Fundamentals of Vectors

1. The vector projection of a vector $3\hat{i}+4\hat{k}$ on *y*-axis is
(A) 5 (B) 4 (C) 3 (D) Zero

2. Position of a particle in a rectangular-co-ordinate system is (3, 2, 5). Then its position vector will be
(A) $3\hat{i}+5\hat{j}+2\hat{k}$ (B) $3\hat{i}+2\hat{j}+5\hat{k}$ (C) $5\hat{i}+3\hat{j}+2\hat{k}$ (D) None of these

3. If a particle moves from point *P* (2,3,5) to point *Q* (3,4,5). Its displacement vector be
(A) $\hat{i}+\hat{j}+10\hat{k}$ (B) $\hat{i}+\hat{j}+5\hat{k}$ (C) $\hat{i}+\hat{j}$ (D) $2\hat{i}+4\hat{j}+6\hat{k}$

4. A force of 5 *N* acts on a particle along a direction making an angle of 60° with vertical. Its vertical component be
(A) 10 *N* (B) 3 *N* (C) 4 *N* (D) 2.5 *N*

5. If $A=3\hat{i}+4\hat{j}$ and $B=7\hat{i}+24\hat{j}$, the vector having the same magnitude as *B* and parallel to *A* is
(A) $5\hat{i}+20\hat{j}$ (B) $15\hat{i}+10\hat{j}$ (C) $20\hat{i}+15\hat{j}$ (D) $15\hat{i}+20\hat{j}$

6. 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) $\frac{\sqrt{3}}{A}$

7. If $\vec{A}=2\hat{i}+4\hat{j}-5\hat{k}$ the direction of cosines of the vector $\vec{A}$ are
(A) $\frac{2}{\sqrt{45}},\frac{4}{\sqrt{45}}$ and $\frac{-5}{\sqrt{45}}$ (B) $\frac{1}{\sqrt{45}},\frac{2}{\sqrt{45}}$ and $\frac{3}{\sqrt{45}}$
(C) $\frac{4}{\sqrt{45}},0$ and $\frac{4}{\sqrt{45}}$ (D) $\frac{3}{\sqrt{45}},\frac{2}{\sqrt{45}}$ and $\frac{5}{\sqrt{45}}$

8. The vector that must be added to the vector $\hat{i}-3\hat{j}+2\hat{k}$ and $3\hat{i}+6\hat{j}-7\hat{k}$ so that the resultant vector is a unit vector along the *y*-axis is
(A) $4\hat{i}+2\hat{j}+5\hat{k}$ (B) $-4\hat{i}-2\hat{j}+5\hat{k}$ (C) $3\hat{i}+4\hat{j}+5\hat{k}$ (D) Null vector

9. 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

10. A hall has the dimensions $10m\times12m\times14m$. A fly starting at one corner ends up at a diametrically opposite corner. What is the magnitude of its displacement
(A) 17 *m* (B) 26 *m* (C) 36 *m* (D) 20 *m*

11. 100 coplanar forces each equal to 10 N act on a body. Each force makes angle $\pi/50$ with the preceding force. What is the resultant of the forces
(A) 1000 *N* (B) 500 *N* (C) 250 *N* (D) Zero

12. The magnitude of a given vector with end points (4, – 4, 0) and (– 2, – 2, 0) must be
(A) 6 (B) $5\sqrt{2}$ (C) 4 (D) $2\sqrt{10}$

13. The expression $\left(\frac{1}{\sqrt{2}}\hat{i}+\frac{1}{\sqrt{2}}\hat{j}\right)$ is a
(A) Unit vector (B) Null vector
(C) Vector of magnitude $\sqrt{2}$ (D) Scalar

14. Given vector $\vec{A}=2\hat{i}+3\hat{j}$, the angle between $\vec{A}$ and *y*-axis is
(A) $\tan^{-1}3/2$ (B) $\tan^{-1}2/3$ (C) $\sin^{-1}2/3$ (D) $\cos^{-1}2/3$

15. The unit vector along $\hat{i}+\hat{j}$ is

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

16. A vector is represented by $3\hat{i}+\hat{j}+2\hat{k}$. Its length in XY plane is

(A) 2 (B) $\sqrt{14}$ (C) $\sqrt{10}$ (D) $\sqrt{5}$

17. Five equal forces of 10 *N* each are applied at one point and all are lying in one plane. If the angles between them are equal, the resultant force will be **[CBSE PMT 1995]**

(A) Zero (B) 10 *N*

(C) 20 *N* (D) $10\sqrt{2}N$

18. The angle made by the vector $A=\hat{i}+\hat{j}$ with *x*- axis is

(A) 90° (B) 45° (C) 22.5° (D) 30°

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. Angular momentum is

(A) A scalar (B) A polar vector (C) An axial vector (D) None of these

21. Which of the following is a vector

(A) Pressure (B) Surface tension (C) Moment of inertia (D) None of these

22. If $\vec{P}=\vec{Q}$ then which of the following is NOT correct

(A) $\hat{P}=\hat{Q}$ (B) $|\vec{P}|=|\vec{Q}|$ (C) $P\hat{Q}=Q\hat{P}$ (D) $\vec{P}+\vec{Q}=\hat{P}+\hat{Q}$

23. 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 the position vector (B) Perpendicular to the position vector

(C) Directed towards the origin (D) Directed away from the origin

24. Which of the following is a scalar quantity

(A) Displacement (B) Electric field (C) Acceleration (D) Work

25. 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) $\sqrt{0.39}$

26. A boy walks uniformally along the sides of a rectangular park of size 400 *m*× 300 *m*, starting from one corner to the other corner diagonally opposite. Which of the following statement is incorrect

(A) He has travelled a distance of 700 *m* (B) His displacement is 700 *m*

(C) His displacement is 500 *m* (D) His velocity is not uniform throughout the walk

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

28. Surface area is

(A) Scalar (B) Vector

(C) Neither scalar nor vector (D) Both scalar and vector

29. With respect to a rectangular cartesian coordinate system, three vectors are expressed as

$\vec{a}=4\hat{i}-\hat{j}$, $\vec{b}=-3\hat{i}+2\hat{j}$ and $\vec{c}=-\hat{k}$

where $\hat{i},\hat{j},\hat{k}$ are unit vectors, along the *X*, *Y* and *Z*-axis respectively. The unit vectors $\hat{r}$ along the direction of sum of these vector is

(A) $\hat{r}=\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}-\hat{k})$ (B) $\hat{r}=\frac{1}{\sqrt{2}}(\hat{i}+\hat{j}-\hat{k})$ (C) $\hat{r}=\frac{1}{3}(\hat{i}-\hat{j}+\hat{k})$ (D) $\hat{r}=\frac{1}{\sqrt{2}}(\hat{i}+\hat{j}+\hat{k})$

30. The angle between the two vectors $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{B} = 3\hat{i} + 4\hat{j} + 5\hat{k}$ is

(A) 60° (B) Zero (C) 90° (D) None of these

31. The position vector of a particle is determined by the expression $\vec{r} = 3t^2\hat{i} + 4t^2\hat{j} + 7\hat{k}$

The distance traversed in first 10 *sec* is

(A) 500 *m* (B) 300 *m* (C) 150 *m* (D) 100 *m*

32. Unit vector parallel to the resultant of vectors $\vec{A} = 4\hat{i} - 3\hat{j}$ and $\vec{B} = 8\hat{i} + 8\hat{j}$ will be

(A) $\frac{24\hat{i} + 5\hat{j}}{13}$ (B) $\frac{12\hat{i} + 5\hat{j}}{13}$ (C) $\frac{6\hat{i} + 5\hat{j}}{13}$ (D) None of these

33. 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

34. The angle between the two vectors $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{B} = 3\hat{i} + 4\hat{j} - 5\hat{k}$ will be

(A) 90° (B) 0° (C) 60° (D) 45°

Addition and Subtraction of Vectors

1. 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°, 180° and 90° (B) 0°, 90° and 180° (C) 0°, 90° and 90° (D) 180°, 0° and 90°

2. 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) $5, \tan^{-1}(3/4)$ (B) $5\sqrt{5}, \tan^{-1}(1/2)$ (C) $10, \tan^{-1}(5)$ (D) $25, \tan^{-1}(3/4)$

3. A truck travelling due north at 20 *m/s* turns west and travels at the same speed. The change in its velocity be

(A) 40 *m/sN–W* (B) $20\sqrt{2}$ *m/s N–W* (C) 40 *m/s S–W* (D) $20\sqrt{2}$ *m/sS–W*

4. If the sum of two unit vectors is a unit vector, then magnitude of difference is **[CPMT 1995; CBSE PMT 1989]**

(A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) $1/\sqrt{2}$ (D) $\sqrt{5}$

5. $\vec{A} = 2\hat{i} + \hat{j}, B = 3\hat{j} - \hat{k}$ and $\vec{C} = 6\hat{i} - 2\hat{k}$.

Value of $\vec{A} - 2\vec{B} + 3\vec{C}$ would be

(A) $20\hat{i} + 5\hat{j} + 4\hat{k}$ (B) $20\hat{i} - 5\hat{j} - 4\hat{k}$ (C) $4\hat{i} + 5\hat{j} + 20\hat{k}$ (D) $5\hat{i} + 4\hat{j} + 10\hat{k}$

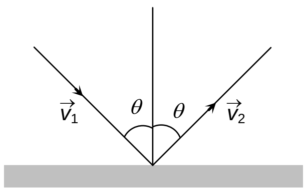
6. An object of *m kg* with speed of *vm/s* strikes a wall at an angle θ and rebounds at the same speed and same angle. The magnitude of the change in momentum of the object will be

(A) $2mv\cos\theta$

(B) $2mv\sin\theta$

(C) 0

(D) $2mv$



7. Two forces, each of magnitude *F* have a resultant of the same magnitude *F.* The angle between the two forces is

(A) 45° (B) 120° (C) 150° (D) 60°

8. For the resultant of the two vectors to be maximum, what must be the angle between them

(A) 0° (B) 60° (C) 90° (D) 180°

9. A particle is simultaneously acted by two forces equal to 4 *N* and 3 *N*. The net force on the particle is

(A) 7 *N* (B) 5 *N* (C) 1 *N* (D) Between 1 *N* and 7 *N*

10. Two vectors $\vec{A}$ and $\vec{B}$ lie in a plane, another vector $\vec{C}$ lies outside this plane, then the resultant of these three vectors *i.e.*, $\vec{A}+\vec{B}+\vec{C}$

(A) Can be zero (B) Cannot be zero

(C) Lies in the plane containing $\vec{A}+\vec{B}$ (D) Lies in the plane containing $\vec{C}$

11. If the resultant of the two forces has a magnitude smaller than the magnitude of larger force, the two forces must be

(A) Different both in magnitude and direction (B) Mutually perpendicular to one another

(C) Possess extremely small magnitude (D) Point in opposite directions

12. Forces F_1 and F_2 act on a point mass in two mutually perpendicular directions. The resultant force on the point mass will be

(A) $F_1 + F_2$ (B) $F_1 - F_2$ (C) $\sqrt{F_1^2 + F_2^2}$ (D) $F_1^2 + F_2^2$

13. If $|\vec{A}-\vec{B}|=|\vec{A}|=|\vec{B}|$, the angle between $\vec{A}$ and $\vec{B}$ is

(A) 60° (B) 0° (C) 120° (D) 90°

14. Let the angle between two nonzero vectors $\vec{A}$ and $\vec{B}$ be 120° and resultant be $\vec{C}$

(A) $\vec{C}$ must be equal to $|\vec{A}-\vec{B}|$ (B) $\vec{C}$ must be less than $|\vec{A}-\vec{B}|$

(C) $\vec{C}$ must be greater than $|\vec{A}-\vec{B}|$ (D) $\vec{C}$ may be equal to $|\vec{A}-\vec{B}|$

15. The magnitude of vector $\vec{A}, \vec{B}$ and $\vec{C}$ are respectively 12, 5 and 13 units and $\vec{A}+\vec{B}=\vec{C}$ then the angle between $\vec{A}$ and $\vec{B}$ is

(A) 0 (B) π (C) $\pi/2$ (D) $\pi/4$

16. Magnitude of vector which comes on addition of two vectors, $6\hat{i}+7\hat{j}$ and $3\hat{i}+4\hat{j}$ is

(A) $\sqrt{136}$ (B) $\sqrt{13.2}$ (C) $\sqrt{202}$ (D) $\sqrt{160}$

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

(A) 12 (B) 10.04 *m* (C) 14.31 *m* (D) None of these

18. The three vectors $\vec{A}=3\hat{i}-2\hat{j}+\hat{k}$, $\vec{B}=\hat{i}-3\hat{j}+5\hat{k}$ and $\vec{C}=2\hat{i}+\hat{j}-4\hat{k}$ form

(A) An equilateral triangle (B) Isosceles triangle

(C) A right angled triangle (D) No triangle

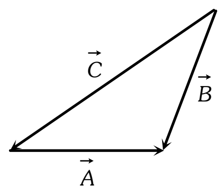
19. For the figure

(A) $\vec{A}+\vec{B}=\vec{C}$

(B) $\vec{B}+\vec{C}=\vec{A}$

(C) $\vec{C}+\vec{A}=\vec{B}$

(D) $\vec{A}+\vec{B}+\vec{C}=0$



20. Let $\vec{C}=\vec{A}+\vec{B}$ then

(A) $|\vec{C}|$ is always greater then $|\vec{A}|$ (B) It is possible to have $|\vec{C}|<|\vec{A}|$ and $|\vec{C}|<|\vec{B}|$

(C) *C* is always equal to *A* + *B* (D) *C* is never equal to *A* + *B*

21. The value of the sum of two vectors $\vec{A}$ and $\vec{B}$ with θ as the angle between them is

(A) $\sqrt{A^2+B^2+2AB\cos\theta}$ (B) $\sqrt{A^2-B^2+2AB\cos\theta}$

(C) $\sqrt{A^2+B^2-2AB\sin\theta}$ (D) $\sqrt{A^2+B^2+2AB\sin\theta}$

22. Following sets of three forces act on a body. Whose resultant cannot be zero **1985]**

(A) 10, 10, 10 (B) 10, 10, 20 (C) 10, 20, 23 (D) 10, 20, 40

23. When three forces of 50 *N*, 30 *N* and 15 *N* act on a body, then the body is

(A) At rest (B) Moving with a uniform velocity

(C) In equilibrium (D) Moving with an acceleration

24. The sum of two forces acting at a point is 16 *N.* If the resultant force is 8 *N* and its direction is perpendicular to minimum force then the forces are

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

25. If vectors *P, Q* and *R* have magnitude 5, 12 and 13 units and $\vec{P}+\vec{Q}=\vec{R},$ the angle between *Q* and *R* is

(A) $\cos^{-1}\frac{5}{12}$ (B) $\cos^{-1}\frac{5}{13}$ (C) $\cos^{-1}\frac{12}{13}$ (D) $\cos^{-1}\frac{7}{13}$

26. The resultant of two vectors *A* and *B* is perpendicular to the vector *A* and its magnitude is equal to half the magnitude of vector *B.* The angle between *A* and *B* is

(A) 120° (B) 150° (C) 135° (D) None of these

27. What vector must be added to the two vectors $\hat{i}-2\hat{j}+2\hat{k}$ and $2\hat{i}+\hat{j}-\hat{k},$ so that the resultant may be a unit vector along *x*-axis

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

28. What is the angle between $\vec{P}$ and the resultant of $(\vec{P}+\vec{Q})$ and $(\vec{P}-\vec{Q})$

(A) Zero (B) $\tan^{-1}(P/Q)$ (C) $\tan^{-1}(Q/P)$ (D) $\tan^{-1}(P-Q)/(P+Q)$

29. The resultant of $\vec{P}$ and $\vec{Q}$ is perpendicular to $\vec{P}$. What is the angle between $\vec{P}$ and $\vec{Q}$

(A) $\cos^{-1}(P/Q)$ (B) $\cos^{-1}(-P/Q)$ (C) $\sin^{-1}(P/Q)$ (D) $\sin^{-1}(-P/Q)$

30. Maximum and minimum magnitudes of the resultant of two vectors of magnitudes *P* and *Q* are in the ratio $3:1.$ Which of the following relations is true

(A) $P=2Q$ (B) $P=Q$ (C) $PQ=1$ (D) None of these

31. The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is $\vec{R}.$ If *Q* is doubled, the new resultant is perpendicular to *P.* Then *R* equals

(A) *P* (B) (*P*+*Q*) (C) *Q* (D) (*P*–*Q*)

32. Two forces, F_1 and F_2 are acting on a body. One force is double that of the other force and the resultant is equal to the greater force. Then the angle between the two forces is

(A) $\cos^{-1}(1/2)$ (B) $\cos^{-1}(-1/2)$ (C) $\cos^{-1}(-1/4)$ (D) $\cos^{-1}(1/4)$

33. Given that $\vec{A}+\vec{B}=\vec{C}$ and that $\vec{C}$ is $\perp$ to $\vec{A}$. Further if $|\vec{A}|=|\vec{C}|$, then what is the angle between $\vec{A}$ and $\vec{B}$

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

34. A body is at rest under the action of three forces, two of which are $\vec{F}_1=4\hat{i},\vec{F}_2=6\hat{j},$ the third force is

(A) $4\hat{i}+6\hat{j}$ (B) $4\hat{i}-6\hat{j}$ (C) $-4\hat{i}+6\hat{j}$ (D) $-4\hat{i}-6\hat{j}$

35. A plane is revolving around the earth with a speed of 100 *km/hr* at a constant height from the surface of earth. The change in the velocity as it travels half circle is

(A) 200 *km/hr* (B) 150 *km/hr* (C) $100\sqrt{2}\,km/hr$ (D) 0

36. What displacement must be added to the displacement $25\hat{i}-6\hat{j}\ m$ to give a displacement of 7.0 *m* pointing in the *x*- direction

(A) $18\hat{i}-6\hat{j}$ (B) $32\hat{i}-13\hat{j}$ (C) $-18\hat{i}+6\hat{j}$ (D) $-25\hat{i}+13\hat{j}$

37. A body moves due East with velocity 20 *km/hour* and then due North with velocity 15 *km/hour.* The resultant velocity

(A) 5 *km/hour* (B) 15 *km/hour* (C) 20 *km/hour* (D) 25 *km/hour*

38. The magnitudes of vectors $\vec{A},\vec{B}$ and $\vec{C}$ are 3, 4 and 5 units respectively. If $\vec{A}+\vec{B}=\vec{C}$, the angle between $\vec{A}$ and $\vec{B}$ is

(A) $\frac{\pi}{2}$ (B) $\cos^{-1}(0.6)$ (C) $\tan^{-1}\left(\frac{7}{5}\right)$ (D) $\frac{\pi}{4}$

39. While travelling from one station to another, a car travels 75 *km* North, 60 *km* North-east and 20 *km* East. The minimum distance between the two stations is

(A) 72 *km* (B) 112 *km* (C) 132 *km* (D) 155 *km*

40. A scooter going due east at 10 ms^{-1} turns right through an angle of 90°. If the speed of the scooter remains unchanged in taking turn, the change is the velocity of the scooter is

(A) 20.0 ms^{-1} south eastern direction (B) Zero

(C) 10.0 ms^{-1} in southern direction (D) 14.14 ms^{-1} in south-west direction

41. A person goes 10 *km* north and 20 *km* east. What will be displacement from initial point

(A) 22.36 *km* (B) 2 *km* (C) 5 *km* (D) 20 *km*

42. Two forces $\vec{F}_1 = 5\hat{i} + 10\hat{j} - 20\hat{k}$ and $\vec{F}_2 = 10\hat{i} - 5\hat{j} - 15\hat{k}$ act on a single point. The angle between $\vec{F}_1$ and $\vec{F}_2$ is nearly

(A) 30° (B) 45° (C) 60° (D) 90°

43. Which pair of the following forces will never give resultant force of 2 *N*

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

44. 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 2*R*. The value of θ is

(A) 30° (B) 60° (C) 90° (D) 120°

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

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

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

46. If $|\vec{A} + \vec{B}| = |\vec{A}| + |\vec{B}|$, then angle between $\vec{A}$ and $\vec{B}$ will be

(A) 90° (B) 120° (C) 0° (D) 60°

47. The maximum and minimum magnitude of the resultant of two given vectors are 17 *units* and 7 *unit* respectively. If these two vectors are at right angles to each other, the magnitude of their resultant is **[Kerala CET**

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

48. The vector sum of two forces is perpendicular to their vector differences. In that case, the forces

(A) Are equal to each other in magnitude (B) Are not equal to each other in magnitude

(C) Cannot be predicted (D) Are equal to each other

49. *y* component of velocity is 20 and *x* component of velocity is 10. The direction of motion of the body with the horizontal at this instant is

(A) $\tan^{-1}(2)$ (B) $\tan^{-1}(1/2)$ (C) 45° (D) 0°

50. Two forces of 12 *N* and 8 *N*act upon a body. The resultant force on the body has maximum value of

(A) 4 *N* (B) 0 *N* (C) 20 *N* (D) 8 *N*

51. Two equal forces (*P* each) act at a point inclined to each other at an angle of 120°. The magnitude of their resultant is

(A) $P/2$ (B) $P/4$ (C) P (D) 2*P*

52. The vectors $5i + 8j$ and $2i + 7j$ are added. The magnitude of the sum of these vector is

(A) $\sqrt{274}$ (B) 38 (C) 238 (D) 560

53. Two vectors $\vec{A}$ and $\vec{B}$ are such that $\vec{A} + \vec{B} = \vec{A} - \vec{B}$. Then

(A) $\vec{A}.\vec{B} = 0$ (B) $\vec{A} \times \vec{B} = 0$ (C) $\vec{A} = 0$ (D) $\vec{B} = 0$

Multiplication of Vectors

1. If a vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to the vector $4\hat{j} - 4\hat{i} + \alpha\hat{k}$. Then the value of α is

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

2. If two vectors $2\hat{i}+3\hat{j}-\hat{k}$ and $-4\hat{i}-6\hat{j}-\lambda\hat{k}$ are parallel to each other then value of λ be

(A) 0 (B) 2 (C) 3 (D) 4

3. A body, acted upon by a force of 50 *N* is displaced through a distance 10 *meter* in a direction making an angle of 60° with the force. The work done by the force be

(A) 200 *J* (B) 100 *J* (C) 300 (D) 250 *J*

4. A particle moves from position $3\hat{i}+2\hat{j}-6\hat{k}$ to $14\hat{i}+13\hat{j}+9\hat{k}$ due to a uniform force of $(4\hat{i}+\hat{j}+3\hat{k})N$. If the displacement in meters then work done will be

(A) 100 *J* (B) 200 *J* (C) 300 *J* (D) 250 *J*

5. If for two vector $\vec{A}$ and $\vec{B}$, sum $(\vec{A}+\vec{B})$ is perpendicular to the difference $(\vec{A}-\vec{B})$. The ratio of their magnitude is

(A) 1 (B) 2 (C) 3 (D) None of these

6. The angle between the vectors $\vec{A}$ and $\vec{B}$ is θ. The value of the triple product $\vec{A}.(\vec{B}\times\vec{A})$ is

(A) A^2B (B) Zero (C) $A^2B\sin\theta$ (D) $A^2B\cos\theta$

7. If $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$ then the angle between *A* and *B* is

(A) $\pi/2$ (B) $\pi/3$ (C) π (D) $\pi/4$

8. If $\vec{A}=3\hat{i}+\hat{j}+2\hat{k}$ and $\vec{B}=2\hat{i}-2\hat{j}+4\hat{k}$ then value of $|\vec{A}\times\vec{B}|$ will be

(A) $8\sqrt{2}$ (B) $8\sqrt{3}$ (C) $8\sqrt{5}$ (D) $5\sqrt{8}$

9. The torque of the force $\vec{F}=(2\hat{i}-3\hat{j}+4\hat{k})N$ acting at the point $\vec{r}=(3\hat{i}+2\hat{j}+3\hat{k})m$ about the origin be

(A) $6\hat{i}-6\hat{j}+12\hat{k}$ (B) $17\hat{i}-6\hat{j}-13\hat{k}$ (C) $-6\hat{i}+6\hat{j}-12\hat{k}$ (D) $-17\hat{i}+6\hat{j}+13\hat{k}$

10. 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) $\vec{C}\perp(\vec{A}\times\vec{B})$

11. If a particle of mass *m* is moving with constant velocity *v* parallel to *x*-axis in *x*-*y* plane as shown in fig. Its angular momentum with respect to origin at any time *t* will be

(A) $mvb\,\hat{k}$ (B) $-mvb\,\hat{k}$ (C) $mvb\,\hat{i}$ (D) $mv\,\hat{i}$

12. Consider two vectors $\vec{F}_1=2\hat{i}+5\hat{k}$ and $\vec{F}_2=3\hat{j}+4\hat{k}$. The magnitude of the scalar product of these vectors is

(A) 20 (B) 23 (C) $5\sqrt{33}$ (D) 26

13. Consider a vector $\vec{F}=4\hat{i}-3\hat{j}$. Another vector that is perpendicular to $\vec{F}$ is

(A) $4\hat{i}+3\hat{j}$ (B) $6\hat{i}$ (C) $7\hat{k}$ (D) $3\hat{i}-4\hat{j}$

14. Two vectors $\vec{A}$ and $\vec{B}$ are at right angles to each other, when

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

15. If $|\vec{V}_1+\vec{V}_2|=|\vec{V}_1-\vec{V}_2|$ and V_2 is finite, then

(A) V_1 is parallel to V_2 (B) $\vec{V}_1=\vec{V}_2$

(C) V_1 and V_2 are mutually perpendicular (D) $|\vec{V}_1|=|\vec{V}_2|$

16. A force $\vec{F}=(5\hat{i}+3\hat{j})$ Newton is applied over a particle which displaces it from its origin to the point $\vec{r}=(2\hat{i}-1\hat{j})$ *metres*. The work done on the particle is

(A) – 7 *J* (B) +13 *J* (C) +7 *J* (D) +11 *J*

17. The angle between two vectors $-2\hat{i}+3\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}-4\hat{k}$ is

(A) 0° (B) 90° (C) 180° (D) None of the above

18. The angle between the vectors $(\hat{i}+\hat{j})$ and $(\hat{j}+\hat{k})$ is

(A) 30° (B) 45° (C) 60° (D) 90°

19. A particle moves with a velocity $6\hat{i}-4\hat{j}+3\hat{k}\,m/s$ under the influence of a constant force $\vec{F}=20\hat{i}+15\hat{j}-5\hat{k}\,N.$ The instantaneous power applied to the particle is

(A) 35 *J/s* (B) 45 *J/s* (C) 25 *J/s* (D) 195 *J/s*

20. If $\vec{P}.\vec{Q}=PQ,$ then angle between $\vec{P}$ and $\vec{Q}$ is

(A) 0° (B) 30° (C) 45° (D) 60°

21. A force $\vec{F}=5\hat{i}+6\hat{j}+4\hat{k}$ acting on a body, produces a displacement $\vec{S}=6\hat{i}-5\hat{k}.$ Work done by the force is

(A) 10 units (B) 18 units (C) 11 units (D) 5 units

22. The angle between the two vectors $\vec{A}=5\hat{i}+5\hat{j}$ and $\vec{B}=5\hat{i}-5\hat{j}$ will be

(A) Zero (B) 45° (C) 90° (D) 180°

23. The vector $\vec{P}=a\hat{i}+a\hat{j}+3\hat{k}$ and $\vec{Q}=a\hat{i}-2\hat{j}-\hat{k}$ are perpendicular to each other. The positive value of *a* is

(A) 3 (B) 4 (C) 9 (D) 13

24. A body, constrained to move in the *Y*-direction is subjected to a force given by $\vec{F}=(-2\hat{i}+15\hat{j}+6\hat{k})N.$ What is the work done by this force in moving the body a distance 10 *m* along the *Y*-axis

(A) 20 *J* (B) 150 *J* (C) 160 *J* (D) 190 *J*

25. A particle moves in the *x*-*y* plane under the action of a force $\vec{F}$ such that the value of its linear momentum $(\vec{P})$ at anytime*t* is $P_x=2\cos t, p_y=2\sin t.$ The angle θ between $\vec{F}$ and $\vec{P}$ at a given time *t.* will be

(A) $\theta=0°$ (B) $\theta=30°$ (C) $\theta=90°$ (D) $\theta=180°$

26. The area of the parallelogram represented by the vectors $\vec{A}=2\hat{i}+3\hat{j}$ and $\vec{B}=\hat{i}+4\hat{j}$ is

(A) 14 units (B) 7.5 units (C) 10 units (D) 5 units

27. A vector $\vec{F}_1$ is along the positive *X*-axis. If its vector product with another vector $\vec{F}_2$ is zero then $\vec{F}_2$ could be

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

28. If for two vectors $\vec{A}$ and $\vec{B},\vec{A}\times\vec{B}=0,$ the vectors

(A) Are perpendicular to each other (B) Are parallel to each other
(C) Act at an angle of 60° (D) Act at an angle of 30°

29. The angle between vectors $(\vec{A}\times\vec{B})$ and $(\vec{B}\times\vec{A})$ is

(A) Zero (B) π (C) $\pi/4$ (D) $\pi/2$

30. What is the angle between $(\vec{P}+\vec{Q})$ and $(\vec{P}\times\vec{Q})$

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

31. The resultant of the two vectors having magnitude 2 and 3 is 1. What is their cross product

(A) 6 (B) 3 (C) 1 (D) 0

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

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

(C) $\hat{i}B\sin\theta-jB\cos\theta$ (D) $\hat{i}B\cos\theta-jB\sin\theta$

33. The angle between two vectors given by $6\bar{i}+6\bar{j}-3\bar{k}$ and $7\bar{i}+4\bar{j}+4\bar{k}$ is

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

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

(A) Zero (B) Along west (C) Along east (D) Vertically downward

35. Angle between the vectors $(\hat{i}+\hat{j})$ and $(\hat{j}-\hat{k})$ is

(A) 90° (B) 0° (C) 180° (D) 60°

36. The position vectors of points *A*, *B*, *C* and *D* are $A = 3\hat{i} + 4\hat{j} + 5\hat{k}, B = 4\hat{i} + 5\hat{j} + 6\hat{k}, C = 7\hat{i} + 9\hat{j} + 3\hat{k}$ and $D = 4\hat{i} + 6\hat{j}$ then the displacement vectors *AB* and *CD* are

(A) Perpendicular (B) Parallel (C) Antiparallel (D) Inclined at an angle of 60°

37. If force $(\vec{F}) = 4\hat{i} + 5\hat{j}$ and displacement $(\vec{s}) = 3\hat{i} + 6\hat{k}$ then the work done is

(A) 4×3 (B) 5×6 (C) 6×3 (D) 4×6

38. If $|\vec{A} \times \vec{B}| = |\vec{A}.\vec{B}|$, then angle between $\vec{A}$ and $\vec{B}$ will be

(A) 30° (B) 45° (C) 60° (D) 90°

39. In an clockwise system

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

40. 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

41. Three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ satisfy the relation $\vec{a}.\vec{b} = 0$ and $\vec{a}.\vec{c} = 0$. The vector $\vec{a}$ is parallel to

(A) $\vec{b}$ (B) $\vec{c}$ (C) $\vec{b}.\vec{c}$ (D) $\vec{b} \times \vec{c}$

42. The diagonals of a parallelogram are $2\hat{i}$ and $2\hat{j}$. What is the area of the parallelogram

(A) 0.5 units (B) 1 unit (C) 2 units (D) 4 units

43. What is the unit vector perpendicular to the following vectors $2\hat{i} + 2\hat{j} - \hat{k}$ and $6\hat{i} - 3\hat{j} + 2\hat{k}$

(A) $\frac{\hat{i} + 10\hat{j} - 18\hat{k}}{5\sqrt{17}}$ (B) $\frac{\hat{i} - 10\hat{j} + 18\hat{k}}{5\sqrt{17}}$ (C) $\frac{\hat{i} - 10\hat{j} - 18\hat{k}}{5\sqrt{17}}$ (D) $\frac{\hat{i} + 10\hat{j} + 18\hat{k}}{5\sqrt{17}}$

44. The area of the parallelogram whose sides are represented by the vectors $\hat{j} + 3\hat{k}$ and $\hat{i} + 2\hat{j} - \hat{k}$ is

(A) $\sqrt{61}$ sq.unit (B) $\sqrt{59}$ sq.unit (C) $\sqrt{49}$ sq.unit (D) $\sqrt{52}$ sq.unit

45. The position of a particle is given by $\vec{r} = (\vec{i} + 2\vec{j} - \vec{k})$ momentum $\vec{P} = (3\vec{i} + 4\vec{j} - 2\vec{k})$. The angular momentum is perpendicular to

(A) *x*-axis (B) *y*-axis
(C) *z*-axis (D) Line at equal angles to all the three axes

46. Two vector*A* and *B* have equal magnitudes. Then the vector *A* + *B* is perpendicular to

(A) $A \times B$ (B) *A* – *B* (C) 3*A* – 3*B* (D) All of these

47. Find the torque of a force $\vec{F} = -3\hat{i} + \hat{j} + 5\hat{k}$ acting at the point $\vec{r} = 7\hat{i} + 3\hat{j} + \hat{k}$

(A) $14\hat{i} - 38\hat{j} + 16\hat{k}$ (B) $4\hat{i} + 4\hat{j} + 6\hat{k}$ (C) $21\hat{i} + 4\hat{j} + 4\hat{k}$ (D) $-14\hat{i} + 34\hat{j} - 16\hat{k}$

48. The value of $(\vec{A} + \vec{B}) \times (\vec{A} - \vec{B})$ is

(A) 0 (B) $A^2 - B^2$ (C) $\vec{B} \times \vec{A}$ (D) $2(\vec{B} \times \vec{A})$

49. If $\vec{A}$ and $\vec{B}$ are perpendicular vectors and vector $\vec{A} = 5\hat{i} + 7\hat{j} - 3\hat{k}$ and $\vec{B} = 2\hat{i} + 2\hat{j} - a\hat{k}$. The value of *a* is

(A) – 2 (B) 8 (C) – 7 (D) – 8

50. A force vector applied on a mass is represented as $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ and accelerates with $1\,m/s^2$. What will be the mass of the body in kg.

(A) $10\sqrt{2}$ (B) 20 (C) $2\sqrt{10}$ (D) 10

51. Two adjacent sides of a parallelogram are represented by the two vectors $\hat{i} + 2\hat{j} + 3\hat{k}$ and $3\hat{i} - 2\hat{j} + \hat{k}$. What is the area of parallelogram

(A) 8 (B) $8\sqrt{3}$ (C) $3\sqrt{8}$ (D) 192

52. The position vectors of radius are $2\hat{i} + \hat{j} + \hat{k}$ and $2\hat{i} - 3\hat{j} + \hat{k}$ while those of linear momentum are $2\hat{i} + 3\hat{j} - \hat{k}$. Then the angular momentum is

(A) $2\hat{i} - 4\hat{k}$ (B) $4\hat{i} - 8\hat{k}$ (C) $2\hat{i} - 4\hat{j} + 2\hat{k}$ (D) $4\hat{i} - 8\hat{k}$

53. 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) $-18\hat{i} - 13\hat{j} + 2\hat{k}$

54. Dot product of two mutual perpendicular vector is

(A) 0 (B) 1 (C) ∞ (D) None of these

55. When $\vec{A}.\vec{B} = -|A||B|$, then

(A) $\vec{A}$ and $\vec{B}$ are perpendicular to each other (B) $\vec{A}$ and $\vec{B}$ act in the same direction

(C) $\vec{A}$ and $\vec{B}$ act in the opposite direction (D) $\vec{A}$ and $\vec{B}$ can act in any direction

56. 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) $(A^2 + B^2 + AB)^{1/2}$

57. A force $\vec{F} = 3\hat{i} + c\hat{j} + 2\hat{k}$ acting on a particle causes a displacement $\vec{S} = -4\hat{i} + 2\hat{j} - 3\hat{k}$ in its own direction. If the work done is 6*J*, then the value of *c* will be

(A) 12 (B) 6 (C) 1 (D) 0

58. A force $\vec{F} = (5\hat{i} + 3\hat{j})\,N$ is applied over a particle which displaces it from its original position to the point $\vec{s} = (2\hat{i} - 1\hat{j})\,m$. The work done on the particle is

(A) + 11 *J* (B) + 7 *J* (C) + 13 *J* (D) – 7 *J*

59. If a vector $\vec{A}$ is parallel to another vector $\vec{B}$ then the resultant of the vector $\vec{A} \times \vec{B}$ will be equal to

(A) *A* (B) $\vec{A}$ (C) Zero vector (D) Zero

Lami's Theorem

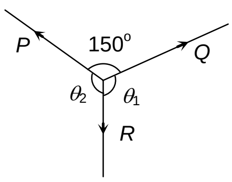
1. *P*, *Q* and *R* are three coplanar forces acting at a point and are in equilibrium. Given *P* = 1.9318 *kg wt*, $\sin\theta_1 = 0.9659$, the value of *R* is (in *kg wt*)

(A) 0.9659

(B) 2

(C) 1

(D) $\frac{1}{2}$



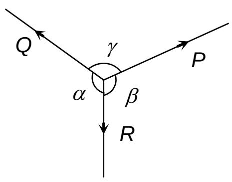
2. A body is in equilibrium under the action of three coplanar forces *P*, *Q* and *R* as shown in the figure. Select the correct statement

(A) $\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}$

(B) $\frac{P}{\cos\alpha} = \frac{Q}{\cos\beta} = \frac{R}{\cos\gamma}$

(C) $\frac{P}{\tan\alpha} = \frac{Q}{\tan\beta} = \frac{R}{\tan\gamma}$

(D) $\frac{P}{\sin\beta} = \frac{Q}{\sin\gamma} = \frac{R}{\sin\alpha}$



3. If a body is in equilibrium under a set of non-collinear forces, then the minimum number of forces has to be

(A) Four (B) Three (C) Two (D) Five

4. How many minimum number of non-zero vectors in different planes can be added to give zero resultant

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

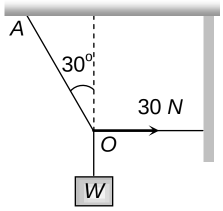
5. As shown in figure the tension in the horizontal cord is 30 *N*. The weight *W* and tension in the string *OA* in Newton are

(A) $30\sqrt{3}, 30$

(B) $30\sqrt{3}, 60$

(C) $60\sqrt{3}, 30$

(D) None of these



Relative Velocity

1. Two cars are moving in the same direction with the same speed 30 *km/hr.* They are separated by a distance of 5 *km,* the speed of a car moving in the opposite direction if it meets these two cars at an interval of 4 minutes, will be

(A) 40 *km/hr* (B) 45 *km/hr* (C) 30 *km/hr* (D) 15 *km/hr*

2. A man standing on a road hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 *km/hr.* He finds that raindrops are hitting his head vertically, the speed of raindrops with respect to the road will be

(A) 10 *km/hr* (B) 20 *km/hr* (C) 30 *km/hr* (D) 40 *km/hr*

3. In the above problem, the speed of raindrops *w.r.t.* the moving man, will be

(A) $10/\sqrt{2}\,km/h$ (B) 5 *km/h*(C) $10\sqrt{3}\,km/h$ (D) $5/\sqrt{3}\,km/h$

4. A boat is moving with a velocity 3*i* + 4*j* with respect to ground. The water in the river is moving with a velocity – 3*i* – 4*j* with respect to ground. The relative velocity of the boat with respect to water is

(A) *8j* (B) *– 6i – 8j* (C) 6*i +8j* (D) $5\sqrt{2}$

5. A 150 m long train is moving to north at a speed of 10 m/s. A parrot flying towards south with a speed of 5 m/s crosses the train. The time taken by the parrot the cross to train would be:

(A) 30 s (B) 15 s (C) 8 s (D) 10 s

6. A river is flowing from east to west at a speed of 5 m/min. A man on south bank of river, capable of swimming 10m/min in still water, wants to swim across the river in shortest time. He should swim

(A) Due north

(B) Due north-east

(C) Due north-east with double the speed of river

(D) None of these

7. A person aiming to reach the exactly opposite point on the bank of a stream is swimming with a speed of 0.5 *m/s* at an angle of 120^0 with the direction of flow of water. The speed of water in the stream is

(A) 1 *m/s* (B) 0.5 *m/s* (C) 0.25 *m/s* (D) 0.433 *m/s*

8. A moves with 65 *km/h* while *B* is coming back of *A* with 80 *km/h*. The relative velocity of *B* with respect to *A* is

(A) 80 *km/h* (B) 60 *km/h* (C) 15 *km/h* (D) 145 *km/h*

9. A thief is running away on a straight road on a jeep moving with a speed of 9 *m/s*. A police man chases him on a motor cycle moving at a speed of 10 *m/s*. If the instantaneous separation of jeep from the motor cycle is 100 *m*, how long will it take for the policemen to catch the thief

(A) 1 second (B) 19 second (C) 90 second (D) 100 second

10. A man can swim with velocity *v* relative to water. He has to cross a river of width *d* flowing with a velocity *u* (*u* >*v*). The distance through which he is carried down stream by the river is *x*. Which of the following statement is correct

(A) If he crosses the river in minimum time $x = \frac{du}{v}$

(B) *x*can not be less than $\frac{du}{v}$

(C) For x to be minimum he has to swim in a direction making an angle of $\frac{\pi}{2}+\sin^{-1}\left(\frac{v}{u}\right)$ with the direction of the flow of water

(D) x will be max. if he swims in a direction making an angle of $\frac{\pi}{2}+\sin^{-1}\frac{v}{u}$ with direction of the flow of water

11. A man sitting in a bus travelling in a direction from west to east with a speed of 40 *km*/*h* observes that the rain-drops are falling vertically down. To the another man standing on ground the rain will appear
(A) To fall vertically down
(B) To fall at an angle going from west to east
(C) To fall at an angle going from east to west
(D) The information given is insufficient to decide the direction of rain.

12. A boat takes two hours to travel 8 *km* and back in still water. If the velocity of water is 4 *km/h*, the time taken for going upstream 8 *km* and coming back is
(A) 2*h* (B) 2*h* 40 *min*
(C) 1*h* 20 *min* (D) Cannot be estimated with the information given

13. A 120 *m* long train is moving towards west with a speed of 10 *m/s*. A bird flying towards east with a speed of 5 *m/s* crosses the train. The time taken by the bird to cross the train will be
(A) 16 *sec* (B) 12 *sec* (C) 10 *sec* (D) 8 *sec*

14. A boat crosses a river with a velocity of 8 *km/h*. If the resulting velocity of boat is 10 *km/h* then the velocity of river water is
(A) 4 *km/h* (B) 6 *km/h* (C) 8 *km/h* (D) 10 *km/h*

Critical Questions

1. If a vector $\vec{P}$ making angles α, β, and γ respectively with the *X, Y* and *Z* axes respectively. Then $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=$
(A) 0 (B) 1 (C) 2 (D) 3

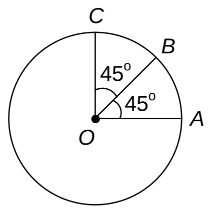
2. If the resultant of *n* forces of different magnitudes acting at a point is zero, then the minimum value of *n* is
(A) 1 (B) 2 (C) 3 (D) 4

3. Can the resultant of 2 vectors be zero
(A) Yes, when the 2 vectors are same in magnitude and direction
(B) No
(C) Yes, when the 2 vectors are same in magnitude but opposite in sense
(D) Yes, when the 2 vectors are same in magnitude making an angle of $\frac{2\pi}{3}$ with each other

4. The sum of the magnitudes of two forces acting at point is 18 and the magnitude of their resultant is 12. If the resultant is at 90° with the force of smaller magnitude, what are the, magnitudes of forces
(A) 12, 5 (B) 14, 4 (C) 5, 13 (D) 10, 8

5. A vector $\vec{a}$ is turned without a change in its length through a small angle $d\theta$. The value of $|\Delta\vec{a}|$ and Δa are respectively
(A) $0, a\,d\theta$ (B) $a\,d\theta, 0$ (C) 0, 0 (D) None of these

6. Find the resultant of three vectors $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ shown in the following figure. Radius of the circle is *R.*
(A) 2*R*
(B) $R(1+\sqrt{2})$
(C) $R\sqrt{2}$
(D) $R(\sqrt{2}-1)$



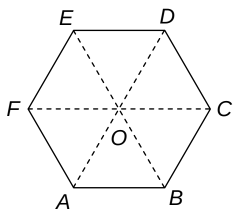
7. Figure shows *ABCDEF* as a regular hexagon. What is the value of $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}$

(A) $\overrightarrow{AO}$

(B) $2\overrightarrow{AO}$

(C) $4\overrightarrow{AO}$

(D) $6\overrightarrow{AO}$



8. The length of second's hand in watch is 1 *cm.* The change in velocity of its tip in 15 seconds is

(A) Zero (B) $\frac{\pi}{30\sqrt{2}}\ cm/\sec$ (C) $\frac{\pi}{30}\ cm/\sec$ (D) $\frac{\pi\sqrt{2}}{30}\ cm/\sec$

9. A particle moves towards east with velocity 5 *m/s.* After 10 seconds its direction changes towards north with same velocity. The average acceleration of the particle is

(A) Zero (B) $\frac{1}{\sqrt{2}} m/s^2\ N-W$ (C) $\frac{1}{\sqrt{2}} m/s^2\ N-E$ (D) $\frac{1}{\sqrt{2}} m/s^2\ S-W$

10. A force $\vec{F} = -K(y\hat{i} + x\hat{j})$ (where *K* is a positive constant) acts on a particle moving in the *x*-*y* plane. Starting from the origin, the particle is taken along the positive *x*- axis to the point (*a,* 0) and then parallel to the *y*-axis to the point (*a, a*). The total work done by the forces $\vec{F}$ on the particle is

(A) $-2Ka^2$ (B) $2Ka^2$ (C) $-Ka^2$ (D) Ka^2

11. The vectors from origin to the points *A* and *B* are $\vec{A} = 3\hat{i} - 6\hat{j} + 2\hat{k}$ and $\vec{B} = 2\hat{i} + \hat{j} - 2\hat{k}$ respectively. The area of the triangle *OAB* be

(A) $\frac{5}{2}\sqrt{17}$ *sq.unit* (B) $\frac{2}{5}\sqrt{17}$ *sq.unit* (C) $\frac{3}{5}\sqrt{17}$ *sq.unit* (D) $\frac{5}{3}\sqrt{17}$ *sq.unit*

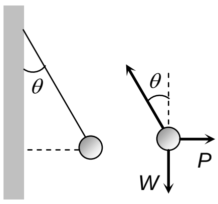
12. A metal sphere is hung by a string fixed to a wall. The sphere is pushed away from the wall by a stick. The forces acting on the sphere are shown in the second diagram. Which of the following statements is wrong

(A) $P = W\tan\theta$

(B) $\vec{T} + \vec{P} + \vec{W} = 0$

(C) $T^2 = P^2 + W^2$

(D) $T = P + W$



13. The speed of a boat is 5 *km/h* in still water. It crosses a river of width 1 *km* along the shortest possible path in 15 minutes. The velocity of the river water is

(A) 1 *km/h* (B) 3 *km/h* (C) 4 km/h (D) 5 *km/h*

14. A man crosses a 320 *m* wide river perpendicular to the current in 4 minutes. If in still water he can swim with a speed 5/3 times that of the current, then the speed of the current, in *m/min* is

(A) 30 (B) 40 (C) 50 (D) 60.

Assertion & Reason Type

Read the assertion and reason carefully to mark the correct option out of the options given below:

(A) *If both assertion and reason are true and the reason is the correct explanation of the assertion.*

(B) *If both assertion and reason are true but reason is not the correct explanation of the assertion.*

(C) *If assertion is true but reason is false.*

(D) *If the assertion and reason both are false.*

(e) *If assertion is false but reason is true*

1. Assertion : $\vec{A}\times\vec{B}$ is perpendicular to both $\vec{A}+\vec{B}$ as well as $\vec{A}-\vec{B}$.

Reason : $\vec{A}+\vec{B}$ as well as $\vec{A}-\vec{B}$ 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.	Assertion	:	Angle between $\hat{i}+\hat{j}$ and $\hat{i}$ is 45°
	Reason	:	$\hat{i}+\hat{j}$ is equally inclined to both $\hat{i}$ and $\hat{j}$ and the angle between $\hat{i}$ and $\hat{j}$ is 90°
3.	Assertion	:	If θ be the angle between $\vec{A}$ and $\vec{B}$, then $\tan\theta = \frac{\vec{A}\times\vec{B}}{\vec{A}.\vec{B}}$
	Reason	:	$\vec{A}\times\vec{B}$ is perpendicular to $\vec{A}.\vec{B}$
4.	Assertion	:	If $\lvert\vec{A}+\vec{B}\rvert = \lvert\vec{A}-\vec{B}\rvert$, then angle between $\vec{A}$ and $\vec{B}$ is 90°
	Reason	:	$\vec{A}+\vec{B} = \vec{B}+\vec{A}$
5.	Assertion	:	Vector product of two vectors is an axial vector
	Reason	:	If $\vec{v}$ = instantaneous velocity, $\vec{r}$ = radius vector and $\vec{\omega}$ = angular velocity, then $\vec{\omega} = \vec{v}\times\vec{r}$.
6.	Assertion	:	Minimum number of non-equal vectors in a plane required to give zero resultant is three.
	Reason	:	If $\vec{A}+\vec{B}+\vec{C} = \vec{0}$, then they must lie in one plane
7.	Assertion	:	Relative velocity of *Aw.r.t.B* is greater than the velocity of either, when they are moving in opposite directions.
	Reason	:	Relative velocity of *Aw.r.t.* $B = \vec{v}_A - \vec{v}_B$
8.	Assertion	:	Vector addition of two vectors $\vec{A}$ and $\vec{B}$ is commutative.
	Reason	:	$\vec{A}+\vec{B} = \vec{B}+\vec{A}$
9.	Assertion	:	$\vec{A}.\vec{B} = \vec{B}.\vec{A}$
	Reason	:	Dot product of two vectors is commutative.
10.	Assertion	:	$\vec{\tau} = \vec{r}\times\vec{F}$ and $\vec{\tau} \neq \vec{F}\times\vec{r}$
	Reason	:	Cross product of vectors is commutative.
11.	Assertion	:	A negative acceleration of a body is associated with a slowing down of a body.
	Reason	:	Acceleration is vector quantity.
12.	Assertion	:	A physical quantity cannot be called as a vector if its magnitude is zero.
	Reason	:	A vector has both, magnitude and direction.
13.	Assertion	:	The sum of two vectors can be zero.
	Reason	:	The vector cancel each other, when they are equal and opposite.
14.	Assertion	:	Two vectors are said to be like vectors if they have same direction but different magnitude.
	Reason	:	Vector quantities do not have specific direction.
15.	Assertion	:	The scalar product of two vectors can be zero.
	Reason	:	If two vectors are perpendicular to each other, their scalar product will be zero.
16.	Assertion	:	Multiplying any vector by an scalar is a meaningful operations.
	Reason	:	In uniform motion speed remains constant.
17.	Assertion	:	A null vector is a vector whose magnitude is zero and direction is arbitrary.
	Reason	:	A null vector does not exist.
18.	Assertion	:	If dot product and cross product of $\vec{A}$ and $\vec{B}$ are zero, it implies that one of the vector $\vec{A}$ and $\vec{B}$ must be a null vector.
	Reason	:	Null vector is a vector with zero magnitude.
19.	Assertion	:	The cross product of a vector with itself is a null vector.
	Reason	:	The cross-product of two vectors results in a vector quantity.
20.	Assertion	:	The minimum number of non coplanarvectors whose sum can be zero, is four.
	Reason	:	The resultant of two vectors of unequal magnitude can be zero.
21.	Assertion	:	If $\vec{A}.\vec{B} = \vec{B}.\vec{C}$, then $\vec{A}$ may not always be equal to $\vec{C}$
	Reason	:	The dot product of two vectors involves cosine of the angle between the two vectors.
22.	Assertion	:	Vector addition is commutative.
	Reason	:	$(\vec{A}+\vec{B}) \neq (\vec{B}+\vec{A})$.