

PRACTICE EXERCISES
SINGLE CORRECT CHOICE TYPE QUESTIONS

This section contains Single Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

- A particle starts from rest at the origin with a constant acceleration $\vec{a} = 2\hat{i} + 8\hat{j} - 6\hat{k} \text{ ms}^{-2}$. Its position at $t = 5 \text{ s}$ is

(A) $(25\hat{i} + 100\hat{j} - 75\hat{k}) \text{ m}$ (B) $(25\hat{i} - 100\hat{j} - 75\hat{k}) \text{ m}$
 (C) $(100\hat{i} - 25\hat{j} + 75\hat{k}) \text{ m}$ (D) $(25\hat{i} - 100\hat{j} + 75\hat{k}) \text{ m}$
- Three forces $\vec{F}_1 = (3\hat{i} + 2\hat{j} - \hat{k})\text{N}$, $\vec{F}_2 = (3\hat{i} + 4\hat{j} - 5\hat{k})\text{N}$ and $\vec{F}_3 = A(\hat{i} + \hat{j} - \hat{k})\text{N}$ act simultaneously on a particle. In order that the particle remains in equilibrium, the value of A should be

(A) -6 (B) 6
 (C) 9 (D) -9
- The magnitude of vector product of two non zero vectors \vec{A} and \vec{B} is zero. The scalar product of \vec{A} and $\vec{A} + \vec{B}$ is equal to

(A) zero (B) AB
 (C) A^2 (D) $A^2 + AB$
- The magnitude of resultant of two equal forces is equal to either of two forces. The angle between forces is

(A) $\frac{\pi}{3}$ (B) $\frac{2\pi}{3}$
 (C) $\frac{\pi}{2}$ (D) $\frac{3\pi}{4}$
- The condition under which the vectors $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$ are parallel is

(A) $\vec{a} \perp \vec{b}$ (B) $|\vec{a}| = |\vec{b}|$
 (C) $\vec{a} \neq \vec{b}$ (D) $\vec{a} \parallel \vec{b}$
- The two vectors \vec{A} and \vec{B} that are parallel to each other are

(A) $\vec{A} = 3\hat{i} + 6\hat{j} + 9\hat{k}$, $\vec{B} = \hat{i} + 2\hat{j} + 3\hat{k}$
 (B) $\vec{A} = 3\hat{i} - 6\hat{j} + 9\hat{k}$, $\vec{B} = \hat{i} + 2\hat{j} + 3\hat{k}$
 (C) $\vec{A} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{B} = \hat{i} + 2\hat{j} - 3\hat{k}$
 (D) $\vec{A} = 3\hat{i} + 6\hat{j} - 9\hat{k}$, $\vec{B} = \hat{i} - 2\hat{j} - 3\hat{k}$
- The sum, difference and cross product of two vectors \vec{A} and \vec{B} are mutually perpendicular if

(A) \vec{A} and \vec{B} are perpendicular to each other
 (B) \vec{A} and \vec{B} are perpendicular but their magnitudes are arbitrary
 (C) $|\vec{A}| = |\vec{B}|$ and their directions are arbitrary
 (D) $\vec{A} \perp \vec{B}$ and $|\vec{A}| = |\vec{B}|$
- Three forces 9, 12 and 15 N acting at a point are in equilibrium. The angle between 9 N and 15 N is

(A) $\cos^{-1}\left(\frac{3}{5}\right)$ (B) $\cos^{-1}\left(\frac{4}{5}\right)$
 (C) $\pi - \cos^{-1}\left(\frac{3}{5}\right)$ (D) $\pi - \cos^{-1}\left(\frac{4}{5}\right)$
- The condition that $(\vec{a} \cdot \vec{b})^2 = a^2 b^2$ is satisfied when

(A) $\vec{a} \parallel \vec{b}$ (B) $\vec{a} \neq \vec{b}$
 (C) $\vec{a} \cdot \vec{b} = 1$ (D) $\vec{a} \perp \vec{b}$
- The sides of the triangle representing three force vectors are in the ratio 2000 : 1732 : 1000. The angles of the triangle (in degrees) are

(A) 70, 65, 45 (B) 80, 55, 45
 (C) 90, 60, 30 (D) 90, 61, 39
- A force $\vec{F} = (-3\hat{i} + \hat{j} + 5\hat{k})\text{N}$ acts at a point (7, 3, 1). The torque about the origin (0, 0, 0) will be

(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) $14\hat{i} + 38\hat{j} + 16\hat{k}$
- A vector $\vec{C} = \vec{A} - \vec{B}$ has a magnitude equal to $A + B$, the angle between \vec{A} and \vec{B} is

(A) zero (B) $\frac{\pi}{2}$
 (C) π (D) 2π
- The vector having module equal to 3 and perpendicular to two vectors $\vec{A} = 2\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{B} = 2\hat{i} - 2\hat{j} + 3\hat{k}$ is

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

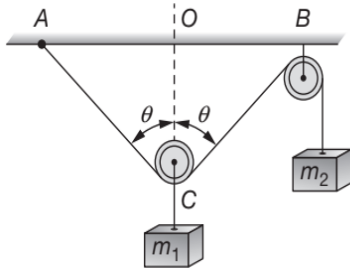
14. The vector sum of three vectors \vec{a} , \vec{b} and \vec{c} is zero. If \hat{i} and \hat{j} are unit vectors in the directions of \vec{a} and \vec{b} respectively, then
- (A) \vec{c} is in the plane of \hat{i} and \hat{j} .
 (B) \vec{c} is along $(\hat{i} \times \hat{j})$.
 (C) \vec{c} is along \hat{i} .
 (D) \vec{c} is along \hat{j} .
15. 12 coplanar 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°
16. If $|\vec{F}_1 \times \vec{F}_2| = \vec{F}_1 \cdot \vec{F}_2$, then $|\vec{F}_1 + \vec{F}_2|$ is
- (A) $|\vec{F}_1| + |\vec{F}_2|$
 (B) $\sqrt{|\vec{F}_1|^2 + |\vec{F}_2|^2}$
 (C) $\sqrt{|\vec{F}_1|^2 + |\vec{F}_2|^2 + \frac{|\vec{F}_1||\vec{F}_2|}{\sqrt{2}}}$
 (D) $\sqrt{|\vec{F}_1|^2 + |\vec{F}_2|^2 + \sqrt{2}|\vec{F}_1||\vec{F}_2|}$
17. The value of p so that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} + p\hat{j} + 5\hat{k}$ are coplanar should be
- (A) 16 (B) -4
 (C) 4 (D) -8
18. ABCD is a quadrilateral. Forces \vec{BA} , \vec{BC} , \vec{CD} and \vec{DA} act at the point. Their resultant is
- (A) $2\vec{AB}$ (B) $2\vec{DA}$
 (C) $2\vec{BC}$ (D) $2\vec{BA}$
19. Which of the following group of forces will not accelerate a body?
- (A) 5 N, 10 N, 12 N (B) 5 N, 10 N, 16 N
 (C) 8 N, 10 N, 20 N (D) 7 N, 5 N, 15 N
20. Consider the two vectors \vec{A} and \vec{B} . The magnitude of their sum, i.e. $|\vec{A} + \vec{B}|$, if $|\vec{A}| > |\vec{B}|$
- (A) is equal to $|\vec{A}| + |\vec{B}|$
 (B) cannot be less than $|\vec{A}| + |\vec{B}|$
 (C) cannot be greater than $|\vec{A}| + |\vec{B}|$
 (D) must be equal to $|\vec{A}| - |\vec{B}|$
21. Three vectors \vec{P} , \vec{Q} and \vec{R} are such that $|\vec{P}| = |\vec{Q}|$, $|\vec{R}| = \sqrt{2}|\vec{P}|$ and $\vec{P} + \vec{Q} + \vec{R} = \vec{0}$. The angles between \vec{P} and \vec{Q} , \vec{Q} and \vec{R} and \vec{P} and \vec{R} are respectively (in degrees)
- (A) 90, 135, 135 (B) 90, 45, 45
 (C) 45, 90, 90 (D) 45, 135, 135
22. If \hat{A} is a unit vector. The value $\hat{A} \cdot \frac{d\hat{A}}{dt} =$
- (A) 0 (B) 1
 (C) $\frac{\pi}{2}$ (D) π
23. If four non zero vectors satisfy $\vec{a} \times \vec{b} = \vec{c} \times \vec{d}$ and $\vec{a} \times \vec{c} = \vec{b} \times \vec{d}$ with $|\vec{a}| \neq |\vec{d}|$ and $|\vec{b}| \neq |\vec{c}|$, then
- (A) $(\vec{a} - \vec{d})$ and $(\vec{b} - \vec{c})$ are perpendicular
 (B) $(\vec{a} - \vec{d})$ and $(\vec{b} - \vec{c})$ are parallel
 (C) $(\vec{a} - \vec{d})$ must equal $(\vec{b} - \vec{c})$
 (D) $(\vec{a} - \vec{d})$ must equal $-(\vec{b} - \vec{c})$
24. If two non parallel vectors \vec{A} and \vec{B} are equal in magnitude, then the vectors $(\vec{A} - \vec{B})$ and $(\vec{A} + \vec{B})$ will be
- (A) parallel to each other
 (B) parallel but oppositely directed
 (C) perpendicular to each other
 (D) inclined at an angle $\theta < 90^\circ$
25. A point of application of force $\vec{F} = -5\hat{i} + 3\hat{j} + 2\hat{k}$ is moved from $\vec{r}_1 = 2\hat{i} + 7\hat{j} + 4\hat{k}$ to $\vec{r}_2 = 5\hat{i} + 2\hat{j} + 4\hat{k}$. The work done will be
- (A) -22 unit (B) 22 unit
 (C) -30 unit (D) +30 unit
26. If vectors $\vec{a} = 2\hat{i} + 4\hat{j} - \hat{k}$ and $\vec{b} = 3\hat{i} - 2\hat{j} + x\hat{k}$ are to be perpendicular to each other, the value of x should be
- (A) 2 (B) -2
 (C) 3 (D) -3
27. When $t = 0$, a particle at (1, 0, 0), moves towards (4, 4, 12) with a constant speed of 65 ms^{-1} . The position of the particle is measured in meter and the time in second. Assume constant velocity, the position of the particle for $t = 2 \text{ s}$ is
- (A) $(30\hat{i} - 120\hat{j} + 40\hat{k}) \text{ m}$ (B) $(40\hat{i} + 31\hat{j} - 120\hat{k}) \text{ m}$
 (C) $(13\hat{i} - 40\hat{j} + 12\hat{k}) \text{ m}$ (D) $(31\hat{i} + 40\hat{j} + 120\hat{k}) \text{ m}$

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28. The condition under which vectors $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$ should be at right angles to each other is

- (A) $\vec{a} \neq \vec{b}$ (B) $\vec{a} \cdot \vec{b} = 0$
 (C) $|\vec{a}| = |\vec{b}|$ (D) $\vec{a} \cdot \vec{b} = 1$

29. In the arrangement shown in figure, the instantaneous velocities of masses m_1 and m_2 are v_1 and v_2 , respectively and $\angle ACB = 2\theta$ at the instant, then



- (A) $\theta = \cos^{-1}\left(\frac{v_1}{2v_2}\right)$ (B) $\theta = \cos^{-1}\left(\frac{v_2}{2v_1}\right)$
 (C) $\theta = \tan^{-1}\left(\frac{v_1}{2v_2}\right)$ (D) $\theta = \sin^{-1}\left(\frac{v_1}{v_2}\right)$

30. One vertex of a parallelepiped is at the point $(1, -1, -2)$ of rectangular cartesian coordinates. If three adjacent vertices are at $(0, 1, 3)$, $(3, 0, -1)$ and $(1, 4, 1)$, the volume of the parallelepiped is

- (A) 400 unit (B) 80 unit
 (C) 40 unit (D) 120 unit

31. $|\vec{A} \times \vec{B}|^2 + |\vec{A} \cdot \vec{B}|^2$ is equal to

- (A) $(\vec{A} + \vec{B})^2$ (B) $(\vec{A} - \vec{B})^2$
 (C) $A^2 + B^2$ (D) $A^2 B^2$

32. In equation $\vec{F} = q(\vec{v} \times \vec{B})$, the quantity \vec{F}

- (A) is perpendicular to \vec{v} only
 (B) is perpendicular to \vec{B} only
 (C) is perpendicular to both \vec{v} and \vec{B}
 (D) is perpendicular to q and \vec{B}

33. A particle moves from point $(1, 0, 2.5)$ to the point $(-2, 3, 4)$ m when a force $\vec{F} = (\hat{i} + 4\hat{k})$ N acts on it. The work done on it is

- (A) 6 J (B) 30 J
 (C) 3 J (D) 9 J

34. The vector that is added to $(\hat{i} - 5\hat{j} + 2\hat{k})$ and $(3\hat{i} + 6\hat{j} - 7\hat{k})$ to give a unit vector along the x -axis is

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

35. Forces of 1 N and 2 N act along the lines $x = 0$ and $y = 0$. The equation of the line along which the resultant lies is given by

- (A) $y - 2x = 0$ (B) $2y - x = 0$
 (C) $y + x = 0$ (D) $y - x = 0$

36. The radius vector of a point is $\vec{r} = (\hat{i} - 2\hat{j} + 3\hat{k})$ m and a force $\vec{F} = (4\hat{i} + 5\hat{j})$ acts at that point. The moment of the force in Nm is

- (A) $-15\hat{i} + 12\hat{j} + 13\hat{k}$ (B) $15\hat{i} - 12\hat{j} + 13\hat{k}$
 (C) $-15\hat{i} - 12\hat{j} + 13\hat{k}$ (D) $15\hat{i} + 12\hat{j} + 13\hat{k}$

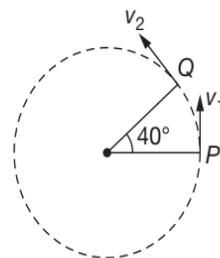
37. The area of a triangle bounded by vectors \vec{a} , \vec{b} and \vec{c} is

- (A) $\frac{1}{2}|\vec{a} + \vec{b} + \vec{c}|$
 (B) $\frac{1}{2}|\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}|$
 (C) $\frac{1}{6}|\vec{b} \times \vec{c} + \vec{c} \times \vec{a} + \vec{a} \times \vec{b}|$
 (D) $\frac{1}{2}|(\vec{a} \cdot \vec{b}) + (\vec{b} \cdot \vec{c}) + (\vec{c} \cdot \vec{a})|$

38. If $\vec{a} = 2\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} - 2\hat{k}$, the cosine of angle θ between them is equal to

- (A) $\frac{5}{14}$ (B) $\frac{1}{7}$
 (C) $\frac{3}{14}$ (D) $\frac{1}{14}$

39. A particle is moving in a circle of radius r centred at O with constant speed v . The change in velocity in moving from P to Q ($\angle POQ = 40^\circ$) is



- (A) $2v \cos(40^\circ)$ (B) $2v \sin(40^\circ)$
 (C) $2v \cos(20^\circ)$ (D) $2v \sin(20^\circ)$

40. Following set of forces act on a body. In which case the resultant cannot be zero?
 (A) 10 N, 10 N, 20 N (B) 10 N, 10 N, 10 N
 (C) 10 N, 20 N, 20 N (D) 10 N, 20 N, 40 N
41. $\frac{d}{dt}(\vec{A} \times \vec{B})$
 (A) $\vec{A} \times \frac{d\vec{B}}{dt} + \vec{B} \times \frac{d\vec{A}}{dt}$ (B) $\frac{d\vec{A}}{dt} \times \vec{B} + \vec{A} \times \frac{d\vec{B}}{dt}$
 (C) $-\vec{A} \times \frac{d\vec{B}}{dt} - \frac{d\vec{A}}{dt} \times \vec{B}$ (D) $\vec{0}$
42. How many minimum number of coplanar vectors having different magnitudes can be added to give zero resultant.
 (A) 2 (B) 3
 (C) 4 (D) 5
43. How many minimum number of vectors in different planes can be added to give zero resultant?
 (A) 2 (B) 3
 (C) 4 (D) 5
44. If none of the vectors \vec{A} , \vec{B} and \vec{C} are zero and if $\vec{A} \times \vec{B} = 0$ and $\vec{B} \times \vec{C} = 0$, the value of $\vec{A} \times \vec{C}$ is
 (A) unity (B) zero scalar
 (C) zero vector (D) $AC \cos \theta$
45. In a watch the average angular velocity is maximum for the tip of
 (A) second's hand (B) minute's hand
 (C) hour's hand (D) equal for all hands
46. The volume of a parallelepiped bounded by vectors \vec{A} , \vec{B} and \vec{C} can be obtained from the expression
 (A) $(\vec{A} \cdot \vec{B}) \times \vec{C}$ (B) $(\vec{A} \times \vec{B}) \cdot \vec{C}$
 (C) $(\vec{A} \cdot \vec{C}) \times \vec{B}$ (D) $(\vec{A} \times \vec{B}) \times \vec{C}$
47. Pick up the axial vector
 (A) force (B) acceleration
 (C) linear momentum (D) torque
48. Pick out the only vector quantity
 (A) pressure
 (B) impulse
 (C) gravitational potential
 (D) coefficient of friction
49. Which of the following quantities is a scalar
 (A) electric field
 (B) electrostatic potential
 (C) magnetic moment
 (D) acceleration due to gravity
50. A body of mass 2 kg is constrained to move along the Y-direction. When a force of $2\hat{i} + 5\hat{j} + 7\hat{k}$ newton acts on it and the body is displaced through 10 m, the kinetic energy gained by the body is
 (A) 50 J (B) 100 J
 (C) 150 J (D) 350 J
51. If \vec{a} denotes a unit vector along an incident light ray, \vec{b} a unit vector along refracted ray into a medium having refractive index x (relative to first medium) and \vec{c} a unit vector normal to boundary of two media and directed towards first medium, then law of refraction is
 (A) $\vec{a} \cdot \vec{c} = x(\vec{b} \cdot \vec{c})$ (B) $\vec{a} \times \vec{c} = x(\vec{c} \times \vec{b})$
 (C) $\vec{a} \times \vec{c} = x(\vec{b} \times \vec{c})$ (D) $x(\vec{a} \times \vec{c}) = (\vec{b} \times \vec{c})$
52. The maximum and minimum magnitudes of the resultant of two given vectors are 17 unit and 7 unit respectively. If these two vectors are at right angles to each other, the magnitude of their resultant is
 (A) 14 (B) 16
 (C) 18 (D) 13
53. A vector of magnitude $5\sqrt{3}$ unit and another vector of magnitude 10 unit are inclined to each other at an angle of 30° . The magnitude of their vector product is
 (A) $5\sqrt{3}$ unit (B) 10 unit
 (C) $25\sqrt{3}$ unit (D) 50 unit
54. What is the value of linear velocity, if $\vec{\omega} = 3\hat{i} - 4\hat{j} + \hat{k}$ and $\vec{r} = 5\hat{i} - 6\hat{j} + 6\hat{k}$;
 (A) $6\hat{i} + 2\hat{j} - 3\hat{k}$ (B) $6\hat{i} - 2\hat{j} + 8\hat{k}$
 (C) $4\hat{i} - 13\hat{j} + 6\hat{k}$ (D) $-18\hat{i} - 13\hat{j} + 2\hat{k}$
55. Which (one or more) of the following quantities is a vector?
 (A) Pressure (B) Power
 (C) Current (D) Angular momentum
56. The position vector of a particle is, $\vec{r} = (a \cos \omega t)\hat{i} + (a \sin \omega t)\hat{j}$. The velocity of the particle is
 (A) parallel to position vector
 (B) perpendicular to position vector
 (C) directed towards the origin
 (D) directed away from the origin
57. Given that $A = B = C$. If $\vec{A} + \vec{B} = \vec{C}$, then the angle between \vec{A} and \vec{C} is θ_1 . If $\vec{A} + \vec{B} + \vec{C} = 0$, then the angle between \vec{A} and \vec{C} is θ_2 . What is the relation between θ_1 and θ_2 ?

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

58. The magnitudes of the X and Y components of \vec{P} are 7 and 6. Also, the magnitudes of the X and Y components $\vec{P} + \vec{Q}$ are 11 and 9 respectively. What is the magnitude of Q?

- (A) 5 (B) 6
 (C) 8 (D) 9

59. Which of the following statements is false?

- (A) Mass, speed and energy are scalar quantities
 (B) Momentum, force and torque are vector quantities
 (C) Distance is a scalar quantity but displacement is a vector quantity
 (D) A vector has only magnitude, whereas a scalar has both magnitude and direction

60. The sum of the magnitudes of two vectors is 18 and the magnitude of their resultant is 12. If the resultant is perpendicular to one of the vectors, then what are the magnitudes of the two vectors?

- (A) 5, 13 (B) 6, 12
 (C) 7, 11 (D) 8, 10

61. When a mass is rotating in a plane about a fixed point its angular momentum is directed along

- (A) the radius
 (B) the tangent to the orbit
 (C) the axis of rotation
 (D) line at an angle of 45° to the axis of rotation

62. The momentum of a particle is $\vec{p} = 2[(\cos t)\hat{i} + (\sin t)\hat{j}]$.

What is the angle between the force \vec{F} acting on the particle and the momentum \vec{p} ?

- (A) 45° (B) 90°
 (C) 135° (D) 180°

63. Three forces of magnitudes 30, 60 and P newton acting at a point are in equilibrium. If the angle between the first two is 60° , the value of P is

- (A) $25\sqrt{2}$ (B) $30\sqrt{3}$
 (C) $30\sqrt{6}$ (D) $30\sqrt{7}$

64. The acceleration of a particle is given by

$$\vec{a} = \left[2\hat{i} + 6t\hat{j} + \frac{2\pi^2}{9} \cos\left(\frac{\pi t}{3}\right)\hat{k} \right] \text{ms}^{-2}. \quad \text{The initial}$$

conditions are $\vec{r}(0) = x(0)\hat{i} + y(0)\hat{j} + z(0)\hat{k} = \vec{0}$,

$\vec{v}(0) = (2\hat{i} + \hat{j}) \text{ms}^{-1}$ where

$$\vec{v}(0) = \frac{d\vec{r}(0)}{dt} = \frac{dx(0)}{dt}\hat{i} + \frac{dy(0)}{dt}\hat{j} + \frac{dz(0)}{dt}\hat{k}$$

The position vector at $t = 2$ s is

- (A) $(3\hat{i} + 8\hat{j} + 10\hat{k})$ m (B) $(8\hat{i} + 10\hat{j} + 3\hat{k})$ m
 (C) $(10\hat{i} + 3\hat{j} + 8\hat{k})$ m (D) $(3\hat{i} + 10\hat{j} + 8\hat{k})$ m

65. Pick out the only scalar quantity

- (A) power (B) electric field
 (C) magnetic moment (D) average velocity

66. Angular displacement is

- (A) a scalar (B) a vector
 (C) either (D) neither

67. If the vectors $\vec{P} = a\hat{i} + a\hat{j} + 3\hat{k}$ and $\vec{Q} = a\hat{i} - 2\hat{j} - \hat{k}$ are perpendicular to each other, then the positive value of a is

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

68. A particle of mass $m = 5$ unit is moving with a uniform speed $v = 3\sqrt{2}$ unit in the XOY plane along the line $y = x + 4$. The magnitude of the angular momentum of the particle about the origin is

- (A) 60 unit (B) $40\sqrt{2}$ unit
 (C) ZERO (D) 7.5 unit

69. Consider three vectors \vec{P} , \vec{Q} and \vec{R} . Which of the following is independent of choice of coordinate system?

- (A) $(\vec{P} + \vec{Q} + \vec{R})$ (B) $(P_x + Q_x + R_x)\hat{i}$
 (C) $(P_x\hat{i} + Q_y\hat{j} + R_z\hat{k})$ (D) All of these

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

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

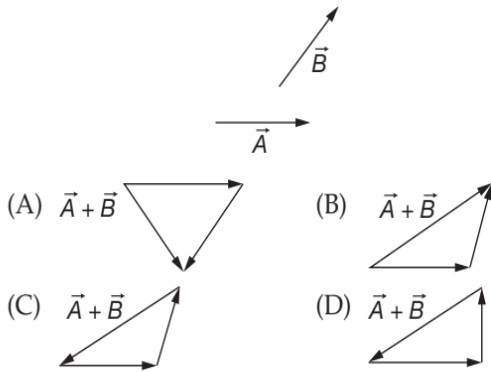
71. A wheel of radius r is rolling on a horizontal surface. At $t = 0$, T is the top most point on the wheel then magnitude of displacement of point T when wheel has completed one-fourth rolling is

- (A) $\sqrt{2}r$ (B) 2r
 (C) $r\sqrt{\left(\frac{\pi}{2} - 1\right)^2 + 1}$ (D) $r\sqrt{\left(\frac{\pi}{2} + 1\right)^2 + 1}$

72. The direction of resultant of \vec{a} and \vec{b} remains same when magnitudes of \vec{a} and \vec{b} are increased by m units and n units respectively then

- (A) $\frac{a}{b} = \frac{m}{n}$ (B) $\frac{a}{b} = \frac{n}{m}$
 (C) $\frac{a}{b} = \frac{m+n}{m-n}$ (D) $\frac{a}{b} = \frac{m-n}{m+n}$

73. Vectors \vec{A} and \vec{B} are shown in figure then diagram of $\vec{A} + \vec{B}$ is



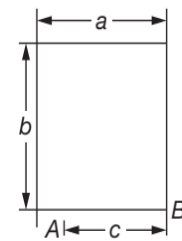
74. The resultant of two forces, one double the other in magnitude, is perpendicular to the smaller of the two forces. The angle between the two forces is
 (A) 120° (B) 60°
 (C) 90° (D) 150°
75. If \vec{a} and \vec{b} are two unit vectors and $\vec{R} = \vec{a} + \vec{b}$ and also if $|\vec{R}| = R$, then
 (A) $R < 0$ (B) $R > 2$
 (C) $0 \leq R \leq 2$ (D) R must be 2
76. If \vec{a} and \vec{b} are two sides of a parallelogram and \vec{c} and \vec{d} are the diagonals, then
 (A) $c^2 + d^2 = a^2 + b^2$ (B) $c^2 + d^2 = 2(a^2 + b^2)$
 (C) $c^2 - d^2 = a^2 - b^2$ (D) $c^2 - d^2 = 2(a^2 - b^2)$
77. In Problem 76, if the angle between \vec{a} and \vec{b} is θ , then $\cos\theta$ is equal to
 (A) $\frac{(a^2 + b^2)}{4cd}$ (B) $\frac{(a^2 - b^2)}{4cd}$
 (C) $\frac{(c^2 - d^2)}{4ab}$ (D) $\frac{(c^2 + d^2)}{4ab}$
78. If magnetic force on a charge is given by $q(\vec{v} \times \vec{B})$ and a charged particle is projected in a magnetic field $(2\hat{i} + 2\hat{j} + 2\hat{k})$ tesla. The acceleration of the particle at an instant is $(x\hat{i} + 2\hat{j} - 6\hat{k}) \text{ ms}^{-2}$, then of x equals

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

79. There are two vectors $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} + 2\hat{j} - 2\hat{k}$, then vector component of \vec{A} along \vec{B} is

- (A) $\frac{2\hat{i} + 2\hat{j} - 2\hat{k}}{9}$ (B) $\frac{2}{3}(2\hat{i} + \hat{j} + \hat{k})$
 (C) $\frac{2}{3}(\hat{i} + 2\hat{j} - 2\hat{k})$ (D) None of these

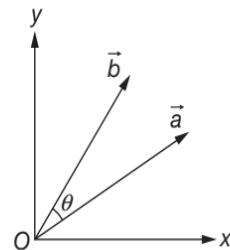
80. A billiards ball is at point A on a billiards table whose dimensions are shown in figure.



At what angle should the ball be struck so that it should rebound from two cushions and go into pocket B? Assume that in striking the cushion, the ball's direction of motion changes according to the law of reflection of light from a mirror, i.e., the angle of reflection equals the angle of incidence.

- (A) $\frac{a-2c}{b}$ (B) $\frac{2a-c}{b}$
 (C) $\frac{2a-c}{2b}$ (D) $\frac{a}{b} - \frac{a}{2c}$

81. For the vectors \vec{a} and \vec{b} shown in figure, $\vec{a} = \sqrt{3}\hat{i} + \hat{j}$ and $|\vec{b}| = 10$ units while $\theta = 23^\circ$, then the value of $R = |\vec{a} + \vec{b}|$ is nearly



- (A) 12 (B) 13
 (C) 14 (D) 15

82. The sum, difference and cross product of two vectors \vec{A} and \vec{B} are mutually perpendicular if

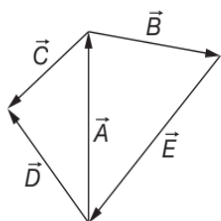
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- (A) \vec{A} and \vec{B} are perpendicular to each other and $|\vec{A}| = |\vec{B}|$
 (B) \vec{A} and \vec{B} are perpendicular to each other
 (C) \vec{A} and \vec{B} are perpendicular but their magnitudes are arbitrary
 (D) $|\vec{A}| = |\vec{B}|$ and their directions are arbitrary

83. A particle moves in x - y plane. The position vector of particle at any time t is $\vec{r} = \{(2t)\hat{i} + (2t^2)\hat{j}\}$ m. The rate of change of θ at time $t = 2$ s, where θ is the angle which its velocity vector makes with positive x -axis is

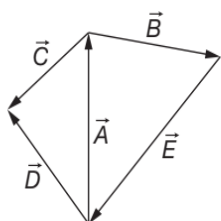
- (A) $\frac{2}{17}$ rads $^{-1}$ (B) $\frac{1}{14}$ rads $^{-1}$
 (C) $\frac{4}{7}$ rads $^{-1}$ (D) $\frac{6}{5}$ rads $^{-1}$

84. In figure, \vec{E} equals



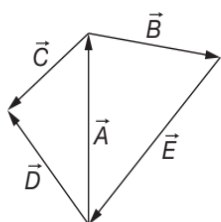
- (A) \vec{A} (B) \vec{B}
 (C) $\vec{A} + \vec{B}$ (D) $-(\vec{A} + \vec{B})$

85. In figure, $\vec{D} - \vec{C}$ equals



- (A) \vec{A} (B) $-\vec{A}$
 (C) \vec{B} (D) $-\vec{B}$

86. In figure, $\vec{E} + \vec{D} - \vec{C}$ equals



- (A) \vec{A} (B) $-\vec{A}$
 (C) \vec{B} (D) $-\vec{B}$

87. 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 $\vec{\omega} = \vec{\omega} = \hat{i} - 2\hat{j} + 2\hat{k}$ and their radius vector $\vec{r} = 4\hat{j} - 3\hat{i}$, then $|\vec{v}|$ is

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

88. Which of the following sets of displacements might be capable of returning a car to its starting point?

- (A) 4, 6, 8 and 15 km (B) 10, 30, 50 and 120 km
 (C) 5, 10, 30 and 50 km (D) 50, 50, 75 and 200 km

89. The magnitude of the vector product of two vectors \vec{A} and \vec{B} may be

- (a) Greater than AB (b) Equal to AB
 (c) Less than AB (d) Equal to Zero
 (A) a, b, c (B) b, c, d
 (C) a, c, d (D) a, b, d

90. If $\vec{A} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{B} = 3\hat{i} + 6\hat{j} + 2\hat{k}$, then the vector in the direction of \vec{A} and having same magnitude as $|\vec{B}|$, is

- (A) $\frac{7}{3}(\hat{i} + 2\hat{j} + 2\hat{k})$ (B) $7(\hat{i} + 2\hat{j} + 2\hat{k})$
 (C) $\frac{3}{7}(\hat{i} + 2\hat{j} + 2\hat{k})$ (D) $\frac{7}{9}(\hat{i} + 2\hat{j} + 2\hat{k})$

91. The area of the triangle whose vertices are $A(1, -1, 2)$, $B(2, 1, -1)$ and $C(3, -1, 2)$ is

- (A) 26 (B) $7\sqrt{13}$
 (C) $\sqrt{13}$ (D) 8

92. An engine exerts a force $\vec{F} = (20\hat{i} - 3\hat{j} + 5\hat{k})$ N and moves with velocity $\vec{v} = (6\hat{i} + 20\hat{j} - 3\hat{k})$ ms $^{-1}$. The power of the engine (in watt) is

- (A) 45 (B) 75
 (C) 20 (D) 10

93. The maximum and the minimum magnitudes of the resultant of two given vectors are 17 unit and 7 unit respectively. If these two vectors are at right angles to each other, the magnitude of their resultant is

- (A) 14 (B) 16
(C) 18 (D) 13

94. For two vectors \vec{a} and \vec{b} , if $\vec{R} = \vec{a} + \vec{b}$ and $\vec{S} = \vec{a} - \vec{b}$, if $2|\vec{R}| = |\vec{S}|$, when \vec{R} is perpendicular to \vec{a} , then

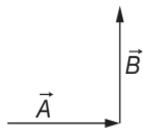
- (A) $\frac{a}{b} = \sqrt{\frac{3}{7}}$ (B) $\frac{a}{b} = \sqrt{\frac{7}{3}}$
(C) $\frac{a}{b} = \sqrt{\frac{1}{5}}$ (D) $\frac{a}{b} = \sqrt{\frac{5}{1}}$

95. Which one is correct?
(A) Resultant of two vectors of unequal magnitude can be zero
(B) Resultant of three non-coplanar vectors of equal magnitude can be zero
(C) Resultant of three coplanar vectors is always zero
(D) Minimum number of non-coplanar vectors whose resultant can be zero is four

96. If $\vec{r} = bt^2\hat{i} + ct^3\hat{j}$, where b and c are positive constant, the time at which velocity vector makes an angle $\theta = 60^\circ$ with positive y -axis is

- (A) $\frac{c}{b}$ (B) $\frac{2b}{3\sqrt{3}c}$
(C) $\frac{2c}{\sqrt{3}b}$ (D) $\frac{2b}{\sqrt{3}c}$

97. Two vectors \vec{A} and \vec{B} are shown in the figure



Then $\vec{A} - \vec{B}$ is given by

- (A) (B)
(C) (D) None of these

98. Resultant of two vectors \vec{A} and \vec{B} is \vec{R} . Now magnitude of vector is doubled keeping direction same, then magnitude of the resultant becomes $|\vec{B}|$. Angle between vector \vec{A} and \vec{B} is 120° . Then magnitude of \vec{A} is equal to

- (A) $|\vec{B}|$ (B) $2|\vec{B}|$
(C) $\frac{|\vec{B}|}{2}$ (D) $4|\vec{B}|$

99. If \vec{R} is the resultant of the vectors \vec{A} and \vec{B} . The ratio of minimum value of $|\vec{R}|$ to the maximum value of $|\vec{R}|$ is $\frac{1}{4}$. Then $\frac{A}{B}$ may be

- (A) $\frac{4}{1}$ (B) $\frac{2}{1}$
(C) $\frac{3}{5}$ (D) $\frac{1}{4}$

100. If a vector $(2\hat{i} + 3\hat{j} + 8\hat{k})$ is perpendicular to the vector $-4\hat{i} + 4\hat{j} + \alpha\hat{k}$, then the value of α is

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

101. 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) $\frac{1}{49}(3\hat{i} + 6\hat{j} - 2\hat{k})$

102. 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

103. A vector \vec{F}_1 is along the positive x -axis. If its vector product with another vector \vec{F}_2 is zero then \vec{F}_2 may be

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

104. The component of $3\hat{i} + 4\hat{j}$ along $\hat{i} + \hat{j}$

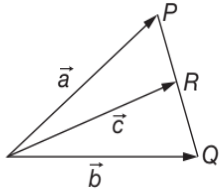
- (A) $\frac{\hat{i} + \hat{j}}{2}$ (B) $\frac{3}{2}(\hat{i} + \hat{j})$
(C) $\frac{5}{2}(\hat{i} + \hat{j})$ (D) $\frac{7}{2}(\hat{i} + \hat{j})$

105. A vector of length l is turned through the angle θ about its tail. The change in the position vector of its head is

- (A) $l \sin\left(\frac{\theta}{2}\right)$ (B) $2l \sin\left(\frac{\theta}{2}\right)$
(C) $2l \cos\left(\frac{\theta}{2}\right)$ (D) $l \cos\left(\frac{\theta}{2}\right)$

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106. Figure shows three vectors \vec{a} , \vec{b} and \vec{c} , where R is the mid point of PQ . Then which of the following relation 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) $\vec{a} - \vec{b} = \vec{c}$
107. A unit vector perpendicular to both vectors $\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$ is
 (A) $\hat{i} + \hat{j}$ (B) $\frac{-\hat{i} + \hat{k}}{\sqrt{2}}$
 (C) $\hat{j} + \hat{k}$ (D) $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$
108. The adjacent sides of a parallelogram are represented by co-initial vectors $2\hat{i} + 3\hat{j}$ and $\hat{i} + 4\hat{j}$. The area of the parallelogram is
 (A) 5 units along z-axis (B) 5 units in x - y plane
 (C) 3 units in x - z plane (D) 3 units in y - z plane
109. Given that $\vec{A} + \vec{B} + \vec{C} = 0$, out of three vectors two are equal in magnitude and the magnitude of third vector is $\sqrt{2}$ times that of either of the two having equal magnitude. Then the angles between vectors are given by
 (A) $30^\circ, 60^\circ, 90^\circ$ (B) $45^\circ, 45^\circ, 90^\circ$
 (C) $45^\circ, 60^\circ, 90^\circ$ (D) $90^\circ, 135^\circ, 135^\circ$
110. If a particle is moving on an elliptical path given by $\vec{r} = b \cos(\omega t)\hat{i} + a \sin(\omega t)\hat{j}$, then radial acceleration along \vec{r} is
 (A) $\omega\vec{r}$ (B) $\omega^2\vec{r}$
 (C) $-\omega^2\vec{r}$ (D) None of these
111. Two forces of magnitudes 30, 60 and P Newton acting at a point are in equilibrium. If the angle between the first two is 60° , the value of P is
 (A) $25\sqrt{2}$ (B) $30\sqrt{3}$
 (C) $30\sqrt{6}$ (D) $30\sqrt{7}$
112. The angle made by the vector $4\hat{i} - 3\hat{j} + 5\hat{k}$ with z -axis is
 (A) 30° (B) 45°
 (C) 90° (D) 120°
113. Given $|\vec{A}_1| = 2$, $|\vec{A}_2| = 3$ and $|\vec{A}_1 + \vec{A}_2| = 3$ then $(\vec{A}_1 + 2\vec{A}_2) \cdot (3\vec{A}_1 - 4\vec{A}_2)$ is
 (A) -64 (B) 60
 (C) -62 (D) None of these
114. Vector \vec{A} makes equal angles with x , y and z -axis. Value of its components (in terms of magnitude of \vec{A}) will be
 (A) $\frac{A}{\sqrt{3}}$ (B) $\frac{A}{\sqrt{2}}$
 (C) $\sqrt{3}A$ (D) $\frac{\sqrt{3}}{A}$
115. The angle made by the vector $A = \hat{i} + \hat{j}$ with x -axis is
 (A) 90° (B) 45°
 (C) 22.5° (D) 30°
116. 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) $\sqrt{0.39}$
117. The component of vector $A = 2\hat{i} + 3\hat{j}$ along the vector $\hat{i} + \hat{j}$ is
 (A) $\frac{5}{\sqrt{2}}$ (B) $10\sqrt{2}$
 (C) $5\sqrt{2}$ (D) 5
118. There are two force vectors, one of 5 N and other of 12 N at what angle the two vectors be added to get resultant vector of 17 N, 7 N and 13 N respectively
 (A) $0^\circ, 180^\circ$ and 90° (B) $0^\circ, 90^\circ$ and 180°
 (C) $0^\circ, 90^\circ$ and 90° (D) $180^\circ, 0^\circ$ and 90°
119. If $\vec{A} = 4\hat{i} - 3\hat{j}$ and $\vec{B} = 6\hat{i} + 8\hat{j}$ then magnitude and direction of $\vec{A} + \vec{B}$ will be
 (A) $5, \tan^{-1}\left(\frac{3}{4}\right)$ (B) $5\sqrt{5}, \tan^{-1}\left(\frac{1}{2}\right)$
 (C) $10, \tan^{-1}(5)$ (D) $25, \tan^{-1}\left(\frac{3}{4}\right)$
120. Two forces 3 N and 2 N are at an angle θ such that the resultant is R . The first force is now increased to 6 N and the resultant become $2R$. The value of θ is

- (A) 30° (B) 60°
 (C) 90° (D) 120°
- (A) $6\hat{i} + 2\hat{j} + 2\hat{k}$ (B) $2\hat{i} + 2\hat{j} + 2\hat{k}$
 (C) $\hat{i} + \hat{j} + \hat{k}$ (D) $6\hat{i} + 2\hat{j} - 2\hat{k}$

121. If $\vec{A} \times \vec{B} = \vec{C}$, then which of the following statements is wrong?

- (A) $\vec{C} \perp \vec{A}$ (B) $\vec{C} \perp \vec{B}$
 (C) $\vec{C} \perp (\vec{A} + \vec{B})$ (D) $\vec{C} \perp (\vec{A} \times \vec{B})$

122. The velocity of a particle is $\vec{v} = 6\hat{i} + 2\hat{j} - 2\hat{k}$. The component of the velocity of a particle parallel to vector $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ in vector form is

123. Two forces of magnitude 7 newton and 5 newton act on a particle at an angle θ to each other. The minimum magnitude of the resultant force is

- (A) 5 newton (B) 8 newton
 (C) 12 newton (D) 2 newton

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

This section contains Multiple Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONE OR MORE is/are correct.

- Which of the following will not depend on orientation of frame of reference
 - a scalar
 - a vector
 - the magnitude of a vector
 - component of a vector
- If $\vec{P} \times \vec{Q} = \vec{R}$, $\vec{Q} \times \vec{R} = \vec{P}$ and $\vec{R} \times \vec{P} = \vec{Q}$, then
 - \vec{P} , \vec{Q} and \vec{R} are coplanar.
 - angle between \vec{P} and \vec{Q} may be less than 90° .
 - $(\vec{P} + \vec{Q} + \vec{R})$ cannot be equal to zero.
 - \vec{P} , \vec{Q} and \vec{R} are mutually perpendicular.
- A particle is moving towards east with velocity 10 ms^{-1} . It suddenly turns to left and continues to move with velocity v now. Change in its velocity $\Delta\vec{v}$
 - cannot be less than 10 ms^{-1} in magnitude
 - will be directed $\theta \text{ NW}$, where θ will depend upon magnitude of v
 - will be directed $\theta \text{ NE}$, where θ will depend upon magnitude of v
 - None of these
- For two vectors \vec{A} and \vec{B} which of the following relations are not commutative
 - $\vec{A} + \vec{B}$ (B) $\vec{A} - \vec{B}$
 - $\vec{A} \times \vec{B}$ (D) $\vec{A} \cdot \vec{B}$
- Four forces acting on a particle keep it at rest. Then
 - the forces must be coplanar.
 - the forces cannot be coplanar.
 - the forces may or may not be coplanar.
 - if three of these forces are coplanar, so must be the fourth.
- A vector will not change when
 - frame of reference is translated
 - frame of reference is rotated
 - vector is translated parallel to itself
 - vector is rotated
- If a vector \vec{A} has magnitude A and \vec{n} is a unit vector in the direction of \vec{A} , then which of the following are correct
 - $A = \frac{\vec{A}}{\vec{n}}$ (B) $\vec{n} = \frac{\vec{A}}{A}$
 - $1 = \frac{|\vec{A}|}{A}$ (D) $\vec{A} = A\vec{n}$
- If $\vec{P} \times \vec{Q} = \vec{R}$ then which of the following statements is/are correct?
 - \vec{R} is perpendicular to $(\vec{P} + \vec{Q})$
 - \vec{R} is perpendicular to $\vec{P} \cdot \vec{Q}$
 - \vec{R} is perpendicular to \vec{P}
 - \vec{P} is perpendicular to $\vec{Q} \times \vec{R}$

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9. Mark the correct statement/s.
- (A) the magnitude of the vector $(3\hat{i} + 4\hat{j})$ is 5
- (B) a force $(3\hat{i} + 4\hat{j})$ N acting on a particle causes a displacement of $5\hat{j}$ metres. The work done by the force is 25 J
- (C) if \vec{a} and \vec{b} represent two adjacent sides of a parallelogram, $|\vec{a} \times \vec{b}|$ gives the area of that parallelogram
- (D) a force has magnitude 20 N. Its component in a direction making an angle of 60° with the force is $10\sqrt{3}$ N
10. The angle that the vector $\vec{A} = 2\hat{i} + 3\hat{j}$ makes with y -axis is
- (A) $\tan^{-1}\left(\frac{3}{2}\right)$ (B) $\tan^{-1}\left(\frac{2}{3}\right)$
- (C) $\cos^{-1}\left(\frac{3}{\sqrt{13}}\right)$ (D) $\sin^{-1}\left(\frac{2}{3}\right)$
11. The momentum of a particle is given by $\vec{p} = 2[(\sin t)\hat{i} - (\cos t)\hat{j}]$ kgms⁻¹. Select the correct options
- (A) momentum \vec{p} of the particle is always perpendicular to \vec{F}
- (B) momentum \vec{p} of the particle is always parallel to \vec{F}
- (C) magnitude of momentum remain constant
- (D) None of these
12. Mark the correct statement(s)
- (A) displacement is a polar vector.
- (B) angular displacement is a polar vector.
- (C) displacement is an axial vector.
- (D) angular displacement is an axial vector.

REASONING BASED QUESTIONS

This section contains Reasoning type questions, each having four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Each question contains STATEMENT 1 and STATEMENT 2. You have to mark your answer as

Bubble (A) If both statements are TRUE and STATEMENT-2 is the correct explanation of STATEMENT 1.

Bubble (B) If both statements are TRUE but STATEMENT-2 is not the correct explanation of STATEMENT 1.

Bubble (C) If STATEMENT 1 is TRUE and STATEMENT 2 is FALSE.

Bubble (D) If STATEMENT 1 is FALSE but STATEMENT 2 is TRUE.

1. **Statement-1:** $\vec{A} \times \vec{B}$ is perpendicular to both $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$.
Statement-2: Both $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$ lie in the plane containing \vec{A} and \vec{B} , but $\vec{A} \times \vec{B}$ lies perpendicular to the plane containing \vec{A} and \vec{B} .
2. **Statement-1:** Angle between $\hat{i} + \hat{j}$ and \hat{i} is 45° .
Statement-2: $\hat{i} + \hat{j}$ is equally inclined to both \hat{i} and \hat{j} and the angle between \hat{i} and \hat{j} is 90° .
3. **Statement-1:** If θ be the angle between \vec{A} and \vec{B} , then $\tan \theta = \frac{|\vec{A} \times \vec{B}|}{\vec{A} \cdot \vec{B}}$.
Statement-2: $\vec{A} \times \vec{B}$ is perpendicular to $\vec{A} + \vec{B}$.
4. **Statement-1:** If $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, then angle between \vec{A} and \vec{B} is 90° .
Statement-2: $\vec{A} + \vec{B} = \vec{B} + \vec{A}$.
5. **Statement-1:** Vector product of two vectors represents an axial vector.
Statement-2: If \vec{v} = instantaneous velocity, \vec{r} = radius vector and $\vec{\omega}$ = angular velocity, then $\vec{\omega} = \vec{v} \times \vec{r}$.
6. **Statement-1:** Minimum number of non-equal vectors in a plane required to give zero resultant is three.
Statement-2: If $\vec{A} + \vec{B} + \vec{C} = \vec{0}$, then they must lie in one plane.
7. **Statement-1:** Vector addition of two vectors \vec{A} and \vec{B} is commutative.
Statement-2: $\vec{A} + \vec{B} = \vec{B} + \vec{A}$.
8. **Statement-1:** $\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$.
Statement-2: Dot product of two vectors is commutative.
9. **Statement-1:** $\vec{\tau} = \vec{r} \times \vec{F}$ and $\vec{\tau} \neq \vec{F} \times \vec{r}$.
Statement-2: Cross product of vectors is commutative.

- 10. Statement-1:** A negative acceleration of a body is associated with a slowing down of a body.
Statement-2: Acceleration is vector quantity.
- 11. Statement-1:** A physical quantity cannot be called as a vector if its magnitude is zero.
Statement-2: A vector has both, magnitude and direction.
- 12. Statement-1:** The sum of two vectors can be zero.
Statement-2: The vectors cancel each other, when they are equal and opposite.
- 13. Statement-1:** Two vectors are said to be like vectors if they have same direction but different magnitude.
Statement-2: Vector quantities do not have specific direction.
- 14. Statement-1:** The scalar product of two vectors can be zero.
Statement-2: If two vectors are perpendicular to each other, their scalar product will be zero.
- 15. Statement-1:** Multiplying any vector by a scalar is a meaningful operations.
Statement-2: Taking dot product of a scalar and a vector is meaningless.
- 16. Statement-1:** A null vector is a vector whose magnitude is zero and direction is arbitrary.
Statement-2: A null vector does not exist.
- 17. Statement-1:** If dot product and cross product of \vec{A} and \vec{B} are zero, it implies that either of the vectors \vec{A} and \vec{B} must be a null vector.
Statement-2: Null vector is a vector with zero magnitude.
- 18. Statement-1:** The cross product of a vector with itself is a null vector.
Statement-2: The cross product of two vectors results in a vector quantity.
- 19. Statement-1:** The minimum number of non coplanar vectors whose sum can be zero, is four.
Statement-2: The resultant of two vectors of unequal magnitude can be zero.
- 20. Statement-1:** If $\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{C}$, then \vec{A} may not always be equal to \vec{C} .
Statement-2: The dot product of two vectors involves cosine of the angle between the two vectors.

LINKED COMPREHENSION TYPE QUESTIONS

This section contains Linked Comprehension Type Questions or Paragraph based Questions. Each set consists of a Paragraph followed by questions. Each question has four choices (A), (B), (C) and (D), out of which only one is correct. (For the sake of competitiveness there may be a few questions that may have more than one correct options)

Comprehension I

Consider a parallelogram whose adjacent sides are given by $\vec{a} = 2\vec{m} + \vec{n}$ and $\vec{b} = \vec{m} - 2\vec{n}$, where \vec{m} and \vec{n} are unit vectors inclined at an angle of 60° . Based on this information, answer the following questions.

- One diagonal of the parallelogram is represented by the vector

(A) $\vec{m} + \vec{n}$	(B) $3\vec{m} + \vec{n}$
(C) $3\vec{m} - \vec{n}$	(D) $-\vec{m} + 2\vec{n}$
- The other diagonal of the parallelogram is represented by the vector

(A) $\vec{n} - 3\vec{m}$	(B) $\vec{m} + 3\vec{n}$
(C) $-\vec{m} - 3\vec{n}$	(D) $\vec{m} - \vec{n}$
- The length of the diagonal found in PROBLEM 1 is

(A) $\sqrt{7}$ units	(B) $\sqrt{10}$ units
(C) $\sqrt{12}$ units	(D) $\sqrt{13}$ units
- The length of the diagonal found in PROBLEM 2 is

(A) $\sqrt{7}$ units	(B) $\sqrt{10}$ units
(C) $\sqrt{12}$ units	(D) $\sqrt{13}$ units
- The area of the parallelogram is

(A) $2\sqrt{3}$ sq. units
(B) $5\sqrt{3}$ sq. units
(C) $\frac{5}{2}\sqrt{3}$ sq. units
(D) $\frac{5}{4}\sqrt{3}$ sq. units
- If the angle between the diagonals is θ . Then

(A) $\theta = \cos^{-1}\left(\frac{2}{\sqrt{91}}\right)$	(B) $\theta = \cos^{-1}\left(\frac{1}{\sqrt{91}}\right)$
(C) $\theta = \cos^{-1}\left(\frac{7}{\sqrt{91}}\right)$	(D) $\theta = \cos^{-1}\left(\frac{4}{\sqrt{91}}\right)$

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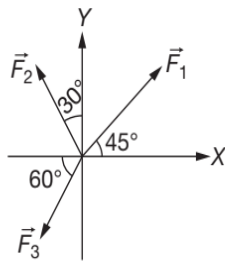
Comprehension 2

One of the principles of addition of vector is the parallelogram law which says that "if two vectors \vec{a} and \vec{b} are acting at point O , then the resultant of these two vectors is obtained by completing a parallelogram whose adjacent sides are \vec{a} and \vec{b} . The resultant is the diagonal of the parallelogram passing through the same point O ." Based on this information, answer the following questions.

- The diagonal \vec{p} of parallelogram passing through point O is
 - $\vec{a} - \vec{b}$
 - $\vec{a} + \vec{b}$
 - $\vec{a} + \sqrt{2}\vec{b}$
 - $\vec{b} + \sqrt{2}\vec{a}$
- The other diagonal \vec{q} of the parallelogram is
 - $\vec{a} - \vec{b}$
 - $\vec{a} + \vec{b}$
 - $\vec{a} + \sqrt{2}\vec{b}$
 - $\vec{b} + \sqrt{2}\vec{a}$
- The diagonals \vec{p} and \vec{q} will be perpendicular to each other if
 - $|\vec{a}| = |\vec{b}|$
 - $|\vec{a}| = 2|\vec{b}|$
 - $|\vec{b}| = 2|\vec{a}|$
 - None of these
- Angle between $\vec{a} + \vec{b}$ and $\vec{a} \times \vec{b}$ is
 - 0°
 - 45°
 - 60°
 - 90°

Comprehension 3

Three forces \vec{F}_1 , \vec{F}_2 and \vec{F}_3 act on a particle as shown in the figure. If $|\vec{F}_1| = 5\sqrt{2}$ N, $|\vec{F}_2| = 10$ N and $|\vec{F}_3| = 20$ N. Based on this information, answer the following questions.



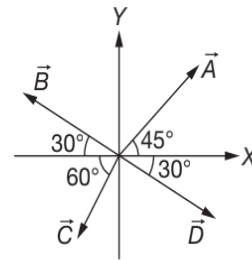
- X component of \vec{F}_2 is
 - 5 N
 - 5 N
 - $5\sqrt{3}$ N
 - $-5\sqrt{3}$ N
- Y component of \vec{F}_3 is
 - $10\sqrt{3}$ N
 - $-10\sqrt{3}$ N
 - 10 N
 - 10 N

13. \vec{F}_1 is written as

- $(5\hat{i} - 5\hat{j})$ N
- $(-5\hat{i} + 5\hat{j})$ N
- $(5\hat{i} + 5\hat{j})$ N
- $5\sqrt{2}(\hat{i} + \hat{j})$ N

Comprehension 4

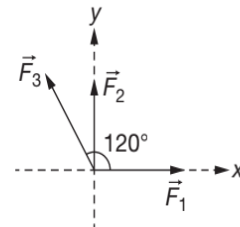
Four vectors are shown in the figure where $|\vec{A}| = 5\sqrt{2}$ m, $|\vec{B}| = 10$ m, $|\vec{C}| = 10$ m and $|\vec{D}| = 10$ m. Based on this information, answer the following questions.



- $(B_x + D_x)$ is equal to
 - $20\sqrt{3}$ m
 - $-10\sqrt{3}$ m
 - zero
 - 10 m
- $(A_x + C_x)$ is equal to
 - zero
 - 10 m
 - 5 m
 - $-5\sqrt{3}$ m
- $(A_y + B_y + C_y + D_y)$ is equal to
 - $5(1 - \sqrt{3})$ m
 - $5(-1)$ m
 - $5\sqrt{3}$ m
 - $10(\sqrt{3} - 1)$ m

Comprehension 5

Three forces \vec{F}_1 , \vec{F}_2 and \vec{F}_3 are acting on a body as shown in figure.



If $F_1 = 10$ N, $F_2 = 10\sqrt{3}$ N and $F_3 = 20$ N.

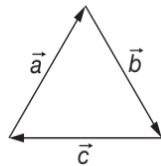
Based on this information, answer the following questions.

- External force required to keep block at rest is (in newton)
 - $20\sqrt{3}\hat{j}$
 - $-20\sqrt{3}\hat{j}$
 - $20\sqrt{2}\hat{i}$
 - $20\hat{i} - 20\sqrt{3}\hat{j}$

18. $\vec{F}_1 + \vec{F}_2 - \vec{F}_3$ is given by
 (A) 20 newton in x -direction
 (B) 20 newton in y -direction
 (C) $20\sqrt{3}$ newton in y -direction
 (D) -20 newton in x -direction
19. $\vec{F}_2 + \vec{F}_3 - \vec{F}_1$ is given by
 (A) 20 newton at angle 120° with x -axis
 (B) 40 newton at angle 120° with x -axis
 (C) $20\sqrt{3}$ newton at angle 150° with x -axis
 (D) $40\sqrt{3}$ newton at angle 150° with x -axis

Comprehension 6

Three vectors \vec{a} , \vec{b} , \vec{c} form a triangle taken in same order. Based on this information, answer the following questions.



20. $\vec{a} + \vec{b} - \vec{c} =$ _____
 (A) $-2\vec{a}$ (B) $-2\vec{b}$
 (C) $-2\vec{c}$ (D) zero
21. $(\vec{a} \times \vec{b}) \cdot \vec{c} =$ _____
 (A) abc (B) $-abc$
 (C) -1 (D) 0
22. $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} =$ _____
 (A) $-b^2$ (B) $-a^2$
 (C) $-c^2$ (D) zero
23. If triangle is equilateral, then angle between \vec{a} and \vec{b} is
 (A) 60° (B) 120°
 (C) 150° (D) 90°

MATRIX MATCH/COLUMN MATCH TYPE QUESTIONS

Each question in this section 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 (and t). Any given statement in **COLUMN-I** can have correct matching with **ONE OR MORE** statement(s) in **COLUMN-II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following examples:

If the correct matches are $A \rightarrow p, s$ and t ; $B \rightarrow q$ and r ; $C \rightarrow p$ and q ; and $D \rightarrow s$ and t ; then the correct darkening of bubbles will look like the following:

	p	q	r	s	t
A	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

1. Match the following

Column-I	Column-II
(A) $\vec{A} \cdot \vec{B}$	(p) Defined
(B) $(\vec{A} \cdot \vec{B})\vec{C}$	(q) Not Defined
(C) $(\vec{A} \cdot \vec{B}) \cdot \vec{C}$	(r) Scalar
(D) $(\vec{A} \times \vec{B}) \times \vec{C}$	(s) Vector

2. Match the following

Column-I	Column-II
(A) $\vec{A} \times \vec{B}$	(p) Zero Scalar
(B) $(\vec{A} \times \vec{B}) \cdot \vec{A}$	(q) Perpendicular to \vec{A}
(C) $\vec{A} \times \vec{A}$	(r) Zero Vector
(D) $\vec{0} \times \vec{A}$	(s) Perpendicular to \vec{B}

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3. Match the following

Column-I	Column-II
(A) Parallel Vectors	(p) $ \vec{A} \times \vec{B} $
(B) Perpendicular Vectors	(q) $\left(\frac{\vec{A} \cdot \vec{B}}{B^2}\right)\vec{B}$
(C) $\vec{A} \times \vec{B} + \vec{C} \times \vec{A} = \vec{0}$	(r) $\vec{A} \times \vec{B} = \vec{0}$
(D) Area of Parallelogram	(s) $\vec{B} = \vec{C} + k\vec{A}$
(E) Component Vector of \vec{A} along \vec{B}	(t) $\vec{A} \cdot \vec{B} = 0$

4. Match the following

Column-I	Column-II
(A) Resultant of two ordered vectors	(p) Zero Vector
(B) Dot Product	(q) Always Negative
(C) $\vec{A} \cdot \vec{B} = 0$ and $ \vec{A} \times \vec{B} = 0$	(r) Triangle Law
(D) $\vec{A} \times (\vec{B} \times \vec{C}) + \vec{B} \times (\vec{A} \times \vec{C}) + \vec{C} \times (\vec{A} \times \vec{B})$	(s) Commutative in nature
(E) Three vectors \vec{A} , \vec{B} and \vec{C} taken in same order form a closed polygon, then $\vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{C} + \vec{C} \cdot \vec{A}$ is	(t) $ \vec{A} = 0$ OR $ \vec{B} = 0$

5. Match the following

Column-I	Column-II
(A) $ \vec{A} + \vec{B} = \vec{A} - \vec{B} $	(p) $ \vec{A} = \vec{B} $
(B) $\vec{A} - \vec{B} = \vec{A} + \vec{B}$	(q) $2(\vec{B} \times \vec{A})$
(C) $(\vec{A} + \vec{B}) \times (\vec{A} - \vec{B})$	(r) $\vec{B} = \vec{0}$
(D) $(\vec{A} + \vec{B}) \perp (\vec{A} - \vec{B})$	(s) $\vec{A} \perp \vec{B}$
	(t) $\vec{A} \cdot \vec{B} = 0$

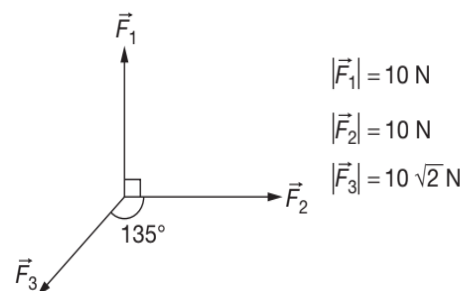
6. Match the following

Column-I	Column-II
(A) Resultant of two vectors of equal magnitude	(p) $\vec{A} \cdot \frac{d\vec{A}}{dt} = 0$
(B) For a vector \vec{A} of fixed magnitude and direction	(q) will be zero
(C) For any vector \vec{A}	(r) lies along the angle bisector of two vectors
(D) Resultant of n vectors of equal magnitude each inclined at an angle $\frac{2\pi}{n}$ with the preceding vector	(s) $\vec{A} \times \frac{d\vec{A}}{dt} = \vec{0}$

7. If $\vec{R} = \vec{a} + \vec{b}$ and $\vec{S} = \vec{a} - \vec{b}$ also θ is angle between \vec{a} and \vec{b} .

Column-I	Column-II
(A) $R^2 + S^2$	(p) \vec{R} is perpendicular to \vec{a}
(B) $R^2 - S^2$	(q) $2(a^2 + b^2)$
(C) $\frac{R}{S}$	(r) $4\vec{a} \cdot \vec{b}$
(D) $R < S$	(s) $\tan\left(\frac{\theta}{2}\right)$ if $ \vec{a} = \vec{b} $

8. Three coplanar forces \vec{F}_1 , \vec{F}_2 and \vec{F}_3 are acting simultaneously on a particle. COLUMN-I contains different operation between forces and COLUMN-II contains their magnitude. Match them

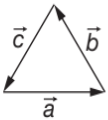


Column-I	Column-II
(A) $\vec{F}_1 + \vec{F}_2 + \vec{F}_3$	(p) 0
(B) $\vec{F}_1 + \vec{F}_2 - \vec{F}_3$	(q) 20
(C) $\vec{F}_1 - \vec{F}_2 + \vec{F}_3$	(r) $20\sqrt{2}$
(D) $\vec{F}_3 \cdot (\vec{F}_1 + \vec{F}_2)$	(s) 200

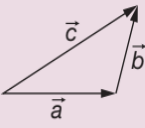
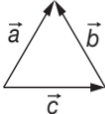
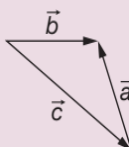
9. If $\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{B} = \hat{i} + 2\hat{j} + 2\hat{k}$ then

Column-I	Column-II
(A) $ \vec{A} \times \vec{B} $	(p) $\sqrt{11}$
(B) $ \vec{A} - \vec{B} $	(q) 6
(C) $\vec{A} \cdot \vec{B}$	(r) $\sqrt{35}$
(D) $ \vec{A} + \vec{B} $	(s) $\sqrt{90}$

10. COLUMN-I contains vector diagram of three vectors \vec{a} , \vec{b} , \vec{c} and COLUMN-II contains vector equation. Match them

Column-I	Column-II
(A) 	(p) $\vec{a} - (\vec{b} + \vec{c}) = 0$

(Continued)

Column-I	Column-II
(B) 	(q) $\vec{b} - \vec{c} = \vec{a}$
(C) 	(r) $\vec{a} + \vec{b} = -\vec{c}$
(D) 	(s) $\vec{a} + \vec{b} = \vec{c}$

11. In vector algebra match the vector operations with conditions under which operation is possible.

Column-I	Column-II
(A) $\vec{A} + \vec{B} = \vec{A} - \vec{B}$	(p) Not possible
(B) $ \vec{A} + \vec{B} = \vec{A} - \vec{B} $	(q) $\theta = 90^\circ$
(C) $ \vec{A} \times \vec{B} = \vec{A} \cdot \vec{C} $	(r) $B = 0$
(D) $\vec{A} \times \vec{B} = \vec{A} \cdot \vec{C}$	(s) $\theta = 45^\circ$

INTEGER/NUMERICAL ANSWER TYPE QUESTIONS

In this section, the answer to each question is a numerical value obtained after doing series of calculations based on the data given in the question(s).

- A particle has a displacement of 12 m towards east, 3 m towards north and 4 m vertically upwards. Find the resultant magnitude of these displacements. Give your answer in cm.
- At what angle, in degree, two forces of magnitude $A+B$ and $A-B$ ($A > B$) act, so that their resultant is $\sqrt{3A^2 + B^2}$?
- Two equal vectors act at a point. The square of their resultant is 3 times their product. Find the angle, in degree, between the vectors.
- Two vectors \vec{A} and \vec{B} are such that $\vec{A} + \vec{B} = \vec{C}$. Also $A^2 + B^2 = C^2$. Find the angle between \vec{A} and \vec{B} , in degree.
- Given that $|\vec{v}_1 + \vec{v}_2| = |\vec{v}_1 - \vec{v}_2|$. Calculate the angle between \vec{v}_1 and \vec{v}_2 , in degree.
- The resultant of two forces \vec{F}_1 and \vec{F}_2 is P . If \vec{F}_2 is reversed, then the new resultant is Q . Find the value of $\frac{P^2 + Q^2}{F_1^2 + F_2^2}$.

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- Calculate the x and y components of a vector in first quadrant having magnitude same as that of $\vec{A} = 7\hat{i} + 24\hat{j}$ and parallel to $\vec{B} = 3\hat{i} + 4\hat{j}$.
- Find $(y - x)$ such that the vectors $\vec{a} = x\hat{i} + 4\hat{j} - 8\hat{k}$ and $\vec{b} = 2\hat{i} + y\hat{j} + 4\hat{k}$ are collinear.
- If a vector \vec{P} makes angles α, β and γ with respect to X, Y and Z axes of a rectangular coordinate system, then find the value of $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$.
- One vertex of a parallelepiped is at the point $(1, -1, -2)$ of rectangular Cartesian coordinates. If three adjacent vertices are at $(0, 1, 3), (3, 0, -1)$ and $(1, 4, 1)$. Calculate the volume of the parallelepiped.

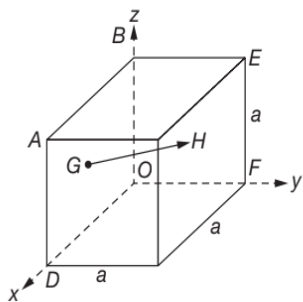
ARCHIVE: JEE MAIN
1. [Online April 2019]

Let $|\vec{A}_1| = 3, |\vec{A}_2| = 5$ and $|\vec{A}_1 + \vec{A}_2| = 5$. The value of $(2\vec{A}_1 + 3\vec{A}_2) \cdot (3\vec{A}_1 - 2\vec{A}_2)$ is

- (A) -106.5 (B) -118.5
(C) -99.5 (D) -112.5

2. [Online January 2019]

In the cube of side a shown in the figure, the vector from the central point of the face $ABOD$ to the central point of the face $BEFO$ will be



- (A) $\frac{1}{2}a(\hat{j} - \hat{i})$ (B) $\frac{1}{2}a(\hat{i} - \hat{k})$
(C) $\frac{1}{2}a(\hat{j} - \hat{k})$ (D) $\frac{1}{2}a(\hat{k} - \hat{i})$

3. [Online January 2019]

Two vectors \vec{A} and \vec{B} have equal magnitudes. The magnitude of $(\vec{A} + \vec{B})$ is n times the magnitude of $(\vec{A} - \vec{B})$. The angle between \vec{A} and \vec{B} is

- (A) $\cos^{-1}\left(\frac{n-1}{n+1}\right)$ (B) $\cos^{-1}\left(\frac{n^2-1}{n^2+1}\right)$
(C) $\sin^{-1}\left(\frac{n-1}{n+1}\right)$ (D) $\sin^{-1}\left(\frac{n^2-1}{n^2+1}\right)$

4. [Online January 2019]

Two forces P and Q , of magnitude $2F$ and $3F$, respectively, are at an angle θ with each other. If the force Q is doubled, then their resultant also gets doubled. Then, the angle θ is

- (A) 30° (B) 90°
(C) 60° (D) 120°

5. [Online January 2019]

A particle is moving along a circular path with a constant speed of 10 ms^{-1} . What is the magnitude of the change in velocity of the particle, when it moves through an angle of 60° around the centre of the circle?

- (A) 10 ms^{-1} (B) Zero
(C) $10\sqrt{3} \text{ ms}^{-1}$ (D) $10\sqrt{2} \text{ ms}^{-1}$

6. [Online 2018]

Let $\vec{A} = (\hat{i} + \hat{j})$ and $\vec{B} = (2\hat{i} - \hat{j})$. The magnitude of a coplanar vector such that $\vec{A} \cdot \vec{C} = \vec{B} \cdot \vec{C} = \vec{A} \cdot \vec{B}$, is given by

- (A) $\sqrt{\frac{20}{9}}$ (B) $\sqrt{\frac{5}{9}}$
(C) $\sqrt{\frac{9}{12}}$ (D) $\sqrt{\frac{10}{9}}$

7. [Online 2015]

A vector \vec{A} is rotated by a small angle $\Delta\theta$ radians ($\Delta\theta \ll 1$) to get a new vector \vec{B} . In that case $|\vec{B} - \vec{A}|$ is

- (A) 0 (B) $|\vec{A}|\left(1 - \frac{\Delta\theta^2}{2}\right)$
(C) $|\vec{A}|\Delta\theta$ (D) $|\vec{B}|\Delta\theta - |\vec{A}|$

ARCHIVE: JEE ADVANCED

Integer/Numerical Answer Type Questions

In this section, the answer to each question is a numerical value obtained after series of calculations based on the data provided in the question(s).

1. [JEE (Advanced) 2018]

Two vectors \vec{A} and \vec{B} are defined as $\vec{A} = a\hat{i}$ and $\vec{B} = a(\cos \omega t \hat{i} + \sin \omega t \hat{j})$, where a is a constant and

$\omega = \frac{\pi}{6} \text{ rads}^{-1}$. If $|\vec{A} + \vec{B}| = \sqrt{3}|\vec{A} - \vec{B}|$ at time $t = \tau$ for the first time, the value of τ , in seconds, is _____.

ANSWER KEYS—TEST YOUR CONCEPTS AND PRACTICE EXERCISES
Test Your Concepts-I (Based on Addition, Subtraction and Resolution)

1. No, Yes
2. (a) $B_x = 6$ and $B_y = 3$
 (b) $3\sqrt{5}$ m
 (c) $\tan^{-1}\left(\frac{1}{2}\right)$, with x -axis

	\vec{A}	\vec{B}	$\vec{A} + \vec{B}$	$\vec{A} - \vec{B}$	$\vec{B} - \vec{A}$
Magnitude	5	10	$5\sqrt{5}$	$5\sqrt{5}$	$5\sqrt{5}$
Direction (θ with x -axis)	$\tan^{-1}\left(\frac{3}{4}\right)$ Below x -axis	$\tan^{-1}\left(\frac{4}{3}\right)$ Above x -axis	$\tan^{-1}\left(\frac{1}{2}\right)$ Above x -axis	$\tan^{-1}\left(\frac{11}{2}\right)$ Below negative x -axis	$\tan^{-1}\left(\frac{11}{2}\right)$ Above x -axis

4. $\sqrt{205}$ m
7. $8\hat{i} - 2\hat{j}$; $2\sqrt{17}$ kgf
8. \vec{a} and \vec{b} are parallel
10. $2v\sin(20^\circ)$
13. Yes

Test Your Concepts-II (Based on Dot Product)

1. $A_x B_x + A_y B_y + A_z B_z$
2. 15°
3. (a) $\vec{A}\left(\frac{4}{\sqrt{61}}, \frac{6}{\sqrt{61}}, -\frac{3}{\sqrt{61}}\right), \vec{B}\left(-\frac{2}{\sqrt{78}}, -\frac{5}{\sqrt{78}}, \frac{7}{\sqrt{78}}\right)$
 (b) 31.3°
5. $\frac{44}{\sqrt{142}}$
6. 12; $\cos^{-1}\left(\frac{12}{77}\right)$
8. $\frac{177}{7}$ J

Test Your Concepts-III (Based on Cross Product, Scalar and Vector Triple Product)

1. (a) $-21\hat{i} + 29\hat{j} + 41\hat{k}$
 (b) $-23\hat{i} + 29\hat{j} + 38\hat{k}$
2. $\hat{i}(A_y B_z - A_z B_y) - \hat{j}(A_x B_z - A_z B_x) + \hat{k}(A_x B_y - A_y B_x)$
4. $\frac{1}{2}\sqrt{234}$ sq units
5. Area, with direction as the outward normal.
6. Yes
7. $\frac{7mv_0^2}{20g}$, along negative z -axis.
8. $v = \frac{E}{B}$, along $+x$ axis or $-x$ axis
9. $4(\hat{j} - \hat{k})$

Single Correct Choice Type Questions

1. A	2. A	3. D	4. B	5. D	6. A	7. C	8. C	9. A	10. C
11. A	12. C	13. A	14. A	15. B	16. D	17. C	18. D	19. A	20. C
21. A	22. A	23. B	24. C	25. C	26. B	27. D	28. C	29. B	30. C
31. D	32. C	33. C	34. C	35. B	36. A	37. C	38. D	39. D	40. D
41. B	42. B	43. C	44. C	45. A	46. B	47. D	48. B	49. B	50. A
51. C	52. D	53. C	54. D	55. D	56. B	57. B	58. A	59. D	60. A
61. C	62. B	63. D	64. B	65. A	66. B	67. A	68. A	69. A	70. A
71. D	72. A	73. B	74. A	75. C	76. B	77. C	78. A	79. A	80. C
81. A	82. D	83. A	84. D	85. A	86. D	87. A	88. A	89. B	90. A
91. C	92. A	93. D	94. A	95. D	96. C	97. D	98. C	99. C	100. C
101. A	102. D	103. D	104. D	105. B	106. A	107. B	108. A	109. D	110. C
111. D	112. B	113. A	114. A	115. B	116. B	117. A	118. A	119. B	120. D
121. D	122. B	123. D							

Multiple Correct Choice Type Questions

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

Reasoning Based Questions

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

Linked Comprehension Type Questions

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

Matrix Match/Column Match Type Questions

1. A \rightarrow (p, r)	B \rightarrow (p, s)	C \rightarrow (q)	D \rightarrow (p, q, s)	
2. A \rightarrow (q, s)	B \rightarrow (p)	C \rightarrow (r)	D \rightarrow (r)	
3. A \rightarrow (r)	B \rightarrow (t)	C \rightarrow (s)	D \rightarrow (p)	E \rightarrow (q)
4. A \rightarrow (r, s)	B \rightarrow (s)	C \rightarrow (t)	D \rightarrow (p)	E \rightarrow (q)
5. A \rightarrow (s, t)	B \rightarrow (r)	C \rightarrow (q)	D \rightarrow (p)	
6. A \rightarrow (r)	B \rightarrow (p)	C \rightarrow (s)	D \rightarrow (p)	
7. A \rightarrow (q)	B \rightarrow (r)	C \rightarrow (s)	D \rightarrow (p)	
8. A \rightarrow (p)	B \rightarrow (r)	C \rightarrow (q)	D \rightarrow (s)	
9. A \rightarrow (s)	B \rightarrow (p)	C \rightarrow (q)	D \rightarrow (r)	
10. A \rightarrow (r)	B \rightarrow (s)	C \rightarrow (p)	D \rightarrow (q)	
11. A \rightarrow (r)	B \rightarrow (q)	C \rightarrow (s)	D \rightarrow (p)	

3.50 JEE Advanced Physics: Mechanics - I

Integer/Numerical Answer Type Questions

- | | | | | |
|---------|--------------------------|-------|-------|--------|
| 1. 1300 | 2. 60 | 3. 60 | 4. 90 | 5. 90 |
| 6. 2 | 7. $x = 15$ and $y = 20$ | 8. 2 | 9. 2 | 10. 40 |

ARCHIVE: JEE MAIN

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|------|------|------|------|------|------|------|
| 1. B | 2. A | 3. B | 4. D | 5. A | 6. B | 7. C |
|------|------|------|------|------|------|------|

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Integer/Numerical Answer Type Questions

- | |
|------|
| 1. 2 |
|------|