CPP-10
SS JEE(M) &
ADVANCED

Mathematics

Chapterwise Practise Problems (CPP) for JEE (Main & Advanced)

Chapter - Vector Algebra

Level-1

SECTION - A

Straight Objective Type

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

1. Let non-zero vectors $\vec{a}$ and $\vec{b}$ satisfy $(3\vec{a}-4\vec{b})\cdot(8\vec{a}-15\vec{b})=0$ and $(2\vec{a}+3\vec{b})\cdot(3\vec{a}+5\vec{b})=0$. Then the angle between $\vec{a}$ and $\vec{b}$ is

   (A) $\frac{\pi}{4}$ (B) $\frac{2\pi}{3}$

   (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{2}$

2. $\bar{a},\bar{b},\bar{c},\bar{d}$ are such that no three are coplanar; no two are perpendicular; $\frac{(\bar{b}\times\bar{c})\cdot(\bar{a}\times\bar{d})+(\bar{c}\times\bar{a})\cdot(\bar{b}\times\bar{d})}{(\bar{a}\times\bar{b})\cdot(\bar{d}\times\bar{c})}=$

   (A) $[\bar{a}\,\bar{b}\,\bar{c}]$ (B) $\frac{\bar{a}\cdot\bar{b}+\bar{b}\cdot\bar{c}+\bar{c}\cdot\bar{a}}{[\bar{b}\,\bar{c}\,\bar{d}]}$

   (C) 1 (D) 0

3. The lines $\vec{r_1}=\hat{j}+\hat{k}+\lambda(\hat{i}+3\hat{j}+4\hat{k})$, $\vec{r_2}=2\hat{i}+3\hat{j}+\mu(4\hat{i}-\hat{j}+\hat{k})$ are

   (A) Parallel

   (B) Non-parallel and non-intersecting

   (C) Non-parallel and intersecting

   (D) Perpendicular

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

   (A) 50 (B) $5\sqrt{2}$

   (C) $50\sqrt{2}$ (D) $25\sqrt{2}$

5. If vectors $\sec^2\theta\hat{i}+\hat{j}+\hat{k}$, $\hat{i}+\sec^2\varphi\hat{j}+\hat{k}$ and $\hat{i}+\hat{j}+\sec^2\psi\hat{k}$ are coplanar, then the value of $\text{cosec}^2\theta + \text{cosec}^2\varphi + \text{cosec}^2\psi$ is

   (A) 1 (B) 2

   (C) 6 (D) Not define

6. 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. If $\vec{d}$ is a vector coplanar with $\vec{b}$ and $\vec{c}$ and projection of $\vec{d}$ on $\vec{a}$ is $\sqrt{\frac{2}{3}}$ then $\vec{d}$ is

   (A) $2\hat{i}+3\hat{j}+3\hat{k}$

   (B) $-2\hat{i}-\hat{j}+5\hat{k}$

   (C) $2\hat{i}+\hat{j}+5\hat{k}$

   (D) $2\hat{i}+3\hat{j}+5\hat{k}$

7. STATEMENT-1 : If p^{th}, q^{th} and r^{th} terms of a G.P. are the positive numbers a, b and c then the vectors $(\log a)\hat{i} + (\log b)\hat{j} + (\log c)\hat{k}$ and $(q-r)\hat{i} + (r-p)\hat{j} + (p-q)\hat{k}$ are orthogonal.

STATEMENT-2 : If $\hat{a}, \hat{b}$ and $\hat{c}$ are the unit vectors then $|\hat{a}-\hat{b}|^2 + |\hat{b}-\hat{c}|^2 + |\hat{c}-\hat{a}|^2$ does not exceed 9.

STATEMENT-3 : A unit tangent vector at $t = 2$ on the curve $x = t^2 + 2$, $y = 4t - 5$, $z = 2t^2 - 6t$ is $\frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$.

Identify the correct combination of True (T) and False(F) of the given three statements

(A) T, F, T (B) T, F, F

(C) T, T, F (D) F, T, F

8. Let $\vec{a}, \vec{b}, \vec{c}$ be three unit vectors of which $\vec{b}$ and $\vec{c}$ are nonparallel, Let the angle between $\vec{a}$ and $\vec{b}$ be α and that between $\vec{a}$ and $\vec{c}$ be β. If $\vec{a}\times(\vec{b}\times\vec{c}) = \frac{1}{2}\vec{b}$ If then

(A) $\alpha = \frac{\pi}{3}, \beta = \frac{\pi}{2}$ (B) $\alpha = \frac{\pi}{2}, \beta = \frac{\pi}{3}$

(C) $\alpha = \frac{\pi}{6}, \beta = \frac{\pi}{3}$ (D) $\alpha = \frac{\pi}{2}, \beta = \frac{\pi}{6}$

SECTION - B

Multiple Correct Answer Type

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

9. $[\vec{a}\times(\vec{b}+\vec{c}) \quad \vec{b}\times(\vec{c}-2\vec{a}) \quad \vec{c}\times(\vec{a}+3\vec{b})]$ equals

(A) $7[\vec{a} \ \vec{b} \ \vec{c}]^2$

(B) $5[\vec{a} \ \vec{b} \ \vec{c}]^2$

(C) $7[\vec{a}\times\vec{b} \quad \vec{b}\times\vec{c} \quad \vec{c}\times\vec{a}]$

(D) $5[\vec{a}\times\vec{b} \quad \vec{b}\times\vec{c} \quad \vec{c}\times\vec{a}]$

10. If $\vec{a} = 3\hat{i} + 2\hat{j} + 6\hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{c} = 5\hat{i} + 3\hat{j} + 7\hat{k}$, then

(A) $[\vec{a}\times\vec{b} \quad \vec{b}\times\vec{c} \quad \vec{c}\times\vec{a}] = 2[\vec{a} \ \vec{b} \ \vec{c}]$

(B) $[\vec{a}-\vec{b} \quad \vec{b}-\vec{c} \quad \vec{c}-\vec{a}] = 0$

(C) $[\vec{a}+\vec{b} \quad \vec{b}+\vec{c} \quad \vec{c}+\vec{a}] = [\vec{a} \ \vec{b} \ \vec{c}]^2$

(D) $[\vec{a}\times(\vec{b}\times\vec{c}) \quad \vec{b}\times(\vec{c}\times\vec{a}) \quad \vec{c}\times(\vec{a}\times\vec{b})] = 0$

11. If $\vec{a}$ and $\vec{b}$ are two unit vectors perpendicular to each other and $\vec{c} = t_1\vec{a} + t_2\vec{b} + t_3(\vec{a}\times\vec{b})$ then

(A) $t_1 = \vec{a}\cdot\vec{c}$

(B) $t_2 = |\vec{b}\times\vec{c}|$

(C) $t_3 = |(\vec{a}\times\vec{b})\times\vec{c}|$

(D) $t_1 + t_2 + t_3 = (\vec{a} + \vec{b} + \vec{a}\times\vec{b})\cdot\vec{c}$

SECTION - C

Linked Comprehension Type

This section contains paragraph. Based upon this paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 12 and 13

P is a point on the straight line $\vec{r} = (\hat{j} - \hat{k}) + \lambda(\hat{i} + \hat{j} + \hat{k})$. Q is a point on the straight line $\vec{r} = (\hat{i} + \hat{k}) + \mu(\hat{j} - \hat{k})$ such that $\overrightarrow{PQ}$ is parallel to the vector $\hat{i} + \hat{j} + 2\hat{k}$.

12. The position vector of 'P' is

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

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

13. The distance PQ is

(A) $\sqrt{6}$ (B) $\sqrt{7}$

(C) $\sqrt{8}$ (D) 6

SECTION-D

Single-Match Type

This section contains Single match questions. Each question contains statements given in two columns which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p,q,r,s. Four options A, B, C and D are given below. Out of which, only one shows the right matching

14. Match the expression given in column I with its results in column II

Column I	Column II
(A) If $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, $\lvert\vec{a}\rvert=1, \lvert\vec{b}\rvert=2, \lvert\vec{c}\rvert=3$ then $\lvert\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}\rvert$ is equal to	(p) 8
(B) If the points with position vectors $10\hat{i}+3\hat{j}$, $12\hat{i}-5\hat{j}$ and $2\lambda\hat{i}+11\hat{j}$ are collinear, then λ is equal to	(q) 5
(C) If $\vec{a}$ and $\vec{b}$ are two unit vectors in *X-Y* plane inclined to positive *x*-axis at angles 30° and 120° respectively, then $\lvert\vec{a}+\vec{b}\rvert^6$ is	(r) 4
(D) Let $\vec{a}, \vec{b}, \vec{c}$ be vectors of magnitudes 3, 4 and 5 respectively. If $\vec{a}$ is perpendicular to $\vec{b}+\vec{c}$, $\vec{b}$ is perpendicular to $\vec{c}+\vec{a}$ and $\vec{c}$ is perpendicular to $\vec{a}+\vec{b}$ then $\frac{1}{10}\lvert\vec{a}+\vec{b}+\vec{c}\rvert^2$ equals	(s) 7

	A	B	C	D
(A)	p	s	q	r
(B)	r	s	p	q
(C)	s	r	p	q
(D)	s	r	q	p

15. Match **column I** to **column II** according to the given conditions

Let $\vec{a}=2\hat{i}-3\hat{j}+6\hat{k}$, $\vec{b}=-2\hat{i}+2\hat{j}-\hat{k}$, if $\vec{a}=\lambda\vec{b}+\mu\vec{c}$, where $\vec{c}$ is a unit vector perpendicular to $\vec{b}$. Then

Column I	Column II
(A) Magnitude of projection of $\vec{a}$ on $\vec{b}$ is	(p) $\frac{16}{7}$
(B) Magnitude of projection of $\vec{b}$ on $\vec{a}$ is	(q) $\frac{16}{3}$
(C) Value of $\lvert\lambda\rvert$ is	(r) $\frac{\sqrt{195}}{3}$
(D) Value of $\lvert\mu\rvert$ is	(s) $\frac{16}{9}$

	A	B	C	D
(A)	q	r	p	s
(B)	q	s	r	p
(C)	q	p	r	s
(D)	q	p	s	r

16. Match the column I with column II according to the given conditions

An equation of plane

Column I	Column II
(A) Containing the line $\vec{r}=\vec{a}+t\vec{b}$ and passing through a point $\vec{c}$	(p) $\vec{r}=(1-t-p)\vec{a}+t\vec{b}+p\vec{c}$
(B) Containing the line $\vec{r}=\vec{a}+t\vec{b}$ and perpendicular to the plane $\vec{r}\cdot\vec{c}=q$	(q) $\vec{r}=\vec{a}+t(\vec{c}-\vec{a})+p\vec{b}$
(C) Through points with position vector $\vec{a}, \vec{b}, \vec{c}$	(r) $\vec{r}=\vec{a}+t(\vec{b}-\vec{a})+p\vec{c}$
(D) Through two point whose position vectors are $\vec{a}, \vec{b}$ and parallel to $\vec{c}$	(s) $\vec{r}=\vec{a}+t\vec{b}+p\vec{c}$

	A	B	C	D
(A)	q	s	p	r
(B)	q	s	p	r
(C)	r	q	p	s
(D)	r	s	p	q

17. Match the following

Column I	Column II
(A) If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three mutually perpendicular vectors where $\|\vec{a}\|=2$ $\|\vec{b}\|=2$, $\|\vec{c}\|=1$ then $\left[\vec{a}\times\vec{b}\ \ \vec{b}\times\vec{c}\ \ \vec{c}\times\vec{a}\right]$	(p) –12
(B) If $\vec{a}$ and $\vec{b}$ are two unit vectors inclined at $\pi/3$, then $16\left[\vec{a}\ \ \vec{b}+\vec{a}\times\vec{b}\ \ \vec{b}\right]$ is	(q) 0
(C) If $\vec{b}$ and $\vec{c}$ are orthogonal unit vectors and $\vec{b}\times\vec{c}=\vec{a}$ then $\left[\vec{a}+\vec{b}\ \ \vec{b}+\vec{c}\ \ \vec{c}+\vec{a}\right]$ is	(r) 16
(D) If $\left[\vec{x}\ \vec{y}\ \vec{a}\right]=\left[\vec{x}\ \vec{y}\ \vec{b}\right]=\left[\vec{a}\ \vec{b}\ \vec{c}\right]=0$ each vector being non-zero vector, then $\left[\vec{x}\ \ \vec{y}\ \ \vec{c}\right]$ is	(s) 1
	(t) 2

	A	B	C	D
(A)	r	p	s	q
(B)	s	p	t	q
(C)	r	p	s	q
(D)	r	q	r	p

18. Match the following

Column I	Column II
(A) $\vec{a}$ and $\vec{b}$ are unit vectors and $\vec{a}+2\vec{b}$ is $\perp$ to $5\vec{a}-4\vec{b}$, then $2\left(\vec{a}.\vec{b}\right)$ is equal to	(p) 0
(B) The points (1, 0, 3), (–1, 3, 4), (1, 2, 1) and (k, 2, 5) are coplanar when k is equal to	(q) –1
(C) The vectors (1, 1, m), (1, 1, m+1) and (1, –1, m) are coplanar then the number of values of m	(r) 1
(D) $\vec{a}\times\left(\vec{b}\times\vec{c}\right)+\vec{b}\times\left(\vec{c}\times\vec{a}\right)+\vec{c}\times\left(\vec{a}\times\vec{b}\right)$	(s) 2
	(t) –2

19. Let $\vec{a}, \vec{b}, \vec{c}$ are the three vectors such that $\|\vec{a}\|=\|\vec{b}\|=\|\vec{c}\|=2$ and angle between $\vec{a}$ and $\vec{b}$ is $\pi/3$, $\vec{b}$ and $\vec{c}$ is $\pi/3$ and $\vec{a}$ and $\vec{c}$ $\pi/3$.

Column - I	Column - II
(A) If $\vec{a}, \vec{b}, \vec{c}$ represents adjacent edges of parallelepiped then its volume is	(p) $\frac{2\sqrt{2}}{\sqrt{3}}$
(B) If $\vec{a}, \vec{b}, \vec{c}$ represents adjacent edges of parallelepiped then its height is	(q) $\frac{2\sqrt{2}}{3}$
(C) If $\vec{a}, \vec{b}, \vec{c}$ represents adjacent edges of tetrahedron then its volume is	(r) $4\sqrt{2}$
(D) If $\vec{a}, \vec{b}, \vec{c}$ represents adjacent edges of tetrahedron then its height is	(s) $\sqrt{\frac{2}{3}}$

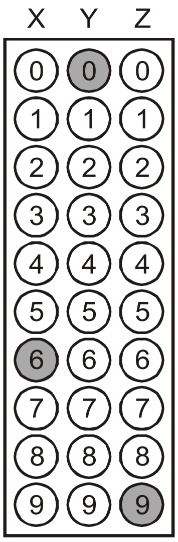
20. Match the following :

Column - I	Column - II
(A) $\vec{c}$ is a vector, such that $\vec{a}=2\hat{i}+3\hat{j}+4\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}$ and $\vec{c}$ are in right hand system and $\vec{c}$ is perpendicular to both $\vec{a}$ and $\vec{b}$ is	(p) $2\hat{j}+\hat{k}$
(B) $\vec{a}=\hat{i}+\hat{j}$ and $\vec{b}=2\hat{i}-\hat{k}$ so that $\vec{r}\times\vec{a}=\vec{b}\times\vec{a}$ and $\vec{r}\times\vec{b}=\vec{a}\times\vec{b}$ then $\vec{r}$	(q) $\frac{3}{2}(\hat{i}+\hat{j})$
(C) $(\vec{a}\times\hat{i})+2\vec{a}-5\hat{j}=\vec{o}$ then $\vec{a}$	(r) $4\hat{i}+4\hat{j}-5\hat{k}$
(D) Vector $\vec{B}=3\hat{i}+4\hat{k}$ is the vectors $\vec{B}_1$ parallel to $\vec{A}=\hat{i}+\hat{j}$ is	(s) $3\hat{i}+\hat{j}-\hat{k}$

SECTION-E

Integer Answer Type

This section contains Integer type questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. For example, if the correct answers to question numbers X, Y and Z(say) are 6, 0 and 9, respectively, then the correct darkening of bubbles will look like the following :



21. If $\bar{a}, \bar{b}$ and $\vec{c}$ are unit vectors, then $|\bar{a}-\bar{b}|^2+|\bar{b}-\bar{c}|^2+|\bar{c}-\bar{a}|^2$ doesn't exceed P, then P is equal to _______.

22. Vectors $-a\hat{i}+\hat{j}+2\hat{k}$, $\hat{i}+2a\hat{j}+\hat{k}$ and $\hat{i}+a\hat{j}-\hat{k}$ are continuous edges of a parallelopiped. Let λ be value of a for which volume of parallelopiped is minimum, then $\frac{1}{\lambda}$ equal to_______.

23. The distance of the point $\hat{i}+2\hat{j}+3\hat{k}$ from the plane $\vec{r}.(\hat{i}+\hat{j}+\hat{k})=5$ measured parallel to the vector $2\hat{i}+3\hat{j}-6\hat{k}$ must be

24. Two points P and Q are given in the rectangular cartesian coordinates on the curve $x = \log_2\left(\frac{y}{4}\right)$ such that $\overrightarrow{OP}.\hat{i} = -1$ and $\overrightarrow{OQ}.\hat{i} = 1$, where $\hat{i}$ is a unit vector along x-axis and O is the origin. The value of $\left|\overrightarrow{OQ} - 2\overrightarrow{OP}\right|$ is ________.

25. Let $\vec{r}=\left(\vec{a}\times\vec{b}\right)\sin x + \left(\vec{b}\times\vec{c}\right)\cos y + 2\left(\vec{c}\times\vec{a}\right)$; where $\vec{a}$, $\vec{b}$, $\vec{c}$ are non zero and non-coplanar vector. If $\vec{r}$ is orthogonal to $\vec{a}+\vec{b}+\vec{c}$ then find the minimum value of $\frac{4}{\pi^2}\left(x^2+y^2\right)$

26. Volume of tetrahedron whose vertices are the points with vectors $\hat{i}-6\hat{j}+10\hat{k}$, $-\hat{i}-3\hat{j}+7\hat{k}$, $5\hat{i}-\hat{j}+h\hat{k}$ and $7\hat{i}-4\hat{j}+7\hat{k}$ is 11 cubic units then the value of h is _______ (h > 1)

27. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a}\cdot\vec{b}=0=\vec{a}\cdot\vec{c}$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$. Then the value of $\left|\vec{a}\times\vec{b}-\vec{a}\times\vec{c}\right|$ is ____________.

❑ ❑ ❑

SECTION - A
Straight Objective Type

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

1. $\vec{a},\vec{b},\vec{c},\vec{d}$ are unit vectors; $\left|(\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d})\right|=1$; $\vec{b}\times\vec{c}=0$; then

(A) $\left[\vec{a}\,\vec{b}\,\vec{d}\right]=0$ (B) $\left[\vec{a}\,\vec{c}\,\vec{d}\right]=0$

(C) $\vec{a}\cdot\vec{c}=0$ (D) $\left[\vec{a}\vec{b}\vec{d}\right]=0$

2. If $\bar{x}_1,\bar{x}_2,\bar{x}_3$ and $\bar{y}_1,\bar{y}_2,\bar{y}_3$ are two sets of non-coplanar vectors such that $\bar{x}_r.\bar{y}_s=\begin{cases}0, \text{if } r\neq s\\ 2, \text{if } r=s\end{cases}$ where r, s = 1, 2, 3 then the value of $[\bar{x}_1\bar{x}_2\bar{x}_3][\bar{y}_1\bar{y}_2\bar{y}_3]$ is

(A) 6 (B) 8

(C) 16 (D) 24

3. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors, then the maximum value of $|\vec{a}-2\vec{b}|^2+|\vec{b}-2\vec{c}|^2+|\vec{c}-2\vec{a}|^2$ is

(A) 10 (B) 21

(C) 11 (D) 6

4. Let $\vec{a}=2\hat{i}+\hat{j}-2\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}$. If $\vec{c}$ is a vector such that $\vec{a}\cdot\vec{c}=|\vec{c}|, |\vec{c}-\vec{a}|=2\sqrt{2}$ and the angle between $\vec{a}\times\vec{b}$ and $\vec{c}$ is 30° then $|(\vec{a}\times\vec{b})\times\vec{c}|$ is equal to

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

(C) 2 (D) 3

5. The edges of parallelopiped are of unit length and are parallel to non-coplanar unit vectors $\hat{a}, \hat{b}, \hat{c}$ such that $\hat{a}\cdot\hat{b}=\hat{b}\cdot\hat{c}=\hat{c}\cdot\hat{a}=\frac{1}{2}$. Then the volume of parallelopiped is

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

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

6. If $\vec{a}=\hat{i}+\hat{j}+2\hat{k}, \vec{b}=\hat{i}+2\hat{j}+2\hat{k}$ and $|\vec{c}|=1$ such that $\left[\vec{a}\times\vec{b}\;\;\vec{b}\times\vec{c}\;\;\vec{c}\times\vec{a}\right]$ has maximum value then the value of $\left|(\vec{a}\times\vec{b})\times\vec{c}\right|^2$ is

(A) 0 (B) 1

(C) $\frac{4}{3}$ (D) $\frac{4}{\sqrt{5}}$

7. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ be three mutually perpendicular vectors of the same magnitude. If a vector $\vec{x}$ satisfies the equation $\vec{a}\times\{(\vec{x}-\vec{b})\times\vec{a}\}+\vec{b}\times\{(\vec{x}-\vec{c})\times\vec{b}\}+\vec{c}\times\{(\vec{x}-\vec{a})\times\vec{c}\}=0$; then $\vec{x}$ is given by-

(A) $\frac{1}{2}(\vec{a}+\vec{b}-2\vec{c})$ (B) $\frac{1}{2}(\vec{a}+\vec{b}+\vec{c})$

(C) $\frac{1}{3}(\vec{a}+\vec{b}+\vec{c})$ (D) $\frac{1}{3}(2\vec{a}+\vec{b}-\vec{c})$

8. If vector $\vec{p}$ satisfying $\vec{p}\times\vec{a}+(\vec{p}\cdot\vec{b})\vec{c}=\vec{d}$ is given by $\vec{p}=\vec{a}\times\left(\frac{\vec{a}\times(\vec{d}\times\vec{c})}{(\vec{a}\cdot\vec{c})|\vec{a}|^2}\right)+k\vec{a}$, then the value of k is equal to

(A) $\frac{\vec{c}\cdot\vec{p}}{|\vec{a}|^2}$ (B) $\frac{\hat{a}\cdot\vec{p}}{|\vec{a}|}$

(C) $\hat{d}\cdot\vec{p}$ (D) 0

SECTION - B

Multiple Correct Answer Type

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

9. Let $\vec{a}, \vec{b}$ be two non-collinear unit vectors. If $\vec{u} = \vec{a} - (\vec{a}.\vec{b})\vec{b}$ and $\vec{v} = \vec{a} \times \vec{b}$, then $|\vec{v}|$ is

(A) $|\vec{u}|$ (B) $|\vec{u}| + |\vec{u}.\vec{a}|$

(C) $|\vec{u}| + |\vec{u}.\vec{b}|$ (D) $|\vec{u}| + \vec{u}.|\vec{u} + \vec{b}|$

10. If $2\vec{a}, -3\vec{b}, 2(\vec{a} \times \vec{b})$ are position vectors of the vertices A, B, C of ΔABC and $|\vec{a}| = 1$, $|\vec{b}| = 1$, $\overline{OA}.\overline{OB} = -3$ (where O is the origin) then

(A) Triangle ABC is right angled

(B) Angle B is 90°

(C) $A = \cos^{-1}\sqrt{\frac{7}{19}}$

(D) The position vector of orthocentre is $2(\vec{a} \times \vec{b})$

11. The resolved part of the vector $\vec{a}$ along the vector $\vec{b}$ is $\vec{\lambda}$ and that perpendicular to $\vec{b}$ is $\vec{\mu}$. Then

(A) $\vec{\lambda} = \frac{(\vec{a}.\vec{b})\vec{a}}{(\vec{a})^2}$ (B) $\vec{\lambda} = \frac{(\vec{a}.\vec{b})\vec{b}}{(\vec{b})^2}$

(C) $\vec{\mu} = \frac{(\vec{b}.\vec{b})\vec{a} - (\vec{a}.\vec{b})\vec{b}}{(\vec{b})^2}$ (D) $\vec{\mu} = \frac{\vec{b} \times (\vec{a} \times \vec{b})}{(\vec{b})^2}$

12. If A, B and C are three points with position vectors $\vec{a}, \vec{b}, \vec{c}$ respectively, then perpendicular distance of A from the line joining B and C is

(A) $\frac{|\vec{a} \times (\vec{b} \times \vec{c})|}{2|(\vec{b} - \vec{c})|}$

(B) $\frac{|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|}{2|(\vec{b} - \vec{c})|}$

(C) $\frac{|\vec{a} \times \vec{b} + \vec{c} \times \vec{a} + \vec{b} \times \vec{c}|}{2|(\vec{b} - \vec{c})|}$

(D) $\frac{|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|}{|(\vec{b} - \vec{c})|}$

13. Let $\vec{r}$ be a unit vector satisfying $\vec{r} \times \vec{a} = \vec{b}$, where $|\vec{a}| = \sqrt{3}$, and $|\vec{b}| = \sqrt{2}$ then

(A) $\vec{r} = \frac{2}{3}(\vec{a} + \vec{a} \times \vec{b})$ (B) $\vec{r} = \frac{1}{3}(\vec{a} + \vec{a} \times \vec{b})$

(C) $\vec{r} = \frac{2}{3}(\vec{a} - \vec{a} \times \vec{b})$ (D) $\vec{r} = \frac{1}{3}(-\vec{a} + \vec{a} \times \vec{b})$

14. The vector sum of $\vec{a}$ and $\vec{b}$ trisects the angle between them. If $|\vec{a}| = 5$, $|\vec{b}| = 3$; then-

(A) angle between the two vectors $\vec{a}$ and $\vec{b}$ is $\cos^{-1}\left\{\frac{-40}{216}\right\}$

(B) angle between the two vectors $\vec{a}$ and $\vec{b}$ is $\cos^{-1}\left\{\frac{-30}{216}\right\}$

(C) Sum vector $\vec{a} + \vec{b}$ has magnitude $\frac{16}{3}$ units

(D) Sum vector $\vec{a} + \vec{b}$ has magnitude $\frac{25}{3}$ units

SECTION - C

Linked Comprehension Type

This section contains paragraph. Based upon this paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for question nos. 15 to 17

Let $\vec{p} = 2i + 3j - 6k$; $\vec{q} = 2i - 3j + 6k$ and $\vec{r} = -2i + 3j + 6k$. Let $\vec{p}_1$ be the projection of $\vec{p}$ on $\vec{q}$ and $\vec{p}_2$ be the projection of $\vec{p}_1$ on $\vec{r}$. Then

15. $\vec{p}_1 \cdot \vec{q}$ is equal to-

(A) $-\frac{41}{7}$ (B) 41

(C) 287 (D) –41

16. $\vec{p}_2$ is equal to-

(A) $\frac{943}{49}(-2i + 3j + 6k)$ (B) $\frac{943}{49}(2i - 3j - 6k)$

(C) $\frac{943}{49^2}(2i - 3j - 6k)$ (D) $\frac{943}{49^2}(-2i + 3j + 6k)$

17. Which of the following is true ?

(A) $\vec{p}$ and $\vec{p}_2$ are collinear

(B) $\vec{p}_1$ and $\vec{r}$ are collinear

(C) $\vec{p}$, $\vec{p}_1$, $\vec{q}_1$ are colanar

(D) $\vec{p}$, $\vec{p}_1$, $\vec{p}_2$ are coplanar

Paragraph for question nos. 18 to 20

Let $\vec{p}$ be a position vector of a variable point in cartesian OXY plane such that $\vec{p} \cdot (10j - 8i - \vec{p}) = 40$ and p_1 = max $\left\{|\vec{p} + 2i - 3j|^2\right\}$, p_2 = min $\left\{|\vec{p} + 2i - 3j|^2\right\}$. A tangent line is drawn to the curve $y = \frac{8}{x^2}dt$ point A with abscissa 2. The drawn line cuts the x-axis at point B.

18. $\vec{p}_1 + \vec{p}_2$ is equal to-

(A) 2 (B) 10

(C) 5 (D) 18

19. $\overline{AB} \cdot \overline{OB}$ is equal to-

(A) 1 (B) 2

(C) 3 (D) 4

20. p_2 is equal to-

(A) 9

(B) $2\sqrt{2} - 1$

(C) $6\sqrt{2} + 3$

(D) $9 - 4\sqrt{2}$

SECTION-D

Single-Match Type

This section contains Single match questions. Each question contains statements given in two columns which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p,q,r,s. Four options A,B,C and D are given below. Out of which, only one shows the right matching

21. Match the column.

Column - I		Column - II
(A) Centre of the parallelopiped whose 3 coterminous edges $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ have position vectors $\vec{a}, \vec{b}$ and $\vec{c}$ respectively where O is the origin is	(P)	$\vec{a} + \vec{b} + \vec{c}$
(B) OABC is a tetrahedron where O is the origin. Positions vectors of its angular points A, B and C are $\vec{a}, \vec{b}$ and $\vec{c}$ respectively. Segments joining each vertex with the centroid of the opposite face	(Q)	$\frac{\vec{a} + \vec{b} + \vec{c}}{2}$

are concurrent at a point P

whose p.v.'s are

(C) Let ABC be a triangle the position vectors of its angular points are $\vec{a}, \vec{b}$ and $\vec{c}$ respectively. If $|\vec{a}-\vec{b}| = |\vec{b}-\vec{c}| = |\vec{c}-\vec{a}|$ then the p.v. of the orthocentre of the triangle is

(R) $\dfrac{\vec{a}+\vec{b}+\vec{c}}{3}$

(D) Let $\vec{a}, \vec{b}, \vec{c}$ be 3 mutually perpendicular vectors of the same magnitude. If an unknown vectors satisfies the equation

$$\vec{a} \times \left(\left(\vec{x}-\vec{b}\right) \times \vec{a}\right) + \left(\left(\vec{x}-\vec{c}\right) \times \vec{b}\right) + \vec{c} \times \left(\left(\vec{x}-\vec{a}\right) \times \vec{c}\right) = 0.$$

Then $\vec{x}$ is given by

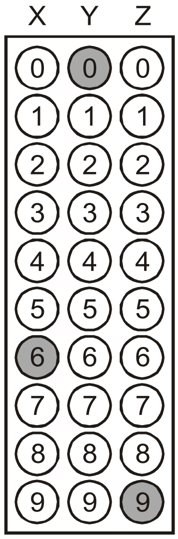
(S) $\dfrac{\vec{a}+\vec{b}+\vec{c}}{4}$

(E) ABC is a triangle whose centroid is G, orthocentre is H and circumcentre is the orign. If position vectos of A, B, C, G and H are $\vec{a}, \vec{b}, \vec{c}$, $\vec{g}$ and $\vec{h}$ respectively, then $\vec{h}$ in terms of $\vec{a}, \vec{b}$ and $\vec{c}$ is equal to

SECTION-E

Integer Answer Type

This section contains Integer type questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. For example, if the correct answers to question numbers X, Y and Z(say) are 6, 0 and 9, respectively, then the correct darkening of bubbles will look like the following :



22. In triangle *ABC* point *P* divides *BC* in the ratio 2 : 3 internally and *Q* divides *CA* in the ratio 1 : 4 internally. If *R* is the point of intersection of *AP* and *BQ*, point *S* is the intersection of *AB* and *CR* and *AS* = λ*BS* then the value of λ is ________.

23. Let $|\vec{a}| = 1$; $|\vec{b}| = 1$, and $|\vec{a}+\vec{b}| = \sqrt{3}$. If $\vec{c}$ be a vector such that $\vec{c} = \vec{a} + 2\vec{b} - 3\left(\vec{a} \times \vec{b}\right)$ and $P = \left|\left(\vec{a} \times \vec{b}\right) \times \vec{c}\right|$, then find [P] (where [.] is GIF)

24. A triangle $A\left(\vec{o}\right), B\left(\vec{b}\right), C\left(\vec{c}\right)$, as consecutive vertices ($\vec{o}, \vec{b}, \vec{c}$ are position vectors of A,B,C respectively), is drawn such that point D divides $\overline{BC}$ in the ratio of 3:2 (internally) and point E divides $\overline{AB}$ in 3 : 2 (externally). Now $\overline{AD}$ and $\overline{CE}$ meet in point F and Q is the mid point of $\overline{AC}$ the $\overline{FQ}$ divides $\overline{BC}$ in the ratio of $2\lambda + 1$; 1 then λ is ____

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ANSWERS

LEVEL-1

1. (D)	2. (C)	3. (B)	4. (B)	5. (D)	6. (B)
7. (C)	8. (B)	9. (A, C)	10. (A, B, C, D)	11. (A, D)	12. (A)
13. (A)	14. (C)	15. (D)	16. (A)	17. (B)	
18. (A-r, B-q,C-p, D-p)		19. (A-r, B-p,C-q, D-p)		20. (A-r, B-s,C-p, D-q)	
21. (9)	22. (3)	23. (7)	24. (5)	25. (5)	26. (7)
27. (1)					

LEVEL-2

1. (A)	2. (B)	3. (B)	4. (B)	5. (D)	6. (A)
7. (B)	8. (B)	9. (A, C)	10. (A, C, D)	11. (B, C, D)	12. (D)
13. (B, D)	14. (A,C)	15. (A-Q B-S C-R D-Q E-P)		16. (D)	17. (C)
18. (C)	19. (D)	20. (C)	21. (D)	22. (6)	23. (2)
24. (2)					

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