PHYSICS

BOOKS - GR BATHLA & SONS PHYSICS (HINGLISH)

VECTORS

Problem

1. What is the displacement of the point of a wheel initially in contact with the ground when the wheel rolls forward half a revolution? Take the radius of the wheel as R and the x-axis as the forward direction?

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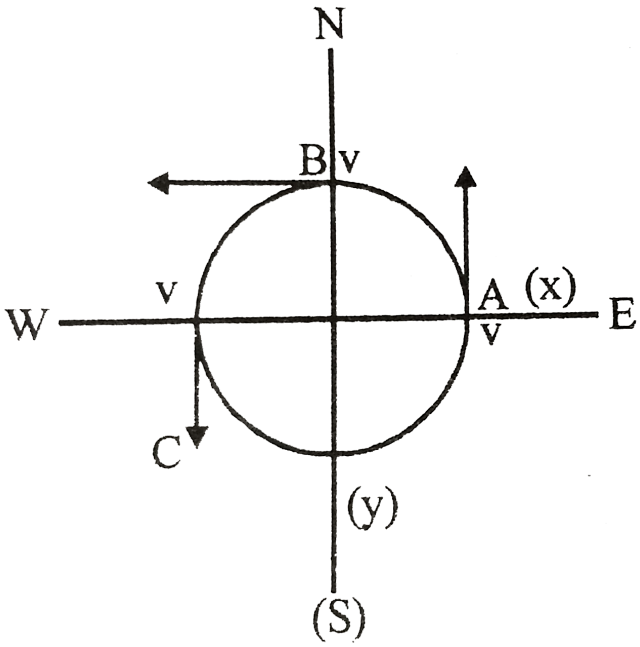
2. A body is moving with uniform speed v on a horizontal circle in anticlockwise direction from A as shown in figure. What is the change in velocity in (a) half revolution (b) first quarter revolution.



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3. What is the property of two vectores $\overrightarrow{A}$ and $\overrightarrow{B}$ if:

(A) $\left|\overrightarrow{A}+\overrightarrow{B}\right|=\left|\overrightarrow{A}-\overrightarrow{B}\right|$ (b) $\overrightarrow{A}+\overrightarrow{B}=\overrightarrow{A}-\overrightarrow{B}$

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4. The x and y-components of vector A are 4 m and 6 m respectively. The x and y-components of vector A + B are 10 m and 9 m respectively. Calculate for the vector B the following:

(a) its x and y-components

(b) its length

(c) the angle it makes with x-axis.

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5. A particle of mass 3 kg moves under a froce of $\left[4\hat{i}+8\hat{j}+10\hat{k}\right]$ newton . Calcutale the acceleration (as vector) to which the particle is subjected. If the particle starts from rest and was at the origin initially. What are its new co - ordinates after 3 s?

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6. Under a force $\left(10\hat{i}-3\hat{j}+6\hat{k}\right)$ newton a body of mass 5 kg moves from position $\left(6\hat{i}+5\hat{j}-3\hat{k}\right)$ m to position $\left(10\hat{i}-2\hat{j}+7\hat{k}\right)$ m . Deduce the work done.

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7. 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 any time $tisP_x = 2\cos t$, $P_y = 2\sin t$

.

The angle θ between vecF and vecP$atagiventime$t` will be:

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8. Considering two vectors,$F = \left(4\hat{i} - 10\hat{j}\right)$ netwon and $\vec{r} = \left(-5\hat{i} - 3\hat{j}\right)$ m compute $\left(\vec{r}\, r \times \vec{F}\right)$ and states what physical quaninty it respresents ?

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9. The sum of the magnitudes of two 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 are the magnitudes of forces?

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10. 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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11. Four forces act along the sides of a smoth square frma ABCD in the order $A \to B, B \to C, C \to D$ and $D \to A$. If the magnetiude of the force are F_1, F_2, F_3 and F_4 respectively, find the force acting on the frame . Assume $F_1 = 1N, F_2 = 2N, F_3 = 3N$ and $F_4 = N$

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12. Find the components of a vector $\vec{R}$ along two straight lines stiuated at both sides of the vector $\vec{R}$ making angles α and β with it.

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13. A particle is moving on a cicular path of radius 'R' . As it moves through an angular displacement θ, its linear displacement will be :

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14. A paarticle starts from origin at $t = 0$ with a velocity $5.0\hat{i}m/s$ and moves in x-y plane under action of a force which produces a constant acceleration of $\left(3.0\hat{i} + 2.0j\right)m/s^2$.

(a) What is the y-cordinate of the particle at the instant its x-coordinate is `84 m ? (b) What is the speed of the particle at this time?

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15. The intantaneous coordinates of a particle are $x = (8t - 1)m$ and $y = \left(4t^2\right)m$. Calculate (i) the average velocity of the particle during time interval from $t = 2s$ to $t = 4s$ (ii) the instantaneous velocity of the particle at $t = 2s$.

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Problems For Parctice

1. Given an example of a physical quantity which :

(a) has neither unit nor direction

(b) has direction but not a vector

(c) can be either a scalar no vector

(d) is nether a scalar nor a vector.

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2. What are the properties of two vectors $\vec{A}$ and $\vec{B}$ such that:

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

(b) $\vec{A} + \vec{B} = \vec{C}$ and $A^2 + B^2 = C^2$

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3. Can the resultant be zero in case of :

(a) two unequal vectros

(b) three coplanar vectors

(c) three non- complanar vectors

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4. Under what consition :

(a) resulant of tow vectors will be zero

(b) sum of the two vectors is equal to their differenc

(c) the magnitude of sum of two vectros is equal to the magnetude of diffrence between them .

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5. State whether the folowing statements are trune or false giving reason in brief :

(a) As adiidtion of vector is commutive so subtraction must also be

(b) Component of a vector is equal to their difference to itself is zero

(c) Angle between two vectors can be greater than m 180°

(d) A vector cannot be divided by a vector.

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6. A room has dimensions $3m \times 4m \times 5m$. A fly starting at one corner ends up at the diametrocally

opposite corner .

(a). What is the magnetic of its displacement ?

(b) Could the length of its path be less than this distance ?

(c) Choosing a situtable cooridinate system find the position vector .

(d) If the fly does not fly but walks , what is the lenght of the shortest path it can take ?

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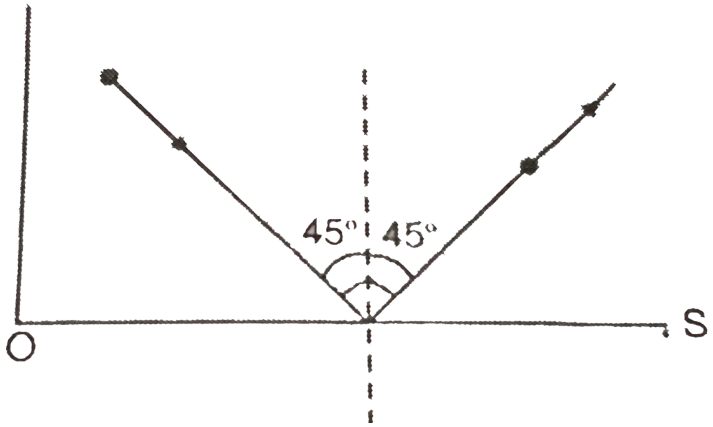
7. A 5 kg object with speed of $30m/s$ strikes a steel plants at an angle 45° and rebound at the same speed and same angle (Fig. 3.43). Calculate.

(a) the magntiude of the change is momentum of the

object and



(b) the change in the magnitude of the momentum of the object.

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8. A body is moving uniformly on a circle with speed v. Find the magnitude of change in its velcotiy whem, it has turend an angle θ.

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9. Why do use express the laws of physics in vector form ? Explain.

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

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11. What is the condition that two non-zero vectors are (a) orhtogonal and (b) collinera?

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12. If $\vec{A} = 2\hat{i} + \hat{j} - 3\hat{k}, \vec{B} = \hat{i} - 2\hat{j} + \hat{k}$ and $\vec{C} = -\hat{i} + \hat{j} - 4\hat{k}$, Calculate (i) $\vec{A}.\left(\vec{B} \times \vec{C}\right), (ii)\vec{C}\left(\vec{A} \times \vec{B}\right), (iii)\vec{A} \times \left(\vec{B} \times \vec{C}\right)$

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13. Two constat forece $\vec{F}_1 = \left(2\hat{i} + 3\hat{j} + 3\hat{k}\right)$ newton and $\vec{F}_2 = \left(5\hat{i} - 6\hat{j} - 2\hat{k}\right)$ newton act toghter on a

particle during its displacement from the position $\left(20\hat{i}+15\hat{j}\right)$m to $8\overrightarrow{K}m$. Calculate the work done.

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14. Find the moment of force $\overrightarrow{F}=\hat{i}+\hat{j}+\hat{k}$ acting at point $(-2,3,4)$ about the point $(1,2,3)$.

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15. Compute the force (in vetcor notation) on an electron moving with velocity $\overrightarrow{V}=2.5\times10^{6}\hat{i}m/s$ in a magnetic field $\overrightarrow{B}=\left(10\hat{i}-6\hat{k}\right)\times10^{2}Wb/m^{2}$, if charge on an electron $e=1.6\times10^{-19}$ coulomb.

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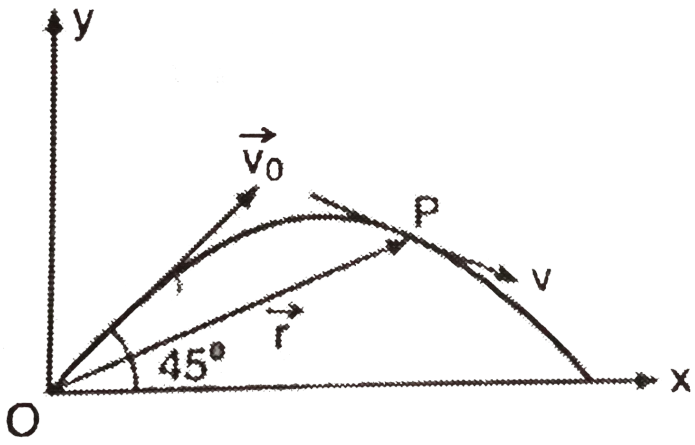
16. The particle of mass m is projected at $t = 0$ from a point O on the ground with speed v_0 at an angle 45° to the horizontal as shown in Figure 3.44. Compute the magnitude and direction of the angular mometum of the particle about the point O at position :



When the velocity of the paticle is , $\vec{V} = (0, 7v_0)\hat{i} - (0.3v_0)\hat{j}$

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17. A river flows at 3 m/s and is 300 m wide . A man swing across the rivers with a velocity of 2 m/s directed always perpendicular to the flow of current . (a) How long does it take the man to cross the river ? (b) In what direction does he actually moves to cross the relative to the shore ? (c) How far down the fiver(from the starting point) does he reach the opposite bank?

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18. A river is flowing from west to east at a speed of $5m/s$. A man on the south bank of the river capable of

swimming at $10m/s$ in a still water wants to swim, across the river in a shortest time. He should swim in a direction

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19. The width of a rivers is 25m and in it water is flowing with a velocity of $4m/\min$. A boatman is standing on the bank of the river . He want to sail the boat to a point at the other bank which is directly opposite to him . In what time will he cross the river , if he can sail the boat at $8m/\min$. relative to the water ?

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20. Given that $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$. Find $\vec{B}$ such that $\vec{B} . \vec{A} = 38$ and $\vec{B} \times A = -\hat{i} + 2\hat{j} - \hat{k}$.

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21. A particle moves such that $x = 2t^3 + t + 8, y = t^2 + t + 3$ and $z = 3\sin \pi t$ where x, y, z are in meter and t in seconds.

Calculate the acceleration of the particle at $t = 3$ second.

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22. A particle stats from rest at the origin with a constant acceleration

Calculate the position of the particle at $t = 5$ second.

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23. A particle moves along ellipatical path gives by

Calculate (i) radial component of acceleration $\left(\overrightarrow{a}_r\right)$

(ii) trasverse component of acceleration $\left(\overrightarrow{a}_\theta\right)$.

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Objective Questions

1. If the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{3}$, then angle between $2\vec{a}$ and $-3\vec{b}$ is :

A. $\pi/3$

B. $2\pi/3$

C. $\pi/6$

D. $5\pi/3$

Answer: B

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2. If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a} + 2\vec{b}$ and $5\vec{a} - 4\vec{b}$ are perpendicular to each other, then the angle between $\vec{a}$ and $\vec{b}$ is

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

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

C. $\cos^{-1}\left(\frac{1}{3}\right)$

D. $\cos^{-1}\left(\frac{2}{7}\right)$

Answer: B

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3. Vector $\vec{a}$ is prepedicular to $\vec{b}$, componets of $\vec{a} - \vec{b}$ along $\vec{a} + \vec{b}$ will be :

A. zero

B. a-b

C. $\frac{a^2 - b^2}{\sqrt{a^2 + b^2}}$

D. $\sqrt{a^2 + b^2}$

Answer: C

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4. If $\vec{A} \times \vec{B} = \vec{C} + \vec{D}$, them select the correct alternative:

A. $\vec{B}$ is parallel to $\vec{C} + \vec{D}$

B. $\vec{A}$ is perpendicular to $\vec{C}$

C. Component of $\vec{C}$ along $\vec{A}$ = Components of $\vec{D}$ along $\vec{A}$

D. Component of $\vec{C}$ along $\vec{A}$ =-Components of $\vec{D}$ along $\vec{A}$

Answer: D

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5. If $\vec{a}$ and $\vec{b}$ are two non-collinear unit vectors and if $\left|\vec{a}_1 + \vec{a}_2\right| = \sqrt{3}$, then the value of

$\left(\vec{a}_1 - \vec{a}_2\right)\left(2\vec{a}_1 + \vec{a}_2\right)$ is:

A. 2

B. $3/2$

C. $1/2$

D. 1

Answer: B

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6. A ray of light is incident on a plane mirror along a vector $\hat{i} + \hat{j} - \hat{k}$.

The normal on incidence point is along $\hat{i} + \hat{j}$.Find a

unit vector along the

reflected ray.

A. $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$

B. $\frac{-1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$

C. $\frac{1}{\sqrt{2}}\left(\hat{i}+\hat{j}\right)$

D. $\frac{-1}{\sqrt{3}}\left(\hat{i}+\hat{j}-\hat{k}\right)$

Answer: B

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7. A particle is moving along a circle with a uniform speed v. Find (a) change in the magnitude of velocity

and (b) the magnitude of change in the velocity when it has rotated an angle θ. $(0 < \theta < 90^\circ)$

A. $2v \sin\theta$

B. $2v \sin(\theta/2)$

C. $2v \cos(\theta/2)$

D. $\sqrt{2}v \cos(\theta/2)$

Answer: B

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8. A plane mirror is moving with vclocity . A point object in fornt of the mirror moves with a velocity . Here $\widehat{K}$ is

along the normal to the plane mirror and facing towards the object . The velocity of the image is :

A. $-3\hat{i}-4\hat{j}+5\hat{k}$

B. $3\hat{i}+4\hat{j}+11\hat{k}$

C. $-4\hat{i}+5\hat{j}+11\hat{k}$

D. $7\hat{i}+9\hat{j}+3\hat{k}$

Answer: B

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

A. 60°

B. 90°

C. 180°

D. 0°

Answer: A

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10. A parallelogram is fromed with $\vec{a}$ and $\vec{b}$ as the sides let $\vec{d}_1$ and $\vec{d}_2$ be the diagonals of the parallelogram , them $a^2 + b^2 =$

A. $\frac{d_1^2 + d_2^2}{2}$

B. $\frac{d_1^2 + d_2^2}{1}$

C. $d_1^2 + d_2^2$

D. $d_1^2 - d_2^2$

Answer: A

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11. If two non-parallel vectors $\vec{A}$ and $\vec{B}$ are equal in magntiude, them vectors $\left(\vec{A} - \vec{B}\right)$ and $\left(\vec{A} + \vec{B}\right)$ will be :

A. parallel to each other

B. parallel but oppositely directed

C. perpendicular to each other

D. inclined at an angle θ always less than 90°

Answer: C

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12. If the vectors $\left(\hat{i}+\hat{j}+\hat{k}\right)$ and $3\hat{i}$ from two sides of a triangle, then area of triangle is :

A. $\sqrt{3}$

B. $2\sqrt{3}$

C. $3/\sqrt{2}$

D. $3\sqrt{2}$

Answer: C

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13. The value of p so that vectors $\left(2\hat{i}-\hat{j}+\right), \left(\hat{i}+2\hat{j}-3\hat{k}\right)$ and $\left(3\hat{i}+p\hat{j}+5\hat{k}\right)$ are coplaner should be:

A. 16

B. -4

C. 4

D. -8

Answer: B

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14. The vector sum of three vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ is zero . If $\hat{i}$ and $\hat{j}$ are the unit vectores in the vectors in the directions of $\vec{A}$ and $\vec{B}$ respectively , them :

A. $\vec{C}$ is in the plane of $\hat{i}$ of $\hat{j}$

B. $\vec{C}$ is along $\hat{i} \times \hat{j}$

C. $\vec{C}$ is along $\hat{i}$

D. $\vec{C}$ is along $\hat{j}$

Answer: A

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15. Three force $F_1 = \left(3\hat{i} + 2\hat{j} - \hat{k}\right)$ $\overrightarrow{F}_2$ and that the particle may be in equilibrum , the value of 'a' is :

A. -6

B. 6

C. 9

D. -9

Answer: A

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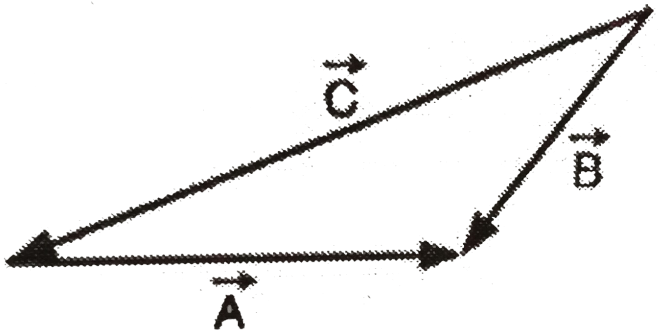
16. For the fig. 350 :



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

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

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

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

Answer: C

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17. A vector may change if :

A. frame of refernce is translated

B. frame of reference id rotated

C. vector is translated parallel to itself

D. vector is rotated

Answer: D

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18. When two vectors $\vec{A}$ and $\vec{B}$ of magnitudes a and b respectively are added, the magnitude of resultant vector is always

A. equal to (a +b)

B. less than (a +b)

C. greater than (a+b)

D. greater than (a +b)

Answer: D

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19. The rectangular compounts of forces of 5 duye are :

A. 1 and 2 dyne

B. 2 and 3 dyne

C. 3 and 4 dyne

D. 2.5 and 2.5 dyne

Answer: C

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20. To get a rsultant displacement of 10m, two displacement vectors, one of magnetic 6 m and another of 8 m,should be combined :

A. parallel

B. anti-parallel

C. at an angle 60°

D. perpendicular to each

Answer: D

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21. A 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. $\pi/4$

Answer: C

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22. If $\vec{A} = \vec{B} + \vec{C}$ and the magnitudes of $\vec{A}, \vec{B}$ and $\vec{C}$ are 5,4 and 3 units respecetively, the angle between $\vec{A}$ and $\vec{C}$ is :

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

B. $\cos^{-1}(4/5)$

C. $\pi/2$

D. $\sin^{-1}(3/4)$

Answer: A

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23. If two waves of same frequency and same amplitude superimpose and produce third wave of same amplitude, then waves differ in phase by –

A. zero

B. π

C. $\pi/2$

D. $\pi/4$

Answer: D

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24. The angle between $\left(\vec{A} \times \vec{B}\right)$ and $\left(\vec{B} \times \vec{A}\right)$ is :

A. zero

B. π

C. $\pi / 4$

D. $2\pi / 3$

Answer: B

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25. Two equal vector have a resultant equal to either of them, then the angle between them will be:

A. 120°

B. 90°

C. 60°

D. 0°

Answer: D

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26. The resultant of two forces acting an anlge of 120° is 10 kg wt and is perpendicular to one of the forces. That force is

A. $10\sqrt{3}\text{kg wt}$

B. $20\sqrt{3}\text{kg wt}$

C. 20kg wt

D. $\left(20\sqrt{3}\right)\text{kg wt}$

Answer: C

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27. The vectors $\vec{A}$ and $\vec{B}$ uur are such that $|\vec{A}+\vec{B}|=|\vec{A}-\vec{B}|$ The angle between the two vectors is

A. 0

B. $\pi/3$

C. $\pi/2$

D. π

Answer: C

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

A. 0°

B. 60°

C. 90°

D. 180°

Answer: A

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29. What are minmum number or unequal fores whose vector sum is zero ?

A. two

B. three

C. four

D. any

Answer: B

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30. 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. can never be zero

C. lies in a plane containing $\vec{A} + \vec{B}$

D. lies in a plane contaninig $\vec{A} - \vec{B}$

Answer: B

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31. Two forces of magentude 7 newton and 5 newton act on a particle at an angle θ can have any value . The minimum magnitude of the resultant forces is :

A. 5 newton

B. 8 newton

C. 12 newton

D. 2 newton

Answer: D

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32. Two forces of 4 dyne and 3 dyne act upon a body . The resultant force on the body can be only be :

A. mare than 3 dyne

B. more than 4 dyne

C. between 3 and 4 dyne

D. between 1 and 7 dyne

Answer: D

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33. A force of 6 kg and another of 8 kg can be applied togther to produce the effects of a signle froce of :

A. 1 kg

B. 11 kg

C. 15 kg

D. 20 kg

Answer: B

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34. Out of the following the resultant of which cannot be 4 netwon ?

A. 2 N and 2 N

B. 2 N and 4 N

C. 2 N and 6 N

D. 2 N and 8 N

Answer: D

35. In case of three vector quanitites of same type, whose resultant cannot be zero ?

A. 120, 10, 10

B. 10, 10, 20

C. 10, 20, 20

D. 10, 20, 40

Answer: D

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36. Five equal forces of $10N$ each are applied at one point and all are lying one plane. If the angles between them are equal, the resultant force will be

A. zero

B. 10 N

C. 20 N

D. $10\sqrt{2}N$

Answer: A

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37. If $\hat{n}$ is a unit vector in the direction of the vector $\vec{A}$, them :

A. $\hat{n} = \vec{A} / \left|\vec{A}\right|$

B. $\hat{n} = \vec{A}\left|\vec{A}\right|$

C. $\hat{n} = \left|\vec{A}\right| / \vec{A}$

D. $\hat{n} = \vec{n} \times \vec{n}$

Answer: A

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38. An aeroplane moving in a circular path with a speed $250km/h$. The change in velocity in half of the revolution is.

A. 500 km/hr

B. 250 km/hr

C. 125 km/hr

D. zero

Answer: A

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39. A truck travelling due North at $50kmh^{-1}$ turns West and travels at the same speed. What is the change in velocity ?

A. 50 km/hr north-west

B. $50\sqrt{2}$ km/hr north-west

C. 50 km/hr south- west

D. $50\sqrt{2}$ km/hr south-west

Answer: D

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40. A boat which has a speed of $5km/hr$ in steel water crosses a river of width $1km$ along the shortest possible path in $15 \min utes$. The velocity of the river water in km/hr is

A. 1

B. 3

C. 4

D. $\sqrt{14}$

Answer: C

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41. A river is flowing from west to east at a speed of 5 metres per minute.A man on the south bank of the river, capable of swimming at 10 metres per minute in still water, wants to swim across the river in the shortest time. He should swim in a direction.

A. due north

B. 30° east of north

C. 30° west of north

D. 60° east of north

Answer: A

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42. I started walking down a road to day-break facing the sun. After walking for some-time, I turned to my left, then I turned to the right once again. In which direction was I going then ?

A. East

B. North-west

C. North-east

D. South

Answer: A

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43. A man travels 1 mile due east. Then 5 miles due south, then 2 miles due east and finally 9 miles due north. His displacement is

A. 3 mile

B. 5 mile

C. 4 mile

D. Between 5 and 9 mile

Answer: B

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44. I walked 4 mile, turned to my left and walked 6mile, then turned to my right and walked 4 mile. Which of the choice mentions the distance from the starting poin to the palce where I stopped ?

A. 15 mile

B. 10 mile

C. 20 mile

D. 14 mile

Answer: B

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45. A person moves 30 m north, then 20 m east and finally $30\sqrt{2}m$ south-west. This displacement from the original position is :

A. 14 m south -west

B. 28 m south

C. 10m west

D. 15 m east

Answer: C

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46. A body, under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$, acquires an acceleration of $1ms^{-2}$. The mass of this body must be.

A. 200 kg

B. 20 kg

C. $10\sqrt{2}kg$

D. $6\sqrt{2}kg$

Answer: C

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47. The angle made by the vector $\vec{A} = 2\hat{i} + 3\hat{j}$ with Y-axis is

A. $\tan^{-1}(3/2)$

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

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

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

Answer: B

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48. 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

Answer: D

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49. 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. $7\hat{k}$

C. $6\hat{i}$

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

Answer: B

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50. The angle between the 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 these

Answer: B

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

A. 90°

B. 180°

C. 0°

D. 60°

Answer: D

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52. A bodys constrained to more in the Y-direction ,Is subject to a force $\vec{F} = \left(-2\hat{i} + 15\hat{j} + 6\hat{k} \right)$ N What is the work done by force in moving the body through a distance of 10 m along the Y-axis ?

A. 190 J

B. 160J

C. 150 J

D. 20 J

Answer: C

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

A. $4\hat{i}$

B. $-\left(\hat{i}+\hat{j}\right)$

C. $\left(\hat{j}+\hat{k}\right)$

D. $-\left(4\hat{j}\right)$

Answer: A

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54. 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 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. $-17\hat{i} + 6\hat{j} - 13\hat{k}$

Answer: B

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55. The position vector of a particle is

$r = a\sin\omega t\hat{i} + a\cos\omega t\hat{j}$

The velocity of the particle is

A. parallel to positive vector

B. perpendicular to position vector

C. directed towards the origin

D. directed away from the origin

Answer: B

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56. The angle made by the vector $4\hat{i} - 3\hat{j} + 5\hat{k}$ with z-axis is :

A. 30°

B. 45°

C. 90°

D. 120°

Answer: B

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57. 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. $\vec{B} \times \vec{C}$

Answer: D

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58. The resultant of two forces , one double the other in magnitude is perpendicular to the smaller of the two forces. The angle between the two forces is _____?

A. 120°

B. 60°

C. 90°

D. 150°

Answer: D

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59. The value of n so that vectors $2\hat{i}+3\hat{j}-2\hat{k}, 5\hat{i}+n\hat{j}+\hat{k}$ and $-\hat{i}+2\hat{j}+3\hat{k}$ may be coplanar.will be

A. 81

B. 36

C. 23

D. 9

Answer: C

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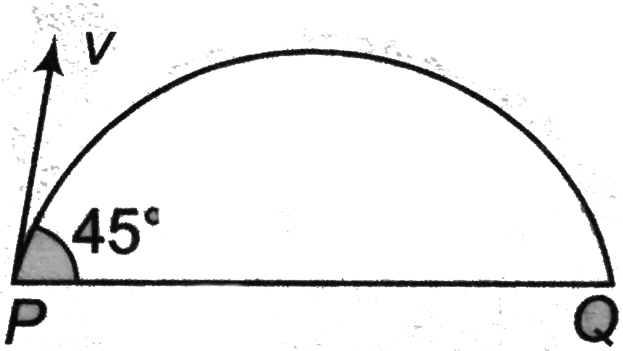
60. A projectile of mass m is fired with a velocity v from point P at an angle 45°. Neglecting air resistance, the magnitude of the change in momentum leaving the

point P and arriving at Q is



A. $\frac{mv}{\sqrt{2}}$

B. 2mv

C. $\sqrt{2}mv$

D. $\frac{\sqrt{2}}{mv}$

Answer: C

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61. Magnitudes of four pairs of displacement vectors are given. Which pair of displacment vectors, under vector addition fails to gives a resultant vectore of magnitude 3 cm ?

A. 2 cm, 7 cm

B. 1 cm,4 cm

C. 2 cm, 3 cm

D. 2 cm, 4 cm

Answer: A

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

A. $\frac{mv}{\sqrt{2}}$

B. 2 mv

C. $\sqrt{2}mv$

D. $\frac{\sqrt{2}}{mv}$

Answer: D

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63. A force $F = a\hat{i} + b\hat{j} + c\hat{k}$ is acted upon a body of mass m. If the body starts from rest and was at athe origin initially, find its new coordinate after time t.

A. $\frac{at^2}{2m}, \frac{bt^2}{2m}, \frac{ct^2}{2m}$

B. $\frac{at^2}{2m}, \frac{2bt^2}{m}, \frac{ct^2}{2m}$

C. $\frac{at^2}{m}, \frac{bt^2}{m}, \frac{ct^2}{2m}$

D. none of these

Answer: A

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64. Let $\vec{F}$ be a force acting on a particle having positon vector $\vec{r}$. $Let \vec{r}$ be the torque of this force about the origin then

A. $\vec{r} . \vec{\tau} = 0$ and $\vec{F} . \vec{\tau} \neq 0$

B. $\vec{r} . \vec{\tau} \neq 0$ and $\vec{F} . \vec{\tau} = 0$

C. $\vec{r} . \vec{\tau} \neq 0$ and $\vec{F} . \vec{\tau} \neq 0$

D. $\vec{r} . \vec{\tau} = 0$ and $\vec{F} . \vec{\tau} = 0$

Answer: D

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65. If $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\vec{A} \cdot \vec{B}$ then the value of $\left|\vec{A} \times \vec{B}\right|$ is :

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66. $\vec{A}, \vec{B}$ and $\vec{C}$ are vectosrs each having a unit magneitude. If $\vec{A} + \vec{B} + \vec{C} = 0$, then $\vec{A} \cdot \vec{B} \cdot \vec{C} + \vec{C} \cdot \vec{A}$ will be:

A. 1

B. $\frac{-3}{2}$

C. $\frac{-1}{2}$

D. 0

Answer: B

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67. Three forces act on a body. The body will certainly have an acceleration of these are:

A. 7N, 8N, 14N

B. 10 N, 4N, 12N

C. 3N, 15N, 8N

D. 2N, 6N, 7N

Answer: C

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68. If the sum and difference of two vectors are at right angles, show that the vectors are equal in magnitude.

A. perpendicular to each other

B. parallel to each other

C. of same magnitude

D. of unequal magnitude

Answer: B

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69. Vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ are mutually perpendicular . Component of $\overrightarrow{A}+\overrightarrow{B}$ in the direction of $\overrightarrow{A}-\overrightarrow{B}$ will be:

A. $\frac{A^2+B^2}{\sqrt{A^2-B^2}}$

B. $\sqrt{A^2-B^2}$

C. $\frac{A+B}{A-B}$

D. $\frac{A^2-B^2}{\sqrt{A^2+B^2}}$

Answer: D

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70. For a particle in uniform circular motion , the acceleration $\overrightarrow{a}$ at a point $p(R, \theta)$ on the circle of radiu R is (Here θ is measured from the $x - a\xi s$)

A. $-\frac{v^2}{R}\sin\theta\hat{i} + \frac{v^2}{R}\cos\theta\hat{j}$

B. $-\frac{v^2}{R}\cos\theta\hat{i} + \frac{v^2}{R}\sin\theta\hat{j}$

C. $-\frac{v^2}{R}\cos\theta\hat{i} + \frac{v^2}{R}\sin\theta\hat{j}$

D. $-\frac{v^2}{R}\hat{i} + \frac{v^2}{R}\hat{j}$

Answer: B

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71. A particle is given successive displacments. Which of the following sets of displacments could be capable of returning the particle to its initial position :

A. 10m, 8m, 6m, 30m

B. 20m, 10m, 6m, 50m

C. 70m, 20 m, 40 m, 30 m

D. 100 m, 18 m, 22 m, 32 m

Answer: C

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72. An expression which cannot be defined meaningfully among vectors is :

A. $\vec{A} . \left(\vec{B} \times \vec{C} \right)$

B. $\vec{A} \times \left(\vec{B} \times \vec{C} \right)$

C. $\left(\vec{A} \times \vec{B} \right) \times \left(\vec{C} \times \vec{D} \right)$

D. $\left(\vec{A} . \vec{B} \right) \times \left(\vec{C} . \vec{D} \right)$

Answer: D

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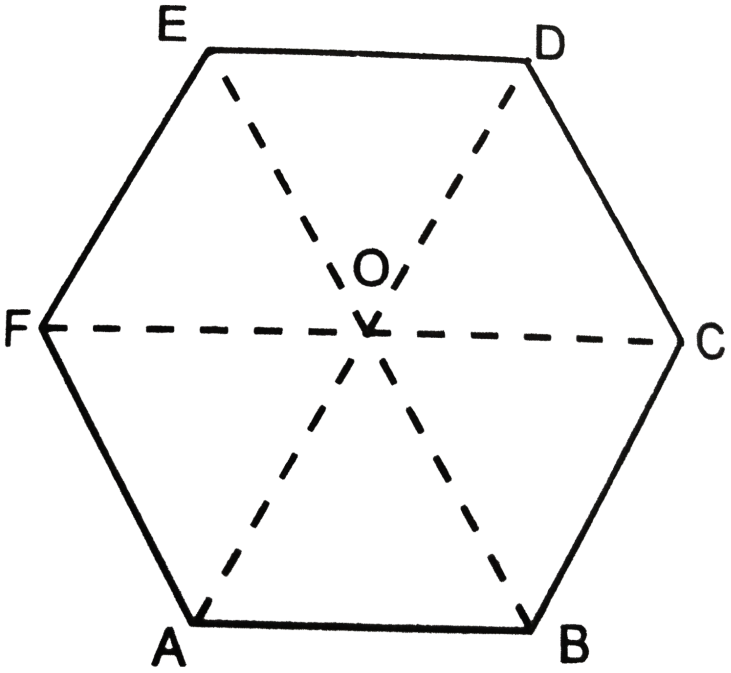
73. $ABCDEF$ is a regular hexagon, Fig. 2 (c) .65. What is the value of

$\left(\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF}\right)$?



A. $4\overrightarrow{AO}$

B. $3\overrightarrow{AD}$

C. $8\overrightarrow{AD}$

D. zero

Answer: B

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74. In the regular hexagon shown in Fig. 3.51, $\overrightarrow{A}B + \overrightarrow{B}C + \overrightarrow{C}D + \overrightarrow{D}E + \overrightarrow{E}F + \overrightarrow{A}F$ can be expressed as :

A. $-2\overrightarrow{F}A$

B. zero

C. $2\overrightarrow{F}A$

D. $\overrightarrow{F}A$

Answer: A

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75. In the regular hexagon shown in fig.3.51, $\overrightarrow{A}O + \overrightarrow{B}O + \overrightarrow{C}O + \overrightarrow{D}O + \overrightarrow{E}O + \overrightarrow{F}O$ can be expressed as :

A. zero

B. $-2\overrightarrow{O}C$

C. $-2\overrightarrow{O}F$

D. $\overrightarrow{O}F$

Answer: B

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76. For vectors $\vec{A}$ and $\vec{B}$, $\left(\vec{A}+\vec{B}\right).\left(\vec{A}\times\vec{B}\right)$ will be :

A. A^2B^2

B. $(A+B)(AB)$

C. zero

D. $\sqrt{A^2+B^2+AB}$

Answer: C

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77. Minimum number of two coplanar vectors of equal magnitude whose vectors sum could be zero, is:

A. 2

B. 3

C. 4

D. 6

Answer: A

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78. Assertion: The minimum number of non-coplanar Vectors whose sum can be zero, is four

Reason: The resultant of two vectors of unequal magnitude can be zero.

A. 2

B. 3

C. 4

D. 6

Answer: B

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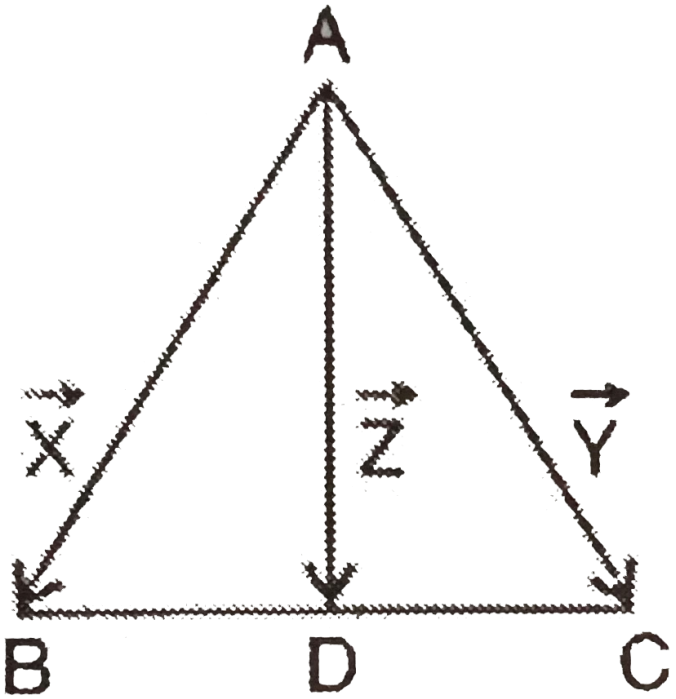
79. In Fig. 3.52, D is the mid-point of $\overrightarrow{BC}$ Which of the following relations is correct ?



A. $\overrightarrow{X} + \overrightarrow{Y} = \overrightarrow{Z}$

B. $\overrightarrow{X} - \overrightarrow{Y} = \overrightarrow{Z}$

C. $\overrightarrow{X} + \overrightarrow{Y} = \overrightarrow{Z}\ /2$

D. $\overrightarrow{X} + \overrightarrow{Y} = 2\overrightarrow{Z}$

Answer: D

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80. Sum of magnetic of two forces acting on a body is 15 N. The resultant force has magnitude 12 N and it is perpendicular to the large forces, magnetiude of smaller forces is :

A. 2.7 N

B. 3.2 N

C. 1.8 N

D. 4.6 N

Answer: A

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81. Resultant of two forces $\vec{F}_1$ and $\vec{F}_2$ has magnitude 50 N. The resultant is inclined to $\vec{F}_1$ at 60° and to $\vec{F}_1$ at 30° . Magnitudes of $\vec{F}_1$ and $\vec{F}_2$, respectively, are:

A. $25N, 25\sqrt{3}N$

B. $20N, 20\sqrt{3}N$

C. $20N, 30N$

D. $30N, 40N$

Answer: A

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82. $\vec{A}, \vec{B}$ and $\vec{C}$ are vectors such that $\vec{C} = \vec{A} + \vec{B}$ and $\vec{C} \perp \vec{A}$ and also C= A . Angle between $\vec{A}$ and $\vec{B}$ is :

A. $\pi/2$

B. $\pi/4$

C. $3\pi/4$

D. π

Answer: C

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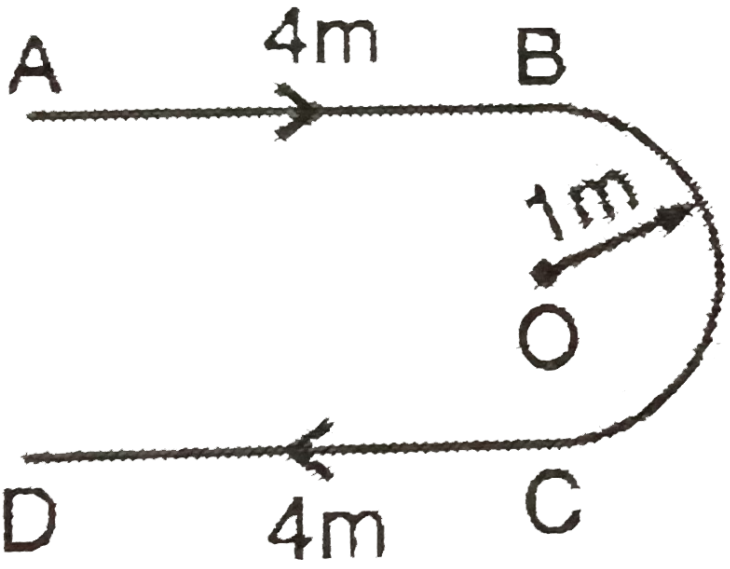
83. A person walks along the path shown in Fig. 3.53. The path from B to C is semicircular and centred at O. If the magnitude of displacment of the person is 2m, distance travelled by him is nearly :



A. 18 m

B. 7 m

C. 14 m

D. 11 m

Answer: D

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84. ABCD is parallelogram $\vec{A}, \vec{B}, \vec{C}$ and $\vec{D}$ are the position vectors of vecticles A, B, C, and D with respect to any origin, them:

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

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

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

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

Answer: C

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85. A lion is at some instant a position $A(2m, 6m, -1m)$ and a goat is at position $B(1m, 2m, 8m)$. The lion is free to move but the goat is unable to move due to some injury . The lion runs towards the goat and reches it in time 2 sec. A verage velocity of the lion can be expreseed as:

A. $\left(-\frac{\hat{i}}{2} - 2\hat{j} + \frac{9}{2}\hat{k}\right) m/s$

B. $\left(\frac{\hat{i}}{2} - 2\hat{j} + \frac{5}{2}\hat{k}\right) m/s$

C. $\left(\hat{i} - \frac{\hat{j}}{2} + \frac{\hat{k}}{2}\right) m/s$

D. $\left(3\hat{i} - \frac{5}{2}\hat{j} + \frac{7}{2}\hat{k}\right)$

Answer: A

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86. A vector $\overrightarrow{A}$ points vertically upward and $\overrightarrow{B}$ points towards north. The vector produce $\overrightarrow{A} \times \overrightarrow{B}$ is

A. east

B. west

C. vertically downward

D. south

Answer: A

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87. A parallelogram is fromed with $\vec{a}$ and $\vec{b}$ as the sides let $\vec{d}_1$ and $\vec{d}_2$ be the diagonals of the parallelogram , them $a^2 + b^2 =$

A. $A^2 + B^2$

B. $\frac{A^2 - B^2}{2}$

C. $\frac{A^2 + B^2}{2}$

D. $2\left(A^2 + B^2\right)$

Answer: D

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88. $\vec{A}$ and $\vec{B}$ and vectors expressed as $\vec{A} = 2\hat{i} + \hat{j}$ and $\vec{B} = \hat{i} - \hat{j}$ Unit vector perpendicular to $\vec{A}$ and $\vec{B}$ is:

A. $\frac{\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}}$

B. $\frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}$

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

D. $\hat{k}$

Answer: D

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89. The vector area of triangle position vectors of whose vertices are $\vec{a}$, $\vec{b}$, $\vec{c}$ is

A. $\dfrac{\vec{A}.\left(\vec{B}\times\vec{C}\right)+\vec{B}.\left(\vec{C}\times\vec{A}\right)+\vec{C}.\left(\vec{A}\times\vec{B}\right)}{3}$

B. $\vec{A}.\left(\vec{B}\times\vec{C}\right)$

C. $\dfrac{\vec{A}\times\vec{B}+\vec{B}\times\vec{C}+\vec{C}\times\vec{A}}{6}$

D. $\vec{A}\times\left(\vec{B}\times\vec{C}\right)$

Answer: C

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90. Area of the parallelogram formed by vectors $\vec{A} = \hat{i} + 2\hat{j} + 4\hat{k}$ and $\vec{B} = 3\hat{i} - 2\hat{j}$ is :

A. $4\sqrt{17}\text{unit}$

B. $2\sqrt{17}\text{unit}$

C. $17\sqrt{2}\text{unit}$

D. $17\sqrt{3}\text{unit}$

Answer: A

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91. Can a flight of a bird be an example of composition of vectors ?

A. addition of vectors

B. dot product of vectors

C. cross product of vectors

D. none of these

Answer: A

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92. 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. $12\hat{i} - 14\hat{j} + 3\hat{k}$

B. $-14\hat{i} + 38\hat{j} - 16\hat{k}$

C. $-12\hat{i}+14\hat{j}-3\hat{k}$

D. $14\hat{i}-38\hat{j}+16\hat{k}$

Answer: D

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93. $\vec{R}$ is the resultant of $\vec{A}$ and $\vec{B}$. $\vec{R}$ is inclined to $\vec{A}$ at angle θ_1 and to $\vec{B}$ at angle θ_2, then :

A. $\frac{3}{4}\left(\hat{i}-\hat{j}\right)$

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

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

D. $\frac{1}{2}\left(\hat{i}+\hat{j}\right)$

Answer: C

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94. Projection of $2\hat{i} + 6\hat{j}$ on Z-axis is :

A. 2

B. 6

C. 4.5

D. none of these

Answer: D

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95. $\vec{R}$ is the resultant of $\vec{A}$ and $\vec{B}$. $\vec{R}$ is inclined to $\vec{A}$ at angle $theat_1$ and to $\vec{B}$ at angle θ_2, then :

A. $\theta_1 < \theta_2$

B. $\theta_1 < \theta_2$ if $A > B$

C. $\theta_1 < \theta_2$ if $A < B$

D. $\theta_1 < \theta_2$ if $A = B$

Answer: B

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96. $\hat{a}, \hat{b}$ and $\hat{c}$ are unit vectors. If the $\hat{a} + \hat{b} = \hat{c}$, them the magnitude of $\hat{a} - \hat{b}$ is :

A. $\frac{1}{\sqrt{3}}$

B. $\frac{1}{\sqrt{2}}$

C. $\sqrt{2}$

D. $\sqrt{3}$

Answer: D

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97. Diagonals of a parallelogram are respresented by vectors $\vec{A} = 5\hat{i} - 4\hat{j} + 3\hat{k}$ and $\vec{B} = 3\hat{i} + 2\hat{j} - \hat{k}$.

Area of the parallelogram is :

A. $\sqrt{171}\text{units}$

B. $\sqrt{72}\text{units}$

C. $\sqrt{72}\text{units}$

D. 72 units

Answer: A

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98. A particle is moving on a cicular path of radius 'R' . As it moves through an angular displacement θ, its linear displacement will be :

A. $R\sin\theta$

B. $2R\cos\theta/2$

C. $2R\sin\theta/2$

D. $R\cos\theta$

Answer: C

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99. If $\vec{A}$ makes an angle α, β and γ from x,y and z axis respectively then $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=$

A. 3

B. 2

C. 1

D. 0

Answer: B

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100. Magnitudes of vectors $\vec{P}$, $\vec{Q}$ and $\vec{R}$ are equal, If $\vec{P}+\vec{Q}+\vec{R}=0$, then angle between $\vec{R}$ and $\vec{Q}$ is α while if $\vec{P}+\vec{Q}=\vec{R}$, the angle between $\vec{R}$ and $\vec{P}$ is β, then :

A. $\alpha=2\beta$

B. $\alpha=\beta$

C. $\alpha=\frac{\beta}{2}$

D. none of these

Answer: A

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101. A vector $\vec{A}$ is rotated through angle θ about its tail. Change of position vector of its tip of is:

A. $A \sin \theta$

B. $2A \cos. \frac{\theta}{2}$

C. $2A \sin. \frac{\theta}{2}$

D. $A \cos \theta$

Answer: C

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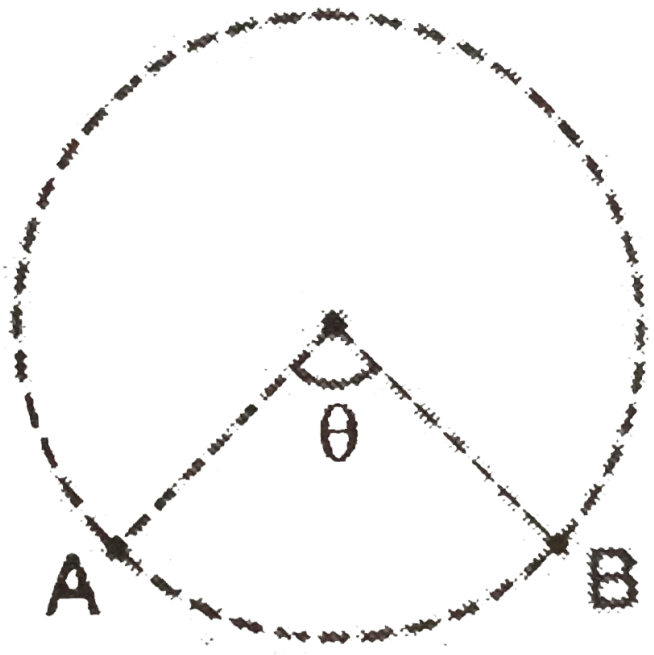
102. A particle is moving on a circular path with a constant speed 'v'. Its change of velocity as it moves from A to B is:



A. $2v \sin \theta$

B. $v \sin \theta / 2$

C. $v \cos \theta$

D. $2v \sin \theta / 2$

Answer: D

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103. Linear momentum of an object can be expressed as $\vec{P} = (4 \cos t)\hat{i} + (4 \sin t)\hat{j}$. Angle between the forces acting on the object and its linear momentum is :

A. $(\pi) / (2)$

B. $(\pi) / (4)$

C. $(3\pi)/(4)$

D. π

Answer: A

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104. $\vec{A}$ and $\vec{B}$ are two vectors. $\left(\vec{A}+\vec{B}\right)\times\left(\vec{A}-\vec{B}\right)$ can be expressed as :

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

B. $2\left(\vec{B}\times\vec{A}\right)$

C. $2\left(\vec{A}\times\vec{B}\right)$

D. zero

Answer: B

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105. Vertices of a triangle are $A(3, 1, 2), B(1, -1, 2)$ and $C(2, 1, 1)$. Area of the triangle will be :

A. $\sqrt{2}\text{units}$

B. $2\sqrt{2}$ units

C. $\sqrt{3}\text{units}$

D. $2\sqrt{3}\text{units}$

Answer: C

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106. A vector remins unchanged on :

A. rotating it through some angle

B. taking its cross product with a units vector

C. taking its cross product with a unit vector

D. shifting it parallel to itself

Answer: D

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

$a = \hat{i} + \hat{j} + 2\hat{k}$ invector from is

A. $6\hat{i} + 2\hat{j} + 2\hat{k}$

B. $2\hat{i} + 2\hat{j} + 2\hat{k}$

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

D. $6\hat{i} + 2\hat{j} - 2\hat{k}$

Answer: B

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108. A particle is displaced from a position $2\hat{i} - \hat{j} + \hat{k}(m)$ to another position $3\hat{i} + 2\hat{j} - 2\hat{k}(m)$

under the action of a force $2\hat{i} + \hat{j} - \hat{k}(N)$. The work done by the force is

A. 8

B. 10

C. 12

D. 16

Answer: A

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109. Two vectors $\overrightarrow{P}$ and $\overrightarrow{Q}$ that are perpendicular to each other are :

A. $\vec{P} = 3\hat{i} + 3\hat{j} + 2\hat{k}, \vec{Q} = 2\hat{i} - 2\hat{j} + 2\hat{k}$

B. $\vec{P} = 2\hat{i} + 3\hat{j} + 2\hat{k}, \vec{Q} = 2\hat{i} - 2\hat{j} + 2\hat{k}$

C. $\vec{P} = 2\hat{i} - 3\hat{j} + 2\hat{k}, \vec{Q} = 2\hat{i} - 2\hat{j} - 2\hat{k}$

D. $\vec{P} = \hat{i} - 3\hat{j} + 2\hat{k}, \vec{Q} = 2\hat{i} - 2\hat{j} + \hat{k}$

Answer: B

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110. 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. 90°

B. 45°

C. 0°

D. 60°

Answer: C

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111. A paricle starting from the origin (0,0) moves in a straight line in (x, y) plane. Its coordinates at a later time are $\left(\sqrt{3}, 3\right)$. The path of the particle makes with the x-axis an angle of

A. 30°

B. 45°

C. 60°

D. 0°

Answer: C

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

A. A =B

B. A= 2B

C. B = 2A

D. $\vec{A}$ and $\vec{B}$ have the same direction

Answer: A

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

A. $\frac{3}{\sqrt{13}}$

B. $\frac{3}{\sqrt{26}}$

C. $\sqrt{\frac{3}{26}}$

D. $\sqrt{\frac{3}{13}}$

Answer: B

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114. A particle acted upon by constant forces $4\hat{i}+\hat{j}-4\hat{k}$ and $3\hat{i}+\hat{j}-\hat{k}$ is displacment from the point $\hat{i}+2\hat{j}+\hat{k}$ to point $5\hat{i}+4\hat{j}+\hat{k}$.Total work done by the forces in SI unit is :

A. 20

B. 40

C. 50

D. 30

Answer: B

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115. The component of vector $A = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$ and the directioin of $\hat{i} - \hat{j}$ is

A. $a_x - a_y + a_z$

B. $a_x - a_y$

C. $\frac{a_x - a_y}{\sqrt{2}}$

D. $a_x + a_y + a_z$

Answer: C

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116. The angle subtended by vector $\vec{A} = 4\hat{i} + 3\hat{j} + 12\hat{k}$ with the x-axis is :

A. $\sin^{-1}\left(\frac{3}{13}\right)$

B. $\sin^{-1}\left(\frac{4}{13}\right)$

C. $\cos^{-1}\left(\frac{4}{13}\right)$

D. $\cos^{-1}\left(\frac{3}{13}\right)$

Answer: C

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117. $\vec{A}$ and $\vec{B}$ are two vectors gives by $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = \hat{i} + \hat{j}$. The magnetiude of the component of $\vec{A}$ along $\vec{B}$ is :

A. $\frac{5}{\sqrt{5}}$

B. $\frac{3}{\sqrt{2}}$

C. $\frac{7}{\sqrt{2}}$

D. $\frac{1}{\sqrt{2}}$

Answer: A

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118. Given $\overrightarrow{C} = \overrightarrow{A} \times \overrightarrow{B}$ and $\overrightarrow{D} = \overrightarrow{B} \times \overrightarrow{A}$. What is the angle between $\overrightarrow{C}$ and $\overrightarrow{D}$?

A. 30°

B. 60°

C. 90°

D. 180°

Answer: D

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119. The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is $\vec{R}$. If the magnitude of $\vec{Q}$ is doudled, the new resultant becomes perpendicuar to $\vec{P}$. Then the magnitude of $\vec{R}$ is :

A. P + Q

B. Q

C. P

D. $\frac{P+Q}{2}$

Answer: B

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120. A particle moves in the xy plane under the influence of a force such that its linear momentum is $\overrightarrow{P}(t) = A\left[\hat{i}\cos(kt) - \hat{j}\sin(kt)\right]$, where A and k are constants. The angle between the force and momentum is

A. 0°

B. 30°

C. 45°

D. 90°

Answer: D

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More Than One Choice Is Correct

1. Which of the following will not depend on orientation of frame of reference ?

A. A scalar

B. A vector

C. The magnitude of a vector

D. Component of a vector

Answer: A::B::C

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2. The momentum of a particle is given by $\vec{P} = \left(2\sin t\hat{i} - 2\cos t\hat{j}\right) kgm/s$. Select the correct option:

A. Momentum $\vec{p}$ of the particle is always perpendicular to $\vec{F}$

B. Momentum $\vec{p}$ of the particle is always parallel t $\vec{F}$

C. Magnitude of momentum remains constant

D. None of the above

Answer: A::C

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3. Which of the following relation are worng ?

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

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

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

D. $A + \vec{B} = \vec{C}$

Answer: A::B::D

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4. If $\hat{n}$ is a unit vector in the direction of the vector $\vec{A}$, them :

A. $A = \vec{A} / \hat{n}$

B. $\hat{n} = \vec{A} / A$

C. $1 = \left|\vec{A}\right| / A$

D. $\vec{A} = A\hat{n}$

Answer: B::C::D

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5. For two vectors $\vec{A}$ and $\vec{B}$ which of the following relations are not commutative ?

A. $\vec{A} + \vec{B}$

B. $\vec{A} - \vec{B}$

C. $\vec{A} \times \vec{B}$

D. $\vec{A} . \vec{B}$

Answer: B::C

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6. The angle made by the vector $\vec{A} = 2\hat{i} + 3\hat{j}$ with Y-axis is

A. $\tan^{-1} 3/2$

B. $\tan^{-1} 2/3$

C. $\cos^{-1}. \frac{3}{\sqrt{13}}$

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

Answer: B::C

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7. If $\vec{X} = \vec{A} \times \left(\vec{B} \times \vec{C}\right)$, then $\vec{X}$ can be expressed as :

A. linear combination of $\vec{A}$ and $\vec{B}$

B. linear combinations of $\vec{B}$ and $\vec{C}$

C. linear combation of $\vec{A}$ and $\vec{B}$

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

Answer: B::D

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8. The vector triple production $\vec{A}\times\left(\vec{B}\times\vec{C}\right)$ will be zero if :

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

B. $\vec{A}$, $\vec{B}$ and $\vec{C}$ are mutually perpendicular

C. $\vec{A}$, $\vec{B}$ and $\vec{C}$ are coplanar vectors

D. $\vec{A}$, $\vec{B}$ and $\vec{C}$ are collinear vectors

Answer: A::B::D

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9. The magnitude of the vectors product of two vectors $\left|\overrightarrow{A}\right|$ and $\left|\overrightarrow{B}\right|$ may be

A. greater than AB

B. equal to AB

C. less than AB

D. equal to zero

Answer: B::C::D

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10. The following sets of three vectors act on a body, whose resultant can be zero. These are :

A. 10, 10 , 10

B. 10,10, 20

C. 10, 20 , 20

D. 10,20, 40

Answer: A::B::C

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11. $\vec{A} + \vec{B} = \vec{C}$. Vectors $\vec{A}$ and $\vec{B}$ if rotated by angle θ in the same sense to from $\vec{A}$ and $\vec{B}$ then $(\theta \neq 0)$:

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

B. $\vec{A} + \vec{B} \neq \vec{C}$

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

D. $\left|\vec{A} + \vec{B}\right| = \left|\vec{C}\right|$

Answer: B::C::D

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12. Which of the following expressions have no meaning ?

A. $\left(\hat{i}.\,\hat{j}\right)\times\hat{j}$

B. $\dfrac{1}{\left(\hat{i}\times\hat{k}\right)\times\hat{j}}$

C. $\dfrac{1}{\left(\hat{i}\times\hat{k}\right).\,\hat{j}}$

D. $\dfrac{1}{\left(\hat{j}\times\hat{k}\right).\,\hat{j}}$

Answer: A::B::D

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13. 2 vectors fo the same physical quantites are unequalities are unequal if :

A. they have the same magnitudes and same direction

B. they have different magnitudes but same directions

C. they have same but different directions

D. they have differement magntiudes and different directions

Answer: B::C::D

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14. Two vectors $\vec{P}$ and $\vec{Q}$ lie one plane. Vectors $\vec{R}$ lies in a differenct plane. In such a case, $\vec{P} + \vec{Q} + \vec{R}$

A. can be zero

B. cannot be zero

C. lies in the sama plane as $\vec{P}$ or $\vec{Q}$

D. lies in the plane different from that of any two of 3 vectors

Answer: B::C

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15. Choose the correct statements:

A. $\vec{A} \times \left(\vec{B} \times \vec{C}\right) = \left(\vec{A} \times \vec{B}\right) \times \vec{C}$

B. $\vec{A} . \left(\vec{B} \times \vec{C}\right) = \vec{C} . \left(\vec{A} \times \vec{B}\right)$

C. The area of parallelogram of sides $\vec{A}$ and $\vec{B}$ is equal to magitude of $\vec{A} \times \vec{B}$

D. $\vec{B} \times \vec{C} = \vec{C} \times \vec{B}$

Answer: A::C

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Assertion Reason

1. (A) : A vectors will not change when the fram of reference in which it is existing is rotated .

(R) : A scalar quantity may (or) may not be independent of arientation of frame of reference :

A. If both A and R are trun and R is the correct explanation of A.

B. If both A and R are true, but R is not correct expalanation of A.

C. If A is true, but R is fasle .

D. If A is fasle , but R is true.

Answer: C

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Matrix Match

1. The two vectors $\vec{A}$ and $\vec{B}$ are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$. In column- I are given the conditions regarding the magnitudes of $\vec{A}$, $\vec{B}$ and $\vec{C}$ as A, B, C respectively. Column- II gives the angle between the vectors $\vec{A}$ and $\vec{B}$. Match them.

Column - I		Column - II	
(a)	$A^2 + B^2 = C^2$	(p)	$\theta > 90°$
(b)	$A^2 + B^2 > C^2$	(q)	$\theta < 90°$
(c)	$A^2 + B^2 < C^2$	(r)	$\theta = 90°$
(d)	$A^2 = B^2 - C^2$	(s)	$\theta = 0°$

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2. Column-I gives operation of vectors $\vec{A}$ and $\vec{B}$ and column- II gives the angle (θ) between $\vec{A}$ and $\vec{B}$ ($\vec{A}$ and $\vec{B}$ are not zero vectors).

Column - I		Column - II	
(a)	$\lvert\vec{A}\times\vec{B}\rvert=\lvert\vec{A}\cdot\vec{B}\rvert$	(p)	$0°$
(b)	$\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$	(q)	$\pi/2$
(c)	$\lvert\vec{A}+\vec{B}\rvert=\lvert\vec{A}-\vec{B}\rvert$	(r)	$\pi/4$
(d)	$\vec{A}+\vec{B}=\vec{C}$ and $A+B=C$	(s)	$3\pi/4$

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3. Match the column-I and column-II .

Column - I		Column - II	
(a)	Triangle law of vectors	(p)	Addition of two vectors
(b)	Parallelogram law of vectors	(q)	Subtraction of two vectors

(c)	Polygon law of vectors	(r)	Addition of more than two vectors
(d)	Component method	(s)	Lami's theorem

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4. Consider three vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ having magnitudes 4, 5, and 3. These vectors are of similar nature, e.g. these could be there displacement. Apply your answer understanding of vectors algebra to match

Column-I with Column-II.

Column - I		Column - II	
(a)	Maximum magnitude of $\vec{A}-\vec{B}$ will be	(p)	zero
(b)	Minimum magnitude of $\vec{A}+\vec{B}-\vec{C}$ will be	(q)	12
(c)	Maximum magnitude of $\vec{A}\cdot(\vec{B}-\vec{C})$ will be	(r)	9
(d)	Maximum magnitude of $\vec{A}+\vec{B}-\vec{C}$ will be	(s)	32

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Interger Answer

1. A point moves according to the $law \quad x = at, y = at(1 - \alpha t)$ where a and α are positive constants and t is time . If the moment at

which angle between velocity vecotrs and acceleration vectors is $\frac{\pi}{4}$ is given by $\frac{A}{\alpha}$. Find the value of A .

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2. If ABC is a right angled triangle with hypotenuse AB=P. Then $\vec{A}\,B.\,\vec{A}\,C + \vec{B}\,C.\,\vec{B}\,A + \vec{C}\,A.\,\vec{C}\,B = mp^2$. Find m.

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3. Two foreces $\vec{P}$ and $\vec{Q}$ are acting at a point . If $\vec{P}$ is reversed, the new resultant becomes between magnitudes of P and Q is given by $P = KQ$. Find k.

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4. Given $\vec{r} = A\cos\alpha t\hat{i} + B\sin\alpha t\hat{j}$. Then if $\frac{d^2\vec{r}}{dt^2} = -\alpha^n\vec{r}$ find the value of n.

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5. If vector A is perpendicular to vectors B and $\left|\vec{A}+\vec{B}\right| = n\left|\vec{A}+\vec{B}\right|$ then the value of n.

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6. If $0.8\hat{i} + 0.2c\hat{j}$ represents direction, then the value of c will be:

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7. If the angle between $2\hat{i} + 2\hat{j} - \hat{k}$ and vector $\hat{i} + c\hat{k}$ is acute, then the maximum value of c is :

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8. $\left|\vec{A} + \vec{B}\right|^2 - \left|\vec{A} - \vec{B}\right|^2 = n\vec{A} . \vec{B}$

The value of n is :

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9. For the value of a, $\vec{A} = 2\hat{i} + a\hat{j} + \hat{k}$ is prependicular to $\vec{B} = 4\hat{i} - 2\hat{j} - 2\hat{k}$?

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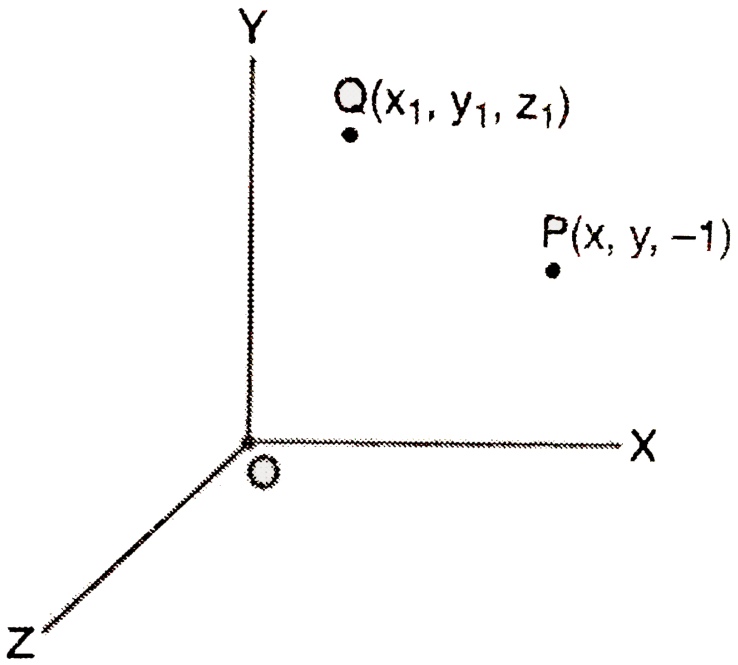
Passage 1

1. Sppose that a point mass 'm' is moving under a constant force $\vec{F} = 2\hat{i} - \hat{j} + \hat{k}$ netweon . At some instant , t=0, point P(xm, ym, -1m) [m- metre] is the instantaneous position of the mass. We know that torque can be expressed as the cross- product of position vector and forces vector, i.e.,

$\tau = \overrightarrow{r} \times \overrightarrow{F}$. At P, torque can be expessed as $\tau = \left(-4\hat{j} - 4\hat{k} \right)$ Nm At some other instant, t=3 sec, the point mass has another instantaneous position $Q(x_1, y_1, z_1)$ such that the displacement vectors between points P and Q and the given force are mutually perpendicular. Also, x-component of torqure at Q is zero and y z-components are equal in magnitude and direction along the negative direction of the respective axes. Using a definite scale, if we construct a parallelogram with the position vectors of Q and the gives force $\overrightarrow{F}$ as its adjacent sides , area of this parallelogram is $2\sqrt{2}m^2$. Area of the given parallelogram , in fact , represents a physical quantity whose magnitude in SI system can be expressed as 5 times the gives are



Answer the following questions.

At Q torque acting on the mass can be expressed as :

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2. Sppose that a point mass 'm' is moving under a constant force $\vec{F} = 2\hat{i} - \hat{j} + \hat{k}$ netweon . At some instant , t=0, point P(xm, ym, -1m) [m- metre] is the

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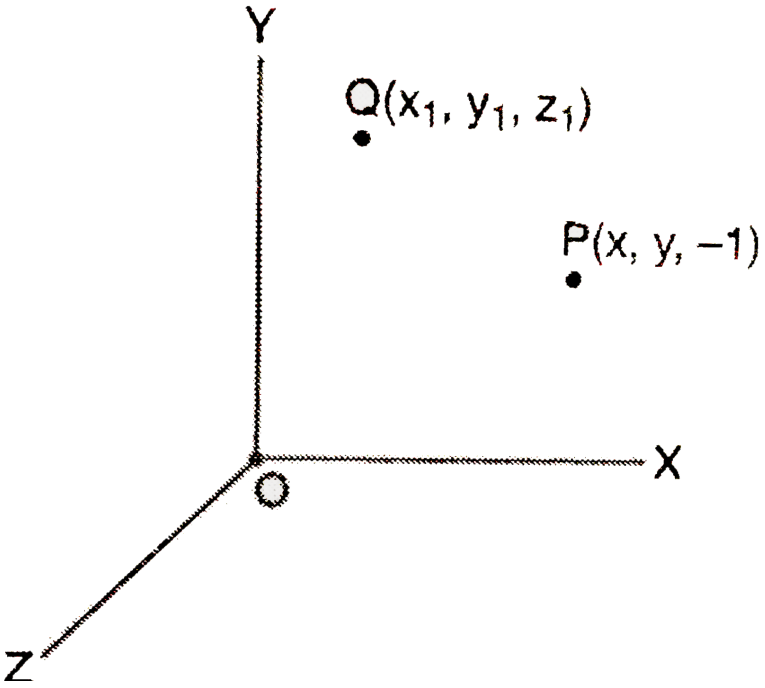

Answer the following questions.

Coordinates of P are :

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3. Sppose that a point mass 'm' is moving under a constant force $\overrightarrow{F} = 2\hat{i} - \hat{j} + \hat{k}$ netweon . At some instant , t=0, point P(xm, ym, -1m) [m- metre] is the instantaneous position of the mass. We know that torque can be expressed as the cross- product of position vector and forces vector, i.e., $\tau = \overrightarrow{r} \times \overrightarrow{F}$. At P, torque can be expessed as $\tau = \left(-4\hat{j} - 4\hat{k} \right)$Nm At some other instant, t=3 sec, the point mass has another instantaneous position $Q(x_1, y_1, z_1)$ such that the displacement vectors between points P and Q and the given force are mutually perpendicular. Also, x-component of torqure at Q is zero and y z-components are equal in magnitude and direction along the negative direction of the respective axes. Using a definite scale, if we construct a

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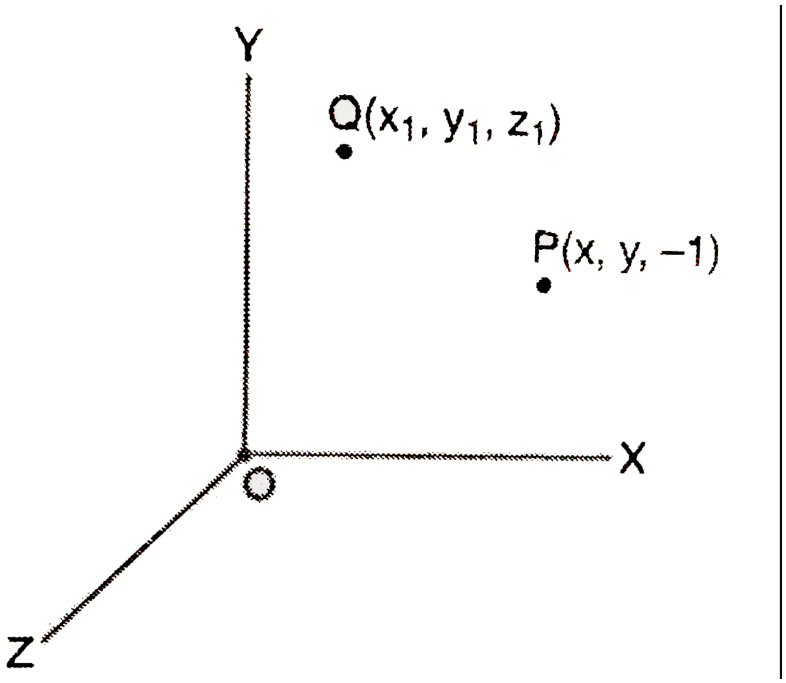

Answer the following questions.

Work done the for the motion of the points mass from P to Q is :

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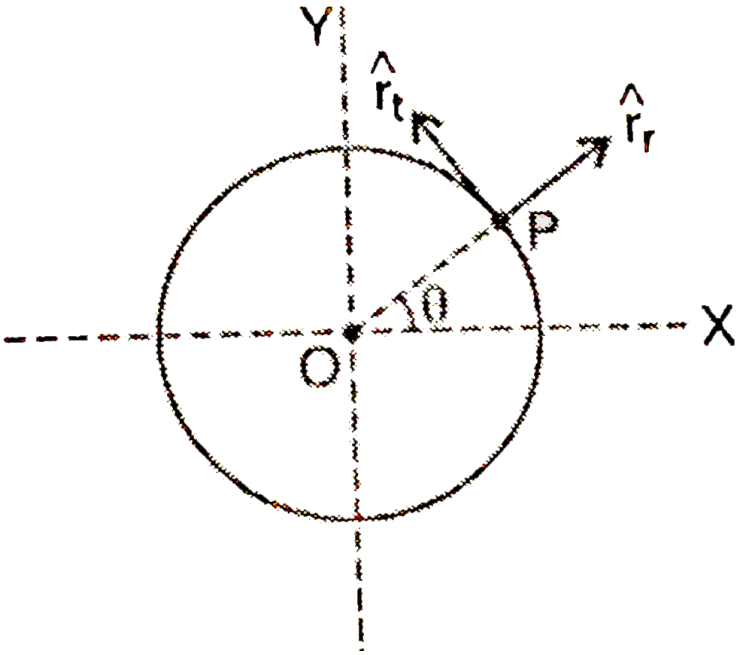
Passage 2

1. Consider a point object of mass 'm' moving in a circle of radius a=1m. For any instantaneous position of the object, θ is the angle that the radial line joining the object and the centre makes with the position X-axis of a cartesian coordinate system with the centre of circle O as the origin. $\hat{i}$ and $\hat{j}$ are unit vectors along X- axis and Y-axis, respectively . Suppose that the motion is a

'Unifrom Circular Motion ' with a constant angular speed $\frac{\pi}{36} rad/\sec$ and that the sense of rotation is counterclockwise with $\theta = 0 att = 0$. For an object which moves in a circle , it is usually convenient to introduce two mutually perpendicular unit vectors $\hat{r}_r$ and $\hat{r}_t$, as shown in the fig 3.57. Here $\hat{r}_r$ is the radial unit vector and $\hat{r}_t$, the tangential unit vector.



Answer the following questions :

For any instantantaneous position of the objected P, the radial unit vector $\hat{r}_r$ can be expressed as :

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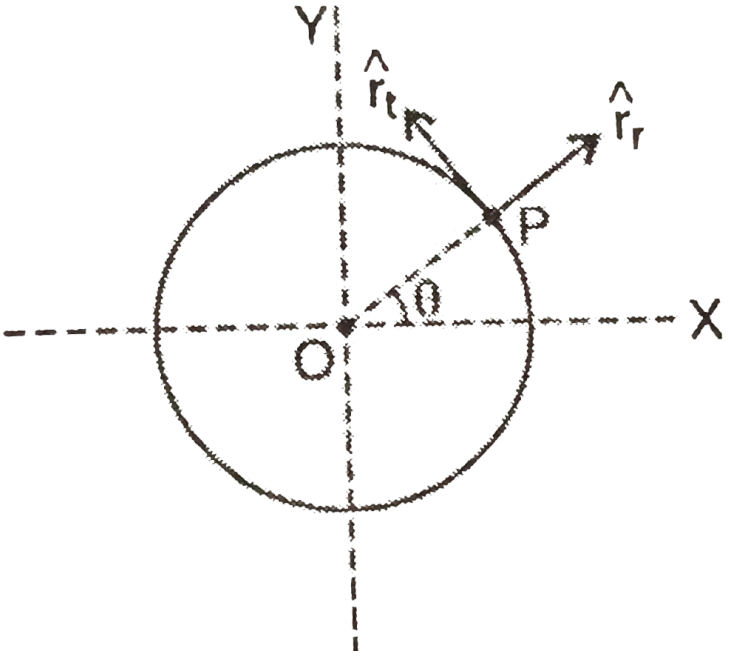
2. Consider a point object of mass 'm' moving in a circle of radius a=1m. For any instantaneous position of the object, θ is the angle that the radial line joining the object and the centre makes with the position X-axis of a cartesian coordinate system with the centre of circle O as the origin. $\hat{i}$ and $\hat{j}$ are unit vectors along X- axis and Y-axis, respectively . Suppose that the motion is a 'Unifrom Circular Motion ' with a constant angular speed $\frac{\pi}{36} rad/\sec$ and that the sense of rotation is counterclockwise with $\theta = 0 att = 0$. For an object

which moves in a circle , it is usually convenient to introduce two mutually perpendicular unit vectors $\hat{r}_r$ and $\hat{r}_t$, as shown in the fig 3.57. Here $\hat{r}_r$ is the radial unit vector and $\hat{r}_t$, the tangential unit vector.



Answer the following questions :

For any position of the objected P, the tangential unit vector can be expressed as :

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3. Consider a point object of mass 'm' moving in a circle of radius a=1m. For any instantaneous position of the object, θ is the angle that the radial line joining the object and the centre makes with the position X-axis of a cartesian coordinate system with the centre of circle O as the origin. $\hat{i}$ and $\hat{j}$ are unit vectors along X- axis and Y-axis, respectively . Suppose that the motion is a 'Unifrom Circular Motion ' with a constant angular speed $\frac{\pi}{36} rad/\sec$ and that the sense of rotation is counterclockwise with $\theta = 0 att = 0$. For an object which moves in a circle , it is usually convenient to introduce two mutually perpendicular unit vectors $\hat{r}_r$ and $\hat{r}_t$, as shown in the fig 3.57. Here $\hat{r}_r$ is the radial unit

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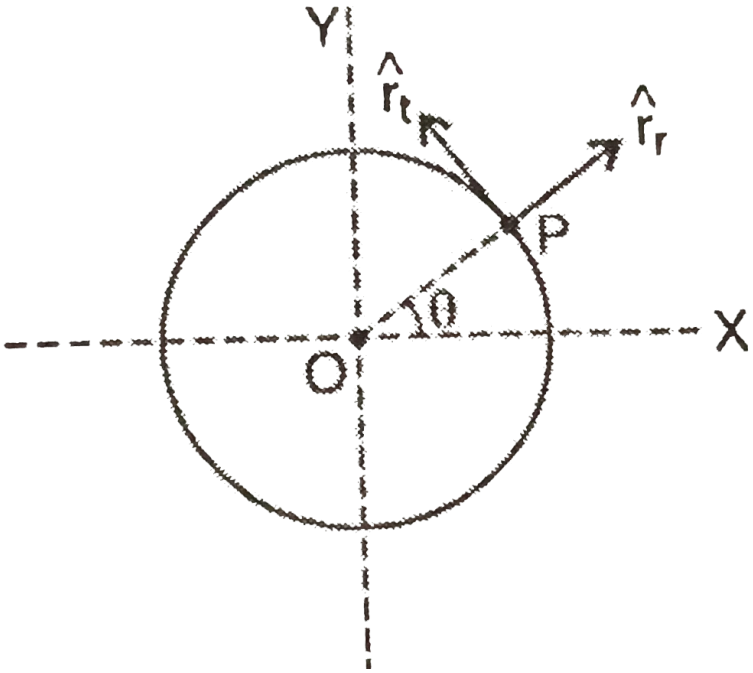

Answer the following questions :

In trems of $\hat{r}_r$, $\hat{r}_t$ and θ, $\hat{i}$ can be expressed as :

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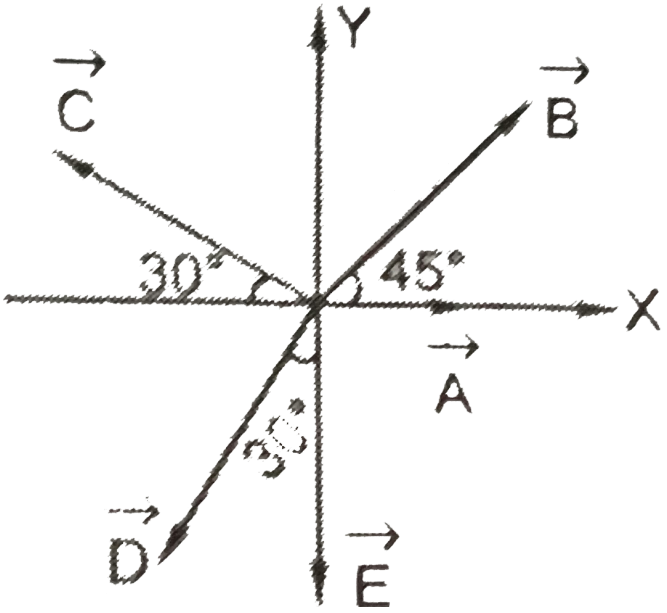
Passage 3

1. Five vectors $\vec{A}, \vec{B}, \vec{C}, \vec{D}$ and $\vec{E}$ have magnitude $10, 12\sqrt{2}, 20, 20$ and 10 unit respectively, they are direacted as shown in the fig. 3.58



Answer the following questions :

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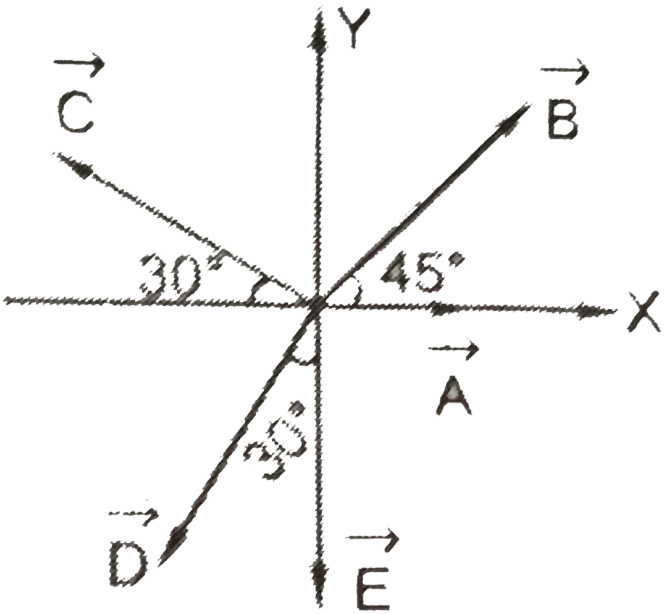
2. Five vectors $\vec{A}, \vec{B}, \vec{C}, \vec{D}$ and $\vec{E}$ have magnitude $10, 12\sqrt{2}, 20, 20$ and 10 unit respectively, they are direacted as shown in the fig. 3.58



Answer the following questions :

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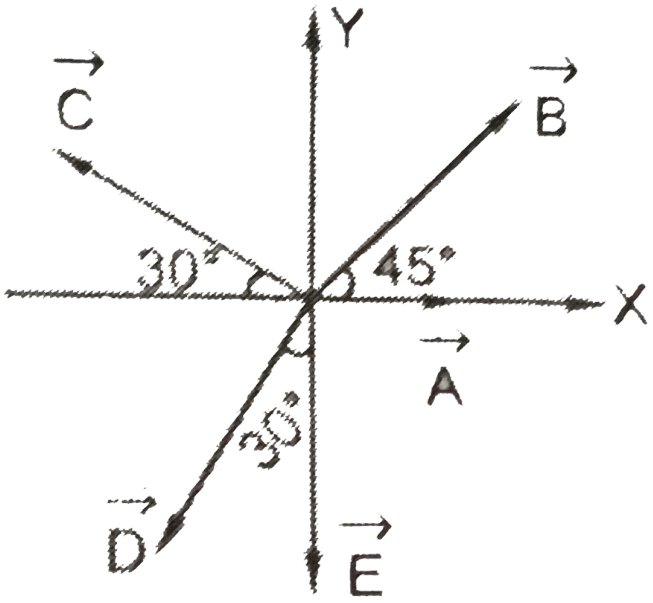
3. Five vectors $\vec{A}, \vec{B}, \vec{C}, \vec{D}$ and $\vec{E}$ have magnitude $10, 12\sqrt{2}, 20, 20$ and 10 unit respectively, they are direacted as shown in the fig. 3.58



Answer the following questions :

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Others

1. We can order events in time and there is a sense of time, distinguishing past,present and futher. Is therefore, time a vector?

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2. Explain why current is not a vector though it appears to possess a direction .

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3. Discuss whether or not , angular displacement is a vector quantity ?`

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4. Does it make a sense to call a physical quantity a vector, when its magnitude is zero ?

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5. Can a vector be zero if any of its components is not zero?

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6. Can you associate vectors with (a) the length of a wire bent into a loop (b) a plane area (c) a sphere ? Explain.

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7. If current density $\vec{J}$ is defined as a vecto with magniutde equal tpo current per unit area, area being normal to the current and direction in which current flows, show that $I = \int \vec{J} . d\vec{s}$

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8. If $\overrightarrow{L}$ and $\overrightarrow{L}$ are two length vectors, what physical quantity does $\left[\overrightarrow{L} \times \overrightarrow{L}\right]$ represent ?

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9. 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 moment with respect to origin at any time t will be

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