{r}$ (4) $3\vec{r}$

13. Let $\vec{a}, \vec{b}, \vec{c}$ be three non zero vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ then $\lambda(\vec{b} \times \vec{a}) + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \vec{0}$, where λ is equal to

(1) 1 (2) 7 (3) 5 (4) 2

14. If a line has a vector equation $\vec{r} = 2\hat{i} + 6\hat{j} + \lambda(\hat{i} - 3\hat{j})$, then which of the following statements does not hold good?

(1) the line is parallel to $2\hat{i} + 6\hat{j}$ (2) the line passes through the point $3\hat{i} + 3\hat{j}$

(3) the line passes through the point $\hat{i} + 9\hat{j}$ (4) the line is parallel to XY-plane

15. A line passes through a point A with position vector $3\hat{i} + \hat{j} - \hat{k}$ and is parallel to the vector $2\hat{i} - \hat{j} + 2\hat{k}$ If P is a point on this line such that AP = 15 units,then the position vector of the point P is/are

(1) $13\hat{i} + 4\hat{j} - 9\hat{k}$ (2) $13\hat{i} + 4\hat{j} + 9\hat{k}$ (3) $7\hat{i} - 6\hat{j} + 11\hat{k}$ (4) $-7\hat{i} + 6\hat{j} - 11\hat{k}$

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

(1) $-\hat{i} + \hat{j} + 2\hat{k}$ (2) $3\hat{i} - \hat{j} + \hat{k}$ (3) $3\hat{i} + \hat{j} - \hat{k}$ (4) $\hat{i} - \hat{j} - \hat{k}$

17. The perpendicular distance of an angular point of a cube from diagonal which does not pass that angular point is (where a is length of side of cube).

(1) $\sqrt{2}\,a$ (2) $\frac{1}{\sqrt{2}}a$ (3) $\frac{\sqrt{3}}{2}a$ (4) $\sqrt{\frac{2}{3}}a$

18. If $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \mu(\hat{i} + \hat{j} - \hat{k})$ are two lines, then the equation of acute angle bisector of two lines is

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

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

19. Let $\vec{a}, \vec{b}, \vec{c}$ be three unit vectors and $\vec{a}\cdot\vec{b} = \vec{a}\cdot\vec{c} = 0$. If the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$, then the value of $\left|[\vec{a}\,\vec{b}\,\vec{c}]\right|$ is

(1) 1 (2) 2 (3) $\sqrt{3}$ (4) $\frac{\sqrt{3}}{2}$

20. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be non-coplanar unit vectors equally inclined to one another at an acute angle θ. Then $\left|[\vec{a}\ \vec{b}\ \vec{c}]\right|$ in terms of θ is equal to:

(1) $(1 + \cos\theta)\sqrt{\cos 2\theta}$ (2) $(1 + \cos\theta)\sqrt{1 - 2\cos 2\theta}$

(3) $(1 - \cos\theta)\sqrt{1 + 2\cos\theta}$ (4) $(1 - \cos\theta)\sqrt{1 - 2\cos 2\theta}$

21. Given the vertices A (2, 3, 1), B (4, 1, −2), C (6, 3, 7) & D (−5, −4, 8) of a tetrahedron. The length of the altitude drawn from the vertex D is:

(1) 7 (2) 9 (3) 11 (4) 22

22. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vector in the plane of $\vec{b}$ and $\vec{c}$ whose projection on $\vec{a}$ is of magnitude $\sqrt{\frac{2}{3}}$, is

(1) $2\hat{i}+3\hat{j}-3\hat{k}$ (2) $-2\hat{i}-\hat{j}+5\hat{k}$ (3) $2\hat{i}+3\hat{j}+3\hat{k}$ (4) $2\hat{i}+\hat{j}+5\hat{k}$

23. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar vectors and $\vec{v}.\vec{a} = \vec{v}.\vec{b} = \vec{v}.\vec{c} = 0$, then $\vec{v}$ must be a

(1) unit vector (2) null vector (3) $2\hat{i}$ (4) $2\hat{j}$

24. Points X and Y are taken on the sides QR and RS, respectively of a parallelogram PQRS, so that QX = 4XR and RY = 4YS. The line XY cuts the line PR at Z. Find the ratio PZ : ZR.

(1) 4 : 21 (2) 3 : 4 (3) 21 : 4 (4) 4 : 3

25. If $\vec{a} = \hat{i}+\hat{j}+\hat{k}$, $\vec{b} = \hat{i}-\hat{j}+\hat{k}$, $\vec{c} = \hat{i}+2\hat{j}-\hat{k}$, then the value of $\begin{vmatrix} \vec{a}.\vec{a} & \vec{a}.\vec{b} & \vec{a}.\vec{c} \\ \vec{b}.\vec{a} & \vec{b}.\vec{b} & \vec{b}.\vec{c} \\ \vec{c}.\vec{a} & \vec{c}.\vec{b} & \vec{c}.\vec{c} \end{vmatrix}$ is equal to :

(1) 2 (2) 4 (3) 16 (4) 64

26. If $\vec{b}$ and $\vec{c}$ are two non-collinear vectors such that $\vec{a} \parallel (\vec{b}\times\vec{c})$, then $(\vec{a}\times\vec{b}).(\vec{a}\times\vec{c})$ is equal to

(1) $\vec{a}^2 (\vec{b}.\vec{c})$ (2) $\vec{b}^2 (\vec{a}.\vec{c})$ (3) $\vec{c}^2 (\vec{a}.\vec{b})$ (4) $\vec{a}^2$

27. The foot of the perpendicular drawn from the origin to the plane is (4, –2, –5), then the vector equation of plane is

(1) $\vec{r}.(4\hat{i}-2\hat{j}-5\hat{k})=35$ (2) $\vec{r}.(4\hat{i}-2\hat{j}-5\hat{k})=45$

(3) $\vec{r}.(4\hat{i}-2\hat{j}-5\hat{k})=55$ (4) $\vec{r}.(4\hat{i}-2\hat{j}-5\hat{k})=46$

28. The plane passing through the points (1, 1, 1), (1, –7, 1) and (–7, –3, –5) is perpendicular to

(1) xy-plane (2) yz-plane (3) xz-plane (4) x+y+z = 5

29. The direction ratios of normal to the plane through (1, 0, 0), (0,1, 0) if plane makes an angle of π/4 with the plane x + y = 3 are :

(1) (1, $\sqrt{2}$,1) (2) (1, 1, $\sqrt{2}$) (3) (1, 1, 2) (4) ($\sqrt{2}$, 1, 1)

30. The angle between the plane 2x – y + z = 6 and a plane perpendicular to the planes x + y + 2z = 7 and x – y = 3 is :

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{2}$

31. If $\vec{a}$ and $\vec{b}$ lie in a plane normal to the plane containing the vectors $\vec{c}$ and $\vec{d}$, then $(\vec{a}\times\vec{b}).(\vec{c}\times\vec{d})$ is equal to

(1) 0 (2) $|\vec{a}||\vec{b}||\vec{c}||\vec{d}|$ (3) $|\vec{a}||\vec{c}|$ (4) $|\vec{b}||\vec{d}|$

32. Two systems of rectangular axes have the same origin. If a plane cuts them at distances a, b, c and a_1, b_1, c_1 from the origin, then

(1) $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2} = \frac{1}{a_1^2}+\frac{1}{b_1^2}+\frac{1}{c_1^2}$ (2) $\frac{1}{a^2}-\frac{1}{b^2}+\frac{1}{c^2} = \frac{1}{a_1^2}-\frac{1}{b_1^2}+\frac{1}{c_1^2}$

(3) $a_2 + b_2 + c_2 = a_1^2+b_1^2+c_1^2$ (4) $a_2 - b_2 + c_2 = a_1^2-b_1^2+c_1^2$

33. If the volume of tetrahedron formed by planes whose equations are y + z = 0, z + x = 0, x + y = 0 and x + y + z = 1 is t cubic unit, then the value of 729 t is equal to
(1) 486 (2) 672 (3) 588 (4) 729

34. The non zero value of 'a' for which the lines 2x – y + 3z + 4 = 0 = ax + y – z + 2 and x – 3y + z = 0 = x + 2y + z + 1 are co-planar is :
(1) – 2 (2) 4 (3) 6 (4) 0

35. If line $\vec{r} = (\hat{i} - 2\hat{j} - \hat{k}) + \lambda(2\hat{i} + \hat{j} + 2\hat{k})$ is parallel to the plane $\vec{r} \cdot (3\hat{i} - 2\hat{j} - m\hat{k}) = 14$, then the value of m is
(1) 2 (2) – 2
(3) 0 (4) can not be predicted with these informations

36. The acute angle that the vector $2\hat{i} - 2\hat{j} + \hat{k}$ makes with the plane contained by the two vectors $2\hat{i} + 3\hat{j} - \hat{k}$ and $\hat{i} - \hat{j} + 2\hat{k}$ is given by:
(1) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (2) $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ (3) $\tan^{-1}\left(\sqrt{2}\right)$ (4) $\cot^{-1}\left(\sqrt{2}\right)$

37. Equation of the plane passing through $A(x_1, y_1, z_1)$ and containing the line $\frac{x-x_2}{d_1} = \frac{y-y_2}{d_2} = \frac{z-z_2}{d_3}$ is

(1) $\begin{vmatrix} x & y & z \\ x_1-x_2 & y_1-y_2 & z_1-z_2 \\ d_1 & d_2 & d_3 \end{vmatrix} = 0$ (2) $\begin{vmatrix} x-x_2 & y-y_2 & z-z_2 \\ x_1-x_2 & y_1-y_2 & z_1-z_2 \\ d_1 & d_2 & d_3 \end{vmatrix} = 0$

(3) $\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \end{vmatrix} = 0$ (4) $\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \end{vmatrix} = 0$

38. The equation of the plane containing parallel lines $(x - 4) = \frac{3-y}{4} = \frac{z-2}{5}$ and $(x - 3) = \lambda(y + 2) = \mu z$ is
(1) 11x + y − 3z = 35 (2) 11x − y − 3z = 35
(3) 11x − y − 3z = 40 (4) 11x + y + 3z = 35

39. The equations of the plane through the origin which is parallel to the line $\frac{x-1}{2} = \frac{y+3}{-1} = \frac{z+1}{-2}$ and distant $\frac{5}{3}$ from it is
(1) 2x + 2y + z = 0 (2) x + 2y + 2z = 0 (3) 2x – 2y + z = 0 (4) x – 2y – 2z = 0

40. The lines $\frac{x+4}{3} = \frac{y+6}{5} = \frac{z-1}{-2}$ and 3x – 2y + z + 5 = 0 = 2x + 3y + 4z – k are coplanar, then k is -
(1) 1 (2) 2 (3) 3 (4) 4

PART - II : MISCELLANEOUS QUESTIONS

Section (A) : ASSERTION/REASONING

Vector

DIRECTIONS :

Each question has 4 choices (1), (2), (3) and (4) out of which ONLY ONE is correct.
(1) Both the statements are true.
(2) Statement-I is true, but Statement-II is false.
(3) Statement-I is false, but Statement-II is true.
(4) Both the statements are false.

A-1. **Statement-1** : If I is incentre of Δ ABC then $|\vec{BC}|\,\vec{IA} + |\vec{CA}|\,\vec{IB} + |\vec{AB}|\,\vec{IC} = \vec{0}$

Statement-2 : In a triangle, if position vector of vertices are , then position vector of incentre is $\dfrac{\vec{a}+\vec{b}+\vec{c}}{3}$

A-2. **Statement 1 :** If α,β,γ are the angles which a half ray makes with the positive directions of the axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$.
Statement 2 : If ℓ,m,n are the direction cosines of a line then $\ell^2 + m^2 + n^2 = 1$.

A-3. **Statement 1 :** The locus represented by xy + yz = 0 is a pair of perpendicular planes.
Statement 2 : If $a_1x + b_1y + c_1z + d_1 = 0$ and $a_2x + b_2y + c_2z + d_2 = 0$ are perpendicular then $a_1a_2 + b_1b_2 + c_1c_2 = 1$.

A-4. **Statement 1 :** Let $\vec{a},\vec{b},\vec{c}$ be unit vectors such that $\vec{a}+5\vec{b}+3\vec{c}=0$, then $\vec{a}.(\vec{b}\times\vec{c}) = \vec{b}.(\vec{a}+\vec{c})$.
Statement 2 : Scalar triple product of three coplanar vectors is 0.

A-5. **Statement 1 :** The shortest distance between the skew lines $\dfrac{x+3}{-4} = \dfrac{y-6}{3} = \dfrac{z}{2}$ and $\dfrac{x+2}{-4} = \dfrac{y}{1} = \dfrac{z-7}{1}$ is 9
Statement 2 : Two lines are skew lines if there exists no plane passing through them.

Section (B) : MATCH THE COLUMN

B-1. Match the following set of lines to the corresponding type :

	Column-I				Column-II
(A)	$\dfrac{x-1}{1} = \dfrac{y-2}{2} = \dfrac{z-3}{3}$	&	$\dfrac{x-1}{2} = \dfrac{y-2}{2} = \dfrac{z-3}{-2}$	(p)	parallel but not coincident
(B)	$\dfrac{x-1}{1} = \dfrac{y-2}{2} = \dfrac{z-3}{3}$	&	$\dfrac{x-5}{1} = \dfrac{y-2}{2} = \dfrac{z-3}{3}$	(q)	intersecting
(C)	$\dfrac{x-1}{2} = \dfrac{y-2}{2} = \dfrac{z-3}{-2}$	&	$\dfrac{x-3}{-1} = \dfrac{y-4}{-1} = \dfrac{z-1}{1}$	(r)	skew lines
(D)	$\dfrac{x-1}{2} = \dfrac{y-2}{2} = \dfrac{z-3}{3}$	&	$\dfrac{x}{2} = \dfrac{y+1}{3} = \dfrac{z}{1}$	(s)	Coincident

B-2. **Column-I** **Column-II**

(A)	Volume of parallelopiped determined by vectors $\vec{a},\vec{b}$ and $\vec{c}$ is 2. Then the volume of the parallelepiped determined by vectors $2(\vec{a}\times\vec{b}), 3(\vec{b}\times\vec{c})$ and $(\vec{c}\times\vec{a})$ is	(p)	100
(B)	Volume of parallelepiped determined by vectors $\vec{a},\vec{b}$ and $\vec{c}$ is 5. Then the volume of the parallelepiped determined by vectors $3(\vec{a}+\vec{b}), (\vec{b}+\vec{c})$ and $2(\vec{c}+\vec{a})$ is	(q)	30
(C)	Area of a triangle with adjacent sides determined by vectors $\vec{a}$ and $\vec{b}$ is 20.Then the area of the triangle with adjacent sides determined by vectors $\left(2\vec{a}+3\vec{b}\right)$ and $(\vec{a}-\vec{b})$ is	(r)	24
(D)	Area of a paralelogram with adjacent sides determined by vectors $\vec{a}$ and $\vec{b}$ is 30. Then the area of the parallelogram with adjacent sides determined by vectors $(\vec{a}+\vec{b})$ and $\vec{a}$ is	(s)	60

B-3.

	Column – I		**Column – II**
(A)	Let $\vec{a}$ & $\vec{b}$ be two non-zero perpendicular vectors. If a vector $\vec{x}$ satisfying the equation $\vec{x}\times\vec{b}=\vec{a}$ is $\vec{x}=\beta\vec{a}-\frac{1}{\lvert\vec{b}\rvert^2}.\vec{a}\times\vec{b}$ then β can be	(p)	2
(B)	If $\vec{x}$ satisfying the conditions $\vec{b}.\vec{x}=\beta$ & $\vec{b}\times\vec{x}=\vec{a}$ is $\vec{x}=\frac{\left(\beta^2-12\right)\vec{b}}{\lvert\vec{b}\rvert^2}+\frac{\vec{a}\times\vec{b}}{\lvert\vec{b}\rvert^2}$ then $\frac{\beta}{2}$ can be	(q)	0
(C)	The points (0, –1, –1), (4, 5, 1), (3, 9, 4) and (–4, 4, k) are coplanar, then k =	(r)	8
(D)	In ΔABC the mid points of the sides AB, BC and CA are respectively (ℓ, 0, 0) (0, m ,0) and (0, 0, n). Then $\frac{AB^2+BC^2+CA^2}{\ell^2+m^2+n^2}$ is equal to	(s)	4

B-4. Consider the lines $L_1 : \frac{x-1}{2}=\frac{y}{-1}=\frac{z+3}{1}$, $L_2 : \frac{x-4}{1}=\frac{y+3}{1}=\frac{z+3}{2}$ and the planes $P_1 : 7x + y + 2z = 3$, $P_2 : 3x + 5y - 6z = 4$. Let ax + by + cz = d the equation of the plane passing through the point of intersection of lines L_1 and L_2, and perpendicular to planes P_1 and P_2.

	Column-I		**Column-II**
(A)	a	(p)	13
(B)	b	(q)	–3
(C)	c	(r)	1
(D)	d	(s)	–2

Section (C) : ONE OR MORE THAN ONE OPTIONS CORRECT

C-1. In ΔOBC, O is origin and position vector of B and C are $\hat{i}+\hat{j}$ and $\hat{i}-\hat{j}$ respectively D and E divides OC and BC in 2 : 1 and 1 : 2 respectively. Also, OE and BD intersect at P, then

(1) P divides BD in 3 : 4
(2) P divides BD in 4 : 3
(3) P divides OE in 1 : 6
(4) P divides OE in 6 : 1

C-2 A vector $\vec{r}$ is inclined at equal angles to OX, OY and OZ. If the magnitude of $\vec{r}$ is 6 units, then $\vec{r}$ is equal to

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

C-3. The direction cosines of the lines bisecting the angle between the lines whose direction cosines are ℓ_1, m_1, n_1 and ℓ_2, m_2, n_2 and the angle between these lines is θ, are

(1) $\dfrac{\ell_1+\ell_2}{\cos\frac{\theta}{2}}, \dfrac{m_1+m_2}{\cos\frac{\theta}{2}}, \dfrac{n_1+n_2}{\cos\frac{\theta}{2}}$
(2) $\dfrac{\ell_1+\ell_2}{2\cos\frac{\theta}{2}}, \dfrac{m_1+m_2}{2\cos\frac{\theta}{2}}, \dfrac{n_1+n_2}{2\cos\frac{\theta}{2}}$
(3) $\dfrac{\ell_1+\ell_2}{\sin\frac{\theta}{2}}, \dfrac{m_1+m_2}{\sin\frac{\theta}{2}}, \dfrac{n_1+n_2}{\sin\frac{\theta}{2}}$
(4) $\dfrac{\ell_1-\ell_2}{2\sin\frac{\theta}{2}}, \dfrac{m_1-m_2}{2\sin\frac{\theta}{2}}, \dfrac{n_1-n_2}{2\sin\frac{\theta}{2}}$

C-4. If $\left(\vec{a}\cdot\vec{b}-\dfrac{\sqrt{3}}{2}\right)\vec{b} = \dfrac{\vec{a}}{2} - (\vec{b}\cdot\vec{c})\,\vec{a}$ and $\vec{a}, \vec{b}, \vec{c}$ are unit vector $\vec{a}$ and $\vec{b}$ are non-collinear then

(1) $\vec{a} \wedge \vec{b} = \dfrac{\pi}{6}$
(2) $\vec{b} \wedge \vec{c} = \dfrac{\pi}{3}$
(3) $\vec{a}\cdot\vec{b} = 0$
(4) $\vec{b}\cdot\vec{c} = 0$.

C-5. A line l passing through the origin is perpendicular to the lines

l_1 : (3 + t) $\hat{i}$ + (– 1 + 2t) $\hat{j}$ + (4 + 2t) $\hat{k}$, $-\infty < t < \infty$

l_2 : (3 + 2s) $\hat{i}$ + (3 + 2s) $\hat{j}$ + (2 + s) $\hat{k}$, $-\infty < s < \infty$

Then, the coordinate(s) of the point(s) on l_2 at a distance of $\sqrt{17}$ from the point of intersection of l and l_1 is(are)

(1) $\left(\frac{7}{3},\frac{7}{3},\frac{5}{3}\right)$
(2) (–1, ,–1, 0)
(3) (1, 1, 1)
(4) $\left(\frac{7}{9},\frac{7}{9},\frac{8}{9}\right)$

C-6 If $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}$, then the vectors $(\vec{a}\cdot\hat{i})\,\hat{i}+(\vec{a}\cdot\hat{j})\,\hat{j}+(\vec{a}\cdot\hat{k})\,\hat{k}$, $(\vec{b}\cdot\hat{i})\,\hat{i}+(\vec{b}\cdot\hat{j})\,\hat{j}+(\vec{b}\cdot\hat{k})\,\hat{k}$ and $\hat{i}+\hat{j}-2\hat{k}$

(1) are mutually perpendicular
(2) are coplanar
(3) form a parallelopiped of volume 6 units
(4) form a parallelopiped of volume 3 units

C-7. The volume of the tetrahedron whose vertices are the points 0(0, 0, 0), A(1, – 1, 1), B(λ, 0, 1) and C(0, 1, λ) is $\frac{5}{6}$ cubic units, if the value of λ is

(1) – 3
(2) 3
(3) – 2
(4) 2

C-8. The vector(s) which is/are coplanar with vectors $\hat{i}+\hat{j}+2\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$, and perpendicular to the vector $\hat{i}+\hat{j}+\hat{k}$ is/are

(1) $\hat{j}-\hat{k}$ (2) $-\hat{i}+\hat{j}$ (3) $\hat{i}-\hat{j}$ (4) $-\hat{j}+\hat{k}$

C-9. If $\vec{x}\times\vec{b} = \vec{c}\times\vec{b}$ and $\vec{x}\perp\vec{a}$ then $\vec{x}$ is equal to

(1) $\frac{\vec{b}\times(\vec{a}\times\vec{c})}{\vec{a}\cdot\vec{b}}$ (2) $\frac{(\vec{b}\times\vec{c})\times\vec{a}}{\vec{b}\cdot\vec{a}}$ (3) $\frac{\vec{a}\times(\vec{c}\times\vec{b})}{\vec{a}\cdot\vec{b}}$ (4) $\frac{\vec{b}\times(\vec{a}\times\vec{c})}{\vec{b}\cdot\vec{c}}$

C-10. Let $\vec{A}$ be vector parallel to line of intersection of planes P_1 and P_2 through origin, P_1 is parallel to the vectors $2\hat{j} + 3\hat{k}$ and $4\hat{j} - 3\hat{k}$ and P_2 is parallel to $\hat{j} - \hat{k}$ and $3\hat{i} + 3\hat{j}$, then the angle between vector $\vec{A}$ and $2\hat{i} + \hat{j} - 2\hat{k}$ is

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{6}$ (4) $\frac{3\pi}{4}$

C-11. The projection of line $3x - y + 2z - 1 = 0 = x + 2y - z - 2$ on the plane $3x + 2y + z = 0$ is

(1) $\frac{x+1}{11} = \frac{y-1}{-9} = \frac{z-1}{-15}$ (2) $3x - 8y + 7z + 4 = 0 = 3x + 2y + z$

(3) $\frac{x+12}{11} = \frac{y+8}{-9} = \frac{z+14}{15}$ (4) $\frac{x+12}{11} = \frac{y+8}{-9} = \frac{z+14}{-15}$

C-12. If the straight lines $\frac{x-1}{2} = \frac{y+1}{k} = \frac{z}{2}$ and $\frac{x+1}{5} = \frac{y+1}{2} = \frac{z}{k}$ are coplanar, then the plane(s) containing these two lines is(are)

(1) $y + 2z = -1$ (2) $y + z = -1$ (3) $y - z = -1$ (4) $y - 2z = -1$

C-13. Two lines $L_1 : x = 5, \frac{y}{3-\alpha} = \frac{z}{-2}$ and $L_2 : x = \alpha, \frac{y}{-1} = \frac{z}{2-\alpha}$ are coplanar. Then α can take value(s)

(1) 1 (2) 2 (3) 3 (4) 4

C-14. If p and q be the perpendicular distances of the plane containing the line $\vec{r} = \hat{i} + \hat{j} + \lambda(-\hat{i} + \hat{j} - 2\hat{k})$ and $\vec{r} = \hat{i} + \hat{j} + \mu(\hat{i} + 2\hat{j} - \hat{k})$ from origin and (1, 1, 1) respectively, then

(1) $\arg (p + iq) = \frac{\pi}{2}$ (2) $| p + q | = \frac{1}{3}$

(3) (p, q) lies on $3x^2 + 3y^2 = 1$ (4) $\arg (q - ip) = 0$

C-15. Consider a pyramid OPQRS located in the first octant ($x \geq 0, y \geq 0, z \geq 0$) with O as origin, and OP and OR along the x-axis and the y-axis, respectively. The base OPQR of the pyramid is a square with OP = 3. The point S is directly above the mid point T of diagonal OQ such that TS = 3. Then

(1) the acute angle between OQ and OS is $\frac{\pi}{3}$

(2) the equation of the plane containing the triangle OQS is x – y = 0

(3) the length of the perpendicular from P to the plane containing the triangle OQS is $\frac{3}{\sqrt{2}}$

(4) the perpendicular distance from O to the straight line containing RS is $\sqrt{\frac{15}{2}}$

Exercise-3

PART - I : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. If $(\vec{a} \times \vec{b}) \times \vec{c} = \vec{a} \times (\vec{b} \times \vec{c})$, where, $\vec{a}$ $\vec{b}$ and $\vec{c}$ are any three vectors such that $\vec{a} \cdot \vec{b} \neq 0$,. $\vec{b} \cdot \vec{c} \neq 0$, then $\vec{a}$ and $\vec{c}$ are- **[AIEEE 2006 (3, –1), 120]**

(1) inclined at an angle of $\frac{\pi}{6}$ between them (2) perpendicular

(3) parallel (4) inclined at an angle of $\frac{\pi}{3}$ between them

2. ABC is a triangle, right angled at A. The resultant of the forces acting along $\vec{AB}$, $\vec{AC}$ with magnitudes $\frac{1}{AB}$ and $\frac{1}{AC}$ respectively is the force along $\vec{AD}$, where D is the foot of the perpendicular from A onto BC. The magnitude of the resultant is- **[AIEEE 2006 (3, –1), 120]**

(1) $\frac{(AB)(AC)}{AB+AC}$ (2) $\frac{1}{AB}+\frac{1}{AC}$ (3) $\frac{1}{AD}$ (4) $\frac{AB^2AC^2}{(AB)^2+(AC)^2}$

3. The value of a, for which the points A, B, C with position vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$ and $a\hat{i} - 3\hat{j} + \hat{k}$ respectively are the vertices of a right angled triangle with C = $\frac{\pi}{2}$ are- **[AIEEE 2006 (3, –1), 120]**

(1) – 2 and – 1 (2) – 2 and 1 (3) 2 and – 1 (4) 2 and 1

4. The two lines x = ay + b, z = cy + d and x = a' y + b' , z = c'y + d' are perpendicular to each other, if- **[AIEEE 2006 (3, –1), 120]**

(1) aa' + cc' = 1 (2) $\frac{a}{a'}+\frac{c}{c'} = -1$ (3) $\frac{a}{a'}+\frac{c}{c'} = 1$ (4) aa' + cc' = – 1

5. The image of the point (– 1, 3, 4) in the plane x – 2y = 0 is : **[AIEEE 2006 (3, –1), 120]**

(1) (15, 11, 4) (2) $\left(-\frac{17}{5},-\frac{19}{5},1\right)$ (3) (8, 4, 4) (4) $\left(\frac{9}{5},-\frac{13}{5},4\right)$

6. If $\hat{u}$ and $\hat{v}$ are unit vectors and θ is the acute angle between them, then $2\hat{u} \times 3\hat{v}$ is a unit vector for- **[AIEEE 2007 (3, –1), 120]**

(1) exactly two values of θ (2) more than two values of θ
(3) no value of θ (4) exactly one value of θ

7. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + 2\hat{k}$ and $\vec{c} = x\hat{i} + (x-2)\hat{j} - \hat{k}$. If the vector $\vec{c}$ lies in the plane of $\vec{a}$ and $\vec{b}$, then x equals **[AIEEE 2007 (3, –1), 120]**
(1) 0 (2) 1 (3) – 4 (4) – 2

8. Let L be the line of intersection of the planes 2x + 3y + z = 1 and x + 3y + 2z = 2. If L makes an angle α with the positive x-axis, then cos α equals **[AIEEE 2007 (3, –1), 120]**
(1) $1/\sqrt{3}$ (2) 1/2 (3) 1 (4) $1/\sqrt{2}$

9. If a line makes an angle of $\frac{\pi}{4}$ with the positive directions of each of x-axis & y-axis then the angle that the line makes with the positive direction of the z-axis is- **[AIEEE 2007 (3, –1), 120]**
(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{2}$

10. If (2, 3, 5) is one end of a diameter of the sphere $x^2 + y^2 + z^2 - 6x - 12y - 2z + 20 = 0$, then the coordinates of the other end of the diameter are- **[AIEEE 2007 (3, –1), 120]**
(1) (4, 9, – 3) (2) (4, –3, 3) (3) (4, 3, 5) (4) (4, 3, – 3)

11. The vector $\vec{a} = \alpha\hat{i} + 2\hat{j} + \beta\hat{k}$ lies in the plane of the vectors $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c} = \hat{j} + \hat{k}$ and bisects the angle between $\vec{b}$ and $\vec{c}$. Then, which one of the following gives possible values of α and β ? **[AIEEE 2008 (3, –1), 105]**
(1) α = 2, β = 2 (2) α = 1, β = 2 (3) α = 2, β = 1 (4) α = 1, β = 1

12. The non-zero vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are related by $\vec{a} = 8\vec{b}$ and $\vec{c} = -7\vec{b}$. Then, the angle between $\vec{a}$ and $\vec{c}$ is- **[AIEEE 2008 (3, –1), 105]**
(1) 0 (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{2}$ (4) π

13. The line passing through the points (5, 1, a) and (3, b, 1) crosses the yz-plane at the point $\left(0, \frac{17}{2}, \frac{-13}{2}\right)$. Then, **[AIEEE 2008 (3, –1), 105]**
(1) a = 2, b = 8 (2) a = 4, b = 6 (3) a = 6, b = 4 (4) a = 8, b = 2

14. If the straight lines $\frac{x-1}{k} = \frac{y-2}{2} = \frac{z-3}{3}$ and $\frac{x-2}{3} = \frac{y-3}{k} = \frac{z-1}{2}$ intersect at a point, then the integer k is equal to **[AIEEE 2008 (3, –1), 10**
(1) – 5 (2) 5 (3) 2 (4) – 2

15. If $\vec{u}, \vec{v}, \vec{w}$ are non-coplanar vectors and p, q are real numbers, then the equality $[3\vec{u}\ \ p\vec{v}\ \ p\vec{w}] - [p\vec{v}\ \ q\vec{w}\ \ \vec{u}] - [2\vec{w}\ \ q\vec{v}\ \ q\vec{u}] = 0$ holds for- **[AIEEE 2009 (4, –1), 144]**

(1) exactly two values of (p, q)
(2) more than two but not all values of (p, q)
(3) all values of (p, q)
(4) exactly one value of (p, q)

16. Let the line $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$ lies in the plane x + 3y – αz + β = 0. Then (α, β) equals **[AIEEE 2009 (4, –1), 144]**

(1) (6, – 17) (2) (– 6, 7) (3) (5, – 15) (4) (– 5, 15)

17. The projections of a vector on the three coordinate axes are 6, –3, 2 respectively. The direction cosines of the vector are. **[AIEEE 2009 (4, –1), 144]**

(1) 6, –3, 2 (2) $\frac{6}{5}, -\frac{3}{5}, \frac{2}{5}$ (3) $\frac{6}{7}, -\frac{3}{7}, \frac{2}{7}$ (4) $-\frac{6}{7}, -\frac{3}{7}, \frac{2}{7}$

18. **Statement -1 :** The point A(3, 1, 6) is the mirror image of the point B(1, 3, 4) in the plane x – y + z = 5.
Statement -2 : The plane x – y + z = 5 bisects the line segment joining A(3, 1,6) and B(1, 3, 4). **[AIEEE 2009 (4, –1),144]**

(1) Statement -1 is true, Statement-2 is true;Statement -2 is not a correct explanation for Statement -1.
(2) Statement-1 is true, Statement-2 is false.
(3) Statement -1 is false, Statement -2 is true.
(4) Statement -1 is true, Statement -2 is true; Statement-2 is a correct explanation for Statement-1.

19. Let $\vec{a} = \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$. Then the vector $\vec{b}$ satisfying $\vec{a} \times \vec{b} + \vec{c} = \vec{0}$ and $\vec{a}.\vec{b} = 3$ is **[AIEEE 2010 (4, –1), 144]**

(1) $2\hat{i} - \hat{j} + 2\hat{k}$ (2) $\hat{i} - \hat{j} - 2\hat{k}$ (3) $\hat{i} + \hat{j} - 2\hat{k}$ (4) $-\hat{i} + \hat{j} - 2\hat{k}$

20. If the vectors $\vec{a} = \hat{i} - \hat{j} + 2\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\vec{c} = \lambda\hat{i} + \hat{j} + \mu\hat{k}$ are mutually orthogonal, then (λ , μ) = **[AIEEE 2010 (4, –1), 144]**

(1) (2, – 3) (2) (–2, 3) (3) (3, – 2) (4) (–3, 2)

21. A line AB in three-dimensional space makes angles 45º and 120º with the positive x-axis and the positive y-axis respectively. If AB makes an acute angle θ with the positive z-axis, then θ equal **[AIEEE 2010 (4, –1), 144]**

(1) 45º (2) 60º (3) 75º (4) 30º

22. If $\vec{a} = \frac{1}{\sqrt{10}}(3\hat{i} + \hat{k})$ and $\vec{b} = \frac{1}{7}(2\hat{i} + 3\hat{j} - 6\hat{k})$, then the value of $(2\vec{a} - \vec{b}).[(\vec{a} \times \vec{b}) \times (\vec{a} + 2\vec{b})]$ is **[AIEEE 2011, I, (4, –1), 120]**

(1) – 5 (2) –3 (3) 5 (4) 3

23. The vectors $\vec{a}$ and $\vec{b}$ are not perpendicular and $\vec{c}$ and $\vec{d}$ are two vectors satisfying : $\vec{b} \times \vec{c} = \vec{b} \times \vec{d}$ and $\vec{a}.\vec{d} = 0$. Then the vector $\vec{d}$ is equal to : **[AIEEE 2011, I, (4, –1), 120]**

(1) $\vec{b} - \left(\frac{\vec{b}.\vec{c}}{\vec{a}.\vec{d}}\right)\vec{c}$ (2) $\vec{c} + \left(\frac{\vec{a}.\vec{c}}{\vec{a}.\vec{b}}\right)\vec{b}$ (3) $\vec{b} + \left(\frac{\vec{b}.\vec{c}}{\vec{a}.\vec{b}}\right)\vec{c}$ (4) $\vec{c} - \left(\frac{\vec{a}.\vec{c}}{\vec{a}.\vec{b}}\right)\vec{b}$

24. If the vector $p\hat{i}+\hat{j}+\hat{k}$, $\hat{i}+q\hat{j}+\hat{k}$ and $\hat{i}+\hat{j}+r\hat{k}$ $(p \neq q \neq r \neq 1)$ are coplanar, then the value of pqr – (p+q+r) is- **[AIEEE 2011, II, (4, –1), 120]**

(1) 2 (2) 0 (3) –1 (4) –2

25. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ be three non-zero vectors which are pairwise non-collinear. If $\vec{a}+3\vec{b}$ is collinear with $\vec{c}$ and $\vec{b}+2\vec{c}$ is collinear with $\vec{a}$, then $\vec{a}+3\vec{b}+6\vec{c}$ is : **[AIEEE 2011, II, (4, –1), 120]**

(1) $\vec{a}$ (2) $\vec{c}$ (3) $\vec{0}$ (4) $\vec{a}+\vec{c}$

26. If the angle between the line $x = \frac{y-1}{2} = \frac{z-3}{\lambda}$ and the plane x + 2y + 3z = 4 is $\cos^{-1}\left(\sqrt{\frac{5}{14}}\right)$, then λ equals: **[AIEEE 2011, I, (4, –1), 120]**

(1) $\frac{2}{3}$ (2) $\frac{3}{2}$ (3) $\frac{2}{5}$ (4) $\frac{5}{3}$

27. **Statement-1 :** The point A(1, 0, 7) is the mirror image of the point B(1, 6, 3) in the line : $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$

Statement-2 : The line : $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ bisects the line segment joining A(1, 0, 7) and B(1, 6, 3). **[AIEEE 2011, I, (4, –1), 120]**

(1) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is **not** a correct explanation for Statement-1.
(3) Statement-1 is true, Statement-2 is false.
(4) Statement-1 is false, Statement-2 is true.

28. The distance of the point (1, –5, 9) from the plane x – y + z = 5 measured along a straight line x = y = z is : **[AIEEE 2011, II, (4, –1), 120]**

(1) $10\sqrt{3}$ (2) $5\sqrt{3}$ (3) $3\sqrt{10}$ (4) $3\sqrt{5}$

29. The length of the perpendicular drawn from the point (3, –1, 11) to the line $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ is : **[AIEEE 2011, II, (4, –1), 120]**

(1) $\sqrt{29}$ (2) $\sqrt{33}$ (3) $\sqrt{53}$ (4) $\sqrt{66}$

30. An equation of a plane parallel to the plane x – 2y + 2z – 5 = 0 and at a unit distance from the origin is : **[AIEEE 2012, (4, –1), 120]**

(1) x – 2y + 2z – 3 = 0 (2) x – 2y + 2z + 1 = 0
(3) x – 2y + 2z – 1 = 0 (4) x – 2y + 2z + 5 = 0

31. If the line $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect, then k is equal to : **[AIEEE 2012, (4, –1), 120]**

(1) – 1 (2) $\frac{2}{9}$ (3) $\frac{9}{2}$ (4) 0

32. Let $\hat{a}$ and $\hat{b}$ be two unit vectors. If the vectors $\vec{c} = \hat{a} + 2\hat{b}$ and $\vec{d} = 5\hat{a} - 4\hat{b}$ are perpendicular to each other, then the angle between $\hat{a}$ and $\hat{b}$ is : **[AIEEE-2012, (4, –1)/120]**

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{2}$ (3) $\frac{\pi}{3}$ (4) $\frac{\pi}{4}$

33. Let ABCD be a parallelogram such that $\overrightarrow{AB} = \vec{q}$, $\overrightarrow{AD} = \vec{p}$ and ∠BAD be an acute angle. If $\vec{r}$ is the vector that coincides with the altitude directed from the vertex B to the side AD, then $\vec{r}$ is given by :

[AIEEE-2012, (4, –1)/120]

(1) $\vec{r} = 3\vec{q} - \frac{3(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$ (2) $\vec{r} = -\vec{q} + \left(\frac{\vec{p}.\vec{q}}{\vec{p}.\vec{p}}\right)\vec{p}$ (3) $\vec{r} = \vec{q} - \left(\frac{\vec{p}.\vec{q}}{\vec{p}.\vec{p}}\right)\vec{p}$ (4) $\vec{r} = -3\vec{q} + \frac{3(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$

34. If the vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ and $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC, then the length of the median through A is **[AIEEE - 2013, (4, – 1) 120]**

(1) $\sqrt{18}$ (2) $\sqrt{72}$ (3) $\sqrt{33}$ (4) $\sqrt{45}$

35. Distance between two parallel planes 2x + y + 2z = 8 and 4x + 2y + 4z + 5 = 0 is

[AIEEE - 2013, (4, – 1) 120]

(1) $\frac{3}{2}$ (2) $\frac{5}{2}$ (3) $\frac{7}{2}$ (4) $\frac{9}{2}$

36. If the lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar, then k can have

[AIEEE - 2013, (4, – 1) 120]

(1) any value (2) exactly one value (3) exactly two values (4) exactly three values

37. If $\left[\vec{a}\times\vec{b}\ \ \vec{b}\times\vec{c}\ \ \vec{c}\times\vec{a}\right] = \lambda\left[\vec{a}\ \vec{b}\ \vec{c}\right]^2$ then λ is equal to **[JEE(Main) 2014, (4, – 1), 120]**

(1) 0 (2) 1 (3) 2 (4) 3

38. The image of the line $\frac{x-1}{3} = \frac{y-3}{1} = \frac{z-4}{-5}$ in the plane 2x – y + z + 3 = 0 is the line :

[JEE(Main) 2014, (4, – 1), 120]

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

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

39. The angle between the lines whose direction cosines satisfy the equations $\ell + m + n = 0$ and $\ell^2 = m^2 + n^2$ is **[JEE(Main) 2014, (4, – 1), 120]**

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{2}$ (3) $\frac{\pi}{3}$ (4) $\frac{\pi}{4}$

40. The distance of the point (1,0,2) from the point of intersection of the line $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$ and the plane x – y + z = 16, is **[JEE(Main) 2015, (4, – 1), 120]**

(1) $2\sqrt{14}$ (2) 8 (3) $3\sqrt{21}$ (4) 13

41. The equation of the plane containing the line 2x – 5y + z = 3, x + y + 4z = 5 and parallel to the plane x + 3y + 6z = 1, is **[JEE(Main) 2015, (4, – 1), 120]**

(1) 2x + 6y + 12z = 13 (2) x + 3y + 6z = –7

(3) x + 3y + 6z = 7 (4) 2x + 6y + 12z = –13

42. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of them are collinear and $(\vec{a} \times \vec{b}) \times \vec{c} = \frac{1}{3}|\vec{b}||\vec{c}|\vec{a}$ If θ is the angle between vectors $\vec{b}$ and $\vec{c}$, then a value of sinθ is **[JEE(Main) 2015, (4, – 1), 120]**

(1) $\frac{2\sqrt{2}}{3}$ (2) $\frac{-\sqrt{2}}{3}$ (3) $\frac{2}{3}$ (4) $\frac{-2\sqrt{3}}{3}$

43. If the line, $\frac{x-3}{2} = \frac{y+2}{-1} = \frac{z+4}{3}$ lies in the plane, lx + my – z = 9, then $l^2 + m^2$ is equal to **[JEE(Main) 2016, (4, – 1), 120]**

(1) 18 (2) 5 (3) 2 (4) 26

44. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\sqrt{3}}{2}(\vec{b} + \vec{c})$. If $\vec{b}$ is not parallel to $\vec{c}$, then the angle between $\vec{a}$ and $\vec{b}$ is **[JEE(Main) 2016, (4, – 1), 120]**

(1) $\frac{\pi}{2}$ (2) $\frac{2\pi}{3}$ (3) $\frac{5\pi}{6}$ (4) $\frac{3\pi}{4}$

45. The distance of the point (1, –5, 9) from the plane x – y + z = 5 measured along the line x = y = z is **[JEE(Main) 2016, (4, – 1), 120]**

(1) $10\sqrt{3}$ (2) $\frac{10}{\sqrt{3}}$ (3) $\frac{20}{3}$ (4) $3\sqrt{10}$

46. If the image of the point P(1, –2, 3) in the plane, 2x + 3y – 4z + 22 = 0 measured parallel to the line, $\frac{x}{1} = \frac{y}{4} = \frac{z}{5}$ is Q, then PQ is equal to : **[JEE(Main) 2017, (4, – 1), 120]**

(1) $3\sqrt{5}$ (2) $2\sqrt{42}$ (3) $\sqrt{42}$ (4) $6\sqrt{5}$

47. The distance of the point (1, 3, – 7) from the plane passing through the point (1, –1, –1), having normal perpendicular to both the lines $\frac{x-1}{1} = \frac{x+2}{-2} = \frac{x-4}{3}$ and $\frac{x-2}{2} = \frac{y+1}{-1} = \frac{z+7}{-1}$, is

[JEE(Main) 2017, (4, – 1), 120]

(1) $\frac{20}{\sqrt{74}}$ (2) $\frac{10}{\sqrt{83}}$ (3) $\frac{5}{\sqrt{83}}$ (4) $\frac{10}{\sqrt{74}}$

48. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$. Let $\vec{c}$ be a vector such that $|\vec{c} - \vec{a}| = 3$, $|(\vec{a} \times \vec{b}) \times \vec{c}| = 3$ and the angle between $\vec{c}$ and $\vec{a} \times \vec{b}$ be 30º. Then $\vec{a}.\vec{c}$ is equal to **[JEE(Main) 2017, (4, – 1), 120]**

(1) $\frac{25}{8}$ (2) 2 (3) 5 (4) $\frac{1}{8}$

PART - II : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - \hat{k}$. A vector in the plane of $\vec{a}$ and $\vec{b}$ whose projection on $\vec{c}$ is $-\frac{1}{\sqrt{3}}$, is **[IIT-JEE-2006, (3, – 1), 184]**

(A) $4\hat{i} - \hat{j} + 4\hat{k}$ (B) $3\hat{i} + \hat{j} - 3\hat{k}$ (C) $2\hat{i} + \hat{j} - 2\hat{k}$ (D) $4\hat{i} + \hat{j} - 4\hat{k}$

2. The number of distinct real values of λ, for which the vectors $-\lambda^2\hat{i} + \hat{j} + \hat{k}$, $\hat{i} - \lambda^2\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} - \lambda^2\hat{k}$ are coplanar, is **[IIT- JEE-2007, Paper-I, (3, – 1), 81]**

(A) zero (B) one (C) two (D) three

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

STATEMENT-1 : $\vec{PQ} \times (\vec{RS} + \vec{ST}) \neq \vec{0}$ **[IIT-JEE-2007, Paper-I, (3, – 1), 81]**

because

STATEMENT-2 : $\vec{PQ} \times \vec{RS} = \vec{0}$ and $\vec{PQ} \times \vec{ST} \neq \vec{0}$

(A) Statement-1 is True, Statement-2 is True ; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True ; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

4. Let $\vec{a}, \vec{b}, \vec{c}$ be unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Which one of the following is correct? **[IIT-JEE-2007, Paper-II, (3, – 1), 81]**

(A) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a} = \vec{0}$ (B) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a} \neq \vec{0}$

(C) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{a} \times \vec{c} \neq \vec{0}$ (D) $\vec{a} \times \vec{b}$, $\vec{b} \times \vec{c}$, $\vec{c} \times \vec{a}$ are mutually perpendicular

5. The edges of a parallelopiped are of unit length and are parallel to non-coplanar unit vectors $\hat{a}, \hat{b}, \hat{c}$ such that $\hat{a}.\hat{b} = \hat{b}.\hat{c} = \hat{c}.\hat{a} = \frac{1}{2}$. Then the volume of the parallelopiped is **[IIT-JEE-2008, Paper-I, (3, – 1), 82]**

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2\sqrt{2}}$ (C) $\frac{\sqrt{3}}{2}$ (D) $\frac{1}{\sqrt{3}}$

6. A line with positive direction cosines passes through the point P(2, –1, 2) and makes equal angles with the coordinate axes. The line meets the plane 2x + y + z = 9 at point Q. The length of the line segment PQ equals **[IIT-JEE-2009, Paper-2, (3, –1), 80]**

(A) 1 (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) 2

7. Let P(3, 2, 6) be a point in space and Q be a point on the line $\vec{r} = (\hat{i} - \hat{j} + 2\hat{k}) + \mu(-3\hat{i} + \hat{j} + 5\hat{k})$. Then the value of μ for which the vector $\vec{PQ}$ is parallel to the plane x – 4y + 3z = 1 is **[IIT-JEE-2009, Paper-I, (3, – 1), 80]**

(A) $\frac{1}{4}$ (B) $-\frac{1}{4}$ (C) $\frac{1}{8}$ (D) $-\frac{1}{8}$

8. Equation of the plane containing the straight line $\frac{x}{2}=\frac{y}{3}=\frac{z}{4}$ and perpendicular to the plane containing the straight lines $\frac{x}{3}=\frac{y}{4}=\frac{z}{2}$ and $\frac{x}{4}=\frac{y}{2}=\frac{z}{3}$ is

[IIT-JEE-2010, Paper-1, (3, –1), 84]

(A) x + 2y – 2z = 0 (B) 3x + 2y – 2z = 0 (C) x – 2y + z = 0 (D) 5x + 2y – 4z = 0

9. The number of 3 × 3 matrices A whose entries are either 0 or 1 and for which the system $A\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}1\\0\\0\end{bmatrix}$ has exactly two distinct solutions, is

[IIT-JEE-2010, Paper-1, (3, –1), 84]

(A) 0 (B) $2^9 - 1$ (C) 168 (D) 2

10. If the distance of the point P(1, –2, 1) from the plane x + 2y – 2z = α, where α > 0, is 5, then the foot of the perpendicular from P to the plane is

[IIT-JEE-2010, Paper-2, (5, –2), 79]

(A) $\left(\frac{8}{3}, \frac{4}{3}, -\frac{7}{3}\right)$ (B) $\left(\frac{4}{3}, -\frac{4}{3}, \frac{1}{3}\right)$ (C) $\left(\frac{1}{3}, \frac{2}{3}, \frac{10}{3}\right)$ (D) $\left(\frac{2}{3}, -\frac{1}{3}, \frac{5}{2}\right)$

11. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}$, $\vec{b}=\hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$ be three vectors. A vector $\vec{v}$ in the plane of $\vec{a}$ and $\vec{b}$, whose projection on $\vec{c}$ is $\frac{1}{\sqrt{3}}$, is given by

[IIT-JEE 2011, Paper-1, (3, –1), 80]

(A) $\hat{i}-3\hat{j}+3\hat{k}$ (B) $-3\hat{i}-3\hat{j}-\hat{k}$ (C) $3\hat{i}-\hat{j}+3\hat{k}$ (D) $\hat{i}+3\hat{j}-3\hat{k}$

12. If $\vec{a}$ and $\vec{b}$ are vectors such that $|\vec{a}+\vec{b}|=\sqrt{29}$ and $\vec{a}\times(2\hat{i}+3\hat{j}+4\hat{k}) = (2\hat{i}+3\hat{j}+4\hat{k})\times\vec{b}$, then a possible value of $(\vec{a}+\vec{b})\cdot(-7\hat{i}+2\hat{j}+3\hat{k})$ is

[IIT-JEE 2012, Paper-2, (3, –1), 66]

(A) 0 (B) 3 (C) 4 (D) 8

13. The equation of a plane passing through 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 the point (3, 1, –1) is

[IIT-JEE 2012, Paper-2, (3, –1), 66]

(A) 5x – 11y + z = 17 (B) $\sqrt{2}x + y = 3\sqrt{2} - 1$

(C) x + y + z = $\sqrt{3}$ (D) x – $\sqrt{2}y$ = 1 – $\sqrt{2}$

14. Let $\overrightarrow{PR}=3\hat{i}+\hat{j}-2\hat{k}$ and $\overrightarrow{SQ}=\hat{i}-3\hat{j}-4\hat{k}$ determine diagonals of a parallelogram PQRS and $\overrightarrow{PT}=\hat{i}+2\hat{j}+3\hat{k}$ be another vector. Then the volume of the parallelepiped determined by the vectors $\overrightarrow{PT}$, $\overrightarrow{PQ}$ and $\overrightarrow{PS}$ is

[JEE (Advanced) 2013, Paper-1, (2, 0)/60]

(A) 5 (B) 20 (C) 10 (D) 30

Vector

15. Perpendicular are drawn from points on the line $\frac{x+2}{2}=\frac{y+1}{-1}=\frac{z}{3}$ to the plane x + y + z = 3. The feet of perpendiculars lie on the line **[JEE (Advanced) 2013, Paper-1, (2, 0)/60]**

(A) $\frac{x}{5}=\frac{y-1}{8}=\frac{z-2}{-13}$ (B) $\frac{x}{2}=\frac{y-1}{3}=\frac{z-2}{-5}$ (C) $\frac{x}{4}=\frac{y-1}{3}=\frac{z-2}{-7}$ (D) $\frac{x}{2}=\frac{y-1}{-7}=\frac{z-2}{5}$

16. From a point P(λ,λ,λ), perpendiculars PQ and PR are drawn respectively on the lines y = x, z = 1 and y = –x, z = –1. If P is such that ∠QPR is a right angle, then the possible value(s) of λ is(are) **[JEE (Advanced) 2014, Paper-1, (3, 0)/60]**

(A) $\sqrt{2}$ (B) 1 (C) –1 (D) $-\sqrt{2}$

17. Let P be the image of the point (3, 1, 7) with respect to the plane x – y + z = 3. Then the equation of the plane passing through P and containing the straight line $\frac{x}{1}=\frac{y}{2}=\frac{z}{1}$ is

(A) x + y – 3z = 0 (B) 3x + z = 0 (C) x – 4y + 7z = 0 (D) 2x – y = 0

18. Let O be the origin and let PQR be an arbitrary triangle. The point S is such that
$\overrightarrow{OP}.\overrightarrow{OQ}+\overrightarrow{OR}.\overrightarrow{OS}=\overrightarrow{OR}.\overrightarrow{OP}+\overrightarrow{OQ}.\overrightarrow{OS}=\overrightarrow{OQ}.\overrightarrow{OR}+\overrightarrow{OP}.\overrightarrow{OS}$ Then the triangle PQR has S as its **[JEE(Advanced) 2017, Paper-2,(3, –1)/61]**

(A) centroid (B) orthocenter (C) incentre (D) circumcenter

19. The equation of the plane passing through the point (1, 1, 1) and perpendicular to the planes 2x + y – 2z = 5 and 3x – 6y – 2z = 7, is **[JEE(Advanced) 2017, Paper-2,(3, –1)/61]**

(A) 14x + 2y – 15z = 1 (B) –14x + 2y + 15z = 3
(C) 14x – 2y + 15z = 27 (D) 14x + 2y + 15z = 31

Answers

EXERCISE # 1

Section (A)

A-1.	(3)	**A-2.**	(4)	**A-3.**	(3)	**A-4.**	(1)	**A-5.**	(3)	**A-6.**	(3)	**A-7.**	(2)
A-8.	(2)	**A-9.**	(4)	**A-10.**	(1)	**A-11.**	(4)	**A-12.**	(1)	**A-13.**	(2)	**A-14.**	(4)
A-15.	(3)	**A-16.**	(1)	**A-17.**	(2)	**A-18.**	(2)	**A-19.**	(1)	**A-20.**	(4)		

Section (B)

B-1.	(2)	**B-2.**	(4)	**B-3.**	(1)	**B-4.**	(4)	**B-5.**	(3)	**B-6.**	(4)	**B-7.**	(2)
B-8.	(3)	**B-9.**	(1)	**B-10.**	(1)	**B-11.**	(3)	**B-12.**	(1)	**B-13.**	(1)	**B-14.**	(3)
B-15.	(4)	**B-16.**	(4)	**B-17.**	(1)	**B-18.**	(3)	**B-19.**	(2)	**B-20.**	(2)	**B-21.**	(2)
B-22.	(3)	**B-23.**	(3)	**B-24.**	(3)	**B-25.**	(4)						

Section (C)

C-1.	(4)	**C-2.**	(3)	**C-3.**	(2)	**C-4.**	(4)	**C-5.**	(1)	**C-6.**	(3)	**C-7.**	(1)
C-8.	(1)	**C-9.**	(3)	**C-10.**	(4)	**C-11.**	(2)	**C-12.**	(4)				

Section (D)

D-1.	(4)	**D-2.**	(3)	**D-3.**	(1)	**D-4.**	(3)	**D-5.**	(3)	**D-6.**	(4)	**D-7.**	(1)
D-8.	(3)	**D-9.**	(4)	**D-10.**	(1)	**D-11.**	(1)	**D-12.**	(2)	**D-13.**	(3)	**D-14.**	(2)
D-15.	(4)	**D-16.**	(1)										

Section (E)

E-1.	(3)	**E-2.**	(4)	**E-3.**	(1)	**E-4.**	(1)	**E-4.**	(3)	**E-5.**	(2)	**E-6.**	(4)
E-7.	(4)	**E-8.**	(1)	**E-9.**	(4)	**E-10.**	(1)	**E-11.**	(3)	**E-12.**	(2)	**E-13.**	(4)
E-14.	(1)	**E-15.**	(2)	**E-16.**	(3)	**E-17.**	(1)	**E-18.**	(1)	**E-19.**	(1)	**E-20.**	(2)
E-21.	(4)												

EXERCISE # 2

PART - I

1.	(2)	**2.**	(2)	**3.**	(3)	**4.**	(3)	**5.**	(2)	**6.**	(3)	**7.**	(2)
8.	(1)	**9.**	(3)	**10.**	(4)	**11.**	(2)	**12.**	(1)	**13.**	(4)	**14.**	(1)
15.	(4)	**16.**	(3)	**17.**	(4)	**18.**	(1)	**19.**	(4)	**20.**	(3)	**21.**	(3)
22.	(2)	**23.**	(2)	**24.**	(3)	**25.**	(3)	**26.**	(1)	**27.**	(2)	**28.**	(3)
29.	(2)	**30.**	(4)	**31.**	(1)	**32.**	(1)	**33.**	(1)	**34.**	(1)	**35.**	(1)
36.	(4)	**37.**	(2)	**38.**	(2)	**39.**	(1)	**40.**	(4)				

PART - II

Section (A)

A-1. (2) **A-2.** (1) **A-3.** (2) **A-4.** (3) **A-5.** (1)

Section (B)

B-1. (A) → (q), (B) → (p), (C) → (s), (D) → (r)

B-2. (A) → r ; (B) → s ; (C) → p ; (D) → q

B-3. (A) → q, (B) → p, (C) → (s), (D) → (r)

B-4. (A) → r ; (B) → q ; (C) → s ; (D) → p

Section (C)

C-1.	(1, 3)	**C-2**	(3, 4)	**C-3.**	(2, 4)	**C-4.**	(1, 2)	**C-5.**	(2, 4)	**C-6**	(1, 3)	**C-7.**	(1, 4)
C-8.	(1, 4)	**C-9.**	(2, 3)	**C-10.**	(2, 4)	**C-11.**	(1, 2)	**C-12.**	(2, 3)	**C-13.**	(1, 4)	**C-14.**	(1,3,4)
C-15.	(2,3,4)												

EXERCISE # 3

PART - I

1.	(3)	**2.**	(3)	**3.**	(4)	**4.**	(4)	**5.**	(4)	**6.**	(4)	**7.**	(4)
8.	(1)	**9.**	(4)	**10.**	(1)	**11.**	(4)	**12.**	(4)	**13.**	(3)	**14.**	(1)
15.	(4)	**16.**	(2)	**17.**	(3)	**18.**	(1)	**19.**	(4)	**20.**	(4)	**21.**	(2)
22.	(1)	**23.**	(4)	**24.**	(4)	**25.**	(3)	**26.**	(1)	**27.**	(2)	**28.**	(1)
29.	(3)	**30.**	(1)	**31.**	(3)	**32.**	(3)	**33.**	(2)	**34.**	(3)	**35.**	(3)
36.	(3)	**37.**	(2)	**38.**	(3)	**39.**	(3)	**40.**	(4)	**41.**	(3)	**42.**	(1)
43.	(3)	**44.**	(3)	**45.**	(1)	**46.**	(2)	**47.**	(2)	**48.**	(2)		

PART - II

1.	(A)	**2.**	(C)	**3.**	(C)	**4.**	(B)	**5.**	(A)	**6.**	(C)	**7.**	(A)
8.	(C)	**9.**	(A)	**10.**	(A)	**11.**	(C)	**12.**	(C)	**13.**	(A)	**14.**	(C)
15.	(D)	**16.**	(C)	**17.**	(C)	**18.**	(B)	**19.**	(D)				