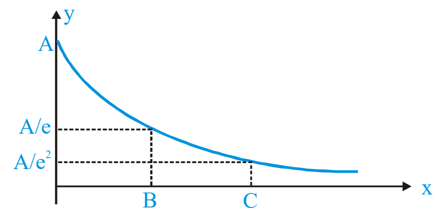
SOLVED EXAMPLES

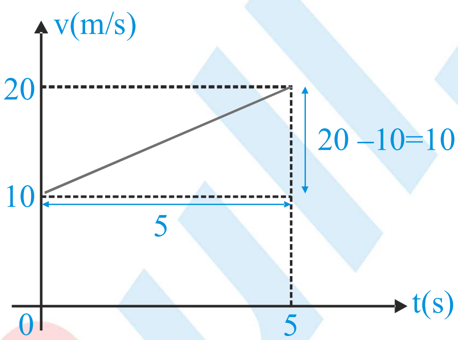
Ex. 1 In the given figure, a function $y = 15e^{-x}$ is shown. What is the numerical value of expression A/(B+C) ?



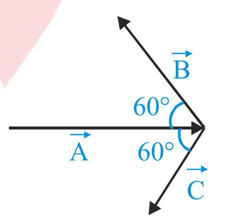
Sol. From graph A = 15 ; B = 1 ; C = 2 . Therefore [A/(B+C) = 15/3 = 5]

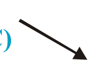
Ex. 2 A car changes its velocity linearly from 10 m/s to 20 m/s in 5 seconds. Plot v-t graph and write velocity as a function of time.

Sol. Slope $= \dfrac{20-10}{5-0} = 2 = m$ y-intercept = 10 = c $\Rightarrow$ v = 2t + 10



Ex. 3 Three coplanar vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ have magnitudes 4, 3 and 2 respectively. If the angle between any two vectors is 120° then which of the following vector may be equal to $\dfrac{3\vec{A}}{4} + \dfrac{\vec{B}}{3} + \dfrac{\vec{C}}{2}$



(A)  **(B)**  **(C)**  **(D)** 

Sol. As $\left|\dfrac{\vec{B}}{3}\right| = \left|\dfrac{\vec{C}}{2}\right|$ so $\dfrac{\vec{B}}{3} + \dfrac{\vec{C}}{2} = -\dfrac{\vec{A}}{4}$ therefore $\dfrac{3\vec{A}}{4} + \dfrac{\vec{B}}{3} + \dfrac{\vec{C}}{2} = \dfrac{\vec{A}}{2}$

Ex. 4 The magnitude of pairs of displacement vectors are given. Which pairs of displacement vectors cannot be added to give a resultant vector of magnitude 13 cm?
(A) 4 cm, 16 cm **(B)** 20 cm, 7 cm **(C)** 1 cm, 15 cm **(D)** 6 cm, 8 cm

Sol. Resultant of two vectors $\vec{A}$ and $\vec{B}$ must satisfy $A \sim B \le R \le A + B$

Ex.5 Three non zero vectors $\vec{A}, \vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A}\cdot\vec{B}=0$ & $\vec{A}\cdot\vec{C}=0$. Then $\vec{A}$ can be parallel to:

(A) $\vec{B}$ **(B)** $\vec{C}$ **(C)** $\vec{B}\cdot\vec{C}$ **(D)** $\vec{B}\times\vec{C}$

Sol. $\vec{A}\cdot\vec{B}=0 \Rightarrow \vec{A}\perp\vec{B}$ & $\vec{A}\cdot\vec{C}=0 \Rightarrow \vec{A}\perp\vec{C}$

But $\vec{B}\times\vec{C}$ is perpendicular to both $\vec{B}$ and $\vec{C}$ so $\vec{A}$ is parallel to $\vec{B}\times\vec{C}$.

Ex.6 α and β are the angle made by a vector from positive x & positive y-axes respectively. Which set of α and β is not possible

(A) $45^0, 60^0$ **(B)** $30^0, 60^0$ **(C)** $60^0, 60^0$ **(D)** $30^0, 45^0$

Sol. α, β must satisfy $\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$

Ex.7 Let $\vec{A}, \vec{B}$ and $\vec{C}$, be unit vectors. Suppose that $\vec{A}\cdot\vec{B}=\vec{A}\cdot\vec{C}=0$ and the angle between $\vec{B}$ and $\vec{C}$ is $\frac{\pi}{6}$ then

(A) $\vec{A}=(\vec{B}\times\vec{C})$ **(B)** $\vec{A}=2(\vec{B}\times\vec{C})$ **(C)** $\vec{A}=2(\vec{C}\times\vec{B})$ **(D)** $|\vec{B}\times\vec{C}|=\frac{\sqrt{3}}{2}$

Sol. As $\vec{A}\perp\vec{B}$ and $\vec{A}\perp\vec{C}$ So $\vec{A}=\pm\frac{(\vec{B}\times\vec{C})}{|\vec{B}\times\vec{C}|}$ But $|\vec{B}\times\vec{C}|=BC\sin 30°=\frac{1}{2}$

So $\vec{A}=\pm 2(\vec{B}\times\vec{C}) \Rightarrow \vec{A}=2(\vec{B}\times\vec{C})$ and $\vec{A}=-2(\vec{B}\times\vec{C})=2(\vec{C}\times\vec{B})$

Ex.8 Angle between $\vec{a}$ and $\vec{b}$ is 60° than

(A) The component of $\vec{a}-\vec{b}$ along $\vec{a}+\vec{b}$ will be $\frac{a^2-b^2}{\sqrt{a^2+b^2+ab}}$

(B) $\vec{a}\times\vec{b}$ is perpendicular to resultant of $(\vec{a}+2\vec{b})$ and $(\vec{a}-\vec{b})$

(C) The component of $\vec{a}-\vec{b}$ along $\vec{a}+\vec{b}$ will be $\frac{a^2-b^2}{\sqrt{a^2+b^2+2ab}}$

(D) The component of $\vec{a}+\vec{b}$ along $\vec{a}-\vec{b}$ will be $\frac{a^2-b^2}{\sqrt{a^2+b^2+\sqrt{3}ab}}$

Sol. **For (A) :** Required component $=\frac{(\vec{a}-\vec{b})\cdot(\vec{a}+\vec{b})}{|\vec{a}+\vec{b}|}=\frac{a^2-b^2}{\sqrt{a^2+b^2+2ab\cos 60°}}=\frac{a^2-b^2}{\sqrt{a^2+b^2+ab}}$

For (B) : $\vec{a}+2\vec{b}+\vec{a}-\vec{b}=2\vec{a}+\vec{b}$ which lies in the plane of $\vec{a}$ and $\vec{b}$

$\Rightarrow$ resultant is perpendicular to $\vec{a}\times\vec{b}$

Ex.9 Which of the following sets of concurrent forces may be in equilibrium?

(A) F_1=3N, F_2=5N, F_3=1N **(B)** F_1=3N, F_2=5N, F_3=6N

(C) F_1=3N, F_2=5N, F_3=9N **(D)** F_1=3N, F_2=5N, F_3=16 N

Sol. For equilibrium, net resultant force must be zero. These forces form a closed triangle such that

$F_1{\sim}F_2 \le F_3 \le F_1+F_2 \Rightarrow 2N \le F_3 \le 8N$

Ex. 10 Consider three vectors

$\vec{A} = 2\hat{i} + 3\hat{j} - 2\hat{k}$ $\quad\quad$ $\vec{B} = 5\hat{i} + n\hat{j} + \hat{k}$ $\quad\quad$ $\vec{C} = -\hat{i} + 2\hat{j} + 3\hat{k}$

If these three vectors are coplanar, then value of n will be

(A) 0 **(B)** 12 **(C)** 16 **(D)** 18

Sol. For coplanar vectors $\vec{A} \cdot (\vec{B} \times \vec{C}) = \begin{vmatrix} A_x & A_y & A_z \\ B_x & B_y & B_z \\ C_x & C_y & C_z \end{vmatrix} = 0$

$$\Rightarrow \begin{vmatrix} 2 & 3 & -2 \\ 5 & n & 1 \\ -1 & 2 & 3 \end{vmatrix} = 2(3n-2) - 3(15+1) - 2(10+n) = 0 \Rightarrow 4n - 72 = 0 \Rightarrow n = 18$$

Ex. 11 to 13

Vector product of three vectors is given by $\vec{A} \times (\vec{B} \times \vec{C}) = \vec{B}(\vec{A}.\vec{C}) - \vec{C}(\vec{A}.\vec{B})$

11. The value of $\hat{i} \times (\hat{j} \times \hat{k})$ is

(A) 0 **(B)** $\vec{0}$ **(C)** 1 **(D)** 3

12. The plane of vector $\vec{A} \times (\vec{A} \times \vec{B})$ is lies in the plane of

(A) $\vec{A}$ **(B)** $\vec{B}$ **(C)** $\vec{A} \times \vec{B}$ **(D)** $\vec{A}$ and $\vec{B}$

13. The value of $\hat{i} \times (\hat{i} \times \hat{j}) + \hat{j} \times (\hat{j} \times \hat{k}) + \hat{k} \times (\hat{k} \times \hat{i})$ is

(A) $\hat{i} + \hat{j} + \hat{k}$ **(B)** $-\hat{i} - \hat{j} - \hat{k}$ **(C)** $\vec{0}$ **(D)** $-3\hat{i} - 3\hat{j} - 3\hat{k}$

Sol.

11. $\hat{i} \times (\hat{j} \times \hat{k}) = \hat{j}(\hat{i} \cdot \hat{k}) - \hat{k}(\hat{i} \cdot \hat{j}) = \vec{0}$

12. $\vec{A} \times (\vec{A} \times \vec{B}) = \vec{A}(\vec{A} \cdot \vec{B}) - \vec{B}(\vec{A} \cdot \vec{A})$ $\Rightarrow$ This vector lies in plane of $\vec{A}$ and $\vec{B}$

13. $\Sigma \hat{i} \times (\hat{i} \times \hat{j}) = \Sigma \hat{i}(\hat{i} \cdot \hat{j}) - \hat{j}(\hat{i} \cdot \hat{i}) = -\Sigma \hat{j} = -(\hat{i} + \hat{j} + \hat{k})$

Ex. 14 If $\vec{A} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{B} = -\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{C} = 3\hat{i} - 3\hat{j} - 12\hat{k}$, then find the angle between the vectors $(\vec{A} + \vec{B} + \vec{C})$ and $(\vec{A} \times \vec{B})$ in degrees.

Sol. $\vec{P} = \vec{A} + \vec{B} + \vec{C} = 3\hat{i} - 5\hat{k}$ and $\vec{Q} = \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ -1 & 1 & 4 \end{vmatrix} = 5\hat{i} - 7\hat{j} + 3\hat{k}$

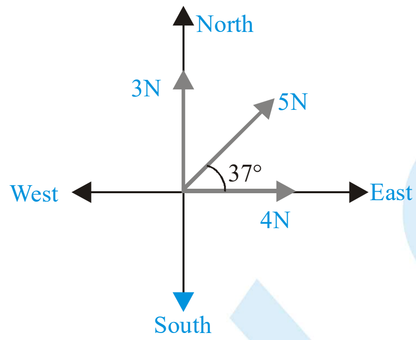
Angle between $\vec{P}$ & $\vec{Q}$ is given by $\cos\theta = \dfrac{\vec{P} \cdot \vec{Q}}{PQ} = \dfrac{15-15}{PQ} = 0$ $\Rightarrow$ $\theta = 90°$

Ex. 15 $\vec{a}$ and $\vec{b}$ are unit vectors and angle between them is $\frac{\pi}{k}$. If $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then find the integer value of k.

Sol. $(\vec{a}+2\vec{b}).(5\vec{a}-4\vec{b})=0 \quad \Rightarrow \quad 5a^2+10\vec{a}.\vec{b}-8b^2-4\vec{a}.\vec{b} \quad \Rightarrow \quad -3+6\vec{a}.\vec{b}=0$

$\Rightarrow \quad ab\cos\theta=\frac{3}{6} \quad \Rightarrow \quad \cos\theta=\frac{1}{2}=\theta=\frac{\pi}{3} \quad \Rightarrow \quad k=3$

Ex. 16 For shown situation, what will be the magnitude of minimum force in newton that can be applied in any direction so that the resultant force is along east direction ?

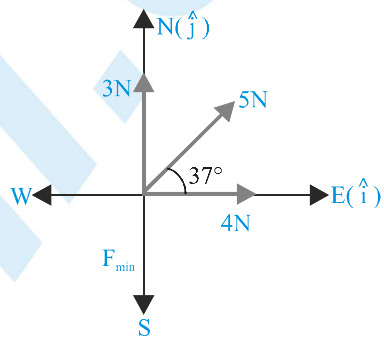


Sol. Let force be F so resultant is in east direction

$4\hat{i}+3\hat{j}+\left(5\cos 37^\circ\hat{i}+5\sin 37^\circ\hat{j}\right)+\vec{F}=k\hat{i}$

$4\hat{i}+3\hat{j}+4\hat{i}+3\hat{j}+\vec{F}=k\hat{i} \quad \Rightarrow \quad 8\hat{i}+6\hat{j}+\vec{F}=k\hat{i}$

$\vec{F}=(k-8)\hat{i}-6\hat{j} \quad \Rightarrow \quad F=\sqrt{(k-8)^2+(6)^2} \quad \Rightarrow \quad F_{min}=6N$



Ex. 17

Column–I (Operation of nonzero vectors $\vec{P}$ and $\vec{Q}$)		Column II (Possible angle between $\vec{P}$ and $\vec{Q}$)	
(A)	$\|\vec{P}\times\vec{Q}\|=0$	(P)	90°
(B)	$\|\vec{P}\times\vec{Q}\|=\sqrt{3}\vec{P}.\vec{Q}$	(Q)	180°
(C)	$\vec{P}+\vec{Q}=\vec{R}$ and P + Q = R	(R)	60°
(D)	$\|\vec{P}+\vec{Q}\|=\|\vec{P}-\vec{Q}\|$	(S)	0°
		(T)	30°

Sol. (A) → Q,S ; (B) → R ; (C) → S ; (D) → P

For (A) $|\vec{P}\times\vec{Q}|=0 \Rightarrow$ Angle between $\vec{P}$ and $\vec{Q}$ is 0^0 or 180^0

For (B) $|PQ\sin\theta|=\sqrt{3}\ PQ\cos\theta \Rightarrow |\sin\theta|=\sqrt{3}\ \cos\theta$

Here $\cos\theta$ must be positive so $\theta = 60°$

For (C) Here $P^2+Q^2+2PQ\cos\theta=P^2+Q^2+2PQ \Rightarrow \cos\theta=1 \Rightarrow \theta=0°$

For (D) Here $P^2+Q^2+2PQ\cos\theta=P^2+Q^2-2PQ\cos\theta \Rightarrow \cos\theta=0, \Rightarrow \theta=90°$

Ex. 18 The position of a particle moving in XY-plane varies with time t as $x = t$, $y = 3t - 5$.

(i) What is the path traced by the particle?

(ii) When does the particle cross-x-axis?

Sol. **(i)** $x = t$, $y = 3t - 5$ By eliminating t from above two equations $y = 3x - 5$

This is the equation of a straight line.

(ii) The particle crosses x-axis when $y = 0$. So $0 = 3t - 5 \Rightarrow t = \frac{5}{3}$

Ex. 19 Two particles A and B move along the straight lines $x+2y+3 = 0$ and $2x + y - 3 = 0$ respectively. Their position vector, at the time of meeting will be

(A) $3\hat{i} + 3\hat{j}$ **(B)** $3\hat{i} - 3\hat{j}$ **(C)** $\frac{\hat{i}}{3} - \frac{\hat{j}}{3}$ **(D)** Particles never meet

Sol. The particles meet at the point of intersection of lines.

By solving them $x=3$, $y=-3$, So position vector of meeting point will be $3\hat{i} - 3\hat{j}$

Exercise # 1

[Single Correct Choice Type Questions]

1. Find points at which the tangent to the curve $y = x^3 - 3x^2 - 9x + 7$ is parallel to the x–axis

(A) (3,–20) and (–1, 12) **(B)** (3,20) and (1, 12) **(C)** (3,–10) and (1, 12) **(D)** None of these

2. A stone is dropped into a quiet lake and waves move in circles at the speed of 5 cm/s. At the instant when the radius of the circular wave is 8 cm, how fast is the enclosed area increasing ?

(A) $80\,\pi$ cm²/s **(B)** $90\,\pi$ cm²/s **(C)** $85\,\pi$ cm²/s **(D)** $89\,\pi$ cm²/s

3. The momentum of a moving particle given by $p = t\ln t$. Net force acting on this particle is defined by equation $F = \frac{dp}{dt}$. The net force acting on the particle is zero at time

(A) $t = 0$ **(B)** $t = \frac{1}{e}$ **(C)** $t = \frac{1}{e^2}$ **(D)** None of these

4. Let $\vec{A} = \hat{i}A\cos\theta + \hat{j}A\sin\theta$, be any vector. Another vector $\vec{B}$ which is normal to $\vec{A}$ is :–

(A) $\hat{i}B\cos\theta + \hat{j}B\sin\theta$ **(B)** $\hat{i}B\sin\theta + \hat{j}B\cos\theta$

(C) $\hat{i}B\sin\theta - \hat{j}B\cos\theta$ **(D)** $\hat{i}A\cos\theta - \hat{j}A\sin\theta$

5. An edge of a variable cube is increasing at the rate of 3 cm/s. How fast is the volume of the cube increasing when the edge is 10 cm long ?

(A) 900 cm³/s **(B)** 920 cm³/s **(C)** 850 cm³/s **(D)** 950 cm³/s

6. Force 3N, 4N and 12N act at a point in mutually perpendicular directions. The magnitude of the resultant force is :–

(A) 19 N **(B)** 13 N **(C)** 11 N **(D)** 5 N

7. If a unit vector is represented by $0.5\hat{i} - 0.8\hat{j} + c\hat{k}$, then the value of 'c' is :–

(A) 1 **(B)** $\sqrt{0.11}$ **(C)** $\sqrt{0.01}$ **(D)** $\sqrt{0.39}$

8. The sum of magnitudes of two forces acting at a point is 16N. If the resultant force is 8N and its direction is perpendicular to smaller force, then the forces are :–

(A) 6N and 10N **(B)** 8N and 8N **(C)** 4N and 12N **(D)** 2N and 14N

9. The unit vector parallel to the resultant of the vectors $\vec{A} = 4\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{B} = -\hat{i} + 3\hat{j} - 8\hat{k}$ is :–

(A) $\frac{1}{7}(3\hat{i} + 6\hat{j} - 2\hat{k})$ **(B)** $\frac{1}{7}(3\hat{i} + 6\hat{j} + 2\hat{k})$ **(C)** $\frac{1}{49}(3\hat{i} + 6\hat{j} + 2\hat{k})$ **(D)** $\frac{1}{49}(3\hat{i} + 6\hat{j} - 2\hat{k})$

10. How many minimum number of coplanar vectors which represent same physical quantity having different magnitudes can be added to give zero resultant

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5

11. A physical quantity which has a direction :–

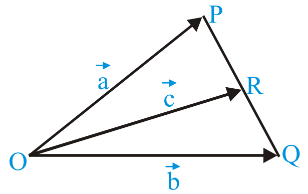
(A) Must be a vector **(B)** May be a vector

(C) Must be a scalar **(D)** None of the above

12. Following sets of three forces act on a body. Whose resultant cannot be zero ?

(A) 10, 10, 10 **(B)** 10, 10, 20 **(C)** 10, 20, 20 **(D)** 10, 20, 40

13. Figure shows three vectors $\vec{a}, \vec{b}$ and $\vec{c}$, where R is the midpoint of PQ. Then which of the following relations is correct ?



(A) $\vec{a} + \vec{b} = 2\vec{c}$ **(B)** $\vec{a} + \vec{b} = \vec{c}$ **(C)** $\vec{a} - \vec{b} = 2\vec{c}$ **(D)** $\vec{a} - \vec{b} = \vec{c}$

14. The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is $\vec{R}$. If $\vec{Q}$ is doubled then the new resultant vector is perpendicular to $\vec{P}$. Then magnitude of $\vec{R}$ is :–

(A) $\dfrac{P^2 - Q^2}{2PQ}$ **(B)** Q **(C)** $\dfrac{P}{Q}$ **(D)** $\dfrac{P+Q}{P-Q}$

15. I started walking down a road in morning facing the sun. After walking for some–time, I turned to my left, then I turned to the right once again. In which direction was I going then –

(A) East **(B)** North–west **(C)** North–east **(D)** South

16. A displacement vector, at an angle of 30° with y–axis has an x–component of 10 units. Then the magnitude of the vector is–

(A) 5.0 **(B)** 10 **(C)** 11.5 **(D)** 20

17. A bird moves from point (1 m, –2 m, 3 m) to (4 m, 2 m, 3 m). If the speed of the bird is 10 m/s, then the velocity vector of the bird in m/s is:

(A) $5\left(\hat{i} - 2\hat{j} + 3\hat{k}\right)$ **(B)** $5\left(4\hat{i} + 2\hat{j} + 3\hat{k}\right)$ **(C)** $0.6\hat{i} + 0.8\hat{j}$ **(D)** $6\hat{i} + 8\hat{j}$

18. There are two force vectors, one of 5N and other of 12N at what angle the two vectors be added to get resultant vector of 17N, 7N and 13N respectively.

(A) 0°, 180° and 90° **(B)** 0°, 90° and 180°

(C) 0°, 90° and 90° **(D)** 180°, 0° and 90°

19. Any vector in an arbitrary direction can always be replaced by two (or three)–

(A) Parallel vectors which have the original vector as their resultant.

(B) Mutually perpendicular vectors which have the original vector as their resultant.

(C) Arbitrary vectors which have the original vector as their resultant.

(D) It is not possible to resolve a vector.

20. 12 coplanar non collinear forces (all of equal magnitude) maintain a body in equilibrium, then the angle between any two adjacent forces is

(A) 15° **(B)** 30° **(C)** 45° **(D)** 60°

21. A particle has displacement of 12m towards east and 5m towards north then 6m vertically upward. The sum of these displacements is–

(A) 12 m (B) 10.04 m (C) 14.31 m (D) 23 m

22. If $|\vec{A}\times\vec{B}| = \sqrt{3}\,\vec{A}.\vec{B}$, then the value of $|\vec{A}+\vec{B}|$ is :–

(A) $\left(A^2+B^2+\frac{AB}{\sqrt{3}}\right)^{1/2}$ (B) A + B (C) $(A^2+B^2+\sqrt{3}AB)^{1/2}$ (D) $(A^2+B^2+AB)^{1/2}$

23. A vector $\vec{A}$ points vertically upward and $\vec{B}$ points towards north. The vector product $\vec{A}\times\vec{B}$ is :–

(A) Null vector (B) Along west (C) Along east (D) Vertically downward

24. Given that P = Q = R. If $\vec{P}+\vec{Q}=\vec{R}$ then the angle between $\vec{P}$ and $\vec{R}$ is θ_1. If $\vec{P}+\vec{Q}+\vec{R}=\vec{0}$ then the angle between $\vec{P}$ and $\vec{R}$ is θ_2. The relation between θ_1 and θ_2 is :–

(A) $\theta_1=\theta_2$ (B) $\theta_1=\frac{\theta_2}{2}$ (C) $\theta_1=2\theta_2$ (D) None of the above

25. The projection of $\vec{A}$ on $\vec{B}$ is :–

(A) $\vec{A}\cdot\vec{B}$ (B) $\vec{A}\cdot\hat{B}$ (C) $\vec{B}\cdot\vec{A}$ (D) $\hat{A}\cdot\hat{B}$

26. At what angle must the two forces (x + y) and (x – y) act so that the resultant may be $\sqrt{(x^2+y^2)}$:–

(A) $\cos^{-1}\frac{-(x^2+y^2)}{2(x^2-y^2)}$ (B) $\cos^{-1}\frac{-2(x^2-y^2)}{x^2+y^2}$ (C) $\cos^{-1}\frac{-(x^2+y^2)}{x^2-y^2}$ (D) $\cos^{-1}\frac{(x^2-y^2)}{x^2+y^2}$

27. The projection of a vector, $\vec{r}=3\hat{i}+\hat{j}+2\hat{k}$, on the x–y plane has magnitude –

(A) 3 (B) 4 (C) $\sqrt{14}$ (D) $\sqrt{10}$

28. The value of $(\vec{A}+\vec{B}).(\vec{A}\times\vec{B})$ is :–

(A) 0 (B) $A^2 – B^2$ (C) $A^2 + B^2 + 2AB$ (D) None of these

29. Select incorrect statement

(A) for any two vectors $|\vec{A}\cdot\vec{B}| \le AB$

(B) for any two vectors $|\vec{A}\times\vec{B}| \le AB$

(C) A vector is not changed if it is slid parallel to itself.

(D) A vector is necessarily changed if it is rotated through an angle.

30. Two balls are rolling on a flat smooth table. One ball has velocity components $\sqrt{3}\hat{j}$ and $\hat{i}$ while the other has components $2\hat{i}$ and $2\hat{j}$. If both start moving simultaneously from the same point, the angle between their paths is

(A) 15° (B) 30° (C) 45° (D) 60°

31. In a clockwise system :

(A) $\hat{k}\times\hat{j}=\hat{i}$ (B) $\hat{i}.\hat{i}=0$ (C) $\hat{j}\times\hat{j}=\hat{i}$ (D) $\hat{k}.\hat{j}=1$

32. If $\vec{e}_1$ and $\vec{e}_2$ are two unit vectors and θ is the angle between them, then $\sin\left(\frac{\theta}{2}\right)$ is :

(A) $\frac{1}{2}|\vec{e}_1 + \vec{e}_2|$ **(B)** $\frac{1}{2}|\vec{e}_1 - \vec{e}_2|$ **(C)** $\frac{\vec{e}_1 \cdot \vec{e}_2}{2}$ **(D)** $\frac{|\vec{e}_1 \times \vec{e}_2|}{2|\vec{e}_1||\vec{e}_2|}$

33. Three concurrent forces of the same magnitude are in equilibrium. What is the angle between the force ? Also name the triangle formed by the force as sides–

(A) 60° equilateral triangle **(B)** 120° equilateral triangle

(C) 120°, 30°, 30° an isosceles triangle **(D)** 120° an obtuse angled triangle

34. The linear velocity of a rotating body is given by $\vec{v} = \vec{\omega} \times \vec{r}$, where $\vec{\omega}$ is the angular velocity and $\vec{r}$ is the radius vector. The angular velocity of a body is $\vec{\omega} = \hat{i} - 2\hat{j} + 2\hat{k}$ and the radius vector $\vec{r} = 4\hat{j} - 3\hat{k}$, then $|\vec{v}|$ is–

(A) $\sqrt{29}$ units **(B)** $\sqrt{31}$ units **(C)** $\sqrt{37}$ units **(D)** $\sqrt{41}$ units

Exercise # 2 Part # I [Multiple Correct Choice Type Questions]

1. A particle moves along the curve $x^2 + 4 = y$. The points on the curve at which the y coordinates changes twice as fast as the x coordinate, is

(A) (1,5) **(B)** (5,1) **(C)** (1,2) **(D)** None of these

2. A ladder 5m long is leaning against a wall. The foot of the ladder is pulled out along the ground away from the wall at a rate of 2m/s. How fast is the height of ladder on the wall decreasing at the instant when the foot of the ladder is 4m away from the wall?

(A) 10 m/s **(B)** $\frac{3}{2}$ m/s **(C)** $\frac{8}{3}$ m/s **(D)** None of these

3. Moment of inertia of a solid about its geometrical axis is given by $I = \frac{2}{5}MR^2$ where M is mass & R is radius. Find out the rate by which its moment of inertia is changing keeping density constant at the moment R = 1m, M = 1 kg & rate of change of radius w.r.t. time 2 ms^{-1}

(A) 4 kg ms^{-1} **(B)** 2 kg m^2s^{-1} **(C)** 4 kg m^2s^{-1} **(D)** None of these

4. Three forces P, Q & R are acting at a point in the plane. The angle between P & Q and Q & R are 150° & 120° respectively, then for equilibrium (i.e. net force = 0), forces P, Q & R are in the ratio

(A) 1 : 2 : 3 **(B)** 1 : 2 : √3 **(C)** 3 : 2 : 1 **(D)** √3 : 2 : 1

5. Angle between the vectors $\vec{a} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b} = x\hat{i} + \hat{j} + (x+1)\hat{k}$

(A) is obtuse angle **(B)** is acute angle **(C)** is 90^0 **(D)** depends on x

6. If the sum of two unit vectors is a unit vector, then magnitude of difference is –

(A) √2 **(B)** √3 **(C)** 1/√2 **(D)** √5

7. Let $\vec{a}, \vec{b}, \vec{c}$ are three unit vectors such that $\vec{a} + \vec{b} + \vec{c}$ is also a unit vector. If pairwise angles between $\vec{a}, \vec{b}, \vec{c}$ are θ_1, θ_2 and θ_3 respectively then $\cos\theta_1 + \cos\theta_2 + \cos\theta_3$ equals

(A) 3 **(B)** – 3 **(C)** 1 **(D)** – 1

8. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ be vectors of length 3, 4, 5 respectively. Let $\vec{a}$ be perpend icular to $\vec{b} + \vec{c}$, $\vec{b}$ to $\vec{c} + \vec{a}$ and $\vec{c}$ to $\vec{a} + \vec{b}$. Then $|\vec{a} + \vec{b} + \vec{c}|$ is :

(A) 2√5 **(B)** 2√2 **(C)** 10√5 **(D)** 5√2

9. *X*–component of $\vec{a}$ is twice of its *Y*–component . If the magnitude of the vector is 5√2 and it makes an angle of 135° with z–axis then the components of vector is :

(A) 2√3, √3, –3 **(B)** 2√6,√6, –6 **(C)** 2√5, √5, –5 **(D)** None of these

10. Which of the following expressions are meaningful ?

(A) $\vec{u}.(\vec{v} \times \vec{w})$ **(B)** $(\vec{u}.\vec{v}).\vec{w}$ **(C)** $(\vec{u}.\vec{v})\vec{w}$ **(D)** $\vec{u} \times (\vec{v}.\vec{w})$

11. If $\vec{a}$ is a vector and x is a non–zero scalar, then

(A) x$\vec{a}$ is a vector in the direction of $\vec{a}$ **(B)** x$\vec{a}$ is a vector collinear to $\vec{a}$

(C) x$\vec{a}$ and $\vec{a}$ have independent directions **(D)** None of these.

12. The two vectors $\vec{A}$ and $\vec{B}$ are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$ then angle between $\vec{A}$ and $\vec{B}$ is

(A) 90^0 if $C^2 \neq A^2 + B^2$
(B) Greater than 90^0 if $C^2 < A^2 + B^2$
(C) Greater than 90^0 if $C^2 > A^2 + B^2$
(D) None of these

13. Following forces start acting on a particle at rest at the origin of the co–ordinate system simultaneously $\vec{F}_1 = -4\hat{i} - 5\hat{j} + 5\hat{k}$, $\vec{F}_2 = -5\hat{i} + 8\hat{j} + 6\hat{k}$, $\vec{F}_3 = -3\hat{i} + 4\hat{j} - 7\hat{k}$ and $\vec{F}_4 = 12\hat{i} - 3\hat{j} - 2\hat{k}$ then the particle will move–

(A) In x–y plane
(B) In y – z plane
(C) In x–z plane
(D) Along x–axis

14. If the vectors $\vec{a}$, $\vec{b}$, $\vec{c}$ form the sides BC, CA and AB respectively of a triangle ABC, then

(A) $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = 0$
(B) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$
(C) $\vec{a}.\vec{b} = \vec{b}.\vec{c} = \vec{c}.\vec{a}$
(D) $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \vec{0}$

15. Position vector of a particle is given by $\vec{r} = a\cos\omega t\hat{i} + a\sin\omega t\hat{j}$ .Which of the following is/are true ?

(A) Velocity vector is parallel to position vector
(B) Velocity vector is perpendicular to position vector
(C) Acceleration vector is directed towards the origin
(D) Acceleration vector is directed away from the origin

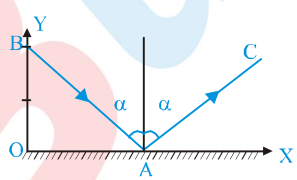
16. The line of action of a force $\vec{F} = \left(-3\hat{i} + \hat{j} + 5\hat{k}\right)$ N passes through a point (7, 3, 1). The moment of force $\left(\vec{\tau} = \vec{r} \times \vec{F}\right)$ about the origin is given by

(A) $14\hat{i} + 38\hat{j} + 16\hat{k}$
(B) $14\hat{i} + 38\hat{j} - 16\hat{k}$
(C) $14\hat{i} - 38\hat{j} + 16\hat{k}$
(D) $14\hat{i} - 38\hat{j} - 16\hat{k}$

17. The magnitude of scalar product of two vectors is 8 and of vector product is $8\sqrt{3}$. The angle between them is :

(A) 30°
(B) 60°
(C) 120°
(D) 150°

18. Equation of line BA is x + y = 1. Find a unit vector along the reflected ray AC.



(A) $\dfrac{(\hat{i} + \hat{j})}{\sqrt{2}}$
(B) $\dfrac{(\hat{i} - \hat{j})}{\sqrt{2}}$
(C) $\sqrt{2}\left(\hat{i} + \hat{j}\right)$
(D) None

19. Force acting on a particle is $\left(2\hat{i} + 3\hat{j}\right)N$. Work done by this force is zero, when the particle is moved on the line 3y + kx = 5. Here value of k is (Work done $W = \vec{F}.\vec{d}$)

(A) 2
(B) 4
(C) 6
(D) 8

20. Forces proportional to AB, BC and 2CA act along the sides of triangle ABC in order. Their resultant represented in magnitude and direction as

(A) CA
(B) AC
(C) BC
(D) CB

21. The vector $\left(\vec{a} + 3\vec{b}\right)$ is perpendicular to $\left(7\vec{a} - 5\vec{b}\right)$ and $\left(\vec{a} - 4\vec{b}\right)$ is perpendicular to $\left(7\vec{a} - 2\vec{b}\right)$. The angle between $\vec{a}$ and $\vec{b}$ is :

(A) 30°
(B) 45°
(C) 60°
(D) None of these

Part # II [Assertion & Reason Type Questions]

These questions contains, Statement 1 (assertion) and Statement 2 (reason).

(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.
(E) Statement- I is false, Statement-II is false.

1. **Statement–I :** If the initial and final positions coincide, the displacement is a *null vector*.
Statement–II : A physical quantity can not be called a vector, if its magnitude is zero.

2. **Statement–I :** Finite angular displacement is not a vector quantity.
Statement–II : It does not obey the vector laws.

3. **Statement–I :** A physical quantity can be regarded as a vector, if magnitude as well as direction is associated with it.
Statement–II : A physical quantity can be regarded as a scalar quantity, if it is associated with magnitude only.

4. **Statement–I :** Minimum number of non–equal vectors in a plane required to given zero resultant is three.
Statement–II : If $\vec{A}+\vec{B}+\vec{C}=\vec{0}$, then vector $\vec{A},\vec{B}$ and $\vec{C}$ must lie in one plane.

5. **Statement–I :** The dot product of one vector with another vector may be a scalar or a vector.
Statement–II : If the product of two vectors is a vector quantity, then product is called a dot product.

6. **Statement–I :** The angle between vectors $\vec{A}\times\vec{B}$ and $\vec{B}\times\vec{A}$ is π radian.
Statement–II : $\vec{B}\times\vec{A}=-\vec{A}\times\vec{B}$

7. **Statement-I :** A vector is a quantity that has both magnitude and direction and obeys the triangle law of addition.
Statement-II : The magnitude of the resultant vector of two given vectors can never be less than the magnitude of any of the given vector.

8. **Statement-I :** If the rectangular components of a force are 8 N and 6N, then the magnitude of the force is 10N.
Statement-II : If $|\vec{A}|=|\vec{B}|=1$ then $|\vec{A}\times\vec{B}|^2+|\vec{A}.\vec{B}|^2=1$.

9. **Statement-I :** If three vectors $\vec{A},\vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A}.\vec{B}=0$ & $\vec{A}.\vec{C}=0$ then the vector $\vec{A}$ is parallel to $\vec{B}\times\vec{C}$.
Statement-II : $\vec{A}\perp\vec{B}$ and $\vec{A}\perp\vec{C}$ and $\vec{B}\times\vec{C}\neq 0$ hence $\vec{A}$ is perpendicular to plane formed by $\vec{B}$ and $\vec{C}$.

10. **Statement-I :** The minimum number of non-zero vectors of unequal magnitude required to produce zero resultant is three.
Statement-II : Three vectors of unequal magnitude which can be represented by the three sides of a triangle taken in order, produce zero resultant.

11. **Statement-I :** The angle between the two vectors $(\hat{i}+\hat{j})$ and $(\hat{k})$ is $\frac{\pi}{2}$ radian.
Statement-II : Angle between two vectors $(\hat{i}+\hat{j})$ and $(\hat{k})$ is given by $\theta=\cos^{-1}\left(\frac{\vec{A}.\vec{B}}{AB}\right)$.

12. **Statement-I :** Distance is a scalar quantity.
Statement-II : Distance is the length of path transversed.

Exercise # 3 Part # I [Matrix Match Type Questions]

Following question contains statements given in two columns, which have to be matched. The statements in **Column-I** are labelled as A, B, C and D while the statements in **Column-II** are labelled as p, q, r and s. Any given statement in **Column-I** can have correct matching with one or more statement(s) in **Column-II**.

1. For component of a vector $\vec{A} = \left(3\hat{i} + 4\hat{j} - 5\hat{k}\right)$, match the following table :

	Column I		Column II
(A)	Along y–axis	**(P)**	5 unit
(B)	Along another vector $(2\hat{i} + \hat{j} + 2\hat{k})$	**(Q)**	4 unit
(C)	Along another vector $(6\hat{i} + 8\hat{j} - 10\hat{k})$	**(R)**	Zero
(D)	Along another vector $(-3\hat{i} - 4\hat{j} + 5\hat{k})$	**(S)**	None

2. Match the integrals (given in column - II) with the given functions (in column - I)

	Column - I		Column - II
(A)	$\int \sec x \tan x \, dx$	**(P)**	$-\dfrac{\operatorname{cosec} Kx}{K} + C$
(B)	$\int \operatorname{cosec} Kx \cot Kx \, dx$	**(Q)**	$-\dfrac{\cot Kx}{K} + C$
(C)	$\int \operatorname{cosec}^2 Kx \, dx$	**(R)**	$\sec x + C$
(D)	$\int \cos Kx \, dx$	**(S)**	$\dfrac{\sin Kx}{K} + C$

3. Match the statements given in **Column-I** with statements given in **Column - II**

	Column - I		Column - II
(A)	if $\lvert\vec{A}\rvert = \lvert\vec{B}\rvert$ and $\lvert\vec{A} + \vec{B}\rvert = \lvert\vec{A}\rvert$ then angle between $\vec{A}$ and $\vec{B}$ is	**(P)**	90°
(B)	Magnitude of resultant of two forces $\lvert\vec{F}_1\rvert = 8\text{N}$ and $\lvert\vec{F}_2\rvert = 4$ N may be	**(Q)**	120°
(C)	Angle between $\vec{A} = 2\hat{i} + 2\hat{j}$ & $\vec{B} = 3\hat{k}$ is	**(R)**	12 N
(D)	Magnitude of resultant of vectors $\vec{A} = 2\hat{i} + \hat{j}$ & $\vec{B} = 3\hat{k}$ is	**(S)**	$\sqrt{14}$

Part # II [Comprehension Type Questions]

Comprehension # 1

Two ships, V and W, move with constant velocities 2 ms^{-1} and 4 ms^{-1} along two mutually perpendicular straight tracks toward the intersection point O. At the moment t = 0, the ships were located at distances 100 m and 200 m from the point O.

1. The distance between them at time t is :-

(A) $\sqrt{(200)^2 + (100)^2}\ m$ **(B)** $\sqrt{(200-4t)^2 + (100-2t)^2}\ m$

(C) $[(200-4t) + (100-2t)]m$ **(D)** $\sqrt{(200-2t)^2 + (100-4t)^2}\ m$

2. The distance between them will be shortest at t = ...

(A) 50 s **(B)** $\dfrac{125}{3}s$ **(C)** $\dfrac{250}{3}s$ **(D)** 40 s

3. The shortest distance between them is :-

(A) $\frac{200\sqrt{5}}{3}m$ (B) $\frac{200\sqrt{3}}{5}m$ (C) $\frac{250}{3}m$ (D) None of these

Comprehension # 2

Path traced by a moving particle in space is called trajectory of the particle. Shape of trajectory is decided by the forces acting on the particle. When a coordinate system is associated with a particle's motion, the curve equation in which the particle moves [y = f(x)] is called equation of trajectory. It is just giving us the relation among x and y coordinates of the particle i.e. the locus of particle. To find equation of trajectory of a particle, find first x and y coordinates of the particle as a function of time and eliminate the time factor.

1. The position vector of car w.r.t. its starting point is given as $\vec{r} = at\,\hat{i} - bt^2\,\hat{j}$ where a and b are positive constants. The locus of a particle is :-

(A) $a^2y + bx^2 = 0$ (B) $a^2y = bx^2$ (C) $y = \frac{b}{a^2}x$ (D) $ay^2 = b^2x$

2. In above question the velocity $\left(i.e. \frac{d\vec{r}}{dt}\right)$ at t = 0 is :-

(A) $2b\hat{j}$ (B) $a\hat{i}$ (C) $(a - 2b)\hat{i}$ (D) None of these

3. In above question initial acceleration $\left(i.e. \frac{d^2\vec{r}}{dt^2}\right)$ of particle is :-

(A) $2b\hat{j}$ (B) $a\hat{i}$ (C) $-2b\hat{j}$ (D) None of these

Comprehension # 3

A particle is moving along positive x-axis. Its position varies as $x = t^3 - 3t^2 + 12t + 20$, where x is in meters and t is in seconds.

1. Initial velocity of the particle is.

(A) 1 m/s (B) 3 m/s (C) 12 m/s (D) 20 m/s

2. Initial acceleration of the particle is

(A) Zero (B) 1 m/s^2 (C) – 3m/s^2 (D) – 6 m/s^2

3. Velocity of the particle when its acceleration zero is

(A) 1 m/s (B) 3 m/s (C) 6 m/s (D) 9 m/s

Comprehension # 4

Two forces $\vec{F}_1 = 2\hat{i} + 2\hat{j}$ N and $\vec{F}_2 = 3\hat{j} + 4\hat{k}$ N are acting on a particle.

1. The resultant force acting on particle is :

(A) $2\hat{i}+5\hat{j}+4\hat{k}$ (B) $2\hat{i}-5\hat{j}-4\hat{k}$ (C) $\hat{i}-3\hat{j}-2\hat{k}$ (D) $\hat{i}-\hat{j}-\hat{k}$

2. The angle between $\vec{F}_1$ & $\vec{F}_2$ is :

(A) $\theta = \cos^{-1}\left(\frac{3}{2\sqrt{5}}\right)$ (B) $\theta = \cos^{-1}\left(\frac{3}{5\sqrt{2}}\right)$ (C) $\theta = \cos^{-1}\left(\frac{2}{3\sqrt{5}}\right)$ (D) $\theta = \cos^{-1}\left(\frac{\sqrt{3}}{5}\right)$

3. The component of force $\vec{F}_1$ along force $\vec{F}_2$ is :

(A) $\frac{5}{6}$ (B) $\frac{5}{3}$ (C) $\frac{6}{5}$ (D) $\frac{5}{2}$

Exercise # 4

[Subjective Type Questions]

1. If $\vec{A} = 2\hat{i} - 2\hat{j} - \hat{k}$ and $\vec{B} = \hat{i} + \hat{j}$, then :

(i) Find angle between $\vec{A}$ and $\vec{B}$.

(ii) Find the projection of resultant vector of $\vec{A}$ and $\vec{B}$ on x–axis.

(iii) Find a vector which is, if added to $\vec{A}$, gives a unit vector along y–axis.

2. The x and y components of vector $\vec{A}$ are 4 m and 6 m respectively. The x and y components of vector $\vec{A} + \vec{B}$ are 10 m and 9 m respectively. For the vector $\vec{B}$ calculate the following –

(i) x and y components **(ii)** length and **(iii)** the angle it makes with x–axis

3. There are two vectors $\vec{A} = 3\hat{i} + \hat{j}$ and $\vec{B} = \hat{j} + 2\hat{k}$. For these two vectors –

(i) Find the component of $\vec{A}$ along $\vec{B}$ and perpendicular to $\vec{B}$ in vector form.

(ii) If $\vec{A}$ and $\vec{B}$ are the adjacent sides of a parallelogram then find the magnitude of its area.

(iii) Find a unit vector which is perpendicular to both $\vec{A}$ and $\vec{B}$.

4. Answer the following :

(i) Can 2 similar vectors of different magnitude yield a zero resultant ? Can 3 yield ?

(ii) Can $\vec{a} + \vec{b} = \vec{a} - \vec{b}$?

(iii) If $\vec{a} + \vec{b} = \vec{c}$ & $|\vec{a}| + |\vec{b}| = |\vec{c}|$. What further information you can have about these vectors .

(iv) If $\vec{a}$ and $\vec{b}$ are two non zero vectors such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, then what is the angle between $\vec{a}$ and $\vec{b}$.

(v) Time has a magnitude & direction . Is it a vector ?

(vi) When will $\vec{a} \times \vec{b} = \vec{a} . \vec{b}$?

(vii) Does the unit vectors $\hat{i}$, $\hat{j}$ and $\hat{k}$ have units ?

5. Find the components of vector $\vec{a} = 3\hat{i} + 4\hat{j}$ along the direction of vectors $\hat{i} + \hat{j}$ & $\hat{i} - \hat{j}$.

6. 3 boys are pulling a heavy trolley by means of 3 ropes . The boy in the middle is exerting a pull of 100 N . The other 2 boys, whose ropes both make an angle of 30° with the centre rope, are pulling with forces of $50\sqrt{3}$N & $100\sqrt{3}$N. Find the magnitude of the resultant pull on the trolley

7. A vector $\vec{A}$ of length 10 units makes an angle of 60^0 with a vector $\vec{B}$ of length 6 units. Find the magnitude of the vector difference $\vec{A} - \vec{B}$ & the angle it makes with vector $\vec{A}$.

8. The greatest & the least magnitude of the resultant of two forces of constant magnitudes are P & Q respectively. If the forces act at an angle 2 α, then prove that the magnitude of their resultant is given by $\sqrt{P^2 \cos^2 \alpha + Q^2 \sin^2 \alpha}$.

9. A radius vector of point A relative to the origin varies with time t as $\vec{r} = at\,\hat{i} - bt^2\,\hat{j}$ where a and b are constants. Find the equation of point's trajectory.

10. Vector $\vec{a}$ has components $a_x = 3$, $a_y = 4$. Find the components of a vector $\vec{c}$ which is perpendicular to $\vec{a}$ and has a magnitude of 5 units.

11. Answer the following :

(i) A vector has magnitude & direction . Does it have a fixed location in space ? Can it vary with time.

(ii) Will two equal vectors $\vec{a}$ and $\vec{b}$ at different locations in space necessarily have identical physical effects?

(iii) Can three non zero vectors, not in one plane, give a zero resultant ? Can four vectors do ?

(iv) Can a vector have zero magnitude if one of its components is not zero ?

12. A room has dimensions 3m × 4m × 5m. A fly starting at one corner ends up at diametrically opposite corner.

(i) What is the magnitude of its displacement

(ii) If the fly does not fly but walks, what is the length of the shortest path it can take.

13. The position vector of a particle of mass m = 6kg is given as $\vec{r} = [(3t^2 - 6t)\hat{i} + (-4t^3)\hat{j}]$ m. Find:

(i) The force $\left(\vec{F} = m\vec{a}\right)$ acting on the particle.

(ii) The torque $\left(\vec{\tau} = \vec{r} \times \vec{F}\right)$ with respect to the origin, acting on the particle.

(iii) The momentum $\left(\vec{p} = m\vec{v}\right)$ of the particle.

(iv) The angular momentum $\left(\vec{L} = \vec{r} \times \vec{p}\right)$ of the particle with respect to the origin.

14. Find :

(i) "north cross west" **(ii)** "down dot south" **(iii)** "west dot west" **(iv)** "south cross south".

Let each vector have unit magnitude.

15. State with reasons, whether the following algebraic operations with scalar and vector physical quantities are meaningful:

(i) Adding any two scalars

(ii) Adding a scalar to a vector of the same dimensions

(iii) Multiplying any vector by any scalar

(iv) Multiplying any two scalars

(v) Adding any two vectors

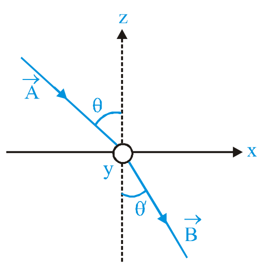
(vi) Adding a component of a vector to the same vector.

16. A plane body has perpendicular axes OX and OY marked on it and is acted on by following forces 5P in the direction OY, 4P in the direction OX, 10P in the direction OA where A is the point (3a, 4a) 15 P in the direction AB where B is the point (–a, a).
Express each force in the unit vector form & calculate the magnitude & direction of the vector sum of these forces.

17. A car travels due east on a level road for 30 km. It then turns due north at an intersection and travels 40 km before stopping. Find the resultant displacement of the car.

18. Find the kinetic energy $\left[K = \frac{1}{2}mv^2 = \frac{1}{2}m(\vec{v}\cdot\vec{v})\right]$ of a particle of mass 200 g moving with velocity $3\hat{i} - 5\hat{j} + 4\hat{k}$ m / s .

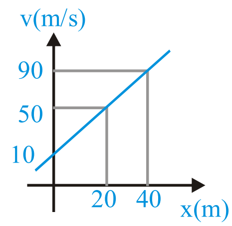
19. Write the vector representation of the vectors A and B with respect to the frame of reference shown in the figure.



20. The position vector of an object moving in X-Z plane is $\vec{r} = v_0 t\hat{i} + a_0 e^{b_0 t}\hat{k}$.

Find its **(i)** velocity $\left(\vec{v} = \frac{d\vec{r}}{dt}\right)$ **(ii)** speed $\left(|\vec{v}|\right)$ **(iii)** Acceleration $\left(\frac{d\vec{v}}{dt}\right)$ as a function of time.

21. Acceleration of particle moving in straight line can be written as $a = \frac{dv}{dt} = v\frac{dv}{dx}$. From the given graph find acceleration at x = 20 m.



22. A bird is at a point P(4m, –1m, 5m) and sees two points P_1(–1m, –1m, 0m) and P_2(3m, –1m,–3m). At time t = 0, it starts flying in a plane of the three positions, with a constant speed of 2 m/s in a direction perpendicular to the straight line P_1P_2 till it sees P_1 & P_2 collinear at time t. Find the time t .

23. A particle moves along a line with a constant speed v. At a certain time it is at a point P on its straight line path. O is fixed point. Prove that $(\overrightarrow{OP} \times \vec{v})$ is independent of the position P.

24. The position vector of a particle is given by $\vec{r} = 1.2t\,\hat{i} + 0.9t^2\,\hat{j} \Rightarrow 0.6(t^3 - 1)\hat{k}$ where t is the time in seconds from the start of motion and where $\vec{r}$ is expressed in metres. For the condition when t=4 second, determine the power $\left(P = \vec{F}.\vec{v}\right)$ in watts produced by the force $\vec{F} = \left(60\hat{i} - 25\hat{j} - 40\hat{k}\right)N$ which is acting on the particle.

25. If the position vector of the vertices of a triangle are $\hat{i} - \hat{j} + 2\hat{k}$; $2\hat{i} + \hat{j} + \hat{k}$ & $3\hat{i} - \hat{j} + 2\hat{k}$, then find the area of the triangle.

26. A particle moves in such a manner that x = At, y = Bt^3 – 2t, z = ct^2 – 4t, where x,y and z are measured in metres and t is measured in seconds, and A, B and C are unknown constants. Given that the velocity of the particle at t = 2s is $\vec{v} = \left(\frac{d\vec{r}}{dt}\right) = 3\hat{i} + 22\hat{j}\,m/s$, determine the velocity of the particle at t =4s.

27. A particle moves in such a way that its position vector at any time t is $\vec{r} = t\hat{i} + \frac{1}{2}t^2\hat{j} + t\hat{k}$.

Find as a function of time :

(i) The velocity $\left(\frac{d\vec{r}}{dt}\right)$ **(ii)** The speed $\left(\left|\frac{d\vec{r}}{dt}\right|\right)$ **(iii)** The acceleration $\left(\frac{d\vec{v}}{dt}\right)$

(iv) The magnitude of the acceleration
(v) The magnitude of the component of acceleration along velocity (called tangential acceleration)
(vi) The magnitude of the component of acceleration perpendicular to velocity (called normal acceleration).

28. A particle travels so that its acceleration is given by $\vec{a} = 5\cos t\,\hat{i} - 3\sin t\,\hat{j}$. If the particle is located at (–3,2) at time t = 0 and is moving with a velocity given by $(-3\hat{i} + 2\hat{j})$. Find

(i) The velocity $\left[\vec{v} = \int \vec{a}.dt\right]$ time t and

(ii) The position vector $[\vec{r} = \int \vec{v}.dt]$ of the particle at time (t > 0).

Exercise # 5

Part # I [Previous Year Questions] [AIEEE/JEE-MAIN]

1. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between $\vec{A}$ and $\vec{B}$ is- **[AIEEE - 2004]**

(1) π **(2)** $\pi/3$ **(3)** $\pi/2$ **(4)** $\pi/4$

2. A force $\vec{F} = \left(5\hat{i}+3\hat{j}+2\hat{k}\right)$ N is applied over a particle which displaces it from its origin to the point $\vec{r} = \left(2\hat{i}-\hat{j}\right)$ m. The work done on the particle in joules is- **[AIEEE - 2004]**

(1) –7 J **(2)** +7J **(3)** +10J **(4)** +13J

3. The 'rad' is the correct unit used to report the measurement of : **[AIEEE - 2006]**

(1) the ability of a beam of gamma ray photons to produce ions in a target
(2) the energy delivered by radiation to a target
(3) the biological effect of radiation
(4) the rate of decay of a radioactive source

Part # II [Previous Year Questions][IIT-JEE ADVANCED]

1. The equation $\sqrt{x+1} - \sqrt{x-1} = \sqrt{4x-1}$ has **[IIT-JEE-1997]**

(A) no solution **(B)** one solution
(C) two solutions **(D)** more than two solutions

2. Solve the equation $\log_{3/4} \log_8 (x^2 + 7) + \log_{1/2} \log_{1/4} (x^2 + 7)^{-1} = -2$. **[IIT-JEE- 2000]**

3. Number of solutions of $\log_4(x-1) = \log_2(x-3)$ is **[IIT-JEE- 2001]**

(A) 3 **(B)** 1 **(C)** 2 **(D)** 0

4. Let (x_0, y_0) be the solution of the following equations **[IIT-JEE- 2011]**

$$(2x)^{\ln 2} = (3y)^{\ln 3}$$

$$3^{\ln x} = 2^{\ln y}$$

Then x_0 is

(A) $\frac{1}{6}$ **(B)** $\frac{1}{3}$ **(C)** $\frac{1}{2}$ **(D)** 6

5. The value of $6+\log_{\frac{3}{2}}\left(\frac{1}{3\sqrt{2}}\sqrt{4-\frac{1}{3\sqrt{2}}\sqrt{4-\frac{1}{3\sqrt{2}}\sqrt{4-\frac{1}{3\sqrt{2}}......}}}\right)$ is **[IIT-JEE- 2012]**

6. If $3^x = 4^{x-1}$, then x = **[IIT-JEE Ad.-2013]**

(A) $\frac{2\log_3 2}{2\log_3 2-1}$ **(B)** $\frac{2}{2-\log_2 3}$ **(C)** $\frac{1}{1-\log_4 3}$ **(D)** $\frac{2\log_2 3}{2\log_2 3-1}$

MOCK TEST : BASIC MATHS

SECTION - I : STRAIGHT OBJECTIVE TYPE

1. The product of all the solutions of the equation $(x-2)^2 - 3|x-2| + 2 = 0$ is

(A) 2 **(B)** -4 **(C)** 0 **(D)** none of these

2. The number of solutions of the equation $\log(-2x) = 2\log(x+1)$ is

(A) zero **(B)** 1 **(C)** 2 **(D)** none

3. Greatest integer less than or equal to the number $\log_2 15 . \log_{1/6} 2 . \log_3 1/6$ is

(A) 4 **(B)** 3 **(C)** 2 **(D)** 1

4. The number of solutions of $|[x] - 2x| = 4$ is
(where [.] denotes greatest integer function)

(A) 2 **(B)** 4 **(C)** 3 **(D)** Infinite

5. The solution set of the inequation $1 + \log_{\frac{1}{3}}(x^2 + x + 1) > 0$ is

(A) $(-\infty, -2) \cup (1, \infty)$ **(B)** $[-1, 2]$ **(C)** $(-2, 1)$ **(D)** $(-\infty, \infty)$

6. Number of values of x satisfying the equations $5\{x\} = x + [x]$ and $[x] - \{x\} = \frac{1}{2}$ is

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

7. If $|x^2 - 9| + |x^2 - 4| = 5$, then the set of values of x is

(A) $(-\infty, -3) \cup (3, \infty)$ **(B)** $(-\infty, -2) \cup (3, \infty)$ **(C)** $(-\infty, 3)$ **(D)** $[-3, -2] \cup [2, 3]$

8. If $\frac{|x+2| - x}{x} < 2$, then the set of values of x is

(A) $(-\infty, 1) \cup (2, \infty)$ **(B)** $(-\infty, 0) \cup (1, \infty)$ **(C)** $(-\infty, -1) \cup (0, \infty)$ **(D)** none of these

9. Solution set of the inequality $\log_e^2 [2x] - \log_e [2x] \le 0$ is

(A) $[1, 3)$ **(B)** $(0, 3)$ **(C)** $\{1, 2\}$ **(D)** $\left[\frac{1}{2}, \frac{3}{2}\right)$

10. Solution set of $|x^2 - 5x + 7| + |x^2 - 5x - 14| = 21$ is

(A) $[-2, 7]$ **(B)** $(-\infty, -2] \cup [7, \infty)$ **(C)** $[7, \infty)$ **(D)** $(-\infty, -2]$

11. The set of real value(s) of p for which the equation $|2x + 3| + |2x - 3| = px + 6$ has exactly two solutions is

(A) $[0, 4)$ **(B)** $(-4, 4) - \{0\}$ **(C)** $R - \{4, -4, 0\}$ **(D)** $\{0\}$

12. $e^{e^{\ell n\, \ell n 3}}$ is simplified to

(A) e^3 **(B)** $\ell n\, 3$ **(C)** 3 **(D)** $\ell n(\ell n\, 3)$

13. $N = \dfrac{81^{\frac{1}{\log_5 9}} + 3^{\frac{3}{\log_{\sqrt{6}} 3}}}{409}\left((\sqrt{7})^{\frac{2}{\log_{25} 7}} - (125)^{\log_{25} 6}\right)$, then $\log_2 N$ has the value

(A) 0 **(B)** 1 **(C)** –1 **(D)** None of these

14. **S1 :** $3^{\sqrt{\log_3 7}} = 7^{\sqrt{\log_7 3}}$

S2 : Number of solution to the equation on $x^{\log_{10} 2x} = 5$ is 2

S3 : Solution set of the inequality $\left(\dfrac{1}{3}\right)^{\log_{1/9}\left(x^2 - \frac{10}{3}x + 1\right)} \le 1$, is $x \le \dfrac{10}{3}$

S4 : Solution set of $\dfrac{(x-2)}{(x-4)} \le 0$ is $x \in [2, 4]$

(A) TFTF **(B)** TTFF **(C)** T T F T **(D)** F T F T

15. Consider the following statements for real values of x :

S1 : $x^2 + |x| + 1 = 0$ has exactly 2 solutions.
S2 : $x^2 - 5|x| + 6 = 0$ has exactly 4 solution.
S3 : $x^2 - |x| - 2 = 0$ has exactly 2 solutions.
S4 : $x^2 - |x| = 0$ has 3 distinct solutions.

State, in order, whether S_1, S_2, S_3, S_4 are true or false

(A) T F T T **(B)** F T T T **(C)** F T F T **(D)** T T F T

16. Consider the following statements :

S1 : $x = \sqrt{\log_{11} 7}$ and $y = \sqrt{\log_7 11}$, then $e^{y\,\ell n 7 - x\,\ell n 11}$ is equal to 1.
S2 : $\log_x 3 > \log_x 2$ is true for all values of $x \in (0, 1) \cup (1, \infty)$
S3 : $|x - 2| = [-\pi]$, then x is 6, –2
S4 : $\log_{25}(2 + \tan^2\theta) = 0.5$, then θ may be $\dfrac{4\pi}{3}$ or $\dfrac{2\pi}{3}$

State, in order, whether S_1, S_2, S_3, S_4 are true or false

(A) T F F T **(B)** F F T T **(C)** F T F T **(D)** T T F T

SECTION - II : MULTIPLE CORRECT ANSWER TYPE

17. If $\ell n(x+z) + \ell n(x-2y+z) = 2\,\ell n(x-z)$, then

(A) $y = \dfrac{2xz}{x+z}$ **(B)** $y^2 = xz$ **(C)** $2y = x + z$ **(D)** $\dfrac{x}{z} = \dfrac{x-y}{y-z}$

18. $\log_{10} 5 \cdot \log_{10} 20 + (\log_{10} 2)^2$ when simplified reduces to

(A) an odd prime number (B) an even prime

(C) a rational number (D) an integer

19. Which of the following when simplified reduces to unity ?

(A) $\log_3 \log_{27} \log_4 64$ (B) $2 \log_{18} (\sqrt{2} + \sqrt{8})$

(C) $\log_2 \sqrt{10} + \log_2 \left(\frac{2}{\sqrt{5}}\right)$ (D) $-\log_{\sqrt{2}-1} (\sqrt{2} + 1)$

20. If $x, y, z \in R^+$ and $z \in R$ then the system $x + y + z = 2$, $2xy - z^2 = 4$

(A) is satisfied for $x = 2, y = 2, z = -2$

(B) has only one real solution

(C) has only two real solution

(D) has infinite solutions.

SECTION - III : ASSERTION AND REASON TYPE

21. **Statement-1 :** If 2, 3 & 6 are the sides of a triangle then it is an obtuse angled triangle.

Statement-2 : If $b^2 > a^2 + c^2$, where b is the greatest side, then triangle must be obtuse angled.

(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

22. **Statement-1 :** Minimum value of $|x-2| + |x-5| + |x+3|$ is 8.

Statement-2 : If $a < b < c$, then the minimum value of $|x-a| + |x-b| + |x-c|$ is $|b-a| + |b-c|$.

(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

23. **Statement-1 :** $\log_e x > \log_e y \Rightarrow x > y, x, y > 0$

Statement-2 : If $\log_a x > \log_a y$, then $x > y$ $(x, y > 0$ & $a > 0, a \neq 1)$

(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

24. **Statement-1 :** $[x] + [-x] = x^2 - 5x + 6$ has only two real solution.

Statement-2 : $[x] + [-x] = \begin{cases} -1 , & x \notin I \\ 0 , & x \in I \end{cases}$

(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

25. **Statement-1 :** If $ax^2 + \alpha x + \beta = 0$, where $\alpha, \beta \in R$, has roots a, b and $\log_a b < 0$, then $\alpha + \beta < 0$.

Statement-2 : If $ax^2 + \alpha x + \beta = 0$, where $\alpha, \beta \in R$, has roots a, b and $\log_a b < 0$, then $a + \alpha + \beta$ must be negative.

(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

SECTION - IV : COMPREHENSION TYPE

Read the following comprehensions carefully and answer the questions.

Comprehension # 1

The general procedure for solving equation containing modulus function is to split the domain into subintervals and solve the various cases. But there are certain structures of equations which can be solved by a different approach. For example, for solving the equation $|f(x)| + |g(x)| = f(x) - g(x)$ one can follow this method. First find the permissible set of values of x for the equation.

Since LHS $\geq 0 \Rightarrow f(x) - g(x) \geq 0$. Now squaring both sides, we get

$f^2 + g^2 + 2|f.g| = f^2 + g^2 - 2fg$

$\Rightarrow$ $|fg| = -fg$. The equation can hold if $f.g \leq 0$ and $f \geq g$. This can be simplified to $f \geq 0, g \leq 0$.

Answer the following questions on the basis of this method

26. The complete solution of the equation $|x^3 - x| + |2 - x| = x^3 - 2$ is

(A) $[2, \infty)$ **(B)** $[-1, 0] \cup [2, \infty)$ **(C)** $\left[2^{\frac{1}{3}}, \infty\right)$ **(D)** none of these

27. The complete solution set of the equation $|x^2 - x| + |x + 3| = |x^2 - 2x - 3|$ is

(A) $[1, \infty)$ **(B)** $[-3, 0] \cup [1, \infty)$ **(C)** $(-\infty, -3]$ **(D)** $(-\infty, -3] \cup [0, 1]$

28. All the condition(s) for which $|f(x) - g(x)| = |f(x)| + |g(x)|$ is true, is

(A) $f(x) \geq 0, g(x) \leq 0$ **(B)** $f(x) \leq 0, g(x) \geq 0$ **(C)** $f(x) . g(x) \leq 0$ **(D)** $f(x) . g(x) = 0$

Comprehension # 2

Let $a_1 < a_2 < a_3 < .... < a_n$, n is an odd natural number and $m, k \in N$

Consider the equation

$$|x - a_1| + |x - a_2| + |x - a_3| + ... + |x - a_n| = kx + d.$$

Case-1 When $2m - n = k$ for some $m < n$, then the equation has

(i) no solution if $(a_{m+1} + a_{m+2} + ... + a_n) - (a_1 + a_2 + ... + a_m) > d$

(ii) infinite solutions if $(a_{m+1} + a_{m+2} + ... + a_n) - (a_1 + a_2 + ... + a_m) = d$

(iii) two solutions if $(a_{m+1} + a_{m+2} + ... + a_n) - (a_1 + a_2 + ... + a_m) < d$

Case-2 Let when $2m - n \neq k$ for any $m < n$

Two cases arise

(A) If $|k| > n$, then there is one solution.

(B) If $|k| < n$, then there is m such that $2m - (n - 1) = k$.

(i) If $(a_{m+2} + a_{m+3} + ... + a_n) - (a_1 + a_2 + ... + a_m) > d$ no solution

(ii) If $(a_{m+2} + a_{m+3} + ... + a_n) - (a_1 + a_2 + ... + a_m) = d$ one solution

(iii) If $(a_{m+2} + a_{m+3} + ... + a_n) - (a_1 + a_2 + ... + a_m) < d$ two solutions

29. Number of solutions of $|x - 1| + |x - 3| + |x - 4| + |x - 7| + |x - 9| = 3x + 5$ is

(A) 0 **(B)** 1 **(C)** 2 **(D)** infinite

30. Number of solutions of $|x-1|+|x-3|+|x-4|+|x-7|+|x-10| = 2x+1$ is

(A) 0 (B) 1 (C) 2 (D) None of these

31. Number of solutions of $|x-1|+|x-2|+|x-4|+|x-6|+|x-7| = 2x+10$ is

(A) 0 (B) 1 (C) 2 (D) None of these

SECTION - V : MATRIX - MATCH TYPE

32. **Match the following :**

Column – I		Column – II	
(A)	Set of all values of x satisfying the inequation $\frac{5x+1}{(x+1)^2} < 1$ is	(P)	$(-\infty, 0) \cup (0, 2) \cup (2, \infty)$
(B)	Set of all values of x satisfying the inequation $|x| + |x-3| > 3$ is	(Q)	$(-\infty, -5) \cup (-3, 3) \cup (5, \infty)$
(C)	Set of all values of x satisfying the inequation $\frac{1}{|x|-3} < \frac{1}{2}$ is	(R)	$(-\infty, -1) \cup (-1, 0) \cup (3, \infty)$
(D)	Set of all values of x satisfying the inequation $\frac{x^4}{(x-2)^2} > 0$ is	(S)	$(0, 3) \cup (4, \infty)$
		(T)	$(-\infty, 0) \cup (3, \infty)$

33. **Match the following**

Column – I		Column – II	
(A)	If $\log_{\sin x}(\log_3(\log_{0.2} x)) < 0$, then	(P)	$x \in [-1, 1]$
(B)	If $\frac{(e^x-1)(2x-3)(x^2+x+2)}{(\sin x-2)\,x(x+1)} \le 0$, then	(Q)	$x \in [-3, 6)$
(C)	If $|2-|[x]-1|| \le 2$, then (where [.] represents greatest integer function).	(R)	$x \in \left(0, \frac{1}{125}\right)$
(D)	If $|\sin^{-1}(3x-4x^3)| \le \frac{\pi}{2}$, then	(S)	$x \in (1, \infty)$
		(T)	$x \in (-\infty, -1) \cup \left[\frac{3}{2}, \infty\right)$

34. Match the column

Column – I		Column – II	
(A)	$x\lvert x\rvert=$	**(P)**	$\begin{cases}-2x & : \quad x<-1\\ 2 & : \quad -1\le x\le 1\\ 2x & : \quad x\ge 1\end{cases}$
(B)	$\lvert x-1\rvert+\lvert x+1\rvert=$	**(Q)**	$\begin{cases}-x^2 & : \quad x\le 0\\ x^2 & : \quad x>0\end{cases}$
(C)	If $-1\le x<2$, then $2x-\{x\}=$	**(R)**	$\begin{cases}-x & : \quad -1\le x<0\\ 0 & : \quad 0\le x<1\\ x & : \quad 1\le x<2\end{cases}$
(D)	If $-1\le x<2$, then $x[x]=$	**(S)**	$\begin{cases}x-1 & : \quad -1\le x<0\\ x+1 & : \quad 0\le x<2\end{cases}$
		(T)	$\begin{cases}x-1 & : \quad -1\le x<0\\ x & : \quad 0\le x<1\\ x+1 & : \quad 1\le x<2\end{cases}$

35. **Match the column**

Column- I		Column-II	
(A)	Interval containing all the solutions of the inequality $3-x>3\sqrt{1-x^2}$ is	**(P)**	$\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$
(B)	Interval containing all the solutions of the inequality $\left(\frac{1}{3}\right)^{\sqrt{x+2}}<3^{-x}$ is	**(Q)**	(π,π^2)
(C)	Interval containing all the solutions of the inequality $\log_5(x-3)+\frac{1}{2}\log_5 3<\frac{1}{2}\log_5(2x^2-6x+7)$ is	**(R)**	$(-\pi,\pi)$
(D)	Interval containing all the solutions of the equation $7^{x+2}-\frac{1}{7}.7^{x+1}-14.7^{x-1}+2.7^x=48$ is	**(S)**	$(-e,e)$
		(T)	$([\pi],-[-\pi^2])$, where [.] is G.I.F.

SECTION - VI : INTEGER TYPE

36. The inequality $\log_{x^2}\lvert x-1\rvert>0$ is not defined for some integral values of x, find the sum of their magnitudes.

37. If set of all real values of x satisfying $\lvert x^2-3x-1\rvert<\lvert 3x^2+2x+1\rvert+\lvert 2x^2+5x+2\rvert$, $x^2-3x-1\ne 0$ is $(-\infty,-a)\cup(-b,\infty)$, then find the value of $a+\log ab$.

38. Let $f(x)=\begin{cases}1 & , \quad -2\le x\le -1\\ x+2 & , \quad -1<x<1\\ 4-x & , \quad 1\le x\le 2\end{cases}$

Find number of solutions of $\{f(x)\}=\frac{1}{2}$ (where {.} denotes fractional part function)

39. Find the number of integral solution of the equation $\sqrt{\left[x+\left[\frac{x}{2}\right]\right]}+\left[\sqrt{\{x\}}+\left[\frac{x}{3}\right]\right]=3$. (where [ ] denotes greatest integer function)

MOCK TEST : VECTOR

SECTION - I : STRAIGHT OBJECTIVE TYPE

1. If $\vec a, \vec b$ are unit vectors such that $(\vec a + \vec b) \cdot \{(2\vec a + 3\vec b) \times (3\vec a - 2\vec b)\} = 0$, then angle between $\vec a$ and $\vec b$ is -

(A) 0 **(B)** $\pi/2$ **(C)** π **(D)** indeterminate

2. If $\vec a' = \hat i + \hat j$, $\vec b' = \hat i - \hat j + 2\hat k$ & $\vec c' = 2\hat i + \hat j - \hat k$. Then altitude of the parallelepiped formed by the vectors $\vec a, \vec b, \vec c$ having base formed by $\vec b$ & $\vec c$ is ($\vec a, \vec b, \vec c$ and $\vec a', \vec b', \vec c'$ are reciprocal systems of vectors)

(A) 1 **(B)** $\frac{3\sqrt{2}}{2}$ **(C)** $\frac{1}{\sqrt{6}}$ **(D)** $\frac{1}{\sqrt{2}}$

3. A unit vector $\vec a$ in the plane of $\vec b = 2\hat i + \hat j$ & $\vec c = \hat i - \hat j + \hat k$ is such that $\vec a \wedge \vec b = \vec a \wedge \vec d$ where $\vec d = \hat j + 2\hat k$ is

(A) $\frac{\hat i + \hat j + \hat k}{\sqrt{3}}$ **(B)** $\frac{\hat i - \hat j + \hat k}{\sqrt{3}}$ **(C)** $\frac{2\hat i + \hat j}{\sqrt{5}}$ **(D)** $\frac{2\hat i + \hat j}{\sqrt{5}}$

4. Let $\vec r, \vec a, \vec b$ & $\vec c$ be four non-zero vectors such that $\vec r \cdot \vec a = 0$, $|\vec r \times \vec b| = |\vec r|\,|\vec b|$, $|\vec r \times \vec c| = |\vec r|\,|\vec c|$, then [a b c] =

(A) $|a|\ |b|\ |c|$ **(B)** $-\ |a|\ |b|\ |c|$ **(C)** 0 **(D)** none of these

5. If $\vec a_1$, $\vec a_2$ & $\vec a_3$ are non-coplanar vectors and

$$(x+y-3)\,\vec a_1 + (2x-y+2)\,\vec a_2 + (2x+y+\lambda)\,\vec a_3 = \vec 0$$

holds for some 'x' and 'y' then 'λ' is

(A) $\frac{7}{3}$ **(B)** 2 **(C)** $-\frac{10}{3}$ **(D)** $\frac{5}{3}$

6. If $\vec a = \hat i + \hat j$, $\vec b = \hat j + \hat k$, $\vec c = \hat k + \hat i$, then in the reciprocal system of vectors of the vectors $\vec a, \vec b, \vec c$, reciprocal $\vec a'$ of vector $\vec a$ is

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

7. If $\vec a + 2\vec b + 3\vec c = \vec 0$, then $\vec a \times \vec b + \vec b \times \vec c + \vec c \times \vec a$ is equal to

(A) $6(\vec b \times \vec c)$ **(B)** $6(\vec c \times \vec a)$ **(C)** $6(\vec a \times \vec b)$ **(D)** none of these

8. Let $\vec a, \vec b, \vec c$ be three non coplanar vectors and $\vec r$ be any vector in space such that $\vec r \cdot \vec a = 1$, $\vec r \cdot \vec b = 2$ and $\vec r \cdot \vec c = 3$. If $[\vec a\ \vec b\ \vec c] = 1$, then $\vec r$ is equal to -

(A) $\vec a + 2\vec b + 3\vec c$ **(B)** $(\vec b \times \vec c) + 2(\vec c \times \vec a) + 3(\vec a \times \vec b)$

(C) $(\vec b \cdot \vec c)\vec a + 2(\vec c \cdot \vec a)\vec b + 3(\vec a \cdot \vec b)\vec c$ **(D)** None of these

9. If three vectors $\vec a = x\hat i + y\hat j + z\hat k$, $\vec b = \hat j$ and $\vec c$ are such that $\vec a$, $\vec c$ and $\vec b$ form a right-handed system, then $\vec c$ is

(A) $z\hat i - x\hat k$ (B) $\vec 0$ (C) $y\hat j$ (D) $-z\hat i + x\hat k$

10. **S1 :** If $\vec a \neq \vec 0$, $\vec b \neq \vec 0$ and $\vec a$, $\vec b$ are non-collinear, then $\vec a$, $\vec b$ and $\vec a + \vec b$ are coplanar vectors.

S2 : Vector $3\hat i - 4\hat j + 7\hat k$, $4\hat i + 7\hat j - 2\hat k$ and $\hat i + 11\hat j - 9\hat k$ form a triangle .

S3 : $[\vec a \;\; \vec a+\vec b \;\; \vec a+\vec b+\vec c] = 2\,[\vec a \;\vec b\; \vec c]$

S4 : If $(\vec a\times\vec b)\times\vec c = \vec a \times (\vec b\times\vec c) \neq \vec 0$, then $\vec c \times (\vec a\times\vec b) = \vec 0$

(A) TTFF (B) FFTT (C) FTFT (D) TTTF

11. **S1 :** If $\lambda \in R$, $\lambda \neq 0$ and $\vec a \neq \vec 0$, then vectors $\vec a$ and $\lambda\vec a$ are non-parallel vectors.

S2 : minimum value of $\vec a \cdot \vec b$ is 0

S3 : If $\vec a$ and $\vec b$ are non-collinear vectors, then $|(\vec a+\vec b)\times(\vec a-\vec b)|$ is equal to twice the area of the parallelogram formed by $\vec a$ and $\vec b$.

S4 : $(\vec a\times\vec b)^2 = \begin{vmatrix} \vec a.\vec a & \vec b.\vec a \\ \vec a.\vec b & \vec b.\vec b \end{vmatrix}$

(A) TTFF (B) FFTT (C) FTFT (D) TTTF

12. **S1 :** $|\vec a| = |\vec b| = |\vec a - \vec b| = 1$, then angle between $\vec a$ and $\vec b$ is $\frac{\pi}{2}$.

S2 : $\dfrac{\vec a+\vec b}{2}$ is a vector in the direction of angle bisector of vectors $\vec a$ and $\vec b$.

S3 : $(\vec a\,.\,\hat i)^2 + (\vec a\,.\,\hat j)^2 + (\vec a\,.\,\hat k)^2$ is equal to $\vec a^2$

S4 : Vector perpendicular to $-\hat i + \hat j + \hat k$ and coplanar with $\hat i + \hat j + \hat k$ and $-\hat i + \hat j + \hat k$ is $3\hat i + 2\hat j + \hat k$

(A) TFTF (B) FTFT (C) FTTF (D) FFTF

13 **S1 :** If $\vec a, \vec b$ and $\vec c$ are three non-coplanar vectors and $\vec d\,.\,\vec a = \vec d\,.\,\vec b = \vec d\,.\,\vec c = 0$, then $\vec d$ is a zero vector.

S2 : If $\vec a, \vec b$ and $\vec c$ are three non-coplanar vectors, then the vector $\vec a\times\vec b + b\times\vec c + \vec c\times\vec a$ and $\vec a + \vec b + \vec c$ are perpendicular to each other.

S3 : If $\vec a$ and $\vec c$ are perpendicular to each other, then the vectors $\vec a\times(\vec b\times\vec c)$ and $(\vec a\times\vec b)\times\vec c$ are also perpendicular to each other.

S4 : If $\vec a, \vec b, \vec c$ and $\vec d$ are coplanar vectors, then $(\vec a\times\vec b)\times(\vec c\times\vec d) = \vec 0$.

(A) TTFF (B) FFTT (C) FTFT (D) TFTT

SECTION - II : MULTIPLE CORRECT ANSWER TYPE

14. If $\vec{a}$ and $\vec{b}$ unequal unit vectors such that $(\vec{a}-\vec{b})\times[(\vec{b}+\vec{a})\times(2\vec{a}+\vec{b})]=\vec{a}+\vec{b}$, then smaller angle θ between $\vec{a}$ and $\vec{b}$ is

(A) $\frac{\pi}{2}$ **(B)** 0 **(C)** π **(D)** $\frac{\pi}{4}$

15. Identify the statement(s) which is/are **incorrect** ?

(A) $\vec{a}\ \mathrm{x}\left[\vec{a}\times\left(\vec{a}\times\vec{b}\right)\right]=\left(\vec{a}\times\vec{b}\right)\left(\vec{a}^2\right)$

(B) If $\vec{a}, \vec{b}, \vec{c}$ are non-zero, non coplanar vectors, and $\vec{v}\cdot\vec{a}=\vec{v}\cdot\vec{b}=\vec{v}\cdot\vec{c}=0$ then $\vec{v}$ must be a null vector

(C) If $\vec{a}$ and $\vec{b}$ lie in a plane normal to the plane containing the vectors $\vec{a}\times\vec{b}$, $\vec{c}\times\vec{d}$; $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are non-zero vector, then $\left(\vec{a}\times\vec{b}\right)\mathrm{x}\left(\vec{c}\times\vec{d}\right)=\vec{0}$

(D) If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{a}', \vec{b}', \vec{c}'$ are reciprocal system of vectors then $\vec{a}\cdot\vec{b}'+\vec{b}\cdot\vec{c}'+\vec{c}\cdot\vec{a}'=3$

SECTION - III : ASSERTION AND REASON TYPE

16. **Statement – 1** : If $\vec{a}=3\hat{i}+\hat{k}$, $\vec{b}=-\hat{i}+2\hat{j}+\hat{k}$, $\vec{c}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{d}=2\hat{i}-\hat{j}$, then there exist real numbers α, β, γ such that $\vec{a}=\alpha\vec{b}+\beta\vec{c}+\gamma\vec{d}$

Statement – 2 : $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are four vectors in a 3 – dimensional space. If $\vec{b}, \vec{c}, \vec{d}$ are non-coplanar, then there exist real numbers α, β, γ such that $\vec{a}=\alpha\vec{b}+\beta\vec{c}+\gamma\vec{d}$

(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

17. **Statement – 1** : Let $A(\vec{a})$, $B(\vec{b})$ and $C(\vec{c})$ be three points such that $\vec{a}=2\hat{i}+\hat{j}+\hat{k}$, $\vec{b}=3\hat{i}-\hat{j}+3\hat{k}$ and $\vec{c}=-\hat{i}+7\hat{j}-5\hat{k}$, then OABC is a tetrahedron.

Statement – 2 : Let $A(\vec{a})$, $B(\vec{b})$ and $C(\vec{c})$ be three points such that $\vec{a}$, $\vec{b}$ and $\vec{c}$ are non-coplanar. then OABC is a tetrahedron, where O is the origin.

(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

18. **Statement – 1** : Let $\vec{a} = 2\hat{i}+3\hat{j}-\hat{k}$, $\vec{b} = 4\hat{i}+6\hat{j}-2\hat{k}$, then $\vec{a}\times\vec{b} = \vec{0}$

Statement – 2 : If $\vec{a} \neq \vec{0}$, $\vec{b} \neq \vec{0}$ and $\vec{a}$ and $\vec{b}$ are non-collinear vectors, then $\vec{a}\times\vec{b}$ = ab sin θ $\hat{n}$, where θ is the smaller angle between the vectors $\vec{a}$ and $\vec{b}$ and $\hat{n}$ is unit vector such that $\vec{a}, \vec{b}, \hat{n}$ taken in this order form right handed orientation

(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

19. **Statement-1 :** Let $\vec{a}, \vec{b}, \vec{c}$ & $\vec{d}$ are position vectors of four points A, B, C & D and $3\vec{a}-2\vec{b}+5\vec{c}-6\vec{d}=\vec{0}$, then points A, B, C and D are coplanar.

Statement-2 : Three non zero, linearly dependent co-initial vectors ($\overrightarrow{PQ}, \overrightarrow{PR}$ & $\overrightarrow{PS}$) are coplanar.

(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

20. **Statement-1 :** Let $\vec{a} = 3\hat{i}-\hat{j}$, $\vec{b} = 2\hat{i}+\hat{j}-3\hat{k}$. If $\vec{b} = \vec{b}_1+\vec{b}_2$ such that $\vec{b}_1$ is collinear with $\vec{a}$ and $\vec{b}_2$ is perpendicular to $\vec{a}$ is possible, then $\vec{b}_2 = \hat{i}+3\hat{j}-3\hat{k}$.

Statement-2 : If $\vec{a}$ and $\vec{b}$ are non-zero, non-collinear vectors, then $\vec{b}$ can be expressed as $\vec{b} = \vec{b}_1+\vec{b}_2$, where $\vec{b}_1$ is collinear with $\vec{a}$ and $\vec{b}_2$ is perpendicular to $\vec{a}$.

(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

SECTION - IV : COMPREHENSION TYPE

Read the following comprehensions carefully and answer the questions.

Comprehension # 1

Let $\vec{a} = 2\hat{i}+3\hat{j}-6\hat{k}$, $\vec{b} = 2\hat{i}-3\hat{j}+6\hat{k}$ and $\vec{c} = -2\hat{i}+3\hat{j}+6\hat{k}$. Let $\vec{a}_1$ be projection of $\vec{a}$ on $\vec{b}$ and $\vec{a}_2$ be the projection of $\vec{a}_1$ on $\vec{c}$, then

21. $\vec{a}_2$ =

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

22. $\vec{a}_1 . \vec{b}$ =

(A) –41 (B) $-\frac{41}{7}$ (C) 41 (D) 287

23. Which of the following is true

(A) $\vec{a}$ and $\vec{a}_2$ are collinear (B) $\vec{a}_1$ and $\vec{c}$ are collinear

(C) $\vec{a}, \vec{a}_1, \vec{b}$ are coplanar (D) $\vec{a}, \vec{a}_1, \vec{a}_2$ are coplanar

Comprehension # 2

Three vector $\hat{a}$, $\hat{b}$ and $\hat{c}$ are forming a right handed system, if $\hat{a}\times\hat{b}=\hat{c}$, $\hat{b}\times\hat{c}=\hat{a}$, $\hat{c}\times\hat{a}=\hat{b}$, then answer the following question

24. If vector $3\hat{a}-2\hat{b}+2\hat{c}$ and $-\hat{a}-2\hat{c}$ are adjacent sides of a parallelogram, then an angle between the diag onals is

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

25. If $\vec{x}=\hat{a}+\hat{b}-\hat{c}$, $\vec{y}=-\hat{a}+\hat{b}-2\hat{c}$, $\vec{z}=-\hat{a}+2\hat{b}-\hat{c}$, then a unit vector normal to the vectors $\vec{x}+\vec{y}$ and $\vec{y}+\vec{z}$ is

(A) $\vec{a}$ (B) $\vec{b}$ (C) $\vec{c}$ (D) none of these

26. Vectors $2\hat{a}-3\hat{b}+4\hat{c}$, $\hat{a}+2\hat{b}-\hat{c}$ and $x\hat{a}-\hat{b}+2\hat{c}$ are coplanar, then x =

(A) $\frac{8}{5}$ (B) $\frac{5}{8}$ (C) 0 (D) 1

27. Let $\vec{x}=\vec{a}+\vec{b}$, $\vec{y}=2\vec{a}-\vec{b}$, then the point of intersection of straight lines $\vec{r}\times\vec{x}=\vec{y}\times\vec{x}$, $\vec{r}\times\vec{y}=\vec{x}\times\vec{y}$ is

(A) $2\vec{b}$ (B) $3\vec{b}$ (C) $3\vec{a}$ (D) $2\vec{a}$

28. $\hat{a}.(\hat{b}\times\hat{c}) + \hat{b}.(\hat{c}\times\hat{a}) + \hat{c}.(\hat{a}\times\hat{b})$ is equal to

(A) 1 (B) 3 (C) 0 (D) – 12

SECTION - V : MATRIX - MATCH TYPE

29. **Match the column**

Column - I		Column - I	
(A)	If $\vec{a}+\vec{b}=\hat{j}$ and $2\vec{a}-\vec{b}=3\hat{i}+\frac{\hat{j}}{2}$, then modulus of cosine of the angle between $\vec{a}$ and $\vec{b}$ is	(P)	1
(B)	If $\lvert\vec{a}\rvert=\lvert\vec{b}\rvert=\lvert\vec{c}\rvert$, angle between each pair of vectors is $\frac{\pi}{3}$ and $\lvert\vec{a}+\vec{b}+\vec{c}\rvert=\sqrt{6}$, then $\lvert\vec{a}\rvert=$	(Q)	$5\sqrt{3}$
(C)	Area of the parallelogram whose diagonals represent the vectors $3\hat{i}+\hat{j}-2\hat{k}$ and $\hat{i}-3\hat{j}+4\hat{k}$ is	(R)	2
(D)	If $\vec{a}$ is perpendicular to $\vec{b}+\vec{c}$, $\vec{b}$ is perpendicular to $\vec{c}+\vec{a}$, $\vec{c}$ is perpendicular to $\vec{a}+\vec{b}$, $\lvert\vec{a}\rvert=2$, $\lvert\vec{b}\rvert=3$ and $\lvert\vec{c}\rvert=6$, then $\lvert\vec{a}+\vec{b}+\vec{c}\rvert=$	(S)	7
		(T)	$\frac{3}{5}$

30. **Match the column**

	Column – I		Column – II
(A)	The area of the triangle whose vertices are the points with rectangular cartesian coordinates (1, 2, 3), (–2, 1, – 4), (3, 4, – 2) is	(P)	0
(B)	The value of $(\vec{a}\times\vec{b}).(\vec{c}\times\vec{d}) + (\vec{b}\times\vec{c}).(\vec{a}\times\vec{d}) + (\vec{c}\times\vec{a}).(\vec{b}\times\vec{d})$ is	(Q)	28
(C)	A square PQRS of side length P is folded along the diagonal PR so that the point Q reaches at Q′ and planes PRQ′ and PRS are perpendicular to one another, the shortest distance between PQ′ and RS is $\frac{kP}{\sqrt{6}}$, then k =	(R)	2
(D)	$\vec{a} = 2\hat{i}+3\hat{j}-\hat{k}$, $\vec{b} = -\hat{i}+2\hat{j}-4\hat{k}$, $\vec{c} = \hat{i}+\hat{j}+\hat{k}$ and $\vec{d} = 3\hat{i}+2\hat{j}+\hat{k}$ then $(\vec{a}\times\vec{b}).(\vec{c}\times\vec{d}) =$	(S)	$\frac{\sqrt{1218}}{2}$
		(T)	21

ANSWER KEY

EXERCISE - 1

1. A **2.** A **3.** B **4.** C **5.** A **6.** B **7.** B **8.** A **9.** A **10.** B **11.** B **12.** D **13.** A
14. B **15.** A **16.** D **17.** D **18.** A **19.** C **20.** B **21.** C **22.** D **23.** B **24.** B **25.** B **26.** A
27. D **28.** A **29.** D **30.** A **31.** A **32.** B **33.** B **34.** A

EXERCISE - 2 : PART # I

1. A **2.** C **3.** C **4.** D **5.** B,D **6.** B **7.** D **8.** D **9.** C **10.** A,C **11.** B **12.** B **13.** B
14. B **15.** B,C **16.** C **17.** B,C **18.** A **19.** A **20.** A **21.** C

PART # II

1. A **2.** C **3.** C **4.** D **5.** B **6.** A **7.** C **8.** B **9.** D **10.** A **11.** A **12.** A

EXERCISE - 3 : PART # I

1. A $\rightarrow$ q, B $\rightarrow$ r, C $\rightarrow$ s, D $\rightarrow$ s **2.** A $\rightarrow$ r, B $\rightarrow$ p, C $\rightarrow$ q, D $\rightarrow$ s **3.** A $\rightarrow$ q, B $\rightarrow$ r, C $\rightarrow$ p, D $\rightarrow$ s

PART # II

Comprehension #1 : **1.** B **2.** A **3.** D **Comprehension #2 :** **1.** A **2.** B **3.** C
Comprehension #3 : **1.** C **2.** D **3.** D **Comprehension #4 :** **1.** A **2.** B **3.** C

EXERCISE - 4

1. (i) $\theta = 90^0$ (ii) 3, (iii) $-2\hat{i}+3\hat{j}+\hat{k}$ **3.** (i) $\frac{1}{5}\left(\hat{j}+2\hat{k}\right)$, $3\hat{i}+\frac{4}{5}\hat{j}-\frac{2}{5}\hat{k}$ (ii) 7 units (iii) $\frac{2}{7}\hat{i}-\frac{6}{7}\hat{j}+\frac{3}{7}\hat{k}$

4. (i) No, yes (ii) yes (iii) vectors are collinear (iv) 90^0 (v) no (vi) never (vii) no **5.** $\frac{7}{2}\left(\hat{i}+\hat{j}\right)$, $-\frac{1}{2}\left(\hat{i}-\hat{j}\right)$

6. 327.9 N **7.** $2\sqrt{19}$, $\tan^{-1}\left(\frac{3\sqrt{3}}{7}\right)$ **9.** $y = \frac{-b}{a^2}x^2$ **10.** $c_x = \pm 4$, $c_y = \mp 3$

11. (i) No, Yes (ii) No, (iii) No, Yes (iv) No **12.** $\sqrt{50}$ m, $\sqrt{74}$ m **13.** (i) $36\hat{i}-144t\hat{j}$ (ii) $(-288\,t^3+864t^2)\hat{k}$

(iii) $(36t-36)\,\hat{i}-72\,t^2\,\hat{j}$ (iv) $-72\,t^4+288\,t^3)\,\hat{k}$ **14.** (i) up (ii) 0 (iii) 1 (iv) $\vec{0}$ **15.** Only C and D are permissible

16. $5P\hat{j}, 4P\hat{i}, 6P\hat{i}+8P\hat{j}, -12P\hat{i}-9P\hat{j}$, $\sqrt{20}P, \tan^{-1}[-2]$ with +ve x-axis **17.** 50 km, 53^0 north of east **18.** 5 J

19. $\vec{A} = A\sin\theta\hat{i} - A\cos\theta\hat{k}$, $\vec{B} = B\sin\theta'\hat{j} - B\cos\theta'\hat{k}$ **20.** (i) $\vec{v} = v_0\hat{i} + a_0b_0e^{b_0t}\hat{k}$ (ii) $|\vec{v}| = \sqrt{v_0^2 + a_0^2b_0^2e^{2b_0t}}$

(iii) $\vec{a} = a_0b_0^2e^{b_0t}\hat{k}$ **21.** 100 m/s² **22.** 3.5 s **24.** 1044 **25.** $\sqrt{5}$ **26.** $3\hat{i}+94\hat{j}+4\hat{k}\,m/s$

27. (i) i + tj + k, (ii) $\sqrt{t^2+2}$, (iii) j, (iv) 1, (v) $t/\sqrt{t^2+2}$, (vi) $\sqrt{2}/\sqrt{t^2+2}$

28. (i) $\vec{v} = (5\sin t - 3)\hat{i} + (3\cos t - 1)\hat{j}$, (ii) $(2-5\cos t-3t)\hat{i}+(2+3\sin t - t)\hat{j}$

EXERCISE - 5 : PART # I

1. 1 **2.** 2 **3.** 3

PART # II

1. A **3.** B **5.** 4 **6.** ABC

MOCK TEST : BASIC MATHS

1. C **2.** B **3.** C **4.** B **5.** C **6.** A **7.** D **8.** B **9.** D **10.** A

11. B **12.** C **13.** A **14.** B **15.** B **16.** A **17.** A,D **18.** C,D **19.** B,D

20. A,B **21.** D **22.** A **23.** C **24.** A **25.** A **26.** A **27.** D **28.** C

29. C **30.** A **31.** C

32. A $\rightarrow$ (r), B $\rightarrow$ (t), C $\rightarrow$ (q), D $\rightarrow$ (p)

33. A $\rightarrow$ (r), B $\rightarrow$ (t), C $\rightarrow$ (p,q,r), D $\rightarrow$ (p,q)

34. A $\rightarrow$ (q), B $\rightarrow$ (p), C $\rightarrow$ (t), D $\rightarrow$ (r)

35. A $\rightarrow$ (p,r,s), B $\rightarrow$ (r,s), C $\rightarrow$ (t), D $\rightarrow$ (p,r,s)

36. (4) **37.** (2) **38.** (3) **39.** (1)

MOCK TEST : VECTOR

1.	D	**2.**	D	**3.**	B	**4.**	C	**5.**	C	**6.**	D	**7.**	A
8.	B	**9.**	A	**10.**	A	**11.**	B	**12.**	D	**13.**	D	**14.**	A,C
15.	A,C,D	**16.**	B	**17.**	D	**18.**	B	**19.**	A	**20.**	D	**21.**	B
22.	A	**23.**	C	**24.**	A	**25.**	D	**26.**	A	**27.**	C	**28.**	B

29. A $\rightarrow$ (t), B $\rightarrow$ (p), C $\rightarrow$ (q), D $\rightarrow$ (s)

30. A $\rightarrow$ (s), B $\rightarrow$ (p), C $\rightarrow$ (r), D $\rightarrow$ **(t)**