PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

MOTION IN A PLANE

Solved Examples

1. PQRS is a parallelogram and $\overrightarrow{QS}$ and $\overrightarrow{PR}$ are its diagonals .Show that $\overrightarrow{PR} + \overrightarrow{QS} - 2\overrightarrow{QR} = 0$

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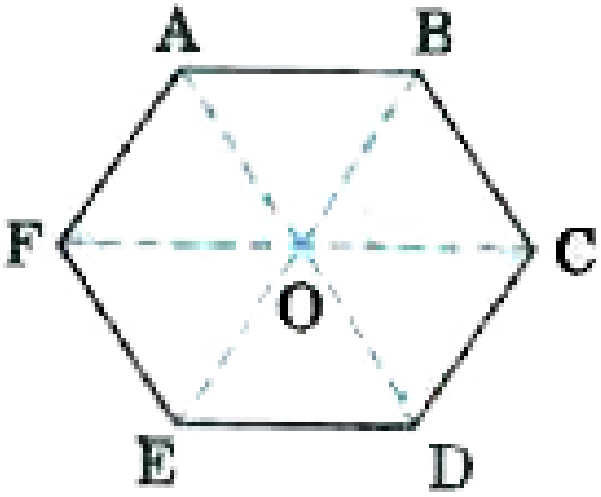
2. For a regular hexagon ABCDEF shown below , prove that $\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF} = 6\overrightarrow{AO}.$



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3. A car travels 8 m due north and then 10 m due east Calculate the displacement of the car .

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4. Two simultaneous forces are applied on a body , one 5N due east and other 7N due north . Find the result force on the body .

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5. A man walks 5 m toward west and 12 m toward north and then 7 m vertically upward . Calculate the magnitude of sum of these displacements .

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6. Two forces of 12 N and 5 N are acting on a particle , with an angle of 60° between them , Calculate the resultant force .

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7. Prove that the resultant of two vector of equal magnitude is equal to either vector if the angle between the two vector is 120°

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8. The magnitudes of two forces X and Y are in the ratio $2:3$. If the resultant of two forces is 25N and angle between them 60°, find the magnitude of each force close to one place of decimal .

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9. The greatest and least resultant of two force acting on a particle are 16 N and 9N, respectively . If the first force is double and the second force is incresed by 5.5N, calculate the resultant of two new force, acting at right angle to each other .

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10. Four forces are acting on a particle simultaneously : 50N due east , 40 N due north , 30 N due west and 20 N due south . Calculate the resultant force on the particle .

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11. Rain is falling vertically with a speed of $35ms^{-1}$. A woman rides a bicycle with a speed of $12ms^{-1}$ in east to west direction. In which direction should she hold her umbrella ?

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12. A motor boat is racing towards North at $25km/h$ and the water current in that region is $10km/h$ in the direction of 60^{00} East of South. Find the resultant velocity of the boat.

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13. A swimmer wants to cross a 600 m wide river . If the speed of swimmer is 12 km/hr in still water and speed of river is 6km/hr , along what direction the swimmer must strike in order to cross the river straight ? Also, calculate his resultant velocity and time taken by him to do so .

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14. For the vectors $\vec{A} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{B} = 2\hat{i} + 3\hat{j} + 2\hat{k}$, find the vector $\overrightarrow{AB}$ and its magnitude.

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15. For the vectors $\vec{A}$ and $\vec{B}$ in the above example , find unit vector parallel to the resultant of the two vectors

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16. When a vector $\vec{C}$ is added to the resultant of vectors $\vec{A} = \hat{i} + 4\hat{j} - 2\hat{k}$ and $\vec{B} = 3\hat{i} - 5\hat{j} + \hat{k}$, a unit vector along Z-axis is obtained . Find the vector $\vec{C}$

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17. Calculate the value of β in the unit vector $0.8\hat{i} - 0.4\hat{j} - \beta\hat{k}$.

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18. Find a vector having same magnitude as vector $\overrightarrow{A} = 6\hat{i} + 18\hat{j}$ and parallel to vector $\overrightarrow{B} = 2\hat{i} + 5\hat{j}$.

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19. A velocity is inclined at 30° to the horizontal . If its rectangular component in horizontal direction is $40km/hr$, find the magnitude of velocity and its vertical component.

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20. Two billiard ball, rolling a flat table, have started moving from the same point. If their x components of velocities are $\sqrt{3}m/s$ and $2m/s$ and y components of velocities are $1m/s$ and $2m/s$, respectively, calculate the angle between their paths .

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21. Calculate the angle between the two vectors

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

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22. For the two vectors $\vec{A} = 2\hat{i} - \hat{j}$ and $\vec{B} = \hat{i} + \alpha\hat{j} + 3\hat{k}$, perpendicular to each other , find the value of a .

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23. If the magnitude of two vectors are 3 and 6 and ther scalar product is 9, find the angle between the two vectors.

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24. A body constrained to move along the Y-axis of a co-ordinate system is subjected to a constant force $\vec{F}$ given unit $\vec{F} = -\hat{i} + 6\hat{j} + 2\hat{k}$ newton where $\hat{i}, \hat{j}$ and $\hat{k}$ represent unit vector along X-, Y- and Z-axis of the system , respectively . Calculate the work done by the force in displacement the body through a distance of 4 m along the Y-axis .

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25. If the magnitude of there vectors $\vec{X}, \vec{Y}$ and $\vec{Z}$ are 4, 3 and 5, respectively and $\vec{X} + \vec{Y} = \vec{Z}$, then calculate the angle between $\vec{Y}$ and $\vec{Z}$.

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26. For three vectors $\vec{P}, \vec{Q}$ and $\vec{R}, \vec{P} + \vec{Q} = \vec{R}$ and $P + Q = R$ Then prove that $\vec{P}$ and $\vec{Q}$ are parallel to each other.

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

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28. Shown that the vectors $3\hat{i} + 3\hat{j} + 9\hat{k}$ and $\hat{i} + \hat{j} + 3\hat{k}$ are parallel.

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29. Find a unit vector perpendicular to both vectors $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 7\hat{j}$.

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30. Calculate the area of a parallelogram whose adjacent sides are formed by the vectors $\vec{A} = \hat{i} - 3\hat{j} + \hat{k}$ and $\vec{B} = 2\hat{i} - \hat{j} + 3\hat{k}$.

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31. Calculate the sine of the angle between the vectors

$\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{B} = -2\hat{i} + \hat{j} - 2\hat{k}$.

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32. For two vectors $\vec{P}$ and $\vec{Q}$, show that

$$\left(\vec{P} + \vec{Q}\right) \times \left(\vec{P} - \vec{Q}\right) = 2\left(\vec{Q} \times \vec{P}\right)$$

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33. If $\vec{A} = 2\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{B} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{C} = \hat{i} + 3\hat{j} - 2\hat{k}$ find $\left(\vec{A} \times \vec{B}\right) \times \vec{C}$

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34. Calculate the area of the triangle formed by the tips of vectors $\vec{P} = 2\hat{i} + \hat{j} - 3\hat{k}, \vec{Q} = 3\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{R} = 4\hat{i} - 3\hat{j} + \hat{k}$

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35. Determine the area of a parallelogram whose diagonals are given by vectors $3\hat{i} + 2\hat{j} - 7\hat{k}$ and $5\hat{i} + 6\hat{j} - 3\hat{k}$.

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36. Calculate the moment of force about the point $i - 2\hat{j} - \hat{k}$ of the force $3i - 5\hat{j} + \hat{k}$ acting at the point $-2\hat{i} - \hat{k}$.

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37. An athlete is running on a circular track of radius 1m with a uniform velocity of $20m/s$. Calculate

(i) the difference in the magnitude of the displacement of the athlete and the distance covered by him in completing half a ground .

(ii) magnitude of change in velocity of the athlete in half a round .

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38. The position of a particle is given by $\vec{r} = 3.0t\,\vec{i} + 2.0t^2\hat{j} + 5.0\hat{k}$ Where is in seconds and the coefficients have the proper unit for r to be in maters . (a) Find v(t) and a(t) of the particle .

(b) Find the magnitude and direction of $v(t)\text{at}t = 1.0s$

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39. A cricket ball is thrown at a speed of $28ms^{-1}$ in a direction 30° above the horizontal. Calculate (a)the maximum height (b) the time taken by ball to return ti the same level, and (c)the distance from the thrower to

the point wher the ball restance from the throwrt to the point where the ball returns to the same level.

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40. A boy stands 19.6 m away from a 9.8m high cliff. If the throws a ball towards the cliff such that it just passes above from it , find the velocity of projection of the ball.

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41. A projectile when fired at a certain inclination has maximum rang R. Find its maximum height attained by it in terms of R .

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42. A stone is projected at an angle of 30° with the vertical. If the horizontal component of its velocity is $9.8m/s$, calculate the maximum

height attained by the stone and its horizontal range .

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43. Two balls A and B are thrown from the same point with similar velocity of $19.6\frac{m}{s}$, at angle θ and $90^\circ - \theta$ with the horizontal , respectively . Ball B reaches 10 m higher than ball A. Find the individual maximum higher reached by ball A and B .

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44. Show that the horizontal range of a projectile is same for two angles of projection . Is the sum of maximum heights for these two angles dependent on the angle of projectile ?

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45. Two projectiles are projected from the same point different velocities and different angles of projection .If the maximum height attained by both the projectiles is same, show that sum of the times taken by each to reach the highest point is equal to the total time of flight of either of the projectiles .

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46. A person sees an object on a tree at a heitht of $40m$ and at a distance of $60m$. Whith what velocity he showld throw an arrow at an angle of 45° so that it may hit the object ? Take $g = 10ms^2$.

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47. A stone is thrown from a cliff 4.2 m high . At what angle he must incline his rifle in order to cover a maximum range of firing on the ground below . Taken muzzle velocity of bullet $= 20m/s$ and $g = 10ms^{-2}$.

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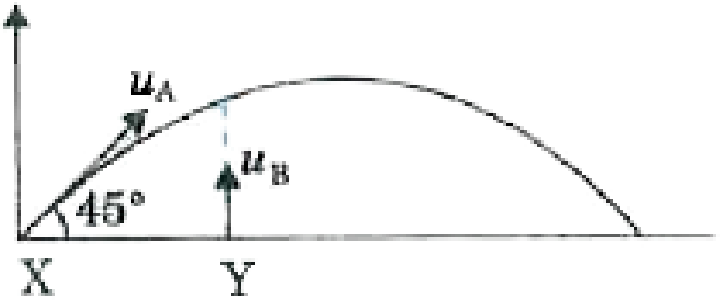
48. Two bodies A and B are projected simultaneously from points X and Y as shown in the figure, with velocities u_A and u_B respectively.



Find the ratio of $\frac{u_A}{u_B}$ for both the bodies to collide .

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49. A stone is thrown horizontally from the top of a cliff and strikes the ground after 5 seconds, at an angle of 45° with the horizontal . Calculate

(i) height of the cliff.

(ii) speed of projection of the stone .

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50. A hiker stands on the edge of a cliff $490m$ above the ground and throwns a stone horiozontally with an initial speed of $15ms^{-1}$ neglecting air resistance.The time taken by the stone to reach the ground in seconds is $(g = 9.8ms^2)$

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51. A pocket is dropped from an aeroplane when it is directly above a point X on the ground and hits the ground at Y. If the aeroplane is moving horizontally with a speed of 600 km/h, 1, 000m above the ground , find the distance XY.

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52. two tall building are situated 300 m apart . A ball is thrown horizontally from the window of 10^{th} floor of one building such that it lands in a windo of 3^{rd} floor of another nuilding. If the vertical distance

between the corresponding floors of the building is 5m, find the velocity with which the ball must be thrown .

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53. A particle is thrown horizontally from the top of an inclined plane , with a speed of $5m/s$. If the inclination of the plane is 30° with the horizontal , how far from the point of projection will the particle strike the plane ?

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54. A helicopter moving horizontally with a velocity of 360 km/h has to drop a food packet directly into a relief fund office . If the height of helicopter from the ground is 200 m , at what distance the helicopter must be from the fund office when the packet is dropped ?

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55. What are the angular velocities of a second hand, minute hand and hour hand of a clock ?

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56. A body of mass 0.5 kg made to revolve in a horizontal circle of radius 3 m with a uniform speed of $12m\frac{m}{s}$. Find its

(i) angular speed

(ii) frequency of revolution.

(iii) time period .

(iv) centripetal acceleration.

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57. An insect trapped in a circular groove of radius $12cm$ moves along the groove steadily and commpletes 7 revoltions in $100s$. (a) What is the angulr speed , and thelinear speed of the motion ? (b) Is the acceleration vector a costant vector ? What is its magnitude?

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58. The earth revolves around the sun in an orbit of radius 15×10^{10} m .Find the angular and linear velocity of the earth . Also calculate the angle through which the earth revolves in a day .

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59. A particle is moving in a circle of radius 0.3 . Calculate its linear acceleration at the instant when its angular velocity is $1 rad/s$ and angular acceleration is $4 rad/s^2$

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60. A car is moving with a velocity of $60 km/h$ due east and a train is moving with a velocity of $80 km/h$ due south . For a passenger sitting inside the train , what is the velocity of car appearing to him ?

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61. A body A is moving along a straight path with a velocity of $4m/s$ Another body B is moving with a velocity of $5m/s$, on a traight path, at an angle of 45° to the path of A. Calculate the spend of B relative to A.

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62. A ship is sailing towards east in a traight line motion, with a speed of $10m/s$. A man on the deck is moving across it , towards north, with a speed of $6m/s$

calculate the velocity of the man relative to the sea.

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63. A man rows across a flowing river in time t_1 and rows an equal distance downstream in time t_2. Calculate the ratio $t_1 : t_2$ if the speed of man in still water is $5m/s$ and speed of stream is $3m/s$.

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Practice Problems 1

1. A body is acted upon by two forces of magnitudes 20 N and 30 N. Calculate the maximum and minimum value of resultant force on the body

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2. Find the components of weight along and perpendicular to a plane if a mass of 4 kg is laying on the plane making an angle making an angle of 60° with the horizontal .

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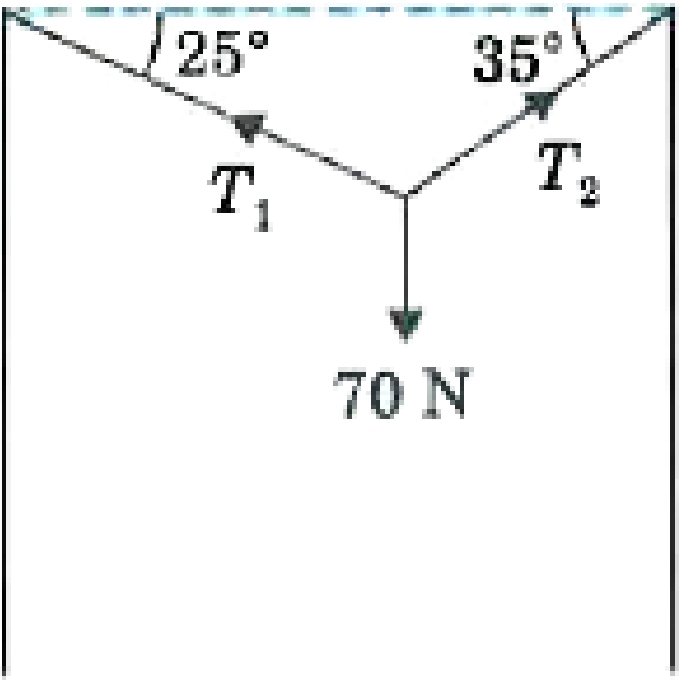
3. A 70 N block hangs from a rope stretched between two pillars . Calculate the tensions T_1 and T_2 for the following system



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4. Two forces A and B are acting at a point . The least and greatest resultants of these forces are 5 N and 10 N respectively . If each of these forces is decreased by 2 N , then what will be the resultant of these new forces acting at an angle of 30° to each other ?

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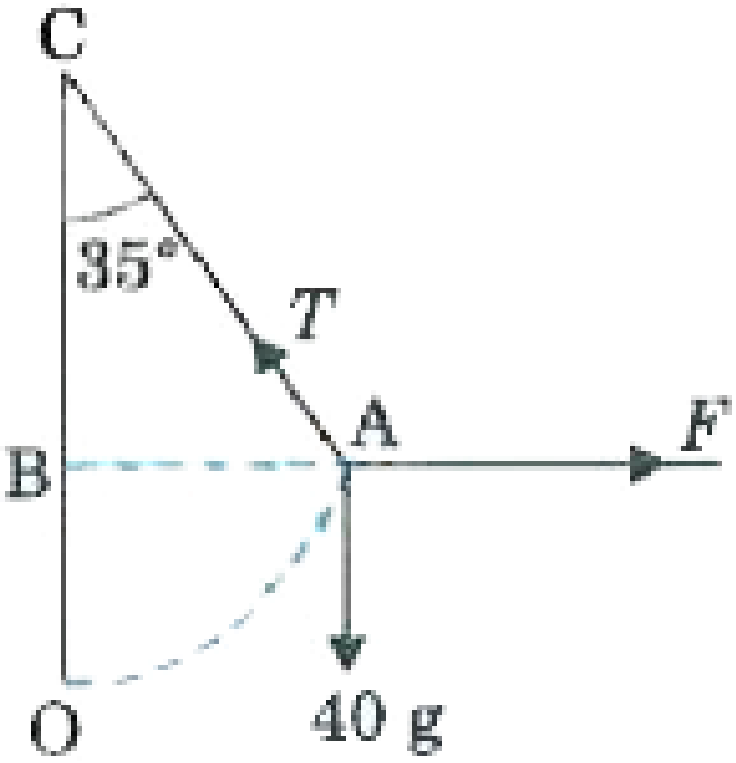
5. Calculate the force F in the following arrangement .



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6. A resultant of 60 N is produced due to two forces having magnitudes in the ratio $4:5$ Calculate the magnitude of each if the angle between them

is 30°

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7. There vectors $\vec{P}, \vec{Q}$ and $\vec{R}$ are such that $\vec{P} + \vec{Q} + \vec{R} = 0$ Vectors $\vec{P}$ and $\vec{Q}$ are equal in , magnitude . The magnitude of vector $\vec{R}$ is $\sqrt{2}$ times the magnitude of either $\vec{P}$ or $\vec{Q}$. Calculate the angle between these vectors .

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8. Find the vector $\vec{X}$ which when added to the vector $\vec{Y} = 6\hat{i} - 7\hat{j}$ in a plane gives a resultant vectors of magnitude 5 units , along the negative y direction .

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Practice Problems 2

1. For what value of x, the vector $\vec{A} = 3\hat{i} + x\hat{j} - 4\hat{k}$ is perpendicular to be vector $\vec{B} = 2\hat{i} - 2\hat{j} + 6\hat{k}$?

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2. Calculate the component of vector $\vec{A} = \left(6\hat{i} + 5\hat{j}\right)$ along the directions of $\left(\hat{i} - \hat{j}\right)$ and $\left(\hat{i} + \hat{j}\right)$.

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3. $\vec{P}$ and $\vec{Q}$ are two vectors having magnitude 1 and 3 respectively and inclined at an angle θ.

If $\left|\vec{P} + \vec{Q}\right| = \sqrt{7}$, then find the value of $\left(2\vec{P} + \vec{Q}\right).\left(\vec{P} - \vec{Q}\right)$

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4. A constant force $\vec{F} = 2\hat{i} - \hat{j} - \hat{k}$ moves a particle from position vector

$\vec{r}_1 = -5\hat{i} - 4\hat{j} + \hat{k}$ to position vector $\vec{r}_2 = -7\hat{i} - 2\hat{j} + 2\hat{k}$. What will be the work done by this force ?

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5. Calculate the angle between two vectors $\vec{P} = 3\hat{i} - \hat{j} + 4\hat{k}$ and $\vec{Q} = \hat{i} + \hat{j} - 6\hat{k}$

Also find the projection of $\vec{P}$ on $\vec{Q}$

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6. Calculate the angle between two vectors having magnitudes 3 and 4. The magnitude of their dot product is $2\sqrt{2}$.

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7. Two vector $\vec{A}$ and $\vec{B}$ of magnitude 50 N and 100N are inclined at an angle of 60°. Calculate the magnitude of cross product and dot product of these two vectors.

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8. Find the unit vector perpendicular to two vectors $\vec{P} = \hat{i} + \hat{j} + 2\hat{k}$ and $\vec{Q} = 2\hat{i} - 4\hat{j} + 5\hat{k}$.

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9. The adjacent sides of a parallelogram are given by $\vec{A} = \hat{i} + \hat{j} - 4\hat{k}$ and $\vec{B} = 2\hat{i} - \hat{j} + 4\hat{k}$. Calculate the area of parallelogram.

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Practice Problems 3

1. Calculate the acceleration of a particle at $t = \frac{\pi}{6}$, if the position vectors of the particle

$\vec{r} = (5\cos t)\hat{i} + (2\sin t)\hat{j} + \left(6t^2 \sin 2t\right)\hat{k}m$

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2. A boy is moving westward with a velocity of $10ms^{-1}$. In 20 seconds, velocity changes to $5ms^{-1}$ southwards. Calculate the average acceleration of the boy in this interval

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Practice Problems 4

1. A ball moving is thrown at an angle of 60° with the horizontal, with initial speed of $30m/s$. Calculate

(a) time of flight of the ball

(b) hrizontal range .

(c) maximum height attained .

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2. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectile is

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3. From the top of a building , a ball is thrown horizontally. The ball strickes the ground after 5 s at an angle of 60° to the horizontal. Calculate the speed with which the ball was projected .

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4. From the top of a tower, a body is thrown horizontally with a speed of $100ms^{-1}$ after 6 s what will be its

(a) Position ? (b) velocity?

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5. Calculate the percentage increase in horizontal range if the maximum height attained by a projectile is inctreased by $20\,\%$ by increasing the speed of projectile, assuming that there is no change in angle of projection .

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6. Find the angle of projection at which horizontal range and maximum height are equal.

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7. A ball is thrown with a velocity of $30ms^{-1}$ from the top of a building 200m high . The ball makes an angle of 30° with the horizontal . Calculate

the distance from the foot of the building where the ball strikes the ground $\left(g = 10ms^{-2}\right)$.

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8. A projectile has the same range (R) when the maximum height attained by it is either H_1 or H_2. Find the relation between R, H_1 and H_2 .

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9. What will be the equation for the path of a projectile if it is fired with initial velocity of $\left(2\hat{i} + 3\hat{j}\right)$. Here $\hat{u}$ and $\hat{j}$ are unit vectors along X-axis and Y-axis $\left(g = 10ms^{-2}\right)$.

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10. A projectile is fired with a velocity u in such a way that its horizontal range is three times the maximum height aatained . Find the value of horizontal range .

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11. Two bodies are projected with velocities v_1 and v_2 at a same instant of time as shown in the figure . For what value of $\frac{v_1}{v_2}$, the bodies will collide ?

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12. Find the angle of projection for a projectile if its speed at maximum height is $\sqrt{5/9}$ times its speed at one-third of maximum height $(g = 10ms^{-2})$

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13. A body is projected from the ground into the air . The velocity of the body at a height of 5 from the ground is given by $\vec{v} = 3\hat{i} + 8\hat{j}$. Calculate the maximum height attained by the body $\left(g = 10ms^{-2}\right)$

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Practice Problems 5

1. A boy sitting on a merry-round make 200 revolutions per minute . Calculate the angular speed of the merry-go-round.

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2. A stone is making 30 revolutions in 40 s when attached to a string of length 3 m and is swiled in a circle . What will be the magnitude and direction of acceleration?

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3. The radius of the earth's orbit around the sun is $1.5 \times 10^{11} m$. Calculate the angular and linear velocity of the earth. Through how much angle does the earth revolve in 2 days?

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4. What are the angular velocities of a second hand, minute hand and hour hand of a clock ?

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5. A particle is moving in a circle of radius 100 cm making 200 revolutions per minute . After 10 minutes , the revolutions per minute are increased to 300. Calculate angular acceleration and linear acceleration.

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Practice Problems 6

1. A car is moving with a speed of $4-0km/h^{-1}$. As the car reaches a circular turn on the road of radius 100m , the driver applies brakes and reduces his speed at the rate of $1ms^2$. Calculate the magnitude of net acceleration of the car.

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Practice Problems

1. Find the velocity of a particle A w.r.t. B if velocity of particle A due west is $5kmh^{-1}$ and that of B due south is $3kmh^{-1}$.

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2. A bus is moving with a velocity of $40kmh^{-1}$ due south, and a car is moving due west with a velocity of $50kmh^{-1}$. What is the velocity of car w.r.t. a passenger in the bus ?

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Conceptual Questions

1. The resultant of two equal velocities is equal to either. What is the angle between them?

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2. For three vectors $\vec{A}, \vec{B}$ and $\vec{C}$ and $\left|\vec{A}\right| + \left|\vec{B}\right| = \left|\vec{C}\right|$. What can we say about direction of these vectors?

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3. A vector $\vec{X}$ is given an increment $\left|\Delta\vec{X}\right|$. Can the increment ΔX in the magnitude of $\vec{X}$ be greater than or equal to the modulus of the increment of the vector, $\left|\vec{X}\right|$? Give reason .

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4. If $\vec{X} . \vec{Y} = \vec{X} . \vec{Z}$, $is \vec{Y} = \vec{Z}$ always?

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5. If the angle between two vectors in increase from 0° to 180°, what is the effect on the magnitude of the resultant of two vectors ?

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6. If $\vec{P} \times \vec{Q} = \vec{R} \times \vec{Q}$, is $\vec{R} = \vec{P}$ always ?

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7. A boy throws a stone vertically upwards and catches it later . Is the motion of stone considered as projectile motion ?

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8. The position vector of a particle at two points along its path is given along with the time taken to move from one point to other . Can we determine particle's instantaneous velocity and its average velocity using this data? Explain.

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9. How can a truck driver steer a truck travelling at constant speed such that (i) its acceleration is zero and (ii) magnitude of acceleration is constant ?

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10. On the surface of the moon , a cricket ball is hit at some angle with the horizontal . As the ball traveles through vecuume , determine which

of the quantities will not change? (a) speed , (b) acceleration , (c) horizontal and vertical components of velocity and (d) resultant velocity .

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11. In the above example , another cricket ball is hit with same speed and angle of projection on the earth . The horizontal range of this projectile as compared to that of the moon is (a) same , (b) less or (c) more .

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12. A rescue helocopter , moving with a constant horizontal speed at a certain height above the ground , drops a food packet from it . If air resistance is negligible, the food packet will land (a) below the plane and ahead of it (b) below the plane and behind it or (c) directly below the plane .

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13. A ball is dropped from the window of a stationary train and lands to the ground after 6 seconds . How much time will the ball take to land if the train is moving with (a) uniform speed of 60 km/hr and (b) uniform acceleration of $4km/h^2$?

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14. A block sides down a smooth inclined plane when released from the top, while another falls freely from the same point. Which one of them will strike the ground : (a) earlier (b) with greater speed ?

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15. Why does a tunnis ball bounce heigher on a hill than on plains?

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16. From the quantities given below , choose the one which is not indepndent of the choice of orientation of the coordinate axes:

(a) $\vec{P} + \vec{q}$

(b) $\left|\vec{P} + \vec{q} - \vec{r}\right|$

(c) $2px + 5qy$

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17. Is it possible to get zero vector as a resultant of three non-coplanar vectors ? Is the same possible in case of four non-coplanar vectors?

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18. A man inside a moving train throwa a baoll vertically upwards . How will the motion of ball appears to a stationary observe (a) inside the train and (b) outside the train?

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19. A bob hung from the ceiling of a room by a string is performing simple harmonic oscillations. What will be the trajectory of the bob, if the string is cut. When bob is (i) at one of its extreme positions (ii) at its mean position ?

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20. Two cannoballs A and B are fired at same angle and with same velocity from a cannon . If mass of $A <$ mass of B, which ball will reach the ground first ? What if the balls are fired with diferent velocities but same angle of projection?

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21. A skilled gunman always keeps his gun slightly tilted above the line of sight while shooting. Why?

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22. A stone is projected horizontally from the top of a towar. At the same time , another stone is dropped down from the same height . Which ball will reach the ground earlier? Will they hit the ground with same velocity ?

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23. A railway carriage moves over a straight track with acceleration a. Passenger in the carriage drops a stone. What is the acceleration of the stone w.r.t. the carriage and the earth?

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Tough Tricky Problems

1. The resultant of two forces 3P and 2P is R. If the first force is doubled then resultant is also doubled.The angle between the two forces is

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2. Three vectors are written as follows:

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

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

$\vec{C} = 5\hat{i} + n\hat{j} + \hat{k}$

What should be the value of a so that three vectors are coplanar ?

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3. The force on a charged particle due to electric and magnetic fields is given by $\vec{F} = q\vec{E} + q\vec{v} + \vec{B}$. Suppose $\vec{E}$ is along the X-axis and $\vec{B}$ along the Y-axis. In what direction and with what minimum speed v should a positively charged particle be sent so that the net force on it is zero?

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4. It is given that $\left|\vec{A}_1\right| = 2, \left|\vec{A}_2\right| = 3$ and $\left|\vec{A}_1 + \vec{A}_2\right| = 3$

Find the value of $\left(\vec{A}_1 + \vec{A}_2\right).\left(2\vec{A}_1 - 3\vec{A}_2\right)$

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5. The sum of the magnitudes of two forces acting at a point is 16 N. The resultant of these forces is perpendicular to the smaller force which has a magnitude of 8 N. If the magnitude of smaller force is x, then the value of x is

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6. Two towns A and B are connected by a regular bus service with a bus leaving in either direction every T min. A man cycling with a speed of $20kmh^{-1}$ in the direction A to B notices that a bus goes past him every $18\ \text{min}$ in the direction of his motion, and every $6\ \text{min}$ in the opposite direction. What is the period T of the bus service and with what speed (assumed constant)do the buses ply on the road?

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7. A particle is projected horizontal with a speed u from the top of plane inclined at an angle θ with the horizontal. How far from the point of projection will the particle strike the plane?

Watch Video Solution

8. A particle is projected from the top of a tower of height H. Initial velocity of projection is u at an angle θ above the horizontal . Particle hits the ground at a distance R from the bottom of tower. What should be the angle of projection θ so that R is maximum ? What is the maximum value of R?

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9. In a criket match a batsman hits a six . Ball is hit 1 m above the ground level from a point which is 110m away from the benches of stadium . Ball

leaves the bat with a speed $35m/s$ and at an angle 53° above the horizontal. Height and width of benches are 1 m each . Assume that benches are perpendicular to the plane of motion of the ball. Which bench will the ball hit ?

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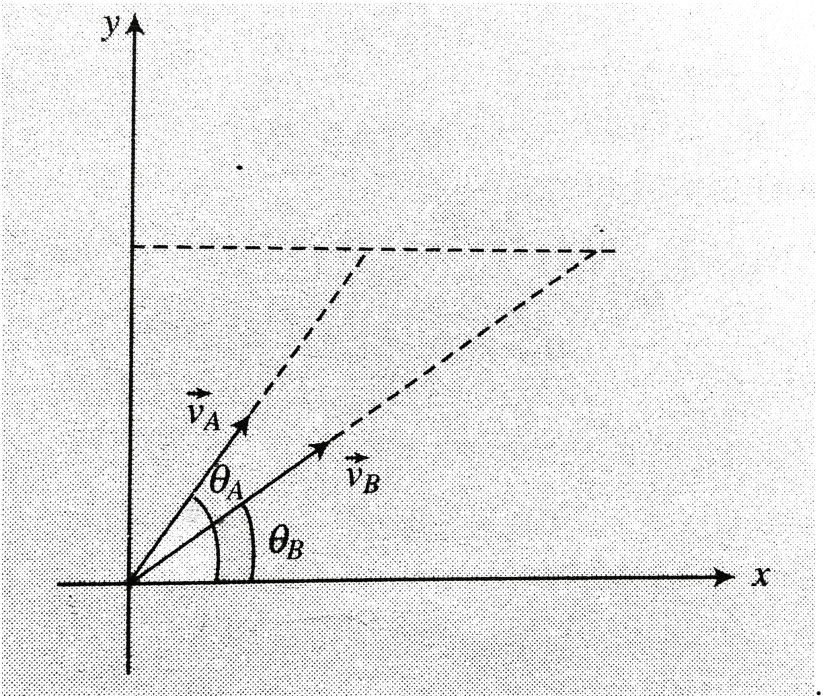
10. Two particles A and B are projected from the same point in different directions in such a manner that vertical components of their initial velocities are same (Fig. 5.8). Find the ratio of range.



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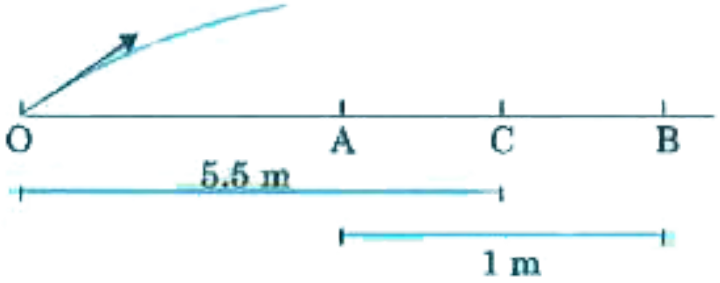
11. Points A and B are market on the ground at a distance 1 m from each other . C is marked as midpoint between A and B .



O is point on the same line at a distance 5. m from point C. A particle is projected with a speed $10m/s$ from point O. What should ne the angle of projection so that particfle strikes somewhere between A and B ?

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12. A particle is projected from origin at an angle is selected as X-axis and verticle as Y-axis . It is found that particle passes through the points (a, b) and (b, a). Calculate range and angle of projection .

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View Text Solution

13. A ball is projected with initial speed u at an angle θ above the horizontal . Calculate the time after which ball will be moving at right angle to its initial velocity.

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14. A man wishes to cross a river which is flowing at a certain speed . Man uses a motor boat whose velocity with respect to water is more than speed of flow. Minimum possible time the boat takes to cross the river is t_1 , but drift along the length of river is x . When boat takes shortest route to cross the river , then it takes time t_2 . Find the velocity of boat with respect to water .

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Ncert File Solved Ncert Textbook Exercises

1. State , for each of the following physical quantities , if it is a scalar or vector :

Volume , mass speed, acceleration , density , number of moles, velocity , angular frequency, displacement , angular velocity.

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2. Pick out the two scalar quantities in the following list :

Force, angular momentum, work, current linear momentum, electric field , average velocity, magnetic moment , relative velocity .

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3. Pick out the only vector quantity in the following list : temperature, pressure, impulse, time, power. Total path-length, energy. Gravitational potential, coefficient of friction, charge,

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4. State with reasons whether the following algebric operations with scalar and vector phisical quantities are meaningful :

(a) adding any two scalars

(b) adding a scalar to a vector of the same dimensions

(c) multiplying any vector by any scalar

(d) multiplaying any two scalars

(e) adding any two vectors

(f) adding a component of a vector to the same vector .

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5. Read each statement below carefully and state with reasons, with it is true or false :

(a) The magnitude of vector is always a scalar.

(b) Each component of a vector is always a scalar.

(c) The total path length is always equal to the magnitude of the displacement vector of a particle.

(d) The average speed of a particle (defined as total path length divided

by the time taken to cover the path) is greater or equal to the magnitude of average velocity of the particle over the same interval of time.

(e) three vectors not lying in a plane can never add up to give a null vector.

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6. निम्नलिखित असमिकाओं की ज्यामिति या किसी अन्य विधि द्वारा स्थापना कीजिए :

(a) $|a+b| \leq |a| + |b|$

(b) $|a+b| \geq ||a| - |b||$

(c) $|A-b| \leq |a| + |b|$

(d) $|A-b| \geq ||a| - |b||$

इनमें समीका (समता) का चिह्न कब लागू होता है ?

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7. Given $a+b+cd+c=0$, which of the following statements are correct?

(a) $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ must each be a null vector .

(b) The magnitude of $\left(\vec{a}+\vec{c}\right)$ equals the magnitude of $(b+d)$

(c) The magnitude of $\vec{a}$ can never be greater than the sum of the magnitudes of $\vec{b}, \vec{c}$ and $\vec{c}$.

(d) $\vec{b}+\vec{c}$ must lie in the plane of $\vec{a}$ and $\vec{d}$ if $\vec{a}$ and $\vec{d}$ are not collinear ,and in the line of $\vec{a}$ and $\vec{d}$, if they are collinear.

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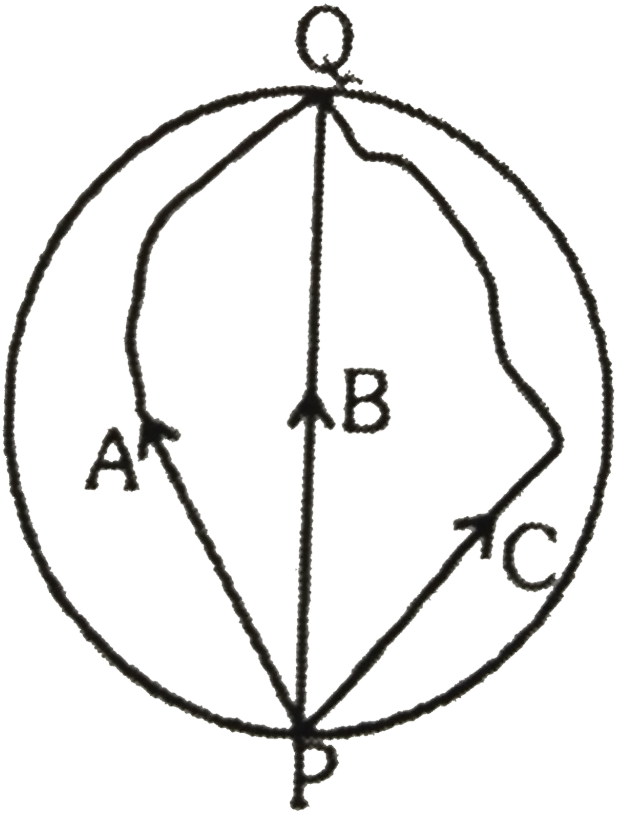
8. Three girls skating on a circular ice ground of radius 200 m start from a point P on the edge of the ground and a point Q diametrically opposite to P following different paths as shown in figure. What is the magnitude of the placement for each ? For which girl is this equal to the actual to

the actual length of path skate ?



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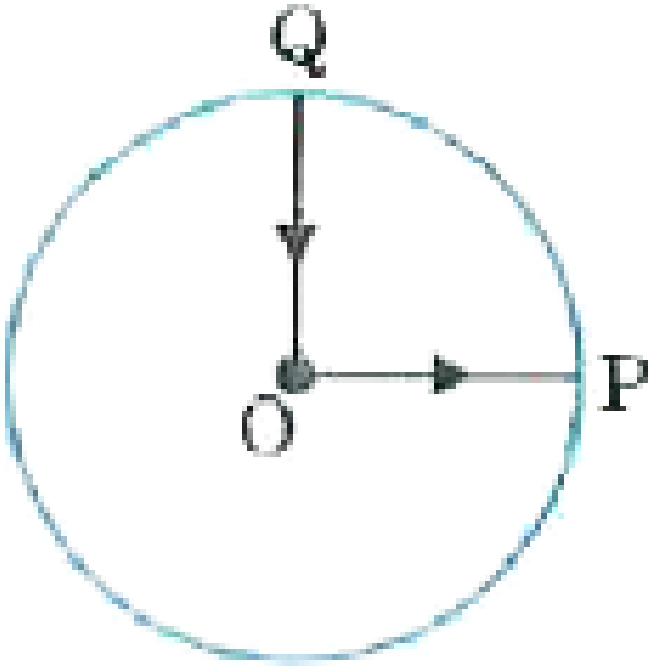
9. A cyclist starts from the centre O of a circular park of radius 1km , reaches the edge P of the park , then cycles along the circumference and returns to the centre along QO as shown in figure . If the round trip takes 10 min. what is the (a) net displacement . (b) average velocity and (c)

average speed of the cyclist ?



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10. On an open ground , a motorist follows a track that turns to his left by an angle of 60° after every $500m$. Starting from a given turn , specify the displacement of the motorist at the third, sixth and eighth turn. Compare the magnitude of the displacement with total path length covered by the motorist in each case.

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11. A passenger arriving in a new town wishes to go from the station to a hotel located 10 km away on a straight road from the station . A dishonest cabman takes him along a circuitous path 23 km long and reaches the hotel in 28 min . What is (a) the average speed of the texi and (b) the magnitude of average velocity ?

Are the two equal ?

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12. Rain is falling vertically with a speed of $30ms^{-1}$. A woman rides a bicycle with a speed of $10ms^{-1}$ in the North to South direction. What is the direction in which she should hold her umbrella ?

Watch Video Solution

13. A man can swim with a speed 4km/hr in still water.

(a) How long does he takes to cross a river 1 km wide if the river flows steadily at 3 km/hr and makes his strokes normal to the river current?

(b) How far down the river does he go when he go when he reaches the other bank?

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14. In a harbour , wind is blowing at the speed of $27km/h$ and the flag on the mast of a boat anchored in the harbour flutters along the N-E direction . If the boat starts moving at a speed of $51km/h$ to the north , what is the direction of the flag on the mast of the boat ?

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15. The ceiling of a long hall is 25 m high. What is the maximum horizontal distance that a ball thrown with a speed of $40ms^{-1}$ can go without hitting the ceiling of the hall ?

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16. A cricketer can throw a ball to a maximum horizontal distance of 100 m. How high above the ground can the cricketer throw the same ball ?

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17. A stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed . If the stone makes 14 revo-lutions is 25 s, what is the magnitude and direction of acceleration of the stone ?

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18. An aircraft executes a horizontal loop of radius 1 km with a steady speed of $900kmh^{-1}$. Compare its centripetal acceleration with the acceleration due to gravity.

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19. Read each statement below carefully and state, with reasons, if it is true or false : (a) The net acceleration of a particle in circular motion is always along the radius of the circle towards the centre.

(b) The velocity vector of a particle at a point is always aling the tagent to the path of the partile at that point. ltbRgt (c) The acceleration vector of a particle in uniform circular motion acraged over one cycle is a null vector.

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20. The position of a particle is given by $\vec{r} = 3.0t\hat{i} - 2.0t^2\hat{j} + 4.0\hat{k}m$, wher (t) in seconds and the coefficients have the proper units for $\vec{r}$ to be in metres. (a) Fing the $\vec{v}$ and $\vec{a}$ of the particle ? (b) What is the magnitude and direction fo velocity of the particle at $t = 2s$?

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21. A particle starts from the origin at $t = 0$ with a velocity of $10.0\hat{j}m/s$ and moves in the X-y plane with a constant accleration of $\left(8.0\hat{I} + 2.0\hat{j}\right)ms^{-2}$. (a) At wht time is the x-coordinate of the particle $16m$? What is the y-coordinate of the particle at that time ? (b) What is the speed of the particle at that time ?

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22. Find the components of a vector $\vec{A} = 2\hat{i} + 3\hat{j}$ along the directions of $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$

Watch Video Solution

23. For an arbitrary motion in space, which of the following relations are true :

(a) $\vec{a}$ (average) = $\frac{1}{2}\left[\vec{v}(t_1) + \vec{v}(t_2)\right]$

(b) $\vec{v}$ (average) = $\left[\vec{r}(t_2) - \vec{r}(t_1)\right]/(t_2 - t_1)$

(c) $\vec{v}(t) = \vec{v}(0) + \vec{a}t$

(d) $\vec{r}(t) = \vec{r}(0) + \vec{v}(0)t + (1/2)\vec{a}t^2$

(e) $\vec{a}$ (average) $= \left[\vec{v}(t_2) - \vec{v}(t_2)\right] / (t_2 - t_1)$

The average stands for average of the quantity over the time interval t_1 and t_2`].

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24. Read each statement below carefully and state with reason and examples, if it is true or false. A scalar quantity is one that (a) is conserved in a process (b) can never take negative values (c) must be dimensionless (d) does not vary from one point to another in space (e) has the same value for observers with different orientations of axes.

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25. An aircraft is flying at a height of $3400m$ above the ground . If the angle subtended at a ground observation point by the aircreaft positions 10.0 s apart is 30° , what is the speed of the aircraft ?

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Ncert File Solved Ncert Additional Exercises

1. Can two equal vects $\vec{a}$ and $\vec{b}$ at different locations in space necessarilly have identical physical effects ?

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2. A vector has both magnitude and direction. Does that mean anything that has magnitude and direction is necessarily a vector ? The rotation of a body can specified by the direction of the axis of rotation and the angle of rotation about the axis. Does the make any rotation a vector ?

Watch Video Solution

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

Watch Video Solution

4. A bullet fired at an angle of 30° with the horizontal hits the ground 3 . 0 km away. By adjusting its angle of projection, can one hope to hit a target 5 . 0 km away ? Assume the muzzle speed to be fixed, and neglect air resestance .

Watch Video Solution

5. A fighter plane flying horizontally at an altitude of $1.5km$ with speed $720kmh^{-1}$ passes directly over head an anticraft gun.

At what angle from the vertical should the gun be fired from the shell with muzzle speed $600ms^{-1}$ to hit plane.

At what minimum altitude should the pilot fly the plane to avoid being hit ? (Take g= 10 ms^{-2}).

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6. A cyclist is riding with a speed of $27kmh^{-1}$. As he approaches a circular turn on the road of radius 80 m, he applies brakes and reduces his speed at the constant rate $0.5ms^{-2}$. What is the magnitude and direction of the net acceleration of the cyclist on the circular turn ?

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7. (a) Show that for a projectile the angle between the velocity and the X-axis as a function of time is given by

$$\theta(t) = \tan^{-1}\left[\frac{v_{oy} - \mathrm{gt}}{v_{\mathrm{ox}}}\right]$$

(b) Show that the projection angle θ_0 for a projectile lunched from the origin is given by $\theta_0 = \tan^{-1}\left(\frac{4h_m}{R}\right)$,

where the symbols have their usual meanings .

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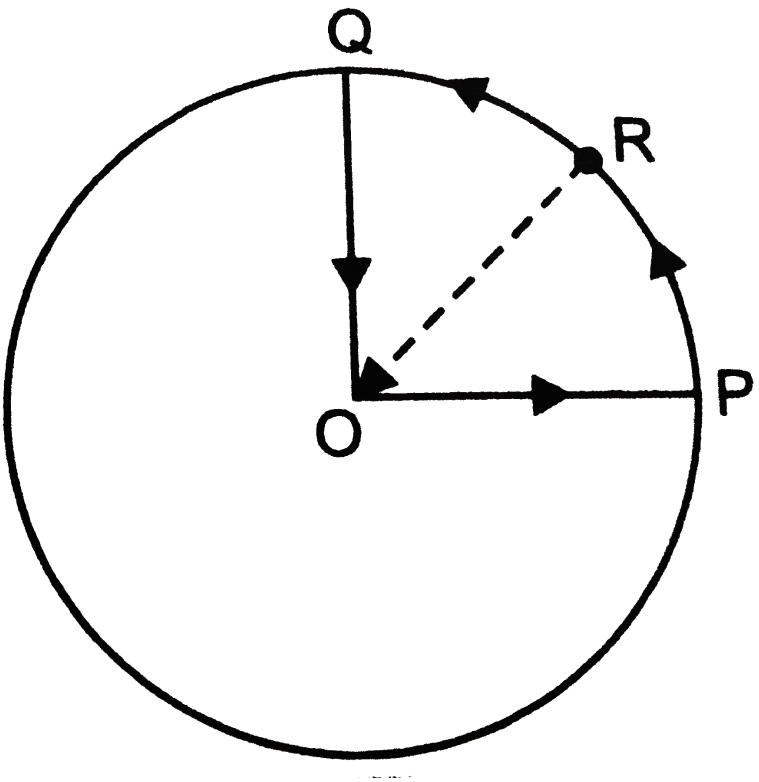
Ncert File Solved Ncert Exemplar Problems Subjective Questions Very Short Nswer Type Questions

1. A cyclist starts form centre O of a circular park of radius $1km$ and moves along the path $OPRQO$ as shown Fig. 2 (EP).15. If he maintains constant speed of $10ms^{-1}$, what is his acceleration at point (R)in magnitude and direction ?



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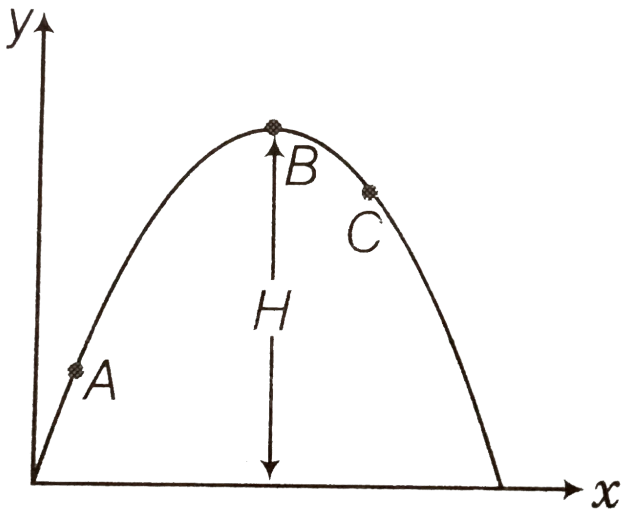
2. A particle is projected in air at some angle to the horizontal, moves along parabola as shown in figure where x and y indicate horizontal and vertical directions, respectively . Shown in the diagram, direction of velocity and acceleration at points A, B and C.



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3. A ball is thrown from a roof top at angle of 40° above the horizontal. It hits the ground a few seconds later. At what point during its motion.

Does the ball have

(a) greatest speed (b) smallest speed (c) greatest acceleration ? Explain.

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4. A football is kicked into the air vertically upwards. What is its (a) acceleration, and (b) velocity at the highest point ?

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5. $\vec{A}, \vec{B}$ and $\vec{C}$ are three non-collinear, non co-planar vectors. What can you say about direction of $\vec{A} \times \overrightarrow{B \times \vec{C}}$) ?

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6. A boy travelling in an open car moving on a levelled road with constant speed tosses a ball vetically up in the air and catches it back. Shetch the

motion of the ball as observed by a boy stanceing on the footpath. Give explanation to support your diagram.

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7. A boy throws a ball in air at 60° to the horizontal along a road with a speed of $10m/s$. Another boy sitting in a car passing by observes the ball. Sketch the motion of the ball as observed by the boy in the car, If car has a speed of $(18km/h)$. Give explanation to support your diagram.

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8. In dealing with motion of projectile in air, we ignore effect of air resistance on motion. This gives trajectory as a parabola as you have studied. What would the trajectory look like it air resistance is included . Sketch such a trajectory and explain why you have drawn it that way.

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9. A fighter plane is flying horizontally at an altitude of 1.5 km with speed $720 kmh^{-1}$. At what angle of sight (w.r.t horizontal) when the target is seen, should the pilot drop the bomb in order to attack the target? $(Takeg = 10ms^{-2})$

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10. (a) Earth can be thought of as a sphere of radius $6400km$. Any object (or a person) is performing circula motion around the axis os earth due to earths rotation (period 1 day). What is acceleration o object on the surface of th earth 9at equator) towards its centre ? What is its altitude θ ? How does these accelerations compare with $g = 9.8m/s^2$?

(b) Earth also moves in circular orbit around sum every year withon orbital radius of $1.5 \times 10^{11}m$. What is the acceleration of earth (or any object on the surface of the earth) towards the centre of the sum ? How dies thsi acceleration comparte with $g = 9.8ms^2$?

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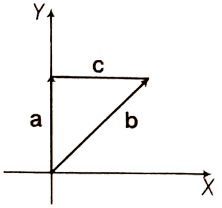
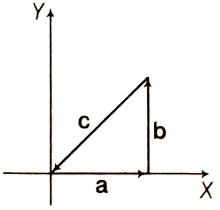
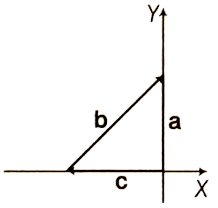
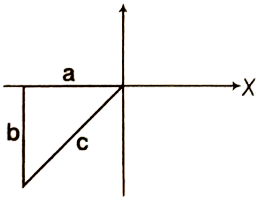
11. Given below in Column I are the relations between vectors a,b and c and in Column II are the orientations of a, b and c in the XY - plane . Match the relation in Column I to correct orientations in Column II.

Column I	Column II
(a) $\mathbf{a}+\mathbf{b}=\mathbf{c}$	(i) 
(b) $\mathbf{a}-\mathbf{c}=\mathbf{b}$	(ii) 
(c) $\mathbf{b}-\mathbf{a}=\mathbf{c}$	(iii) 
(d) $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$	(iv) 

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12. If $\left|\vec{A}\right| = 2$ and $\left|\vec{B}\right| = 4$, then match the relations in colum I with theange θ between $\vec{A}$ and $\vec{B}$ in column II.

Column I , Column II

(a) $\vec{A} . \vec{B} = 0$, (i) θ =0(b) vec A . Vec B= + 8, (ii) theta =90^@(c) vec A .vec B =4, (iii) theta =180^@(d) vec A .vec B =- 8, (iv) theta =60^@`.

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13. If $\left|\vec{A}\right| = 2$ and $\left|\vec{B}\right| = 4$, then match the relations in column I with the angleθ between $\vec{A}$ and $\vec{B}$ in column II.

Column I, Column II

(a) $\left|\vec{A} \times \vec{B}\right| = 0$, (i) $\theta = 30^\circ$

(b) $\left|\vec{A} \times \vec{B}\right| = 0$, (ii) $\theta = 45^\circ$

(c) $\vec{A} \times \vec{B} \mid = 4$, (iii) $\theta = 90^\circ$

(d) $\left|\vec{A} \times x\vec{B}\right| = 4\sqrt{2}$, (iv) $\theta = 0^\circ$.

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Higher Order Thinking Skills Advanced Level

1. A particle is given an initial velocity of $\vec{u} = \left(3\hat{i} + 4\hat{j}\right) m/s$. Acceleration of the particle is $\vec{a} = \left(3t^2 + 2t\hat{j}\right) m/s^2$. Find the velocity of particle at t=2s.

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2. Magnitudes of the vectors $\vec{A}, \vec{B}$ and $\vec{C}$ are 4, 5 and 3 respectively . What is the angle between $\vec{A}$ and $\vec{B}$, if $\vec{A} = \vec{B} + \vec{C}$.

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3. If $\vec{P} + \vec{Q} = \vec{R}$ and $\vec{P} - \vec{Q} = \vec{S}$, prove that $\vec{R}^2 + \vec{S}^2 = 2\left(\vec{P}^2 + \vec{Q}^2\right)$

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4. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to the vector $\vec{A}$ and its magnitude is equal to half the magnitude of vector $\vec{B}$. What is the angle between $\vec{A}$ and $\vec{B}$?

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5. Find the values of a and b so that vectors $\vec{A}$ and $\vec{B}$ are parallel to each other .

$\vec{A} = 2\hat{i} + 3\hat{j} - 4\hat{k}$

$\vec{B} = 3\hat{i} - a\hat{j} + b\hat{k}$

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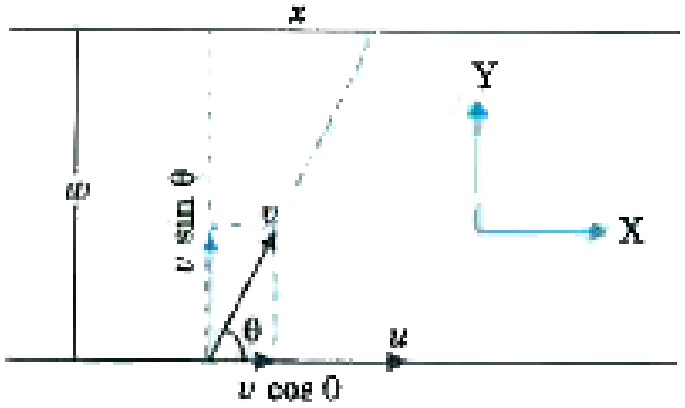
6. A man can swim in still water with a speed v . River flows at a speed u which is greater than the swimming speed (v) of the man . Explain that the man cannot move perpendicular to the flow . If man swims at an angle θ with the river flow , then find drift along the flow by the time he crosses the river . Also find the minimum value of the drift along the flow

x by the time he crosses the river .



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Revision Exercises Very Short Answer Questions

1. Define vector and scalar quantity

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2. What is a unit vector ?

Watch Video Solution

3. What is the direction of a unit vector ?

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4. Give two examples of scalars and vectors ?

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5. When two vectors are said to be equal vectors?

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6. What is a null vector ?

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7. Explain (i) Unit vector (ii) Equal vectors (iii) Negative vectors, (iv) Coinitial v ectors (v) Collinear vectors and (vi) Copanar vectors.

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8. What are co-initial and collinear vectors?

Watch Video Solution

9. What are coplanar vectors ?

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10. What do you mean by resultant vector ?

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11. State the essential condition for the addition of vectors.

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12. can a physical quantity having both magnitude and direction be a vector?

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13. State triangle law of vectors addition. Find analytically the magnitude and direction of resultant vector.

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14. State parallelogram law of vectors addition .Find analytcallly the magnitude and direction of resultant vector, When (i) two vectors are parallel to each other (ii) two vectors are perpendicular to each other.

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15. When is the sum of the two vectors are maximum and when minumum ?

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16. Is it possible that the sum of two vectors is a scalar ?

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17. What do you mean by equilibrant vector ?

Watch Video Solution

18. What do you understand by resolution of a vector ? Show that there is only one way in which a vector can be resolved into two component vectors along the directions of two given vectors.

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19. What are rectangular components of a vector ?

Watch Video Solution

20. Define scalar produt of two vectors.

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21. A vector is by $\vec{V} = \left(8.0\hat{i} + 2.0\hat{j}\right) m/s$. What will be direction of unit vector perpendicular to $\vec{V}$?

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22. Can the magnitude of $\vec{A} - \vec{B}$ be equal to $\vec{A} + \vec{B}$?

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23. Is the associative law applicable to vector subtraction ?

Watch Video Solution

24. Can the magnitude of the reultant vector of two given vectros be less than the magitude of any of the given vector ?

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25. Can three vectors not in one phane giv e a zero resultant ? Can four vectors do ?

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26. Can a vector be multiplied with both dimensional and non-dimensional scaler ?

Watch Video Solution

27. What will be the value of $\vec{A} \cdot \left(\vec{B}_C\right)$ if $\vec{A}, \vec{B}, \vec{C}$ are perpendicular to each other ?

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28. Under what condition, the three vectors (i) cannot giv zero resultant (ii) can give zero resultant ?

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29. What is a projectile ? Give its examples. Show that the path of projectile is a parabolic path when projected horizontally from a certain height.

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30. TRAJECTORY OF HORIZONTAL PROJECTILE

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31. Define time of flight for a projectile .

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32. The horizontal range for projectile is given by

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33. What do you mean by maximum height attained by a projectile ?

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34. What do you mean by angular displacement ? Is it a scalar or vector ?

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35. What is angular velocity ? What is its unit?

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36. What is centriprtal acceleration ? In which direction it acts ?

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37. Can there be a motion in two dimensions with an acceleration only in one direction?

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38. A ball is thrown straight up. What is its velocity and acceleration at the top?

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39. CENTRIFUGAL FORCE

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40. At which angle the maximum height attained by aprojectile is maximum ?

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41. What will be the ratio of time of flights of two projectiles fired at angles of $\theta \text{ and } 90^\circ - \theta$?

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42. Two bodies of masses 4 kg and 6 kg are thrown with the same velocity in the same direction . Which body will reach the ground first ?

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43. What is the angle between velocity vector and acceleration vector in unitorm circular motion ?

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44. A projectile is fired from horizontal at an angle θ . What are the horizontal and vertical acceleration at the highest point ?

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45. A body is projected at angle of 45° to the horizontal . What is its velocity at the highest point ?

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46. A body is thrown with a kinetic energy of 5 j. What will be its kinetic energy at the highest point of its motion if the horizontal range is maximum ?

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Revision Exercises Additional Questions

1. Out of the following set of physical quantities , the vector quantities are

A. area and area vector

B. impulse and area vector

C. gravitational potential and force

D. kinetic energy and velocity

Answer:

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2. If a force of $\left(8.0\hat{i}+2.0\hat{j}+3\hat{k}\right)N$ displaces a body through a distance of $\left(6.0\hat{i}-3.0\hat{j}-9\hat{k}\right)$m . The work done will be

A. 15 J

B. 34 J

C. 56 J

D. 42 J

Answer: A

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3. Which of the following is correct ?

A. The acceleration vector of a particle moving with uniform velocity can never be a null vector .

B. Non-localised vector is also known as fixed vector .

C. The magnitude of the vector $\left(6.0\hat{i} - 3.0\hat{j} - 9\hat{k}\right)$ is $\sqrt{136}$.

D. Vector substraction is not associative in nature .

Answer: d

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4. Centripetal acceleration is

A. acts along the tangent to the circular path .

B. acts along the radius and towards the centre .

C. acts along the radius and towards the centre .

D. acts away from the radius and away from the centre .

Answer:

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Revision Exercises Fill In The Blanks

1. The magnitude of the resultant of two vectors is .....When they act in the same direction and is ..... When they act in opposite direction.

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2. The rotation of a body is a scalar quantity .

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3. Multiplication of a scalar with a vector given a quantity.

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4. Assertion: Horizontal range is same for angle of projection θ and $(90^\circ - \theta)$.

Reason : Horizontal range is independent of angle of projection.

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5. The maximum height attained by a projectile is equal to.....of its maximum range.

Watch Video Solution

6. The path of an object moving with uniform velocity in two dimension is a .....line .

Watch Video Solution

7. Tangential acceleration acts along the ..... to the circular path and is ..... To the centripetal acceleration .

Watch Video Solution

8. When a body is moving with a constant angular velocity , its angular acceleration is..... .

Watch Video Solution

9. The centripetal force .....increase the kinetic energy of a particle moving in a circular path .

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Revision Exercises Short Answer Question

1. What do you mean by zero vector ? Write any three properties of zero vector .

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2. It is easier to pull a lawn roller than to push it because pulling .

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3. SCALAR PRODUCT OF TWO VECTORS

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4. Write any three properties of vector product of two vectors .

Watch Video Solution

5. GEOMETRIC INTERPRETATION OF DOT PRODUCT

Watch Video Solution

6. Give the geometrical interpretation of vector product of two vectors.

Watch Video Solution

7. State right hand thumb rule and right hand srew rule .

Watch Video Solution

8. Can we add a displacement vector of 20 m to a displacement vector of 30 m. Expalin .

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9. Show that on adding vectors $\vec{A}$ and $\vec{B}$, the resultant vector can never be greater than $\left|\vec{A}\right| + \left|\vec{B}\right|$ and smaller than $\left|\vec{A}\right| - \left|\vec{B}\right|$.

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10. If $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}s-\vec{b}\right|,\left(\vec{a},\vec{b}\neq\vec{0}\right)$ show that the vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other.

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11. Under what condition the dot product of two vectors is maximum or minimum ?

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12. What will be the angle between the vectors $\vec{A}$ and $\vec{B}$ if $\vec{A}+\vec{B}=\vec{R}$ and $A^2+B^2=R^2$?

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13. Vector addition is different from scalar addition. Explain.

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14. What do you understand by resolution of a vector ? Show that there is only one way in which a vector can be resolved into two component vectors along the directions of two given vectors.

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15. MULTIPLICATION OF A VECTOR BY SCALAR

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16. What is a projectile ? Give its examples. Show that the path of projectile is a parabolic path when projected horizontally from a certain height.

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17. What is a uniform circular motion ? Explain the terms , time period, frequency and angular velocity. Establish relation between them.

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18. Write relation between angular velocity and linear velocity,

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19. Derive the relation between centripetal acceleration and linear velocity .

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20. The angle of projection at which the horizontal range and maximum height of projectile are equal is

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21. What are the assumptions made in the study of a projectile motion ?

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22. Show that there are two angles of projection for which the horizontal range is the same.

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23. At which point of projectile motion (i) potential energy is maximum (ii) kinetic energy is maximum (iii) total mechanical energy is maximum.

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24. Which is large : angular velocity of the earth about its axis or angular velocity of hour hand of a watch ?

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25. Two balls of masses 2 m and 6 m are thrown in air : one vertically upwards and other at an angle θ with the vertical . The balls remain in air for the same time . Find the ratio of maximum heights attained by them.

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26. For which angle of projection the horizontal range is 5 times the maximum height attrained ?

Watch Video Solution

27. Is the flying of a bird an example of parallelogram law of addition of vectors ? Explain.

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28. Show that the horizontal vector and displacement vector in two dimensions .

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29. What do you understand by (i) position vector and (ii) displacement vector. Distinguish them with illustration.

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30. A ball is thrown in air at an angle 45° and the other ball at an angle of 60° . Calculate the ratio of maximum height and horizontal range of two balls .

Watch Video Solution

31. Two bodies of masses M and m are allowed to fall from the same height . If air resistance for each body be same , will the two bodies reach the ground simultaneously ?

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Revision Exercises Long Answer Question

1. Distinguish between

(a) scalar and vector quantities.

(d) dot product and vector product by giving suitable examples .

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2. State triangle law of vectors addition. Find analytically the magnitude and direction of resultant vector.

Watch Video Solution

3. (a) Show that vector adition is commutative but vector subtraction is non-commutative .

? (b) Find the cross product of two vectors.

$\vec{A} = \left(2.0\hat{i} + 3.0\hat{j} + 4\hat{k}\right)$ and $\vec{B} = \left(3.0\hat{i} - 3.0\hat{j} - 4\hat{k}\right)$.

(c) Find the unit vector of $\left(4.0\hat{i} - 2.0\hat{j} - 3\hat{k}\right)$

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4. Find (a) time of flight , (b) Max.height (c) Horizontal range of projectile projected with speed (v) making an angle θ with the horizontal direction from ground.

Watch Video Solution

5. Find the equation of trajectory, time of flight , maximum height and horizontal range of a projectile when projected at an angle θ with the vertical direction .

Watch Video Solution

6. What is centripetal acceleration ? Find its magniude and direction in case of a uniform circualar motion of an object .

Watch Video Solution

Revision Exercises Numerical Problems

1. Caculate the resultant of two forces, one 12 N due east and other 9N due north .

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2. Calculate the angle between two factors $\vec{X}$ and $\vec{Y}$ if the resultant of vectors is given by $R^2 = X^2 + Y^2$.

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3. A boatman wants to reach from one bank of a 2km wide river to a point on another bank , directly opposite to the point from where he started . If he rows with a speed of 8 km/h , in still water and river flows at the rate of $14km/he$, in which direction he should row ?

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4. Find a vector which is parallel to vector $\vec{A} = 4\hat{i} - 3\hat{j}$ and have the same magnitude as vector $\vec{B} = 8\hat{i} + 6\hat{j}$.

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5. An aeroplane takes off at an angle of 60° to the vertical .If the component of velocity along the vertical is $250km/hr$, calculate its

(i) actual velocity and

(ii) horizontal component of velocity.

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6. A man rides a jet boat with a speed of $40km/hr$ in the north -east direction and the shore line makes an angle of 10° south of east . Find the component of the velocity of the jet boat

(i) along the shoreline and

(ii) perpendicular to the shoreline .

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7. For the vector $\vec{A} = a\hat{i} + 2\hat{j} - \hat{j}$ and $\vec{B} = 2a\hat{i} - a\hat{j} + 4\hat{k}$ to the perpendicular to each other , find the value of a.

Watch Video Solution

8. Under the effect of a force $\vec{F} = 5\hat{i} - 2\hat{j} + 3\hat{k}$N, abody of mass 1 kg is displaced from position $5\hat{i} + 4\hat{j} - 2\hat{k}$ to position $8\hat{i} - \hat{j} - \hat{4}k$. Calculate the work done .

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9. For three vectors $\vec{X}, \vec{Y}$ and $\vec{Z}, \vec{Z} = \vec{X} + \vec{Y}$ and $\left|\vec{X}\right| = 12, \left|\vec{Y}\right| = 5$ and $\left|\vec{Z}\right| = 13$ Calculate the angle between $\vec{Y}$ and $\vec{Z}$.

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10. The resultant of vectors $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{B} = 5\hat{i} + 3\hat{j} + 4\hat{k}$ makes an angle θ with the X-axis . Evaluate $\cos\theta$.

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11. For vectors $\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{B} = \hat{i} - \hat{j} - \hat{k}$, calculate the value of $\left(\vec{A} + \vec{B}\right) \times \left(\vec{A} - \vec{B}\right)$

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12. Determine the value of α for which the vectors $i - 3\alpha\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$ are parallel.

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13. Determine a unit vector perpendicular to both the vectors $\overrightarrow{A} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ and $\overrightarrow{B} = \hat{i} - 2\hat{j} + 4\hat{k}$

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14. The magnitude of two vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ is 3 and 4 respectively . If $\overrightarrow{A} \times \overrightarrow{B} = 5\hat{i} + 6\hat{j} - 7\hat{k}$. Calculate the angle between $\overrightarrow{A}$ and $\overrightarrow{B}$.

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15. Find the area of the triangle determined by two vectors: $\overrightarrow{A} = \hat{i} - 3\hat{j} + 4\hat{k}$ and $\overrightarrow{B} = 3\hat{j} + 2\hat{k}$.

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16. The diagonals of a parallelogram are given by $-3\hat{i}+2\hat{j}-4\hat{k}$ and $-\hat{i}+2\hat{j}+\hat{k}$. Calculate the area of parallelogram.

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17. The position vector of a particle is given by $\vec{r}=(2\sin 2t)\hat{i}+(3+\cos 2t)\hat{j}+(8t)\hat{k}$. Determine its velocity and acceleration at $t=\pi/3$.

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18. From the top of a hill 480 m high , a projectile is fired horizontally with a speed of $96m/s$. Calculate

(i) the time taken by projectile to reach the ground .

(ii) the distance of the target from the hill .

(iii) the velocity with which the projectile hits the ground . Take $g = 10ms^{-2}$

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19. A body is projected horizontally with a velocity of $39.4m/s$ from the top of a building . After what time the horizontal and vertical velocities of the body become equal ?

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20. Two hills of height 100 m and 80 m have a valley of breadth 15 between them . A stunt diver jumps from the first hill to the second hill . Calculate his minimum horizontal velocity so that he may not fall into the vailly . Take $g = 10ms^{-2}$.

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21. A particle is projected with a velocity of $25m/s$ at an angle of 30° with the horizontal . Calculate

(i) The maximum height ,

(ii) time of flight and

(iii) horizontal range .

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22. Find the angle of projection of a projectile for which the horizontal range and maximum height are equal.

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23. A batman hits a cricket ball with a speed of $25m/s$ at a projection angle of 45° . A fielder is 30 m away in the direction in which ball is hit . He runs at the same instant to catch the ball . Calculate the speed of fielder if he has to catch the ball before it hits the ground .

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24. From the top of a cliff of height 150 m, a stone is thrown up with a velocity of $19.6m/s$, at an angle of 60° with the vertical . Calculate the distance of the point where it strickes on the ground from the foot of the cliff .

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25. Calculate the angular speed of againt wheel of radius 10 m, moving with a speed of $10m/s$.

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26. Moon takes 27.3 days to complete one revolution around the earth , in a cirular orbit of radius 3.9×10^5km. Calculate the centripetal acceleration of the moon .

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Competition File Objective Type Questions A Multiple Choice Questions

1. There are two vectors of equal magnitudes. When these vectors are added, then magnitude of the resultant is also equal to the magnitude of each of the two given vectors. Angle between the vectors is

A. 120°

B. 60°

C. 30°

D. 150°

Answer: A

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2. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is

A. 120°

B. 90°

C. 60°

D. 30°

Answer: B

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3. Which ofthe sets given below may represent the magnitydes of three vectors adding to zero? (A) 2,4, 8 (B) 4, 8, 16 (C)1 , 2, 1 (D) 0.5,1,2

A. $2, 3, 7$

B. $3, 5, 10$

C. $1, 2, 15$

D. $0.5, 1, 2$

Answer: C

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4. It is given that $\vec{R} = \vec{P} + \vec{Q}$. Angle between vectors $\vec{P}$ and $\vec{Q}$ is 120° . Select the correct option .

A. R must be grater than $|P - Q|$

B. R must be less than $|P - Q|$

C. R must be equal to $|P - Q|$

D. None of these

Answer: A

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

A. $A = 3B$

B. $A = 2B$

C. $A = B$

D. $B = 2A$

Answer: C

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6. Magnitude of the cross product of the two vectors $\left(\vec{A} \text{ and } \vec{B}\right)$ is equal to the dot product of the two . Magnitude of their resultant can be written as

A. $\sqrt{A^2 + B^2 + AB\sqrt{3}}$

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

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

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

Answer: D

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7. If the sum of two unit vectors is a unit vector, prove that the magnitude of their difference is $\sqrt{3.}$

A. $\sqrt{2}$

B. $\sqrt{3}$

C. $\sqrt{5}$

D. 1

Answer: B

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8. There are two vectors having magnitudes a and b (a $>$ b) . Ratio of their maximum possible resultant to that with minimum possible resultant is 3 . Choose the correct option .

A. $a = 2b$

B. $a = 3b$

C. $a = 4b$

D. $b = 2a$

Answer: A

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9. Angular between two vectors $\vec{A}$ and $\vec{B}$ is θ . Resulatnt of the two makes an angle $\theta/2$ with the vector $\vec{A}$. Select the correct option .

A. $A = 1/B$

B. $A = 2B$

C. $A = B$

D. None of these

Answer: C

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

A. C is never equal to A+B

B. C is always equal to A+B

C. C must be grater than eithre A or B

D. It is possible that $C < A$ and $C > B$

Answer: D

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11. The resultant of $\vec{A}$ and $\vec{B}$ makes an angle α with $\vec{A}$ and β with $\vec{B}$, then -

A. $\alpha > \beta \text{if} A = B$

B. $\alpha > \beta \text{if} A > B$

C. $\alpha > \beta \text{if} A < B$

D. $\alpha > \beta$

Answer: C

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12. Two vectors $\vec{A}$ and $\vec{B}$ are joined with their tails at the same position . A parallelogram is completed using these two vectors . It is found that both the diagonals of this parallelogram are perpendicular to each other . Select the correct option .

A. $A = 4B$

B. $A = 3B$

C. $A = 2B$

D. $A = B$

Answer: D

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13. A particle is projected with a speed u at an angle θ with the horizontal. What will be the speed of the particle when direction of motion of particle is at an angle α with the horizontal?

A. $u \cos \theta \sec \alpha$

B. $u \sec \theta \cos \alpha$

C. $u \cos \theta \tan \alpha$

D. $u \cos \theta \cot \alpha$

Answer: A

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14. In a projectile motion the velocity

A. is perpendicular to the acceleration at one instant only.

B. is never perpendicular to acceleration .

C. is always perpendicular to acceleration .

D. is always at an angle less than 90° with the acceleratio

Answer: A

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15. Two particles are projected simultaneously from a point with different speeds and along the different directions. When both the particles are in air, then

what will be the path of one particle with respect to the other ?

A. parabola

B. hyperbola

C. straight line

D. ellipse

Answer: C

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16. Two particle A and B are projectied from the same point at angles 37° and 45° respectile. If R_A and R_B are the range of two projectile ,then

A. $R_A = R_B$

B. $R > R_B$

C. Information is insuffcient to compare R_A and R_B.

D. $R_A < R_B$

Answer: D

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17. A trolley is moving with velocity v_1 in the horizontal direction . A bullet is fired from his trolley in the upward direction with a speed v_2 . Observer

is standing on the ground and observes the bullet to be moving in a parabolic path. What will be the range of projectile ?

A. $\frac{2v_1v_2}{g}$

B. $\frac{2v_1^2}{g}$

C. $\frac{2v_2^2}{g}$

D. $\frac{v_1v_2}{g}$

Answer: A

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18. Two objects A and B are horizontal at angles 45° and 60° respectively with the horizontal. It is found that both the objects attain same maximum height . If u_A and u_B are initial speeds of projection of objects A and B respectively , then u_A/u_B is

A. $\sqrt{\frac{5}{2}}$

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

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

D. $\sqrt{\frac{5}{3}}$

Answer: B

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19. Two particles A and B are projected simultaneously in horizontal direction with speed $50m/s$ and $100m/s$ respectively . If t_A and t_B are the time taken by the projectiles to hit the ground by the particles A and B respectively, then

A. $t_A = t_B$

B. $t_a > t_B$

C. $t_A < t_B$

D. Information is insufficient to compare t_A and t_B.

Answer: A

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20. An object is projected with speed u and range of the projectile is found to be double of the maximum height attained by it . Range of the projectile is .

A. $\frac{2u^2}{5g}$

B. $\frac{3u^2}{5g}$

C. $\frac{4u^2}{5g}$

D. $\frac{u^2}{g}$

Answer: C

Watch Video Solution

21. An object is projected with speed u and range of the projectile is found to be double of the maximum height attained by it . Range of the projectile is .

A. $v_A = v_B = v_C$

B. $v_A > v_B > v_C$

C. $v_A < v_B < v_C$

D. $v_a = v_B > v_C$

Answer: A

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22. The vertical height of the projectile at the time is given by $y = 4t - t^2$ and the horizontal distance covered is given by $x = 3t$. What is the angle of projection with the horizontal ?

A. 37°

B. 53°

C. 45°

D. 60°

Answer: B

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23. A particle is projected from the ground . Point of projection is taken as origin, horizontal direction as X-axis and verticle upward direction ass Y-axis. Equation of trajectory of the partcle is $y = \alpha x - \beta x^2$. Horizontal range of the projectile is

A. $\alpha + \beta$

B. $\alpha + \beta$

C. α / β

D. β / α

Answer: C

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24. A particle is moving in a circular path of radius r with constant speed v . At a particular instant particle is at point A and then it reaches a point B which is diametrically opposite to point A . Average acceleration during this interval is .

A. $\frac{v^2}{\pi r}$

B. $\frac{3v^2}{\pi r}$

C. 0

D. $\frac{2v^2}{\pi r}$

Answer: D

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25. A particle starts from the origin of co-ordinates at time $t = 0$ and moves in thexy plane with a constant acceleration α in the y-direction. Its equation of motion is $y = \beta x^2$. Its velocity component in the x-direction

A. $\sqrt{\frac{a}{2b}}$

B. $\sqrt{\frac{2a}{b}}$

C. $\sqrt{\frac{a}{b}}$

D. $\sqrt{\frac{2a}{2b}}$

Answer: A

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26. Two particles are projected obliquely from ground with same speed such that their range $'R'$ are same but they attain different maximum heights h_1 and h_2 then relation between R, h_1 and h_2 is:

A. $2\sqrt{h_1 h_2}$

B. $4\sqrt{h_1 h_2}$

C. $\sqrt{h_1 h_2}$

D. $\sqrt{2h_1 h_2}$

Answer: B

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27. Particle is projected from the ground at a certain angle with horizontal . If particle takes time T to hit the ground again , then maximum height of the projectile is

A. $\frac{T^2 g}{2}$

B. $\frac{T^2 g}{4}$

C. $\frac{T^2 g}{8}$

D. $\frac{T^2 g}{5}$

Answer: C

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28. Several bullets are fired from a particular gun in various possible directions . If bullets are fired with a speed u, then maximum area of ground covered by the bullets is

A. $\frac{\pi u^4}{g}$

B. $\frac{\pi u^4}{g^2}$

C. $\frac{4\pi u^4}{g^2}$

D. $\frac{\pi u^4}{g^4}$

Answer: B

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29. A particle P is moving with uniform speed in a circular path . C is the centre of circle and AB is a diameter of circle. Let ω_A be the angular speed is particle about C and A. Then value of ω_C / ω_A is

A. 1

B. 2

C. 3

D. 4

Answer: B

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30. A particle is projected at an angle θ with the horizontal . If angle of elevation of highest point of trajectory is ϕ when seen from point of projection, then

A. $\tan\phi = 2\tan\phi$

B. $\tan\theta = 3\tan\phi$

C. $\tan\theta = 2\tan\phi$

D. $\tan\theta = 4\tan\phi$

Answer: C

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Competition File Objective Type Questions B Multiple Choice Questions

1. Two projectiles are thrown from the same point simultaneously with same velocity $10ms^{-1}$. One goes straight vertically while other at 60° with the vertical . What will be the distance of separation between the after 1 second of their throw?

A. $20m$

B. $10m$

C. $5m$

D. $15m$

Answer: B

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2. A stone is thrown at an angle of 45° to the horizontal with kinetic energy K. The kinetic energy at the highest point is

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

B. $\frac{K}{2}$

C. $2K$

D. k

Answer: B

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

A. 90°

B. 120°

C. 0°

D. 60°

Answer: C

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

A. 60°

B. 90°

C. 100°

D. 120°

Answer: D

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5. Two projectile are projected with the same velocity. If one is projected at an angle of 30° and other at 60° to the horizontal. The ratio if

maximum heights reached, is:

A. $3:1$

B. $1:3$

C. $1:2$

D. $2:1$

Answer: B

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6. During a projectile motion if the maximum height equal the horizontal range, then the angle of projection with the horizontal is :

A. 32°

B. 48°

C. 76°

D. 84°

Answer: C

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7. An aeroplane moving horizontally with a speed of $720km/h$ drops a food pocket, while flying at a height of 396.9 m . the time taken by a food pocket to reach the ground and its horizontal range is (Take $g = 9.8m/\sec$)

A. $9s, 1800m$

B. $8s, 1500m$

C. $3s, 2000m$

D. $5s, 500m$

Answer: A

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8. At the topmost point of a trajectory, its velocity and acceleration are an angle of

A. 0°

B. 45°

C. 90°

D. 180°

Answer: C

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9. The vector sum of two forces is perpendicular to their vector difference. In that case, the forces :

A. are equal to each other in magnitude

B. are not equal to each other in magnitude

C. cannot be predicted

D. are equal to each other

Answer: C

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

A. $22:36km$

B. $22.46km$

C. $25.23km$

D. $20.36km$

Answer: A

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11. If $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\vec{A} . \vec{B}$, then the value of $\left|\vec{A} + \vec{B}\right|$ is

A. $\left(A^2 + B^2 + \frac{AB}{\sqrt{3}}\right)^{\frac{1}{2}}$

B. $A + B$

C. $\left(A^2 + B^\circ + \sqrt{3}AB\right)^{\frac{1}{2}}$

D. $\left(A^2 + B^2 + AB\right)^{\frac{1}{2}}$

Answer: D

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12. An aeroplane flies 400 m north and 300 m south and then flies 1200 m upwards then net displacerment is

A. greater than $1200m$

B. less than 1200m

C. $1400m$

D. $1500m$

Answer: A

Watch Video Solution

13. If the angle between the vectors $\vec{A}$ and $\vec{B}$ is θ, the value of the product $\left(\vec{B} \times \vec{A}\right) \cdot \vec{A}$ is equal to

A. zero

B. $BA^2 \sin\theta$

C. $BA^2 \cos\theta$

D. $BA^2 \sin\theta \cos\theta$

Answer: A

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14. What is the minimum number of vectors required to give zero resultants?

A. two

B. three

C. four

D. None of these

Answer: B

Watch Video Solution

15. The maximum horizontal range of a projectile is 400 m . The maximum value of height attained by it will be

A. $100m$

B. $200m$

C. $400m$

D. $800m$

Answer: B

Watch Video Solution

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

A. 45°

B. 90°

C. 60°

D. 75°

Answer: B

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17. For angles of projection of a projectile at angle $(45^\circ - \theta)$ and $(45^\circ + \theta)$, the horizontal ranges described by the projectile are in the ratio of :

A. $2:1$

B. $1:1$

C. $2:3$

D. $1:2$

Answer: B

Watch Video Solution

18. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed u_A and u_B respectively. Their time period of rotation is the same. The ratio of angular speed of a to that of B will be:

A. $1:1$

B. $r_A : r_B$

C. $v_A : v_B$

D. $r_B : r_A$

Answer: A

Watch Video Solution

19. $\vec{A}$ and $\vec{B}$ are two vectors and θ is the angle between them, if $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\left(\vec{A} . \vec{B}\right)$ the value of θ is:-

A. 45°

B. 30°

C. 90°

D. 60°

Answer: D

Watch Video Solution

20. A particle has an initial velocity $3\hat{i} + 4\hat{j}$ and an accleration of $0.4\hat{i} + 0.3\hat{j}$. Its speed after 10s is

A. 8.5 units

B. 10 units

C. 7 units

D. $7\sqrt{2}$ units

Answer: D

Watch Video Solution

21. the value of $\left(\vec{A} + \vec{B}\right) \times \left(\vec{A} - \vec{B}\right)$ is

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

B. $-2\left(\vec{b} \times \vec{a}\right)$

C. $\overrightarrow{b} \times \overrightarrow{a}$

D. $\overrightarrow{a} \times \overrightarrow{b}$

Answer: A

Watch Video Solution

22. Two projectiles are fired from the same point with the same speed at angles of projection $60^\circ \text{ and } 30^\circ$ respectively. Which one of the following is true?

A. Their maximum height will be same .

B. Their range will be same

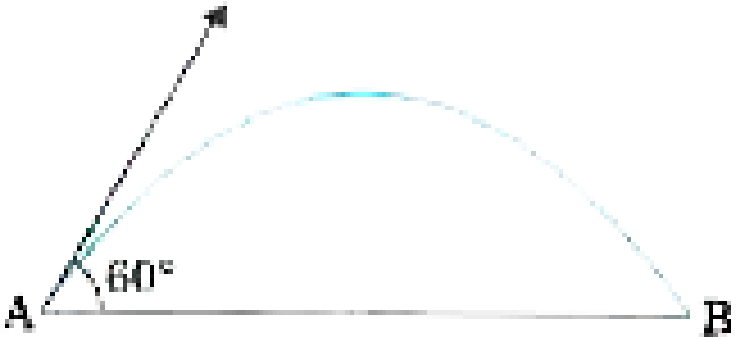
C. Their landing velocity will be same .

D. Their time of flight will be same.

Answer: B

Watch Video Solution

23. A projectile of mass m is thrown with a velocity v making an angle 60° with the horizontal. Neglecting air resistance , the change in momentum from the departure A to its arrival at B is



Watch Video Solution

24. A police jeep is chasing with, velocity of $45km/h$ a thief in another jeep moving with velocity $153km/h$. Police fires a bullet with muzzle velocity of $180m/s$. The velocity it will strike the car of the thief is.

A. $150m/s$

B. $27m/s$

C. $450m/s$

D. $250m/s$

Answer: A

Watch Video Solution

25. The equations of motion of a projectile are given by $x = 36tm$ and $2y = 96t - 9.8t^2m$ .The angle of projection is

A. $\sin^{-1}\left(\frac{4}{5}\right)$

B. $\sin^{-1}\left(\frac{5}{4}\right)$

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

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

Answer: A

Watch Video Solution

26. Two particles having position verctors $\vec{r}_1 = \left(3\hat{i} + 5\hat{j}\right)$ metres and $\vec{r}_2 = \left(-5\hat{i} - 3\hat{j}\right)$ metres are moving with velocities $\vec{v}_1 = \left(4\hat{i} + 3\hat{j}\right) m/s$ and $\vec{v}_2 = \left(\alpha\hat{i} + 7\hat{j}\right) m/s$. If they collide after 2 seconds, the value of α is

A. 2

B. 4

C. 6

D. 8

Answer: D

Watch Video Solution

27. Two stones are projected with the same speed but making different angles with the horizontal. Their horizontal ranges are equal. The angle of projection of one is $\frac{\pi}{3}$ and the maximum height reached by it is 102 m. Then the maximum height reached by the other in metres is

A. 336

B. 224

C. 56

D. 34

Answer: D

Watch Video Solution

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

A. 1

B. -1

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

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

Answer: D

Watch Video Solution

29. 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

Watch Video Solution

30. 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. 45°

B. 60°

C. 0°

D. 30°

Answer: B

Watch Video Solution

31. A missile is fired for maximum range with an initial velocity of $20m/s$. If $g = 10m/s^2$, the range of the missile is

A. $40m$

B. $50m$

C. $60m$

D. $20m$

Answer: A

Watch Video Solution

32. A body is moving with velocity $30m/s$ towards east. After $10s$ its velocity becomes $40m/s$ towards north. The average acceleration of the body is.

A. $1m/s^2$

B. $7m/s^2$

C. $\sqrt{7}m/s^2$

D. $5m/s^2$

Answer: D

Watch Video Solution

33. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectile is

A. $\theta = 45$

B. $\theta = \tan^{-1}\left(\frac{1}{4}\right)$

C. $\theta = \tan^{-1}(4)$

D. $\theta = \tan^{-1}(2)$

Answer: C

Watch Video Solution

34. A particle has initial velocity $\left(2\vec{i} + 3\vec{j}\right)$ and acceleration $\left(0.3\vec{i} + 0.2\vec{j}\right)$. The magnitude of velocity after 10 seconds will be

A. 9 units

B. $9\sqrt{2}$ units

C. $5\sqrt{2}$ units

D. 5 units

Answer: C

Watch Video Solution

35. a projectile is fired from the surface of the earth with a velocity of $5ms^{-1}$ and angle θ with the horizontal. Another projectile fired from another planet with a velocity of $3ms^{-1}$ at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth.The value of the acceleration due to gravity on the planet is in ms^{-2} is given $\left(g = 9.8ms^{-2}\right)$

A. 3.5

B. 5.9

C. 16.3

D. 110.8

Answer: A

Watch Video Solution

36. A particle is moving such that its position coordinates (x, y) are $(2m, 3m)$ at time $t = 0$, $(6m, 7m)$ at time $t = 2s$, and $(13m, 14m)$ at time $t = 5s$.

Average velocity vector $\left(\vec{V}_{av}\right)$ from $t = 0$ to $t = 5s$ is

A. $\frac{1}{5}\left(13\hat{i} + 14\hat{j}\right)$

B. $\frac{7}{3}\left(\hat{i} + \hat{j}\right)$

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

D. $\frac{11}{5}\left(\hat{i} + \hat{j}\right)$

Answer: D

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37. A ship A is moving westwards with a speed of $10kmh^{-1}$ and a ship B 100 km south of A, is moving northwards with a speed of $10kmh^{-1}$ The time after which the distance between them becomes shortest, is

A. 0

B. 5 h

C. $5\sqrt{2}h$

D. $10\sqrt{2}h$

Answer: B

Watch Video Solution

38. A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when:

A. the mass is at the highest point

B. the wire is horizontal

C. the mass is at the lowest point

D. inclined at an angle of 60 from vertical

Answer: C

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Competition File Objective Type Questions Jee Main Other Boards For Engineering Entrance

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

A. $\sqrt{\frac{9}{12}}$

B. $\sqrt{\frac{5}{9}}$

C. $\sqrt{\frac{10}{9}}$

D. $\sqrt{\frac{10}{9}}$

Answer: C

Watch Video Solution

2. A particle has an initial velocity $3\hat{i} + 4\hat{j}$ and an accleration of $0.4\hat{i} + 0.3\hat{j}$. Its speed after 10s is

A. 7 units

B. 8.5 units

C. 10 units

D. $7\sqrt{2}$ units

Answer: D

Watch Video Solution

3. A particle is moving with velocity $\overrightarrow{v} = k\left(y\hat{i} + x\hat{j}\right)$, where k is a constant . The genergal equation for its path is

A. $y = x^2 +$ constant

B. $y^2 = x +$ constant

C. $xy =$ constant

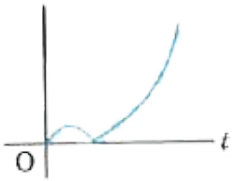
D. $y^2 = x^2 +$ constant

Answer: D

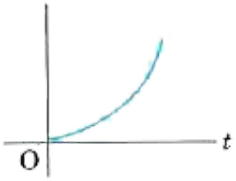
Watch Video Solution

4. A body is at rest at $x = 0$. At $t = 0$, it starts moving in the positive $x - direction$ with a constant acceleration . At the same instant another body passes through $x = 0$ moving in the positive $x - direction$ with a constant speed . The position of the first body is given by $x_1(t)$ after time 't', and that of the second body by $x_2(t)$ after the same time interval . which of the following graphs correctly describes $(x_1 - x_2)$ as a function of time 't' ?

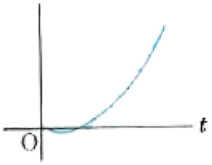
A. $(x_1 - x_2)$



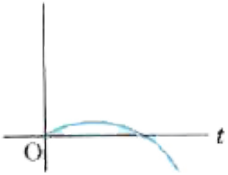
B. $(x_1 - x_2)$



C. $(x_1 - x_2)$



D. $(x_1 - x_2)$



Answer: C

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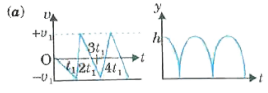
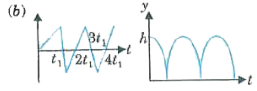
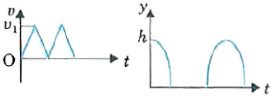
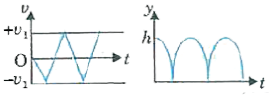
5. Consider a rubber ball freely falling from a height h = 4.9 m on a horizontal elastic plate. Assume that the duration of collision is negligible

and the collision with the plate is totally elastic. Then the velocity as a function of time and the height as a function of time will be:

A. 

B. 

C. 

D. 

Answer: A

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6. A particle of mass 'm' is projected with a velocity v making an angle of 30° with the horizontal. The magnitude of angular moment of the projectile about the point of projection when the particle is at its maximum height 'h' is

A. zero

B. $\frac{mv^2}{\sqrt{2}g}$

C. $\frac{\sqrt{3}mv^3}{16g}$

D. $\frac{\sqrt{3}mv^3}{2g}$

Answer: C

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7. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountains is v, the total area around the fountain that gets wet is:

A. $\pi\frac{v^4}{g^2}$

B. $\frac{\pi}{2}\frac{v^4}{g^2}$

C. $\pi\frac{v^2}{g^2}$

D. $\pi\frac{v^4}{g}$

Answer: A

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8. The position co-ordinates of a particle moving in a 3-D coordinate system is given

by $x = a \cos wt$

$y = a \sin wt$

and $z = awt$

The speed of the particle is :

A. $\sqrt{3}\omega$

B. $2aw$

C. $\sqrt{2}a\omega$

D. aw

Answer: C

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9. A projectile is given an initial velocity of $\left(\hat{i}+2\hat{j}\right)m/s$, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical . If $g=10m/s^2$, the equation of its trajectory is :

A. $y=2x-5x^2$

B. $4y=2x-5x^2$

C. $4y=2x-25x^2$

D. $y=x-5x^2$

Answer: A

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10. From a tower of height H, a particle is thrown vertically upwards with a speed u. The time taken by the particle, to hit the ground, is n times that taken by it to reach the highest point of its path. The relation between H, u and n is

A. $gH = (n-2)u^2$

B. $2gH = n^2u^2$

C. $gH, = (n-2)^2u^2$

D. $2gH = \nu^2(n-2)$

Answer: D

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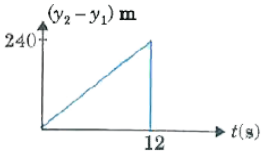
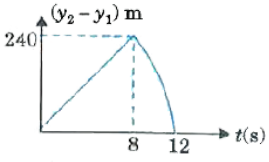
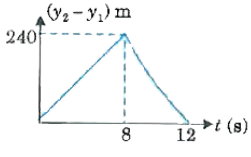
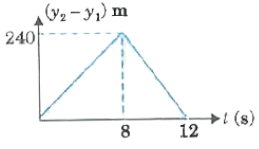
11. Two stones are through up simultaneously from the edge of a cliff 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graphs best represents the time variation of relative position of the second stone with respect to the first? Assume stones do not rebound after hitting the ground and neglect air resistance, take . $g = 10m/s^2$ (The figures are schematic and not drawn to scale)

A.



B. 

C. 

D. 

Answer: B

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12. A ball is thrown upward with an initial velocity V_0 from the surface of the earth.The motion of the ball is affected by a drag force equal to $m\gamma v^2$ (where m is mass of the ball, v is its instantaneous velocity and γ is a constant).Time taken by the ball to rise to its zenith is :

A. $\frac{1}{\sqrt{\gamma g}}\tan^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

B. $\frac{1}{\sqrt{\gamma g}}\sin^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

C. $\frac{1}{\sqrt{\gamma}}\text{In}\left(1+\sqrt{\frac{\gamma}{g}}v_0\right)$

D. $\frac{1}{\sqrt{2\gamma g}}\tan^{-1}\left(\sqrt{\frac{2\gamma}{g}}V_0\right)$

Answer: A

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13. A ball of mass 160 g is thrown up at an angle of 60° to the horizontal at a speed of $10ms^{-1}$. The angular momentum of the ball at highest point of the trajectory with respect to the point from which the ball is thrown is nearly $(g = 10ms^2)$

A. $1.73kgm^2/s$

B. $3.0kgm^2/s$

C. $3.46kgm^2/s$

D. $6.0kgm^2/s$

Answer: B

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14. The position vector of a particle changes with time according to the relation $\vec{r}(t) = 15t^2\hat{i} + \left(4 - 20t^2\right)\hat{j}$ What is the magnitude of the acceleration at t = 1?

A. 40

B. 25

C. 100

D. 50

Answer: D

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Competition File Objective Type Questions Jee Advanced For Iit Entrance

1. A ray of light travelling in the direction $\frac{1}{2}\left(\hat{i}, +\sqrt{3}\hat{j}\right)$ is incident on a plane mirror. After reflection, it travels along the direction (1)/(2)(hati-sqrt3hatj)` . The angle of incidence is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: A

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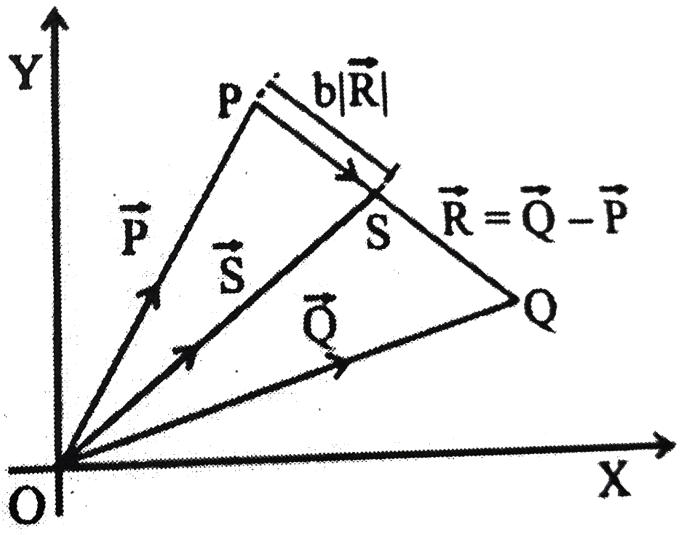
2. Three vectors $\vec{P}, \vec{Q}$ and $\vec{R}$ are shown in the figure. Let S be any point on the vector $\vec{R}$. The distance between the points P and S is $b\left|\vec{R}\right|$.

The general relation among vectors $\vec{P}$, $\vec{Q}$ and $\vec{S}$ is:



A. $\vec{S} = (b-1)\vec{P} + b\vec{Q}$

B. $\vec{S} = (1-b^2)\vec{P} + b\vec{Q}$

C. $\vec{S} = (1-b)\vec{P} + b^2\vec{Q}$

D. $\vec{S} = (1-b)\vec{P} + \vec{Q}$

Answer: D

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Competition File Objective Type Questions C Multiple Choice Questions

1. Two paricles A and B start simultaneously from the same point and move in a horizontal plane. A has an initial velocity u_1 due east and acceleration a_1 due north. B has an intial velocity u_2 due north and acceleration a_2 due east.

A. Paths followed by the particles must intersect at a point

B. Particles must collide at a point

C. Particles will collide if $a_1 u_1 = a_2 u_2$

D. Particles will attain same speed at some point of time if $u_1 < u_2$ and $a_1 > a_2$

Answer: A::C::D

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2. Select incorrect options.

A. Magnitude of instantaneous velocity is same as the instantaneous speed of the particle .

B. Magnitude of average velocity in an interval of time is same as the average speed of the particle in same interval .

C. If speed of the particle is always zero in a time interval, then it is possible that average speed is not zero in the same interval.

D. If speed of the particle is never zero in a time interval, then it is possible that average speed is zero in the same interval.

Answer: B::C::D

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3. A man can swim with a speed v relative to water . There is a river of width d which is flowing at a speed u . A is the point on river bank from where he starts and B is point directly opposite to A on the other side of the river .

A. Man can directly reach point B in time d/l.

B. Man can cross the river in minimum time d/v

C. Man can reach point B directly in time $\frac{d}{\sqrt{v^2-u^2}}$

D. If $u > v$ then man cannot reach the point B directly .

Answer: B::C::D

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4. Which of the following quantities remain constant during projectile motion?

A. $\frac{d\vec{v}}{dt}$

B. $\frac{d^2\vec{v}}{dt^2}$

C. Average speed between any two points

D. Average velocity between any two points

Answer: A::B

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5. A particle is moving in a straight line . Select the correct option (s).

A. If position and velocity are both negative, then particle moves away from the origin .

B. If acceleration of the particle is negative , then magnitude of the velocity of particle may increase .

C. If acceleration of the particle is positive , than magnitude of velocity of particle may decrease .

D. If velocity of the particle remains zero in a time interval, then acceleration is also zero at any instant during the same time interval .

Answer: A::B::C::D

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6. A particle is fired from the ground at some angle $(\theta \neq 90^\circ)$ and it returns to the ground after some time . Select the correct option (s)

A. Acceleration and velocity becomes perpendicular to each other once .

B. Direction of acceleration during first half of motion is upwards and during second half of motion it is downwards .

C. Angle between the velocity and acceleration during the first half of motion is greater than 90° and during the second half of motion the same is less than 90°.

D. Acceleration remains constant .

Answer: A::C::D

Watch Video Solution

7. Two particles projected form the same point with same speed u at angles of projection α and β strike the horizontal ground at the same point. If h_1 and h_2 are the maximum heights attained by the projectile, R is the range for both and t_1 and t_2 are their times of flights, respectively, then

A. $\alpha + \beta = 90^\circ$

B. $t_1 = t_2 \tan\alpha$

C. $R = 4\sqrt{h_1 h_2}$

D. $\frac{h_1}{h_2}\tan^2\alpha$

Answer: A::B::C::D

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Competition File Objective Type Questions D Multiple Choice Questions

1. A particle is projected with initial speed u at an angle θ above the horizontal . Let A be the point of projection , B the point where velocity makes an angle $\theta/2$ above the horizontal and C the highest point of the trajectory .

Radius of curvature of the trajectory at point A is

A. $\frac{u^2}{g\cos\theta}$

B. $\frac{2u^2}{g\cos\theta}$

C. $\frac{u^2}{2g\cos\theta}$

D. $\frac{u^2\cos\theta}{g}$

Answer: A

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2. A particle is projected with initial speed u at an angle θ above the horizontal . Let A be the point of projection , B the point where velocity makes an angle $\theta/2$ above the horizontal and C the highest point of the

trajectory .

Radius of curvature of the trajectory at point B is

A. $\frac{u^2\cos^2\theta}{2g\frac{\cos^3(\theta)}{2}}$

B. $\frac{u^2\cos^2\theta}{g\frac{\cos^3(\theta)}{2}}$

C. $\frac{2u^2\cos^2\theta}{g\frac{\cos^3(\theta)}{2}}$

D. $\frac{u^2\cos^3\theta}{g\frac{\cos^2(\theta)}{2}}$

Answer: B

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3. A particle is projected with initial speed u at an angle θ above the horizontal . Let A be the point of projection , B the point where velocity makes an angle $\theta/2$ above the horizontal and C the highest point of the trajectory .

Radius of curvature of the trajectory at point C is

A. $\frac{u^2 \cos^3 \theta}{g^2}$

B. $\frac{2u^2 \cos^2 \theta}{g}$

C. $\frac{u^2 \cos^2 \theta}{g}$

D. $\frac{u^2 \cos^3 \theta}{g}$

Answer: C

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4. A man running with velocity $3m/s$ finds that raindrops are hitting him vertically with a speed of $4m/s$.

Magnitude of velocity of the raindrops is

A. $3m/s$

B. $4m/s$

C. $5m/s$

D. $6m/s$

Answer: C

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5. A man running with velocity $3m/s$ finds that raindrops are hitting him vertically with a speed of $4m/s$.

Raindrops are falling at an angle θ with the vertical. Value of θ is

A. 37°

B. 53°

C. 45°

D. 60°

Answer: C

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6. If man increases his speed to $6m/s$ in the same direction , then at what angle with the vertical will he observe the rain falling ?

A. 37°

B. 53°

C. 45°

D. 60°

Answer: A

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7. A ball is thrown horizontally with a speed of $20m/s$ from the top of a tower of height 100m

Time taken by the ball to strike the ground is

A. $\sqrt{20}s$

B. $2\sqrt{20}s$

C. $4\sqrt{20}s$

D. $10s$

Answer: A

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8. A ball is thrown horizontally with a speed of $20m/s$ from the top of a tower of height 100m

Horizontal distance travelled by the before it strickes the ground is

A. $10\sqrt{5}m$

B. $20\sqrt{5}m$

C. $30\sqrt{5}m$

D. $40\sqrt{5}m$

Answer: D

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9. A ball is thrown horizontally with a speed of $20m/s$ from the top of a tower of height 100m

velocity with which the ball strikes the ground is .

A. $20\sqrt{6}m/s$ at angle $\tan^{-10}\left(\sqrt{7}\right)$ below the horizontal

B. $20\sqrt{6}m/s$ at an angle $\tan^{-1}\left(\sqrt{6}\right)$ below the horizontal

C. $20\sqrt{6}m/s$ at an angle $\tan^{-1}\left(\sqrt{5}\right)$ below the horizontal

D. $10\sqrt{6}m/s$ at an angle $\tan^{-1}\left(\sqrt{5}\right)$ below the horizontal

Answer: C

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Competition File Objective Type Questions Assertion Reason Type Questions

1. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion : A particle is projected with some speed at a certain angle with the horizontal at time t=0. During the motion , let $\vec{v}1\&\vec{v}2$ be the velocities of v body at time t_1 and t_2 respectively . In this case $\frac{\vec{v}2-\vec{v}1}{t_2-t_1}$ remains constant for any interval of motion .

Reason : At the highest point velocity of the projectile is zero .

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

D. If assertion is incorrect but reason is correct

Answer: A

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2. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion : At the highest point velocity of the projectile is zero

Reason : At the highest point of trajectory acceleration of the particle becomes zero for an instant .

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If both assertion and reason are incorrect .

Answer: D

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3. Assertion : If time of flight in a projectile motion is made two times, its maximum height will become four times.

Reason : In projectile motion $H \propto T^2$, where H is maximum height and T the time of flight.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If assertion is incorrect but reason is correct

Answer: A

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4. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion: Range of projectile motion is same when particle is projected at an angle θ with the horizontal or at an angle $(90^\circ - \theta)$ with the horizontal .

Reason : Range of projectile motion depended only on the angle of projection.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

D. If both assertion and reason are incorrect .

Answer: D

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5. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion: In projectile motion , path followed is a parabola because acceleration due to gravity near the surface of the earth remains constant .

Reason , When acceleration of the particle is constant , then only possible path is parabola .

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If assertion is incorrect but reason is correct

Answer: C

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6. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion : When path of one projectile is observed with respect to another projectile, then it is a straight line .

Reason : Both the projectiles are moving with the same acceleration , hence acceleration of one with respect to the other is zero .

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If assertion is incorrect but reason is correct

Answer: A

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7. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion : We cannot divided a vector quantity by another vector quantity.

Reason : we can divide a vector quantity by a scalar quantity .

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If assertion is incorrect but reason is correct

Answer: B

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8. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer: Reason : When magnitude of acceleration is constant, then speed of particle may remain constant .

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If assertion is incorrect but reason is correct

Answer: D

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9. Statement (I) :The time of flight of a body becomes n times the original value if its speed is made n times.

Statement (II) :This due to the range of the projectile which becomes n times.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

(d) If assertion is incorrect but reason is correct .

D. If assertion is incorrect but reason is correct

Answer: C

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10. The question given below consist of an assertion and the reason . Use the following key to choose appropriate answer:

Assertion : There is a case of ground -to - ground projectile . When projectile is fired at an its path where instantaneous velocity becomes perpendicular to its initial velocity .

Reason : In case of ground -to- ground projectile projected at an angle θ , maximum possible deviation is 2θ ,

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of assertion .

C. If assertion is correct but reason is incorrect .

D. If assertion is incorrect but reason is correct

Answer: A

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Competition File Objective Type Questions Matching Type Questions

1. Particle A is projected with speed u at an angle θ with the horizontal . Another particle B is also projected with same speed u at an angle $90 - \theta$ with the horizontal . Both the projectiles are fired from the ground and reaches the ground after completing the projectile . Time of flight for A is t_A and that for B it is t_B. Range of the projectile A is R_A and that for B is R_B . Maximum height reached by the projectile A is h_A and that for B is h_B

List-I		List-II	
P	$\frac{R_A}{R_B}$	1	$4\sqrt{h_1 h_2}$
Q	$\frac{t_A}{t_B}$	2	1
R	$\frac{h_A}{h_B}$	3	$\tan\theta$
S	R_A	4	$\tan^2\theta$

A.

P	Q	R	S
2	3	4	1

B.

P	Q	R	S
1	2	3	4

C.

P	Q	R	S
2	4	1	3

D.

P	Q	R	S
4	2	3	1

Answer: a

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2. A particle is projected from the top of a tower of height h with a speed u at an angle θ above the horizontal .

T_1=Time taken by the projectile to reach the height of tower again .

T_2=Time taken by the projectile to move at right angle to initial direction of motion .

V_1=Speed of the projectile when it moves at an angle $\theta/2$ with the horizontal .

V_2=Speed with projectile strikes the ground .

List-I		List-II	
P	T_1	1	$\frac{u}{g\sin\theta}$
Q	T_2	2	$\frac{u\cos\theta}{\cos(\theta/2)}$
R	V_1	3	$\sqrt{u^2+2gh}$
S	V_2	4	$\frac{4u}{g}\sin\frac{\theta}{2}\cos\frac{\theta}{2}$

.

A. $\begin{matrix} P & Q & R & S \\ 4 & 1 & 2 & 3 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 1 & 2 & 3 & 4 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 2 & 4 & 1 & 3 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 2 & 1 & 3 & 4 \end{matrix}$

Answer: a

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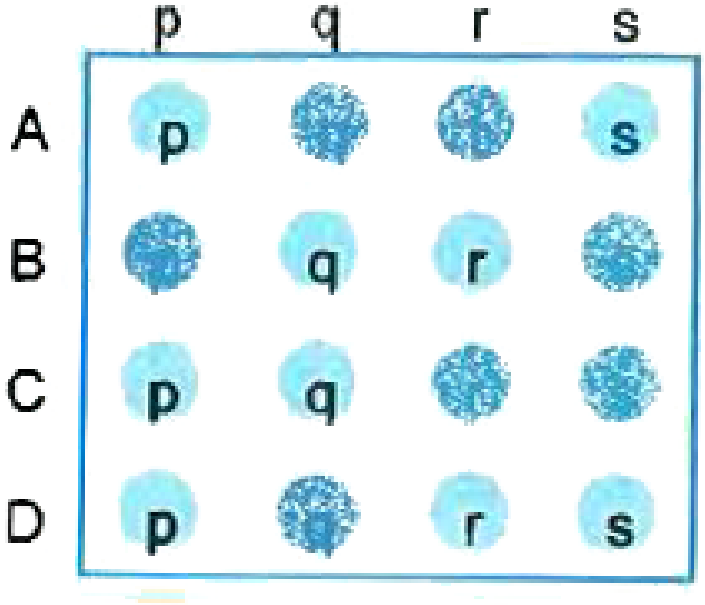
Competition File Objective Type Questions Matrix Match Type Questions

1. Each question contains statements given in two columns , which have to be matched . Statements in olumn I are labelled as A, B, C and D , whereas statemets in column II are labelled as p,q,r, and s. Match the entries of column I with appropriate entries of column I amy have one or more than one correct option from column II. The answer to these questions have to be appropriately bubbled as illustrated in the given example , if the correct matches are $A \to (q, r), B \to (p, s), C \to (r, s)$ and $D \to (q)$.



If u is iitial speed of a particle and a is constant acceleration .

$(\text{Column} I, \quad \text{Column} II), ((A) u = 0, a \neq 0, , (p) \text{Rest}), ((B) u \neq 0, a =$

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Competition File Objective Type Questions Integer Type Questions

1. A ball is projected form the ground at an angle of 45° with the horizonatl surface .It reaches a maximum height of 120 m and return to fthe ground .upon hitting the ground for the first time it loses half of its kinetic energy immediately after the bounce the velocity of the ball makes an angle of 30° with the horizontal surface .The maximum height it reaches after the bounce in metres is _____

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2. A particle is projected from the ground . One second after the projection, the particle is found to be moving at an angle 45° with the

horizontal . Speed of the particle becomes minimum two seconds after the projection . If angle of projection is $\tan^{-1}(n)$, then what is the value of n ?

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3. A particle is projected with a speed u at an angle θ with the horizontal . If R_1 is radius of curvature of trajectory at the initial point and R_2 is the radius of curvature at the highest point . Value of $R_2/(R_1$ is found to be $\cos^n\theta$. What is the value of n ?

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4. A particle is projected from the ground with speed u un such a manner that its range is found to be two times the maximum height . If range of the projectile can be written as $\frac{\text{nu}^2}{5g}$, then what is the value of n ?

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5. Two vectors $\vec{A}$ and $\vec{B}$ are defined as $\vec{A} = a\hat{i}$ and $\vec{B} = a\left(\cos\omega\hat{i} + \sin\omega\hat{j}\right)$, were a is a constant and $\omega = \pi/6 rads^{-1}$. If $\left|\vec{A} + \vec{B}\right| = \sqrt{3}\left|\vec{A} - \vec{B}\right|$ at time $t = \tau$ for the first time, the value of τ, in seconds , is _____

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6. A man can swim in still water at a speed of $5km/h$. Man crosses 1 km width of river along shortest possible path in 15 minutes . What is the speed of river in km/h?

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7. When a particle is projected at an angle to the horizontal, it has range R and time of flight t_1. If the same projectile is projected with same speed at another angle to have the saem range, time of flight is t_2. Show that:

$t_1 t_2 = (2R/g)$

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8. A particle is projected up an inclines plane. Plane is inclined at an angle θ with horizontal and particle is projected at an angle α with horizontal. If particle strikes the plane horizontally prove that $\tan\alpha = 2\tan\theta$

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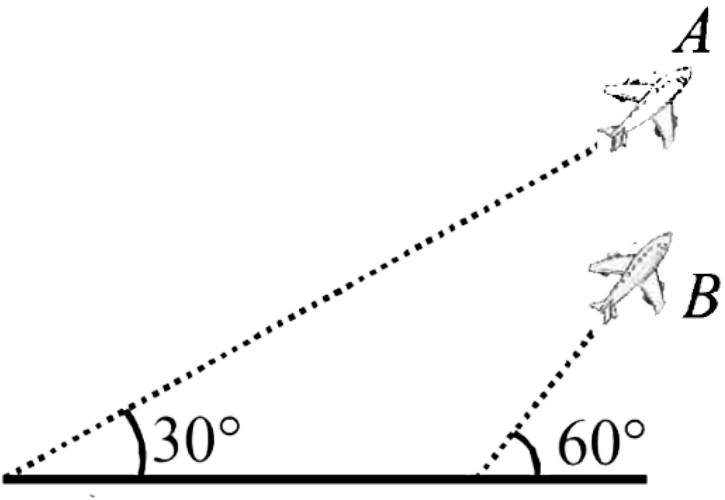
9. Airplanes A and B are flying with constant velocity in the same vertical plane at angles 30° and 60° with respect to the horizontal respectively as shown in figure . The speed of A is $100\sqrt{3}m/s$. At time $t = 0s$, an observer in A finds B at a distance of $500m$. The observer sees B moving with a constant velocity perpendicular to the line of motion of A . If at $t = t_0$, A just escapes being hit by B, t_0 , A just escapes being hit by B, t_0

in seconds is



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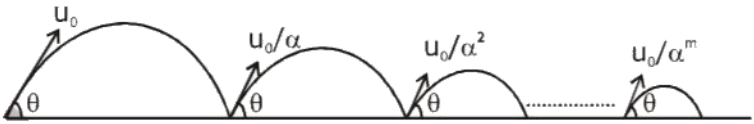
10. A ball is thrown from ground at an angle θ with horizontal and with an initial speed u_0 . For the resulting projectile motion, the magnitude of average velocity of the ball up to the point when it hits the ground for the first time is V_1 . After hitting the ground, the ball rebounds at the same angle θ but with a reduced speed of u_0 / α . Its motion continues for a long time as shown in figure. If the magnitude of average velocity of

the ball for entire duration of motion is 0.8 V_1 ,. the value of α is _____.



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Competition File Objective Type Questions Ncert Exemplar Problems Objective Questions

1. The angle between $\vec{A} = \hat{i} + \hat{j}$ and $\vec{B} = \hat{i} - \hat{j}$ is

A. 45°

B. 90°

C. -45°

D. 180°

Answer: B

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2. Which one of the following statements is true ?

A. A scalar quantity is the one that is conserved in a process.

B. A scalar quantity is the one that can never take negative values.

C. A scalar quantity is the one that does not vary from one point to another in space .

D. A scalar quantity has the same value for observers with different orientations of the axes.

Answer: D

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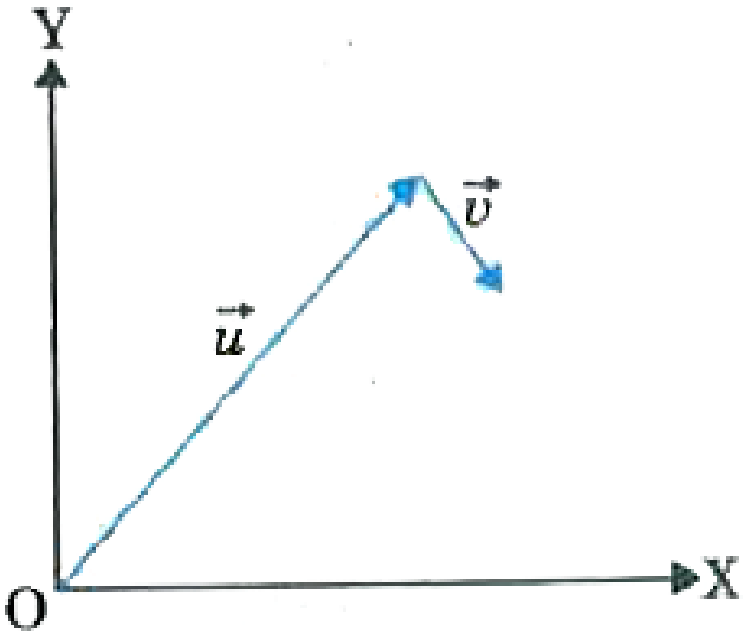
3. The figure given below shows the orientation of two vectors $\vec{u}$ and $\vec{v}$ in the xy plane .



if $\vec{u} = a\hat{i} + b\hat{j}$ and $\vec{v} = p\hat{i} + q\hat{j}$

Which of the following is correct ?

A. a and p are positive , while b and q are negative

B. a ,p and b are positive , while q is negative

C. a, q and b are positive , while p is negative

D. a, b. p and q are all positive .

Answer: B

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4. The component of a vector r along X-axis will have maximum value if

A. $\vec{r}$ is along positive Y-axis

B. $\vec{r}$ is along positive X-axis

C. $\vec{r}$ makes an angle of 45° with X-axis

D. $\vec{r}$ is along negative Y-axis

Answer: B

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5. The range of a projectile fired at an angle of 15° is 50 m. If it is fired with the same speed at an angle of 45° its range will be

A. 60m

B. 71m

C. 100m

D. 141m

Answer: C

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6. Consider the quantities , pressure, power, energy impulse, gravitational potential, electrical charge , temperature, area,Out of these, the only vector quantities are .

A. Impules , pressure and area

B. Impulse and area vector

C. Area and gravitational potential

D. Impulse and pressure .

Answer: B

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7. In a two dimensional motion,instantaneous speed v_0 is a positive constant.Then which of the following are necessarily true?

A. The average velocity is not zero at any time

B. Average acceleration must always vanish

C. Displacements in equal time intervals are equal

D. Equal path lengths are traversed in equal intervals .

Answer: D

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8. In a two -dimensional motion, instantaneous speed $\vec{v}_0$ is a positive constant . Then which of the following are necessarily true ?

A. The acceleration of the particle is zero

B. The acceleration of the particle is bounded

C. The acceleration of the particle is necessarily in the plane of motion

D. The particle must be undergoing a uniform circular motion .

Answer: C

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9. Three vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ add up to zero.Find which is false.

A. $\left(\vec{A} \times \vec{B}\right) \times \vec{C}$ is not zero unless $\vec{B}, \vec{C}$ are parallel

B. $\left(\vec{A} \times \vec{B}\right) . \vec{C}$ is not zero unless $\vec{B}, \vec{C}$ are parallel

C. If $\vec{A}, \vec{B}, \vec{C}$ define a plane , $\left(\vec{A} \times \vec{B}\right) \times \vec{C}$ is in that plane

D. $\left(\vec{A} \times \vec{B}\right) . \vec{C} = \left|\vec{A}\right|\left|\vec{B}\right|\left|\vec{C}\right|$ if $C^2 = A^2 + B^2$

Answer: B

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10. It is found that $|A+B|=|A|$,This necessarily implies.

A. $\vec{B}=0$

B. $\vec{A}$, $\vec{B}$ are antiparallel

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

D. $\vec{A}.\vec{B}\leq 0$.

Answer: B::D

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11. Two particles are projected in air with speed v_0 at angles θ_1 and θ_2 (both acute) to the horizontal,respectively.If the height reached by the first particle greater than that of the second,then thick the right choices

A. angle of projection : $\theta_1>\theta_2$

B. time of flight : $T_1>T_2$

C. horizontal range : $R_1>R_2$

D. total energy : $U_1 > U_2$.

Answer: A::B

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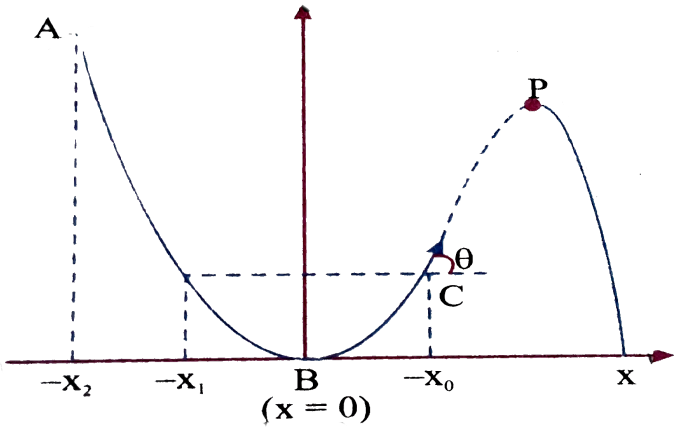
12. A particle slides down a frictionless paraboli $(y = x^2)$ track $(A - B - C)$ starting from rest at point A.Point B is at the vertex of parabola and point C is at a height less than that of point A.After C,the particle moves freely in air as a projectile. If the particle reaches highest point at P,then

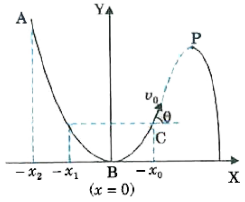


A. KE at P=KE at B

B. height at P=height at A

C. total energy at P=total energy at A

D. time of travel from A to B =time of travel from B to P.



Answer: C

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13. Following are four different relations about displacement, velocity and acceleration for the motion of a particle in general. Choose the incorrect one (s)

A. $\vec{v}_{av} = \frac{1}{2}\left[\vec{v}(t_1) + \vec{v}(t_2)\right]$

B. $\vec{v}_{av} = \left(\vec{r}(t_2)\right) - \vec{r}\,\frac{t_1}{t_2 - t_1}$

C. $\vec{r} = \frac{1}{2}\left(\vec{v}(t_2) - \vec{v}(t_1)\right)(t_2 - t_1)$

D. $\vec{a}_{av} = \frac{\vec{v}(t_2) - \vec{v}(t_1)}{t_2 - t_1}$

Answer: A::C

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14. For a particle performing uniform circular motion , choose the correct statement (s) from the following :

A. Magnitude of particle velocity (speed) remains constant

B. Particle velocity remains directed perpendicular to radius vector

C. Direction of acceleration keeps changing as particle moves .

D. Angular momentum is constant in magnitude but direction keeps changing .

Answer: A::B::C

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15. For tow vectros $\vec{A}$ and $\vec{B}$

$\left|\vec{A}+\vec{B}\right|=\left|\vec{A}-\vec{B}\right|$ is always true when.

A. $\left|\vec{A}\right|=\left|\vec{B}\right|\neq 0$

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

C. $\left|\vec{A}\right|=\left|\vec{B}\right|\neq 0$ and $\vec{A}$ and $\vec{B}$ are parallel or antiparallel

D. when either $\left|\vec{A}\right|$ or $\left|\vec{B}\right|$ is zero

Answer: B::D

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Chapter Practice Test

1. Can a physical quantity having both magnitude and direction be a vector?

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2. When the resultant of two vectors is maximum and when minimum ?

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3. A vector is given by $\vec{V} = \left(8.0\hat{i} + 2.0\hat{j}\right) m/s$. What will be the unit vector perpendicular to $\vec{V}$?

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4. A ball is thrown in air . What are its velocity and acceleration at the highest point ?

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5. Two bodies of masses 4kg and 6kg are thrown with the same velocity in the same direction . Which body will reach the ground first ?

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6. If $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}s-\vec{b}\right|,\left(\vec{a},\vec{b}\neq\vec{0}\right)$ show that the vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other.

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7. Find the angle of projection at which horizontal range and maximum height are equal.

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8. Which is greater , the angular velocity of the hour hand of a watch or angular velocity of earth around its own axis ?

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9. PROPERTIES OF VECTOR CROSS PRODUCT

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10. Show that the horizontal range is maximum when the angle of projection is 45°

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11. Two balls of masses 2m and 6m are thrown in air : one is vertically upwards and other at an angle θ with the vertical. The balls remain in air for the same time . Find the ratio of maximum heights attained by them .

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12. Show that there are two angles of projection for which the horizontal range is the same.

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13. Give the relation between linear acceleration and angular acceleration.

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14. A man rides a jet boat with a speed of $40km/hr$ in the north -east direction and the shore line makes an angle of 10° south of east . Find the component of the velocity of the jet boat

(i) along the shoreline

(ii) perpendicular to the shoreline.

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15. (a) Show that vector adition is commutative but vector subtraction is non-commutative .

(b) For vectors $\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{B} = \hat{i} - \hat{j} - \hat{k}$, calculate the value of $\left(\vec{A} + \vec{B}\right) \times \left(\vec{A} - \vec{B}\right)$

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