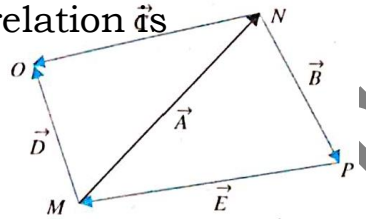
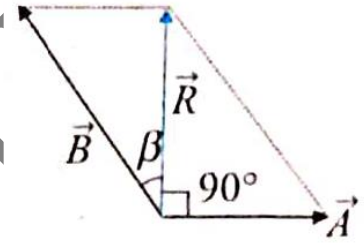
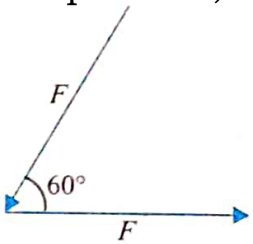
1. The sum and difference of two perpendicular vectors of equal length are
   a) Perpendicular to each other and of equal length
   b) Perpendicular to each other and of different lengths
   c) Of equal length and have an obtuse angle between them
   d) Of equal length and have an acute angle between them
2. The minimum number of vectors having different planes which can be added to give zero resultant is
   a) 2 b) 3 c) 4 d) 5
3. A vector perpendicular to $\hat{i}+\hat{j}+k$ is
   a) $\hat{i}-\hat{j}+k$ b) $\hat{i}-\hat{j}-k$ c) $-\hat{i}-\hat{j}-k$ d) $3\hat{i}+2\hat{j}-5k$
4. From figure, the correct relation is
   a) $\vec{A}+\vec{B}+\vec{E}=\vec{0}$
   b) $\vec{C}-\vec{D}=-\vec{A}$
   c) $\vec{B}+\vec{E}-\vec{C}=-\vec{D}$
   d) All of the above



5. Out of the following set of forces, the resultant of which cannot be zero?
   a) 10, 10, 10 b) 10, 10, 20 c) 10, 20, 20
   d) 10, 20, 40
6. The resultant of two vectors and is perpendicular to the vector $\vec{A}$ and $\vec{B}$ its magnitude is equal to half of the magnitude of vector $\vec{B}$ figure. The angle between $\vec{A}$ and $\vec{B}$ is
   a) 120° b) 150°
   c) 135° d) None of these



7. The ratio maximum and minimum magnitudes of the resultant of two vectors $\vec{a}$ and $\vec{b}$ is 3:1. Now, $|\vec{a}|$ is equal to
   a) $|\vec{b}|$ b) $2|\vec{b}|$ c) $3|\vec{b}|$ d) $4|\vec{b}|$
8. Two forces, each equal to F, act as shown in figure. Their resultant is



a) F/2 b) F c) $\sqrt{3}$F d) $\sqrt{5}$F

9. Vector $\vec{A}$ is 2 cm long and is 60° above the x-axis in the first quadrant. Vector $\vec{B}$ is 2 cm long and is 60° below the x-axis in the fourth quadrant. The sum $\vec{A} + \vec{B}$ is a vector of magnitude
   a) 2 cm along positive y-axis b) 2 cm along positive x-axis
   c) 2 cm along negative y-axis d) 2 cm along negative x-axis
10. What is the angle between two vector forces of equal magnitude such that their resultant is one-third of either of the original forces?
   a) $\cos^{-1}\left(-\frac{17}{18}\right)$ b) $\cos^{-1}\left(-\frac{1}{3}\right)$ c) 45° d) 120°
11. The angle between $\vec{A} + \vec{B}$ and $\vec{A} \times \vec{B}$ is
   a) 0 b) $\pi/4$ c) $\pi/2$ d) π
12. The projection of a vector $r = 3\hat{i} + \hat{j} + 2k$ on the x-y plane has magnitude
   a) 3 b) 4 c) $\sqrt{14}$ d) $\sqrt{10}$
13. If $|\vec{A} + \vec{B}| = |\vec{A}| = |\vec{B}|$, then the angle between $\vec{A}$ and $\vec{B}$ is
   a) 120° b) 60° c) 90° d) 0°
14. If vectors $\vec{A} = \hat{i} + 2\hat{j} + 4k$ and $\vec{B} = 5\hat{i}$ represent the two sides of a triangle, then the third side of the triangle can have length equal to
   a) 6 b) $\sqrt{56}$ c) Both of the above d) None of the above
15. Given $|\vec{A}_1| = 2$, $|\vec{A}_2| = 3$ and $|\vec{A}_1 + \vec{A}_2| = 3$. Find the value of $(\vec{A}_1 + 2\vec{A}_2) \cdot (3\vec{A}_1 - 4\vec{A}_2)$.
   a) –64 b) 60 c) –60 d) 64
16. Three vectors $\vec{A}$, $\vec{B}$, $\vec{C}$ satisfy the relation $\vec{A} \cdot \vec{B} = 0$ and $\vec{A} \cdot \vec{C} = 0$. The vector $\vec{A}$ is parallel to
   a) $\vec{B}$ b) $\vec{C}$ c) $\vec{B} \cdot \vec{C}$ d) $\vec{B} \times \vec{C}$
17. If $\vec{A} = \vec{B} + \vec{C}$, and the magnitudes of $\vec{A}$, $\vec{B}$, $\vec{C}$ are 5, 4, and 3 units, then the angle between $\vec{A}$ and $\vec{C}$ is
   a) $\cos^{-1}\left(\frac{3}{5}\right)$ b) $\cos^{-1}\left(\frac{4}{5}\right)$ c) $\text{in}^{-1}\left(\frac{3}{4}\right)$ d) $\frac{\pi}{2}$
18. Given : $\vec{A} = A\cos\theta\hat{i} + A\sin\theta\hat{j}$. A vector $\vec{B}$, which is perpendicular to $\vec{A}$, is given by
   a) $B\cos\theta\hat{i} - B\sin\theta\hat{j}$ b) $B\sin\theta\hat{i} - B\cos\theta\hat{j}$
   c) $B\cos\theta\hat{i} + B\sin\theta\hat{j}$ d) $B\sin\theta\hat{i} + B\cos\theta\hat{j}$
19. The angle which the vector $\vec{A} = 2\hat{i} + 3\hat{j}$ makes with the y-axis, where $\hat{i}$ and $\hat{j}$ are unit vectors along x- and y-axes, respectively, is

a) $\cos^{-1}(3/5)$ b) $\cos^{-1}(2/3)$ c) $\tan^{-1}(2/3$
d) $\sin^{-1}(2/3)$

20. Given $\vec{P} = 3\hat{i} - 4\hat{j}$. Which of the following is perpendicular to $\vec{P}$?
a) $3\hat{i}$ b) $4\hat{j}$ c) $4\hat{i} + 3\hat{j}$ d) $4\hat{i} - 3\hat{j}$

21. In going from one city to another, a car travels 75 km north, 60 km north-west and 20 km east. The magnitude of displacement between the two cities is (take $1/\sqrt{2} = 0.7$)
a) 170 km b) 137 km c) 119 km d) 140 km

22. What is the angle between $\vec{A}$ and , if $\vec{A}$ and $\vec{B}$ are the adjacent sides of a parallelogram drawn from a common point and the area of the parallelogram is AB/2?
a) 15^o b) 30^o c) 45^o d) 60^o

23. Two vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$. What is the angle between $\vec{a}$ and $\vec{b}$?
a) 0^o b) 90^o c) 60^o d) 180^o

24. Given $\vec{A} = 4\hat{i} + 6\hat{j}$ and $\vec{B} = 2\hat{i} + 3\hat{j}$. Which of the following is correct?
a) $\vec{A} \times \vec{B} =$ b) $\vec{A} \cdot \vec{B} = 24$
c) $\frac{|\vec{A}|}{|\vec{B}|} = \frac{1}{2}$ d) $\vec{A}$ and $\vec{B}$ are antiparallel

25. Given $\vec{A} = 2\hat{i} + p\hat{j} + qk$ and $\vec{B} = 5\hat{i} + 7\hat{j} + 3k$. If $\vec{A} \parallel \vec{B}$, then the value of p and q are, respectively,
a) $\frac{14}{5}$ and $\frac{6}{5}$ b) $\frac{14}{3}$ and $\frac{6}{5}$ c) $\frac{6}{5}$ and $\frac{1}{3}$
d) $\frac{3}{4}$ and $\frac{1}{4}$

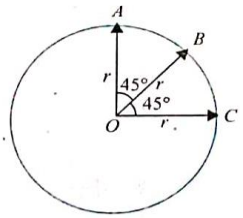
26. The vector sum of two forces is perpendicular to their vector difference. The forces are
a) Equal to each other b) Equal to each other in magnitude
c) Not equal to each other in magnitude d) Cannot be predicted

27. If a parallelogram is formed with two sides represented by vectors $\vec{a}$ and $\vec{b}$, then $\vec{a} + \vec{b}$ represents the
a) Major diagonal when the angle between vectors is acute
b) Minor diagonal when the angle between vectors is obtuse
c) Both of the above
d) None of the above

28. The resultant $\vec{C}$ of $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$. Also, $|\vec{A}| = |\vec{C}|$. The angle between $\vec{A}$ and $\vec{B}$ is
a) $\frac{\pi}{4}$ rad b) $\frac{3\pi}{4}$ rad c) $\frac{5\pi}{4}$ rad d) $\frac{7\pi}{4}$ rad

29. Two forces $\vec{F}_1$ = 500 N due east and $\vec{F}_2$ = 250 N due north have their common initial point. $\vec{F}_2 - \vec{F}_1$ is
a) $250\sqrt{5}$ N, $\tan^{-1}(2)$ W of N b) 250 N, $\tan^{-1}(2)$ W of N
c) Zero d) 750 N, $\tan^{-1}(3/4)$ N of W

30. The resultant of the three vectors $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$ shown in figure is



a) r
b) 2r
c) $r(1 + \sqrt{2})$
d) $r(\sqrt{2} - 1)$

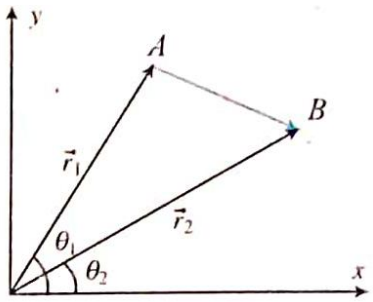
31. Two vectors $\vec{a}$ and $\vec{b}$ are at an angle of 60° with each other. Their resultant makes an angle of 45° with $\vec{a}$. If $|\vec{b}|$ = 2 units, then $|\vec{a}|$ is
a) $\sqrt{3}$ b) $\sqrt{3} - 1$ c) $\sqrt{3} + 1$ d) $\sqrt{3}/2$

32. The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is $\vec{R}$. If the magnitude of $\vec{Q}$ is doubled, the new resultant vector becomes perpendicular to $\vec{P}$. Then, the magnitude of $\vec{R}$ is equal to
a) P + Q b) P c) P – Q d) Q

33. A vector when added to the vector $\vec{B} = 3\hat{i} + 4\hat{j}$ yields a resultant vector that is in the positive y-direction and has a magnitude equal to that of $\vec{B}$. Find the magnitude of $\vec{A}$.
a) $\sqrt{10}$ b) 10 c) 5 d) $\sqrt{15}$

34. ABCDEF is a regular hexagon with point O as center. The value of $\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF}$ is
a) $2\overrightarrow{AO}$ b) $4\overrightarrow{AO}$ c) $6\overrightarrow{AO}$ d) 0

35. In a two-dimensional motion of a particle, the particle moves from point A, with position vector $\vec{r}_1$, to point B, with position vector $\vec{r}_2$. If the magnitudes of these vectors are, respectively, r_1 = 3 and r_2 = 4 and the angles they make with the x-axis are $\theta_1 = 75°$ and $\theta_2 = 15°$, respectively, then find the magnitude of the displacement vector.



a) 15 b) $\sqrt{13}$
c) 17 d) $\sqrt{15}$

36. The sum of the magnitudes of two forces acting at a point is 16 N. The resultant of these forces is perpendicular to the smaller force and has a magnitude of 8 N. If the smaller force is of magnitude x, then the value of x is
a) 2 N b) 4 N c) 6 N d) 7 N

37. The angle between two vectors $\vec{A}$ and $\vec{B}$ is θ. The resultant of these vectors $\vec{R}$ makes an angle of $\theta/2$ with A. Which of the following is true?
a) A = 2B b) A = B/2 c) A = B d) AB = 1

38. The resultant of three vectors 1, 2 and 3 units whose directions are those of the sides of an equilateral triangle is at an angle of
a) 30^o with the first vector b) 15^o with the first vector
c) 100^o with the first vector d) 150^o with the first vector

39. A unit vector along the incident ray of light is $\hat{i}$. The unit vector for the corresponding refracted ray of light is $\hat{r}$. n, n is a unit vector normal to the boundary of the medium and directed towards the incident medium. If μ is the refractive index of the medium, then Snell's law (second law) of refraction is
a) $\hat{i} \times n = \mu (n + \vec{r})$ b) $\hat{i} \cdot n = \mu (\hat{r} \cdot n)$
c) $\hat{i} \times n = \mu (\hat{r} \times n)$ d) $\hat{i} \times n = \mu (\hat{r} \times n)$

40. The components of a vector along the x- and y-directions are (n + 1) and 1, respectively. If the coordinative system is rotated by an angle $\theta = 60^o$, then the components change to n and 3. The value of n is
a) 2 b) cos 60^o c) sin 60^o d) 3.5