PHYSICS

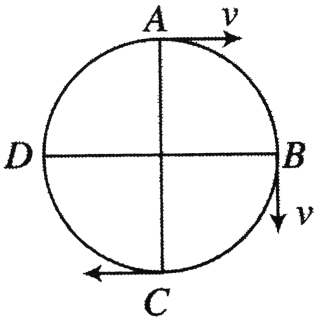
BOOKS - CENGAGE PHYSICS (ENGLISH)

VECTORS

Illustration

1. A car is moving round a circular track with a constant speed $v\text{of}20ms^{-1}$ (As shown in figure).At different times,the car is at A,B and C,respectively . Find the velocity change (a) from A to C, and (b)

from A to B.



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2. The greatest and least resulant of two forces acting at a point is $10N$ and $6N$,respectively. If

each force is increased by $3N$, find the resulant of new forces when acting at a point at an angle of 90° with each other .

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3. Two equal forces have their resultant equal to either. At what angle are they inclined ?.

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4. Two forces whose magnitudes are in the ratio $3:5$ give a resultant of 28N. If the angle of their

inclination is 60°, find the magnitude of each force.

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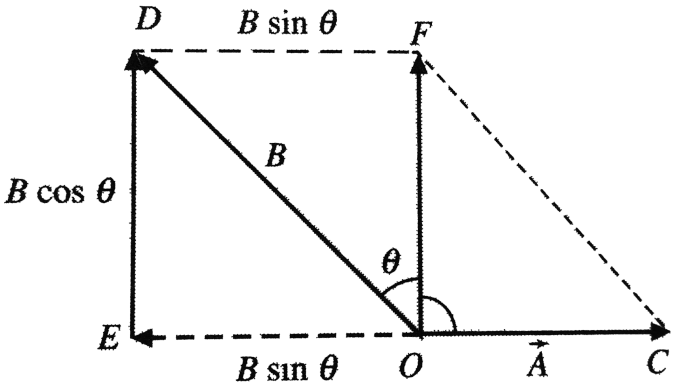
5. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to the vector $\vec{A}$ and its magnitude is equal to half of the magnitude of the vector $\vec{B}$. Find out the angles between $\vec{A}$ and $\vec{B}$.



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6. Two forces of unequal magnitude simultaneously act on a particle making an angle $\theta(=120^{\circ})$ with each other.If one of them is reversed ,the accelaration of the particle is become $\sqrt{3}$ times. Calculate the ratio of the magnitude of the forces.

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7. The resultant of two vector P and Q acting at a point inclined to each other at an angle θ is R . If the magnitude of vector Q is doubled ,R is also

doubled .if the vector Q is reversed in direction R is again doubled .Find the ratio between P , Q and R .

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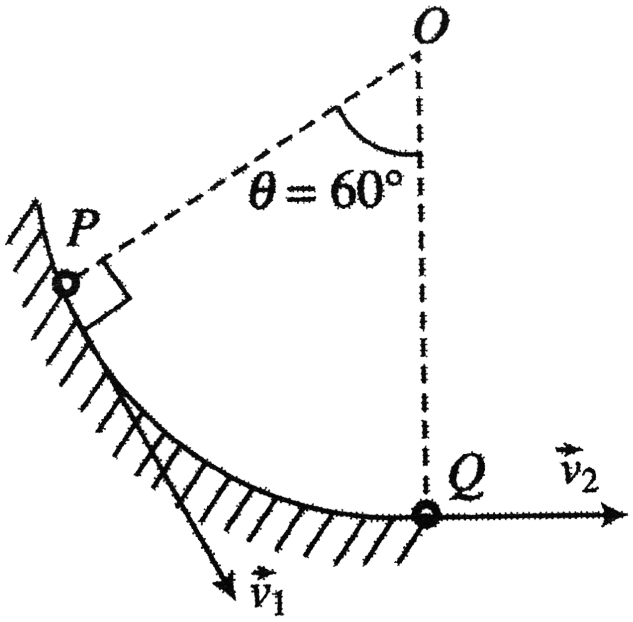
8. A particle slides with a speed of $3ms^{-1}$ at P. When it reaches Q,it acquires a speed of $4ms^{-1}$ after describing an angle of 60° at O as shown in figure .Find the changes in the velocity of the particle between P and Q. Assume that the path

followed by the particle is circular from P to Q



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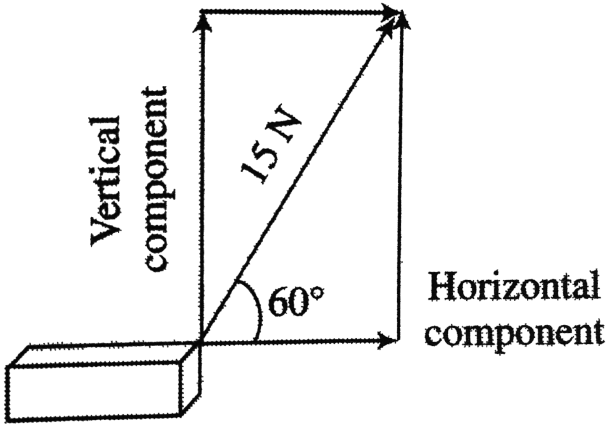
9. A force if $15N$ acts on a box as shown in (figure).What are the horizontal component and

vertical components of force?



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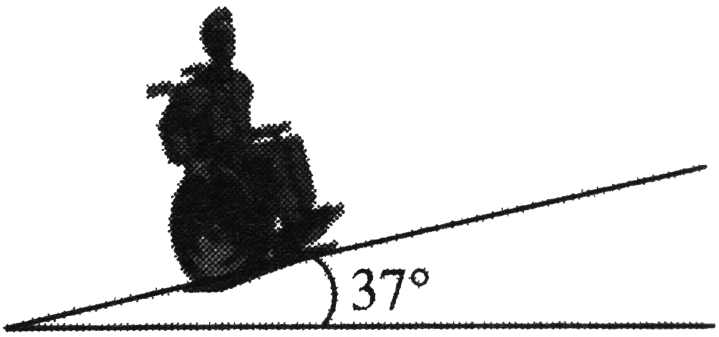
10. A person in a wheelchair is moving up a ramp at constant speed.Their total weight is $900N$. The ramp makes an angle of 37° with the horizontal. Calculate the component of its weight parallel and

perpendicular to ramp.



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11. A particle is moving with velocity $v = 100ms^{-1}$. If one of the rectangular components of a velocity is $50ms^{-1}$. Find the other component of velocity and its angle with the given component of velocity.

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12. An aeroplane takes off at an angle of 60° to the horizontal.If the velocity of the plane is $200kmh^{-1}$,calculate its horizontal and vertical component of its velocity.

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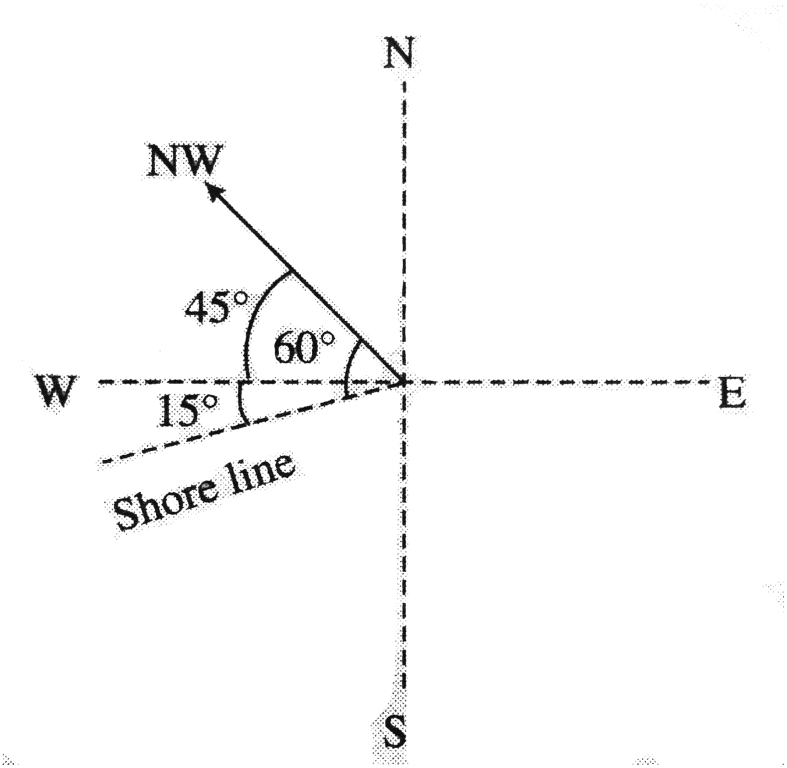
13. A man rows a boat with a speed of $18Kmh^{-1}$ in the north-west direction (figure). The shoreline makes an angle of 15° south of west. Obtain the components of the velocity of the boat along the

shoreline and perpendicular to the shoreline.



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14. Find the unit vector of $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$.

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15. Find the unit vector of $\left(\vec{A}+\vec{B}\right)$ where $\vec{A}=2\hat{i}-\hat{j}+3\hat{k}$ and $\vec{B}=3\hat{i}-2\hat{j}-2\hat{k}$.

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16. Given $\vec{A}=0.3\hat{i}+0.4\hat{j}+c\hat{k}$ calculate the value of c if A is a unit vector.

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17. Determine that vector which when added to the resultant of $\vec{A} = 3\hat{i} - 5\hat{j} + 7\hat{k}$ and $\vec{B} = 2\hat{i} + 4\hat{j} - 3\hat{k}$ gives unit vector along y-direction.

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18. A car is moving in direction $\vec{r} = -4\hat{i} + 3\hat{j}$ with a speed of $10ms^{-1}$. Write the velocity vector of car in unit vector notation.

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19. A car is moving with a speed of $10ms^{-1}$, If the east direction taken as x-axis and the north direction as y-axis . Write the velocity vector of car in unit vector notation.If it is moving (a) in the direction of N-E,(b) in the direction of $N-W$,(C) in the direction of$S-W$, and (d) in the direction of $S-E$.

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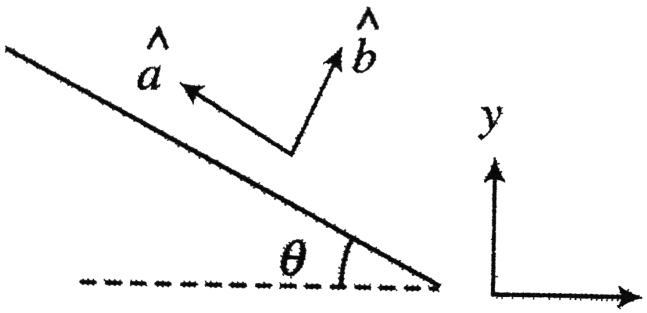
20. An inclined plane is inclined at θ with horizontal as shown in (figure).Write a unit vector in the direction parallel $(\hat{a})$ and perpendicular $\left(\hat{b}\right)$ to

inclined plane,in standard xy coordinate system.



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21. Given $\vec{A} = 5\hat{i} + 2\hat{j} + 4\hat{k}$. Find (a) $\left|\vec{A}\right|$ and (b) the direction cosines of vector $\vec{A}$.

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22. A bird moves with velocity $20ms^{-1}$ in a direction making an angle of 60° with the eastern line and 60° with vertical upward .Represent the velocity vector in a rectangular form.

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23. A particle is initially at point $A(2, 4, 6)m$ moves finally to the point$B(3, 2, -3)m$. Write the initial position vector,final position,and displacement vector of the particle.

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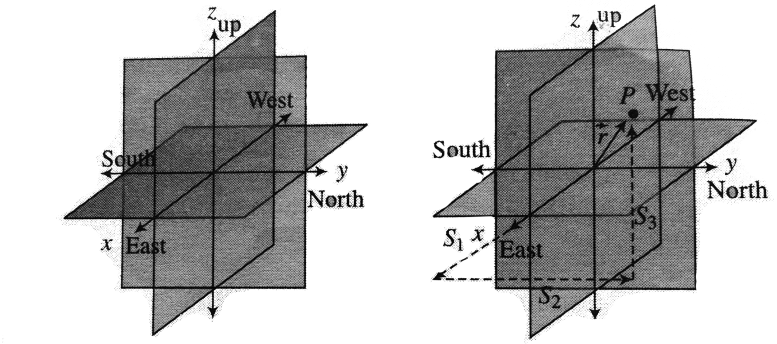
24. A bird flies due east through a distance of $100m$, then heading due north by a distance of $50m$, it flies vertically up through a distance of $20m$. Find the position of the bird relative to its initial position.



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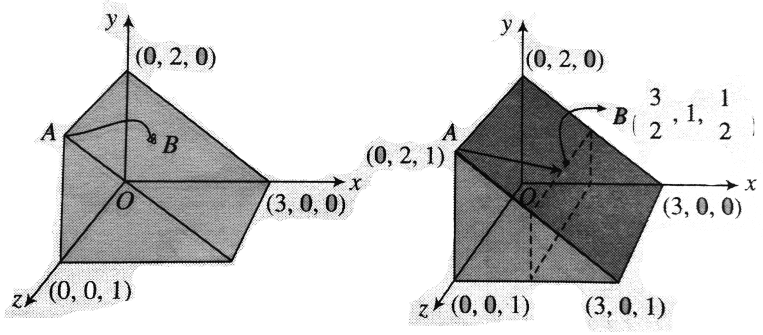
25. An insect crawls from A to B where B is the centre of the rectangular slant face. Find the (a) initial and final position vector of the insect and (b) displacement vector of the insect.



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26. Given that $\vec{A} + \vec{B} + \vec{C} = \vec{0}$. Out of three vectors,two are equal in magnitude and the

magnitude of the third vectors is $\sqrt{2}$ times that of either of the two having equal magnitude. Find the angles between the vectors.

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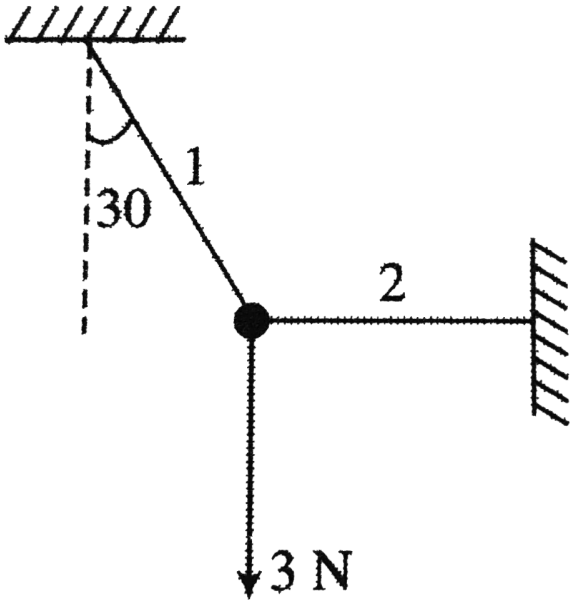
27. A bob of weight $3N$ is in equilibrium under the action of two string 1 and 2 (figure) . Find the

tension forces in the string.



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28. Find the dot product of two vectors $\vec{A} = 3\hat{i} + 2\hat{j} - 4\hat{k}$ and $\vec{B} = 2\hat{i} - 3\hat{j} - 6\hat{k}$.

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29. Find the value of m so that the vector $3\hat{i} - 2\hat{j} + \hat{k}$ may be perpendicular to the vector $2\hat{i} + 6\hat{j} + m\hat{k}$.

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30. What is the angle between the following pair of vectors?

$\overrightarrow{A} = \hat{i} + \hat{j} + \hat{k}$ and $\overrightarrow{B} = -2\hat{i} - 2\hat{j} - 2\hat{k}$.

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31. If the sum of two unit vectors is a unit vector, then the magnitude of their difference is :

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32. Find the value of m so that the vector $3\hat{i} - 2\hat{j} + \hat{k}$ may be perpendicular to the vector $2\hat{i} + 6\hat{j} + m\hat{k}$.

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33. Prove that $\left(\vec{A}+2\vec{B}\right).\left(2\vec{A}-3\vec{B}\right)=2A^2+AB\cos\theta-6B^2$

.

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34. A body constrained to move along the z-axis of a coordinate system is subject to a constant force F is given by

$F=-\hat{i}+2\hat{j}+3\hat{k}$ N

Where, $\hat{i}, \hat{j}, \hat{k}$ are unit vectors along the $x-$, $y-$ and z axis of the system respectively. What is the

work done by this force in moving the body a distance of 4m along the z-axis?

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35. If the diagonals of a parallelogram are perpendicular, then it is a rhombus.

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36. $\hat{i}$ and $\hat{j}$ are unit vectors along x-and y-axes respectively. What is the magnitude and the direction of the vectors $\hat{i}+\hat{j}$ and $\hat{i}-\hat{j}$? What are

the components of a vector $\vec{A} = 2\hat{i} + 3\hat{j}$ along the direction $\hat{i} + \hat{j}$and $\hat{i} - \hat{j}$?

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37. Calculate the are of the triangle determined by the two vectors $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 7\hat{j}$.

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38. Calculate the area of the parallelogram when adjacent sides are given by the vectors

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

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39. a. Prove that the vector $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}$, $\vec{B} = \hat{i} - 3\hat{j} + 5\hat{k}$, and $\vec{C} = 2\hat{i} + \hat{j} - 4\hat{k}$ from a right -angled triangle.

b. Determine the unit vector parallel to the cross product of vector $\vec{A} = 3\hat{i} - 5\hat{j} + 10\hat{k}$ & $= \vec{B} = 6\hat{i} + 5\hat{j} + 2\hat{k}$.

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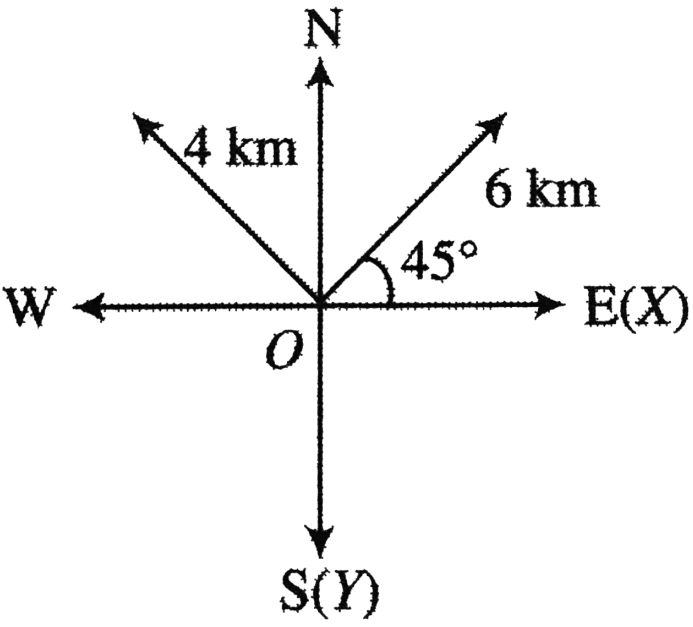
Exercise 3 1

1. A car travles 6km towards north at an angle of 45° to the east and then travles distance of 4km towards north at an angle of 135° to east (figure). How far is the point from the starting point? What angle does the straight line joining its initial and

final position makes with the east?



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2. There are two forces vector,one of 5N and other of 2N. At what angle should the two vector be

added to get the resultant vector of 17N, 7N,and 13N respectively?

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3. Given that $\vec{A} + \vec{B} + \vec{C} = \vec{0}$. Out of three vectors, two are equal in magnitude and the magnitude of the third vectors is $\sqrt{2}$ times that of either of the two having equal magnitude. Find the angles between the vectors.

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4. If $\vec{A} = 4\hat{i} - 3\hat{j}$ and $\vec{B} = 6\hat{i} + 8\hat{j}$,then find the magnitude and direction of $\vec{A} + \vec{B}$.

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5. A truck travelling due to north at $20ms^{-1}$ turns west and travels at the same speed. Find the change in its velocity.

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

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7. The sum of the magnitudes of wto forces acting at a point is 18 and the magnitude of their resultant is 12 If the resultant is at 90° with the force of smaller magnitude , what aarae the magnitude of fores ?

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8. Two forces $F_1 = 1N$ and $F_2 = 2N$ act along the lines x=0 and y=0, respectively. Then find the resultant of forces.

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9. Let $\vec{A} = 2\hat{i} + \hat{j}, B = 3\hat{j} - \hat{k}$ and $\vec{C} = 6\hat{i} - 2\hat{k}$. Find the value of $\vec{A} - 2\vec{B} + 3\vec{C}$.

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10. A vector $\vec{a}$ is turned without a change in its length through a small angle $d\theta$. Find the value of

$\left|\Delta \vec{a}\right|$

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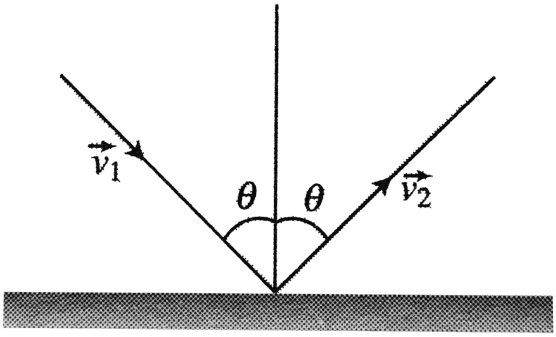
11. An object of m kg with speed of v ms^{-1} strikes a wall at an angle θ and rebounds at the same speed and same angle. Find the magnitude of change in the momentum of object.



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12. If $A = 3\hat{i} + 4\hat{j}$ and $B = 7\hat{i} + 24\hat{j}$,find the vector having the same magnitude as B and parallel to A.

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13. Vector $\vec{A}$ makes equal angles with x-,y-,and z-axis. Find the value of its components (in terms of magnitude of $\vec{A}$)

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14. Find 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.

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15. At what angle should the forces 2P and $\sqrt{2}$ act so that the resultant fforce is $p\sqrt{10}$

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16. Two forces, while acting on particle in opposite directions,have the resultant of 10N. If they act at right angles to each other, the resultant is found to be 50N. Find the two forces?

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17. Two forces each equal to $F/2$ act at right angle. Their effect may be neutralized by a third force acting along their bisector in the opposite direction. What is the magnitude of that third forces.

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18. The resultant of two forces has magnitude 20N. One of the forces is of magnitude $20\sqrt{3}N$ and makes an angle of 30° with the resultant. Then what is the magnitude of the other force?

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19. The resultant of $\vec{P}$ and $\vec{Q}$ is $\vec{R}$. If $\vec{Q}$ is doubled, $\vec{R}$ is doubled, when $\vec{Q}$ is reversed, $\vec{R}$ is again doubled. Find P:Q:R.

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Exercise 3 2

1. $\vec{A} = 2\hat{i} + 4\hat{j} + 4\hat{k}$ and $\vec{B} = 4\hat{i} + 2\hat{j} - 4\hat{k}$ are two vectors. Find the angles between them.

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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 find the value of λ

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3. In Q-2, if vectors are perpendicular to each other then find the value of λ.

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4. If $\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{B} = -\hat{i} + 3\hat{j} + 4\hat{k}$, then find the projection of $\vec{A}$ on $\vec{B}$.

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5. A body, acted upon by a force of 50N, is displaced through a distance 10m in direction making an

angle of 60° with the force. Find the work done by the force.

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6. 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 is in meters, then find the work done by the force.

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7. If for two vectors $\hat{A}$ and $\hat{B}$,sum $\left(\overrightarrow{A}+\overrightarrow{B}\right)$ is perpendicular to the diffrence $\left(\overrightarrow{A}-\overrightarrow{B}\right)$. Find the ratio of their magnitude.

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8. A force $F=-k\left(y\hat{i}+x\hat{j}\right)$ (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 force F on the particle

is

(a) $-2ka^2$, (b) $2ka^2$, (c)-ka^(2), (d)ka^(2)`

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9. If $\vec{A} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{B} = 2\hat{i} - 2\hat{j} + 4\hat{k}$, then find the value of $\left|\vec{A} \times \vec{B}\right|$.

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10. The vector from origion to the point 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. Find the area of the triangle OAB.

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11. The angle between the vector $\vec{A}$ and $\vec{B}$ is θ. Find the value of triple product $\vec{A} . \left(\vec{B} \times \vec{A} \right)$.

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12. Find the torque of the force $\vec{F} = \left(2\hat{i} - 3\hat{j} + 4\hat{k} \right)$ N acting at the point $\vec{r} = \left(3\hat{i} = 2\hat{j} + 3\hat{k} \right)$ m about the origion.

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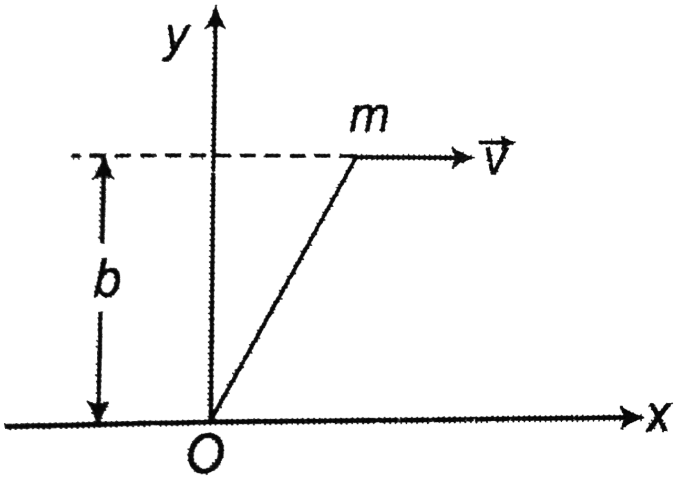
13. If the particle of mass m is moving with constant velocity v parallel to x-axis in x-y plane as shown in (figure), Find its angular momentum with respect of origin at any time t.



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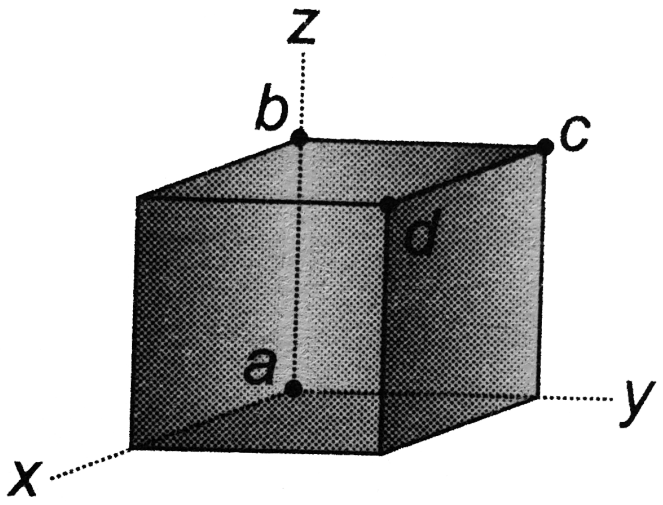
Exercise Subjective

1. A cube is placed so that one corner is at the origin and three edges are along the x-,y-, and ,z-axes of a coordinate system (figure).Use vector to compute

a.The angle between the edge along the z-axis (line ab) and the diagonal from the origin to the opposite corner (line ad).

b. The angle between line ac (the diagonal of a face

) and line ad.



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2. You are given vector $\overrightarrow{A} = 5\hat{i} - 6.5\hat{j}$ and $\overrightarrow{B} = 10\hat{i} + 7\hat{j}$.

A third vector $\overrightarrow{C}$ lies in the $x - y$ plane. Vector

(C) is perpendicular to vector $\vec{A}$ and the scalar product of $\vec{C}$ with $\vec{B}$ is 15. From this information, find the components of $\vec{C}$

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3. Two vector $\vec{A}$ and $\vec{B}$ have magnitudes A=3.00 and B=3.00. Their vector product is $\vec{A} \times \vec{B} = -5.00\hat{k} + 2.00\hat{i}$.

What is the angle between $\vec{A}$ and $\vec{B}$?

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4. Given two vectors $\vec{A} = 3\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} - \hat{j} - \hat{k}$.Find the

a.Area of the triangle whose two adjacent sides are represented by the vector $\vec{A}$ and $\vec{B}$

b.Area of the parallelogram whose two adjacent sides are represented by the vector $\vec{A}$ and $\vec{B}$

c. Area of the parallelogram whose diagnoals are represented by the vector $\vec{A}$ and $\vec{B}$

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5. On a horizontal flat ground, a person is standing at a point A. At this point, he installs a $5m$ long

pole vertically. Now , he moves $5m$ towards east and then $2m$ towards north and reaches at a point B. There he installs another $3m$ long vertical pole . A bird flies from the top of the first pole to the top of the swecond pole. Find the displacement and magnitude of the displacement of the bird.

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6. Find the vector sum of N coplanar forces, each of the magnitude F,when each force makes an angle of $2\pi / N$ with that preceding it.

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7. Can you find at least one vector perpendiculr to $3\hat{i} - 4\hat{j} + 7\hat{k}$?

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8. Two forces P and Q acting at a point are such that if P is reveserd, the direction of the resultant is turned through 90°. Prove that the magnitudes of the forces are equal.

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9. Unit vector $\hat{P}$ and $\hat{Q}$ are inclined at an angle θ. Prove that $\left|\hat{P}-\hat{Q}\right| = 2\sin(\theta/2)$.

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10. A sail boat sails $2km$ due east, $5km37^\circ$ south of east, and finally an unknown displacement. If the final displacement of the boat from the starting point is $6km$ due east. Determine the third displacement.

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11. Two forces of magnitudes P and Q are inclined at an angle (θ). The magnitude of their resultant is 3Q. When the inclination is changed to $(180^\circ - \theta)$, the magnitude of the resultant force becomes Q. Find the ratio of the forces.

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12. A vector $\vec{B}$ which has a magnitude 8.0 is added to a vector $\vec{A}$ which lies along the x-axis. The sum of these two vector is a third vector which lies along the y-axis and has a magnitude that is twice the magnitude of $\vec{A}$. Find the magnitude of $\vec{A}$

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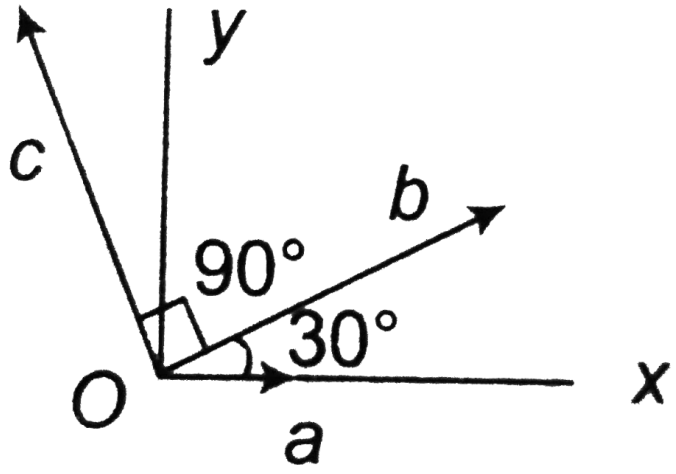
13. Three vector as shown in (figure) have magnitudes $\left|\overrightarrow{a}\right| = 3, \left|\overrightarrow{b}\right| = 4$,and $\left|\overrightarrow{c}\right| = 10$



a.Find the x and y components of these vectors.

b.Find the numbers p and q such that $\overrightarrow{c} = p\overrightarrow{a} + q\overrightarrow{b}$.

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14. A bouy is attached to three tugboats by three ropes. The tugboats are engaged in a tug-Of-war. One tugboat pulls west on the buoy with a force $\overrightarrow{F}_1$ of magnitude $1000N$. The second tugboat pulls south on the buoy with a force $\overrightarrow{F}_2$ of magnitude $2000N$. The third tugboat pulls northeast (that is, half way between north and east), with a force $\overrightarrow{F}_3$ of magnitude $2000N$

a. Express each force in unit vector from $\left(\hat{i}, \hat{j}\right)$.

b. Calculate the magnitude of the resultant force.

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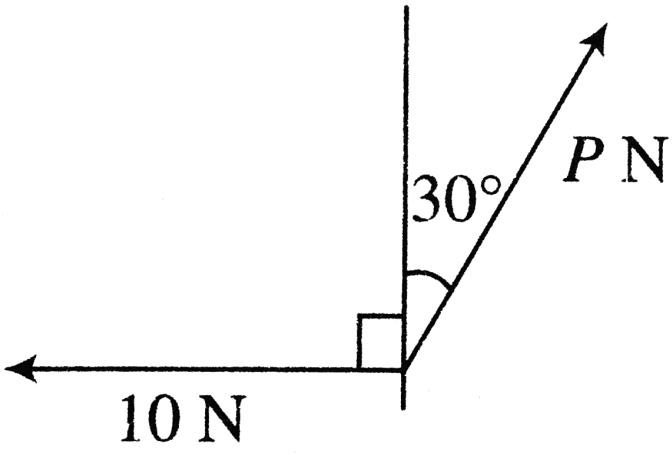
15. Two horizontal forces of magnitudes of $10N$ and PN act on a particle. The force of magnitude $10N$ acts due west and the force of magnitude PN acts on a bearing of 30° east of north as shown in (figure) The resultant of these two force acts due north. Find the magnitude of the resultant.



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16. The position vectors of two balls are given by

$\overrightarrow{r}_1 = 2(m)i + 7(m)j$

$\overrightarrow{r}_2 = -2(m)i + 4(m)j$

What will be the distance between the two balls?

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17. A particle whose speed is $50ms^{-1}$ moves along the line from $A(2, 1)$ to $B(9, 25)$. Find its velocity vector in the from of $a\hat{i} + b\hat{j}$.

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18. A particle travels with speed $50ms^{-1}$ from the point $(3, -7)$ in a direction $7\hat{i} - 24(j)$. Find its position vector after $3s$.

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19. A particle has an initial velocity $3\hat{i} + 4\hat{j}$ and an acceleration of $0.4\hat{i} + 0.30\hat{j}$. Its speed after 10s is

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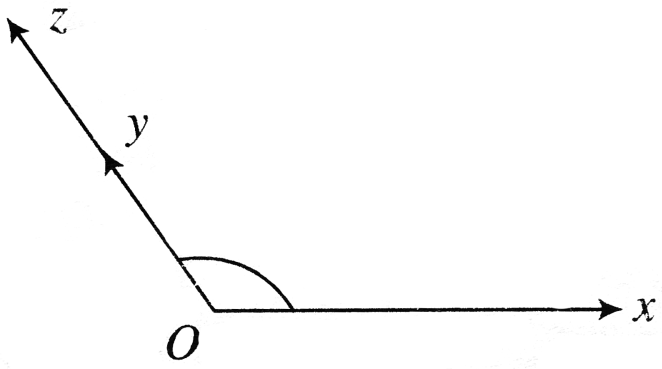
20. Forces X,Y and Z have magnitudes $10N5\left(\sqrt{3}-1\right)N$ and $5\left(\sqrt{3}+1\right)N$, respectively. The forces Y and Z act in the same direction as shown in (figure) The resultant of X and Y and the resultant of X and Z have the same magnitudes. Find θ, the angle between X and Y.



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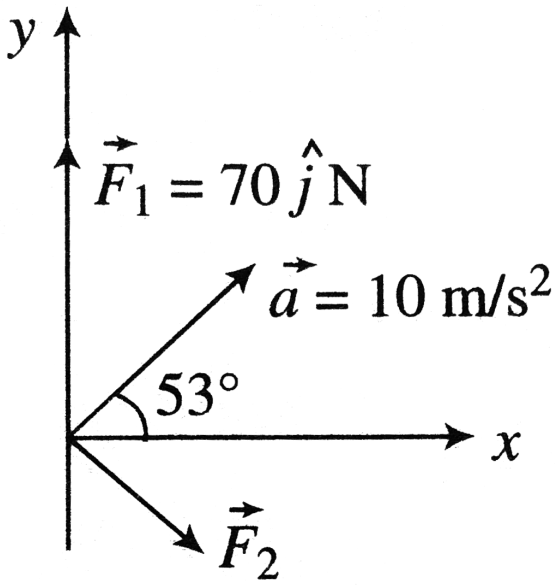
21. A particle of $m = 5kg$ is momentarily at rest at $x = att$=. It is acted upon by two forces $\overrightarrow{F}_1$ and $\overrightarrow{F}_2$. $Vec(F)_1 = 70\hat{j}$ N. The direction and manitude of $\overrightarrow{F}_2$ are unknown. The particle experiences a constant acceleration, $\overrightarrow{a}$,in the direction as shown in (figure) Neglect gravity.



a.Find the missing force $\overrightarrow{F}_2$.

b. What is the velocity vector of the particle at $t = 10s$?

c. What third force, $\overrightarrow{F}_3$ is required to make the acceleration of the particle zero? Either give magnitude and direction of $\overrightarrow{F}_3$ or its components.

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22. A spy plane is being tacked by a radar. At t=0, its position is reported as (100m ,200m, 1000m). 130s later, its position is reported to be (2500m,1200m ,1000 m). Find a unit vector in the direction of

plane velocity and the magnitude of its average velocity.

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23. a. Calculate $\vec{r} = \vec{a} - \vec{b} + \vec{c}$, where $\vec{a} = 5\hat{i} + 4\hat{j} - 6\hat{k}$, $\vec{b} = -2\hat{i} + 2\hat{j} + 3\hat{k}$, and $\vec{c} = 4\hat{i} + 3\hat{j} + 2\hat{k}$.

b. Calculate the angle between $\vec{r}$ and the z-axis.

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24. A force $\vec{F} = 3\hat{i} + 2\hat{j} + c\hat{k}$N causes a displacement $\vec{r} = c\hat{i} + 4\hat{j} + c\hat{k}$ m. The work done is 36 J. Find the values (s) of c.

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25. When two vectors of magnitudes P and Q are inclined at an angle θ, the magnitudes of their resultant is 2P. When the inclination is changed to $180^\circ - \theta$, the magnitudes of the resultant is halved. Find the ratio of P and Q.

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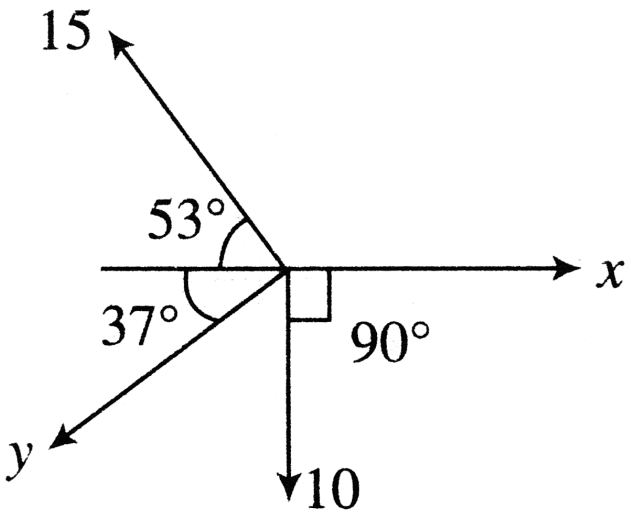
26. Find the magnitudes of the unknown forces if the sum of all forces is zero (figure)



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27. Three boys are pulling a heavy trolled by means of three ropes. The boy in the middle is exerting a

pull of $100N$. The other two boys ,whose ropes both make an angle 30° with the central rope, are pulling with forces of $50\sqrt{3}N$ and $100\sqrt{3}N$. Find the magnitudes of the resultant pull on the trolltey.

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28. If $\vec{A} = 2\hat{i} + \hat{j}$ and $\vec{B} = \hat{i} - \hat{j}$, sketch vector graphically and find the component of $\vec{A}$ along $\vec{B}$ and perpendicular to $\vec{B}$

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Exercise Single Correct

1. The sum and diffrence of two perpendicular vector of equal length are

A. Perpendicular to each other and of equal length.

B. Perpendicular to each other and of different length

C. Of equal length and have an obtuse angle between them

D. Of equal length and have an acute angle between them

Answer: A

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2. The minimum number of vector having different planes which can be added to give zero resultant is

A. a. 2

B. b. 3

C. c. 4

D. d. 5

Answer: C

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3. A vector perpendicular to $\hat{i} + \hat{j} + \hat{k}$ is

A. $\hat{i} - \hat{j} + \hat{k}$

B. $\hat{i} - \hat{j} - \hat{k}$

C. $-\hat{i} - \hat{j} - \hat{k}$

D. $3\hat{i} + 2\hat{j} - 5\hat{k}$

Answer: D

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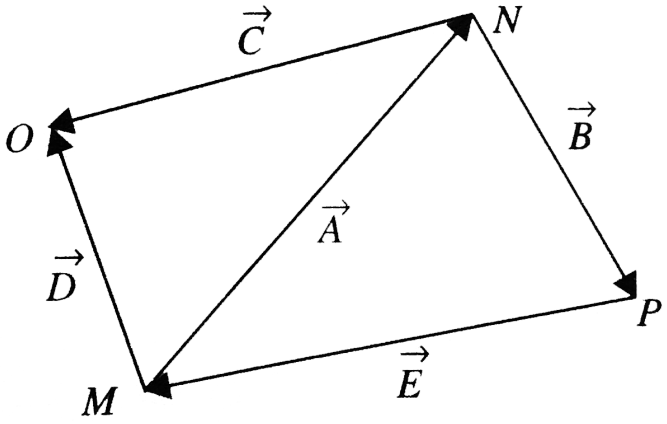
4. From figure the correct relation is



A. a. $\vec{A} + \vec{B} + \vec{E} = \vec{0}$

B. b. $\vec{C} - \vec{D} = -\vec{A}$

C. c. $\vec{B} + \vec{E} - \vec{C} = -\vec{D}$

D. d. All of the above

Answer: D

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5. Out of the following set of forces, the rsultant of which cannot be zero?

A. 10,10,10

B. 10,10,20

C. 10,20,20

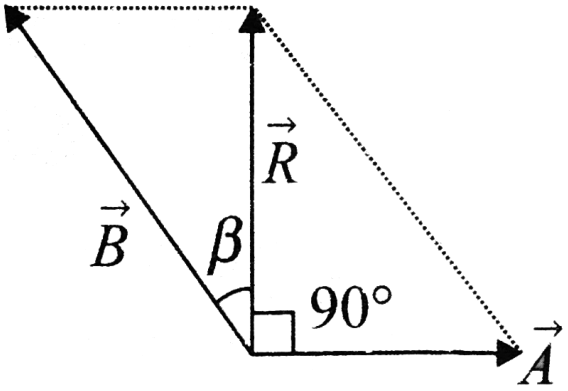
D. 10,20,40

Answer: D

 Watch Video Solution

6. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to the vector $\vec{A}$ and its magnitudes is equal to half of the magnitudes of vector $\vec{B}$

(figure). The angle between $\vec{A}$ and $\vec{B}$ is



A. a. 120°

B. b. 150°

C. c. 135°

D. d. None of these

Answer: B

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7. The ratio of maximum and minimum magnitudes of the resultant of two vectors $\vec{a}$ and $\vec{b}$ is 3:1. Now, $\left|\vec{a}\right|$ is equal to

A. $\left|\vec{b}\right|$

B. $2\left|\vec{b}\right|$

C. $3\left|\vec{b}\right|$

D. $4\left|\vec{b}\right|$

Answer: B

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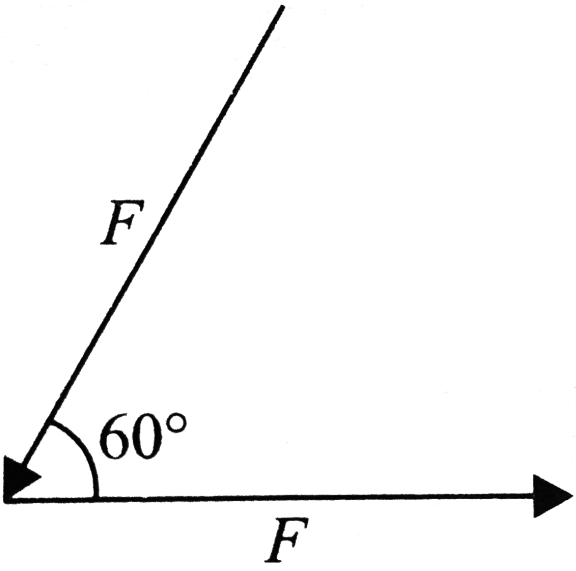
8. Two forces, each equal to F, act as shown in (figure) Their resultant is



A. $F/2$

B. F

C. $\sqrt{3}F$

D. $\sqrt{5}F$

Answer: B

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9. Vector $\vec{A}$ is $2cm$ long and is 60° above the x-axis in the first quadrant. Vactor $\vec{B}$ is $2cm$ long and is 60° below the x-axis in the fourth quadrant. The sum $\vec{A} + \vec{B}$ is a vector of magnitudes

A. $2cm$ along positive y-axis

B. $2cm$ along positive x-axis

C. $2cm$ along negative y-axis

D. $2cm$ along negative x-axis

Answer: B

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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°

Answer: A

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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

Answer: C

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12. The projection of a vector $\overrightarrow{r} = 3\hat{i} + \hat{j} + 2\hat{k}$ on the $x - y$ plane has magnitude

A. 3

B. 4

C. $\sqrt{14}$

D. $\sqrt{10}$

Answer: D

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13. If $\left|\vec{A}+\vec{B}\right|=\left|\vec{A}\right|=\left|\vec{B}\right|$ then the angle between $\vec{A}$ and $\vec{B}$ is

A. 120°

B. 60°

C. 90°

D. 0°

Answer: A

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14. If vectors $A = \hat{i} + 2\hat{j} + 4\hat{k}$ and $B = 5\hat{i}$ represent the two sides of a triangle, then the third side of triangle has length equal to:

A. 6

B. $\sqrt{56}$

C. Both of the above

D. None of the above

Answer: C

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15. Given $\left|\vec{A}_1\right| = 2, \left|\vec{A}_2\right| = 3$ and $\left|\vec{A}_1 + \vec{A}_2\right| = 3.$ Find the value of $\left(\vec{A}_1 + 2\vec{A}_2\right).\left(3\vec{A}_1 - 4\vec{A}_2\right).$

A. -64

B. 60

C. -60

D. 64

Answer: A

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16. Three vector $\vec{A}, \vec{B}, \vec{C}$ 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. $\vec{B} \times \vec{C}$

Answer: D

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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. $\sin^{-1}\left(\frac{3}{4}\right)$

D. $\frac{\pi}{2}$

Answer: A

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18. Let $A = \hat{i}A\cos\theta + \hat{j}A\sin\theta$ be any vector .Another vector B which is perpendiculaar to A can be expressed as

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. $B\sin\theta\hat{i} + B\cos\theta\hat{j}$

Answer: B

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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-axis, respectively, is

A. a. $\cos^{-1}(3/5)$

B. b. $\cos^{-1}(2/3)$

C. c. `tan^(-1)(2//3)

D. d. $\sin^{-1}(2/3)$

Answer: C

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20. Given $\overrightarrow{P} = 3\hat{i} - 4\hat{j}$. Which of the following is perpendicular to $\overrightarrow{P}$?

A. $3\hat{i}$

B. $4\hat{j}$

C. $4\hat{i} + 3\hat{j}$

D. $4\hat{i} - 3\hat{j}$

Answer: C

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

A. $170km$

B. $137km$

C. $119km$

D. $140km$

Answer: C

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22. What is the angle between $\vec{A}$ and $\vec{B}$, If $\vec{A}$ and $\vec{B}$ are the adjacent sides of a parallelogram drwan from a common point and the area of the parallelogram is $AB/2$?

A. 15°

B. 30°

C. 45°

D. 60°

Answer: B

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23. Two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|$. What is the angle between $\vec{a}$ and $\vec{b}$?

A. 0°

B. 90°

C. 60°

D. 180°

Answer: B

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24. Given $\vec{A} = 4\hat{i} + 6\hat{j}$ and $\vec{B} = 2\hat{i} + 3\hat{j}$. Which of the following

A. $\vec{A} \times \vec{B} = \vec{0}$

B. $\vec{A} \cdot \vec{B} = 24$

C. $\frac{|\vec{A}|}{|\vec{B}|} = \frac{1}{2}$

D. $\vec{A}$ and $\vec{B}$ are antiparallel

Answer: A

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25. Given $\vec{A} = 2\hat{i} + p\hat{j} + q\hat{k}$ and $\vec{B} = 5\hat{i} + 7\hat{j} + 3\hat{k}$. If $\vec{A} \mid\mid \vec{B}$, then the values 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 $\frac{1}{4}$

Answer: A

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26. If $\vec{A}$ is perpendicular to $\vec{B}$, then

A. $\vec{A} \times \vec{B} = 0$

B. $\vec{A} . \left[\vec{A} + \vec{B}\right] = A^2$

C. $\vec{A} . \vec{B} = AB$

D. $\vec{A} . \left[\vec{A} + \vec{B}\right] = A^2 + AB$

Answer: B

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27. If the angle between the vectors $\vec{a}$ and $\vec{b}$ is an acute angle, then the diffrence $\vec{a} - \vec{b}$ is

A. The major diagonal of the parallelogram

B. The minor diagnol of the parallelogram

C. Any of the above

D. None of the above

Answer: B

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28. Given that $\vec{A} + \vec{B} = \vec{C}$. If $\left|\vec{A}\right| = 4, \left|\vec{B}\right| = 5$ and $\left|\vec{C}\right| = \sqrt{61}$, the angle between $\vec{A}$ and $\vec{B}$ is

A. 30°

B. 60°

C. 90°

D. 120°

Answer: B

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29. If $\vec{b} = 3\hat{i} + 4\hat{j}$ and $\vec{a} = \hat{i} - \hat{j}$ the vector having the same magnitude as that of $\vec{b}$ and parallel to $\vec{a}$ is

A. $\frac{5}{\sqrt{2}}\left(\hat{i} - \hat{j}\right)$

B. $\frac{5}{\sqrt{2}}\left(\hat{i}+\hat{j}\right)$

C. $5\left(\hat{i}-\hat{j}\right)$

D. $5\left(\hat{i}+\hat{j}\right)$

Answer: A

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30. Choose the wrong statement.

A. a. Three vector of different magnitudes may be combined to give zero resultant.

B. b. Two vectors of different magnitudes can be combined to give a zero resultant.

C. c. The product of a scalar and a vector is a vector quantity.

D. d. All of the above are wrong statements.

Answer: B

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31. What displacement at an angle 60° to the x-axis has an x-component of $5m$? $\hat{i}$ and $\hat{j}$ are unit vector

in x and y directions, respectively.

A. $5\hat{i}$

B. $5\hat{i} + 5\hat{j}$

C. $5\hat{i} + 5\sqrt{3}\hat{j}$

D. All of the above

Answer: C

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32. Mark the correct statement.

A. $\left|\vec{a} + \vec{b}\right| \geq \left|\vec{a}\right| + \left|\vec{b}\right|$

B. $\left|\vec{a}+\vec{b}\right| \leq \left|\vec{a}\right|+\left|\vec{b}\right|$

C. $\left|\vec{a}-\vec{b}\right| \leq \left|\vec{a}\right|+\left|\vec{b}\right|$

D. All of the above

Answer: B

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33. Out of the following forces, the resultant of which cannot be $10N$?

A. $15N$ and $20N$

B. $10N$ and $10N$

C. $5N$ and $12N$

D. $12N$ and $1N$

Answer: D

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34. Which of the following pairs of forces cannot be added to give a resultant force of $4N$?

A. $2N$ and $8N$

B. $2N$ and $2N$

C. $2N$ and $6N$

D. $2N$ and $4N$

Answer: A

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35. In an equilateral triangle ABC, AL, BM, and CN are medians. Forces along BC and BA represented by them will have a resultant represented by

A. 2AL

B. 2BM

C. 2CN

D. AC

Answer: B

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36. The sum of two vectors A and B is at right angles to their difference. Then

A. a. Equal to each other

B. b. Equal to each other in a magnitude

C. c. Not equal to each other in magnitude

D. d. Cannot be predicted

Answer: B

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37. If a parallelogram is formed with two sides represented by vector $\overrightarrow{a}$ and $\overrightarrow{b}$, then $\overrightarrow{a}+\overrightarrow{b}$ represents the

A. Major diagonal when the angle between vectors is acute

B. Minor diagonal when the angle between vector is obtuse

C. Both of the above

D. None of the above

Answer: C

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

A. $\frac{\pi}{4} rad$

B. $\frac{3\pi}{4} rad$

C. $\frac{5\pi}{4} rad$

D. $\frac{7\pi}{4} rad$

Answer: B

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39. Two forces $\overrightarrow{F}_1 = 500N$ due east and $\overrightarrow{F}_2 = 250N$ due north have their common initial point. $\overrightarrow{F}_2 - \overrightarrow{F}_1$ is

A. $250\sqrt{5}N, \tan^{-1}(2)WofN$

B. $250N, \tan^{-1}(2)W$ of N

C. Zero

D. $750N, \tan^{-1}(3/4) NofW$

Answer: A

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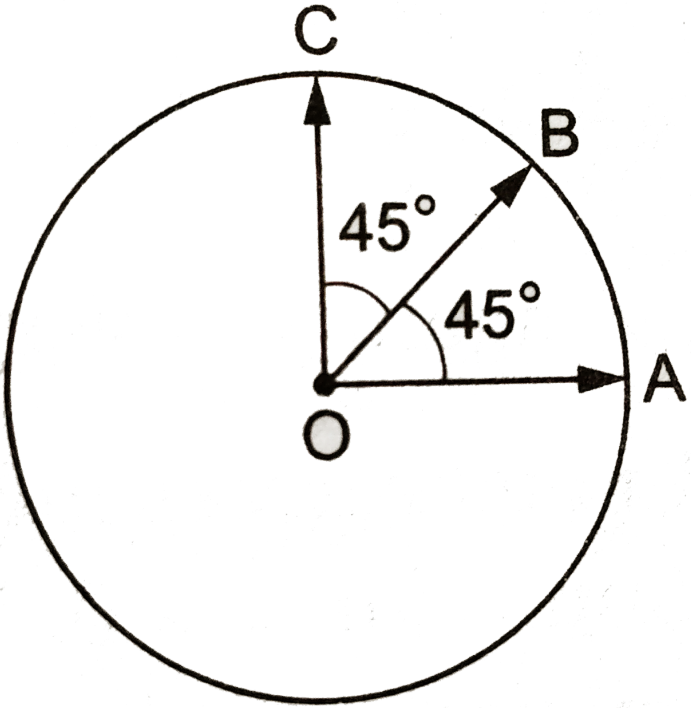
40. Find the resultant of the three vectors $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ shown in figure. Radius of the

circle is R.



A. r

B. $2r$

C. $r\left(1+\sqrt{2}\right)$

D. $r\left(\sqrt{2}\right)$

Answer: C

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41. 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 $\left|\vec{b}\right| = 2\text{unit}$, then $\left|\vec{a}\right|$ is

A. $\sqrt{3}$

B. $\sqrt{3} - 1$

C. $\sqrt{3} + 1$

D. $\sqrt{3}/2$

Answer: B

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

A. $P + Q$

B. P

C. $P - Q$

D. Q

Answer: D

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43. A vector $\vec{A}$ 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. $\sqrt{5}$

Answer: A

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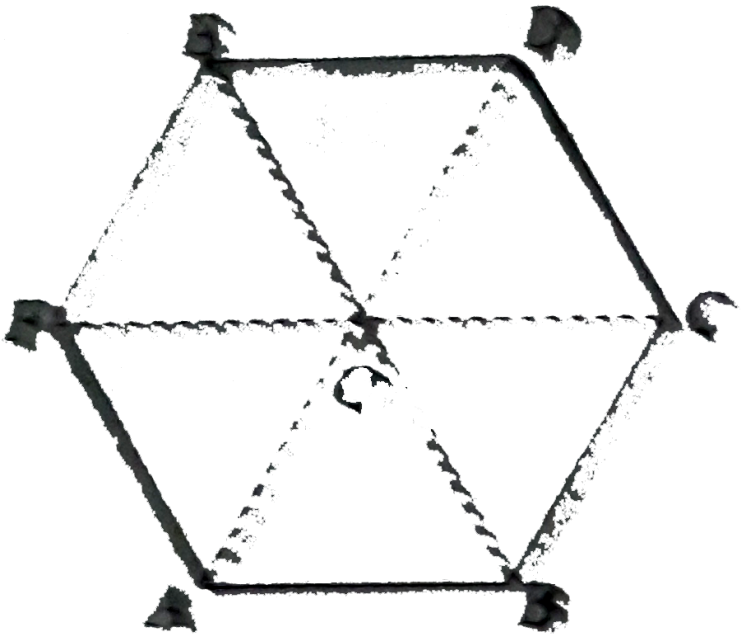
44. IN the figure shown ,ABCDEF is a regular hexagon . What is the of $AB + AC + AD + AE + AF$?



A. $2\overrightarrow{AO}$

B. $2\overrightarrow{AO}$

C. $6\overrightarrow{AO}$

D. 0

Answer: C

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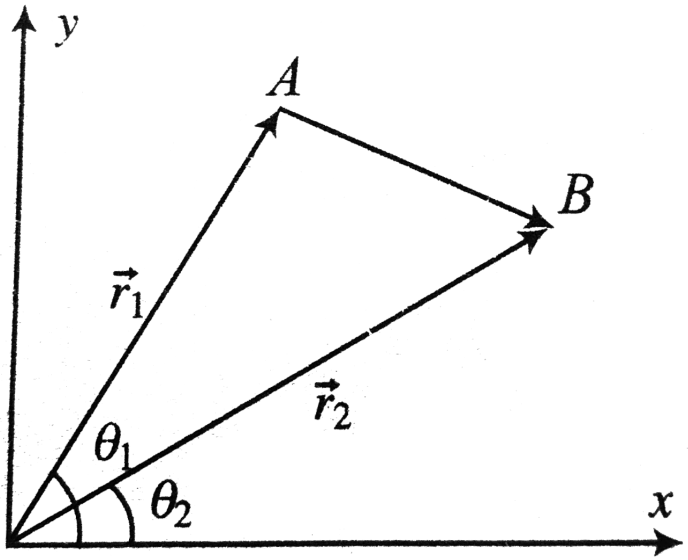
45. In a two diamensional motion of a particle, the particle moves from point A, with position vector $\overrightarrow{r}_1$ to point B, with position vector $\overrightarrow{r}_2$. If the magnitudes of these vectors are, respectively,

$\overrightarrow{r} = 3$ and $r_2 = 4$ and the angles they make with the x-axis are $\theta_1 = 75^\circ$ and $\theta_2 = 15^\circ$, respectively, then find the magnitude of the displacement vector. `



A. 15

B. $\sqrt{13}$

C. 17

D. $\sqrt{15}$

Answer: B

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46. The sum of two forces at a point is 16N. if their resultant is normal to the smaller force and has a magnitude of 8N, then two forces are

A. 2N

B. 4N

C. 6N

D. 7N

Answer: C

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47. The angle between two vector A and B is θ. Vector R is the resultant of the two vectors. If R makes an angle $\frac{\theta}{2}$ with A, then

A. $A = 2B$

B. $A = B/2$

C. $A = B$

D. $AB = 1$

Answer: C

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48. 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° with the first vector

B. 15° with the first vector

C. 100° with the first vector

D. 150° with the first vector

Answer: D

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49. A unit vector along the incident ray of light is $\hat{i}$. The unit vector for the corresponding refracted ray of light is $\hat{r}$. $\hat{n}$, 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. a. $\hat{i} \times \hat{n} = \mu\left(\hat{n} + \overrightarrow{r}\right)$

B. $\hat{\hat{i}}.\hat{n} = \mu(\hat{r}.\hat{n})$

C. $\hat{\hat{i}} \times \hat{n} = \mu(\hat{r} \times \hat{n})$

D. $\hat{\hat{i}} \times \hat{n} = \mu(\hat{r} \times \hat{n})$

Answer: C

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50. The components of a vector along the x- and y-directions are $(n+1)$ and 1, respectively. If the coordinate system is rotated by an angle $\theta = 60^\circ$,

then the components change to n and 3. The value of n is

A. a. 2

B. b. $\cos 60^\circ$

C. c. $\sin 60^\circ$

D. d. 3.5

Answer: D

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51. Two point masses 1 and 2 move with uniform velocities $\overrightarrow{v}_1$ and $\overrightarrow{v}_2$, respectively. Their initial position vectors are $\overrightarrow{r}_1$ and $\overrightarrow{r}_2$, respectively. Which of the following should be satisfied for the collision of the point masses?

A. $\dfrac{\overrightarrow{r}_1 - \overrightarrow{r}_2}{\left|\overrightarrow{r}_2 - \overrightarrow{r}_1\right|} = \dfrac{\overrightarrow{v}_2 - \overrightarrow{v}_1}{\left|\overrightarrow{v}_2 - \overrightarrow{v}_1\right|}$

B. $\dfrac{\overrightarrow{r}_2 - \overrightarrow{r}_1}{\left|\overrightarrow{r}_2 - \overrightarrow{r}_1\right|} = \dfrac{\overrightarrow{v}_2 - \overrightarrow{v}_1}{\left|\overrightarrow{v}_2 - \overrightarrow{v}_1\right|}$

C. $\dfrac{\overrightarrow{r}_2 - \overrightarrow{r}_1}{\left|\overrightarrow{r}_2 + \overrightarrow{r}_1\right|} = \dfrac{\overrightarrow{v}_2 - \overrightarrow{v}_1}{\left|\overrightarrow{v}_2 + \overrightarrow{v}_1\right|}$

D. $\dfrac{\overrightarrow{r}_2 - \overrightarrow{r}_1}{\left|\overrightarrow{r}_2 + \overrightarrow{r}_1\right|} = \dfrac{\overrightarrow{v}_2 - \overrightarrow{v}_1}{\left|\overrightarrow{v}_2 + \overrightarrow{v}_1\right|}$

Answer: B

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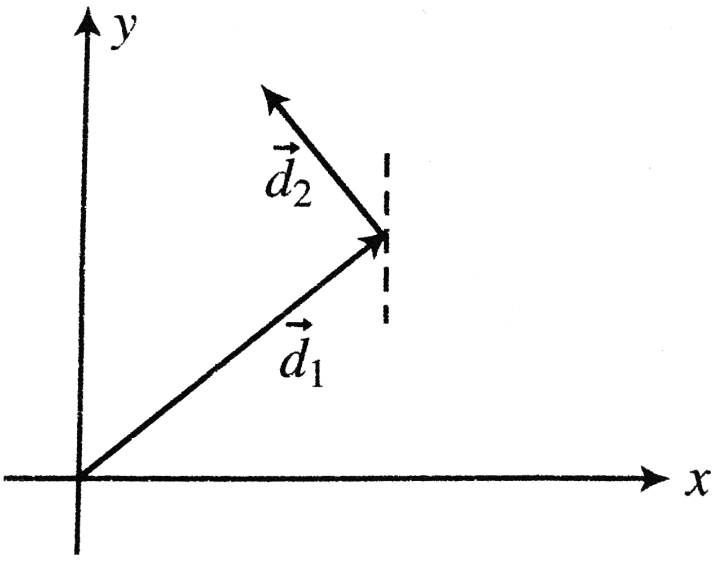
Exercise Multiple Correct

1. Which of the following statements is/ are correct(Figure)



A. The sign of the x-component of $\vec{d}_1$ is positive and that of $\vec{d}_2$ is negative.

B. The signs of the y-components of $\vec{d}_1$ and $\vec{d}_2$ are positive and negative, respectively.

C. The signs of x- and y-components of $\vec{d}_1 + \vec{d}_2$ are positive.

D. None of the above

Answer: A::C

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2. Give two vectors $\overrightarrow{A} = = 3\hat{i} + 4\hat{j}$ and $\overrightarrow{B} = \hat{i} + \hat{j}.\, \theta$ is the angle between $\overrightarrow{A}$ and $\overrightarrow{B}$.

Which of the following statements is/are correct?

A. $\left|\overrightarrow{A}\right| \cos\theta \left(\frac{\hat{i} + \hat{j}}{\sqrt{2}} \right)$ is the component of $\overrightarrow{A}$ along $\overrightarrow{B}$.

B. $\left|\overrightarrow{A}\right| \sin\theta \left(\frac{\hat{i} - \hat{j}}{\sqrt{2}} \right)$ is the component of $\overrightarrow{A}$ perpendicular to $\overrightarrow{B}$.

C. $\left|\overrightarrow{A}\right| \cos\theta \left(\frac{\hat{i} - \hat{j}}{\sqrt{2}} \right)$ is the component of $\overrightarrow{A}$ along $\overrightarrow{B}$.

D. $\left|\vec{A}\right|\sin\theta\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$ is the component of $\vec{A}$ perpendicular to $\vec{B}$.

Answer: A::B

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3. If $\vec{A}=2\hat{i}+\hat{j}+\hat{k}$ and $\vec{B}=\hat{i}+\hat{j}+\hat{k}$ are two vectors, then the unit vector is

A. Perpendicular to $\vec{A}$ is $\left(-\hat{j}+\hat{k}\right)\frac{1}{\sqrt{2}}$

B. Parallel to $\vec{A}$ is $\frac{2\hat{i}+\hat{j}+\hat{k}}{\sqrt{6}}$

C. Perpendicular to $\vec{B}$ is $\left(\frac{-\hat{j}+\hat{k}}{\sqrt{2}}\right)$

D. Parallel to $\vec{A}$ is $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$

Answer: A::B::C

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4. If $\vec{v}_1 + \vec{v}_2$ is perpendicular to $\vec{v}_1 - \vec{v}_2$, then

A. $\vec{v}_1$ is perpendicular to $\vec{v}_2$.

B. $\left|\vec{v}_1\right| = \left|\vec{v}_2\right|$

C. $\vec{v}_1$ is a null vector

D. The angle between $\vec{v}_1$ and $\vec{v}_2$ can have any value

Answer: B::D

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5. Two vectors $\vec{A}$ and $\vec{B}$ lie in 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. cannot be zero

B. can be zero

C. Lies in the plane of $\vec{A}$ or $\vec{B}$

D. Lies in a plane different from that of any of the three vectors

Answer: A::D

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