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PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

VECTOR

Example

1. If $\vec{a} + \vec{b} = \vec{c}$ and $a + b = c$, find the angle between $\vec{a}$ and $\vec{b}$.

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2. Can the magnitude of the resultant of two equal vectors be equal to the magnitude of each of the vectors ? Explain .

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3. 2P and P are two vectors inclined to each other at such an angle that if the 1 st vector is doubled , the value of the resultant becomes three times. What is the angle between the two vectors ?

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4. Using vectors , prove that the line joining the midpoints of two sides of a triangle, is parallel to the base and half its length.

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5. When will the magnitude of the resultant of two equal vectors be

(i) $\sqrt{2}$ times and

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6. When will the magnitude of the resultant of two equal vectors be

(ii) $\sqrt{3}$ times the magnitude of each of them ?

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7. The maximum and the minimum value of the resultant of two forces are 15N and 7N respectively . If the magnitude of each force is increased by 1 N and these new forces act at an angle 90° to each other, find the magnitude and direction of their resultant.

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8. The resultant $\vec{R}$ of two vectors has magnitude equal to one of the vectors and is at right angle to it . Find the value of the other vector.

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9. The maximum magnitude of the resultant of two vectors, $\vec{P}$ and $\vec{Q}(\text{where} P > Q)$ is x times the minimum magnitude ot the resultant. When the angle between $\vec{P}$ and $\vec{Q}$ is θ, the magnitude of the resultant is equal to half the sum of the magnitudes of the two vectors. Prove that, $\cos\theta = \dfrac{x^2+2}{2(1-x^2)}$.

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10. Out of two vectors, the larger one is $\sqrt{2}$ times the smaller one . Show that the resultant cannot make an angle greater than $\dfrac{\pi}{4}$ with the larger one.

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11. Show that if theree forces are represented by the three medians of a triangle, they will be in equilibrium.

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12. The magnitude of the resultant of two forces P and Q acting at a point is (2m+1) $\sqrt{P^2+Q^2}$ When the angle between them is α , and is (2m-1) $\sqrt{P^2+Q^2}$ when the angle is $\left(\frac{\pi}{2}-\alpha\right)$. Prove that, $\tan\alpha=\frac{m-1}{m+1}$.

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13. Two forces P and Q have a resultant R. This resultant is doubled, either when Q is doubled, or when Q is reversed. Show that, $P:Q:R=\sqrt{2}:\sqrt{3}:\sqrt{2}$.

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14. The resultant of two forces P and Q , inclined at a fixed angle, is R which makes an angle θ with P. If P is replaced by (P+Q) keeping the direction unchaged, show that the resultant of (P+R) and Q would be inclined at $\frac{\theta}{2}$ with P+R.

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15. Four forces 2P, P,P and 2P act on a point towards NE, NE,SW and SE directions respectively . Find the resultant of the forces.

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16. A car is travelling towards east at $10m \cdot s^{-1}$. It takes 10s to change its direction of motion to north and continues with the same magnitude of velocity. Find the magnitude and direction of the average acceleration of the car.

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17. A boy runs 210m along corridor of his school turns right at the end of the corridor and runs 180 m to the end of the building and then turns right and runs 30 m.

(i) Construct a vector diagram that represents this motion. Indicate your choice of unit vectors.

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18. A boy runs 210m along corridor of his school turns right at the end of the corridor and runs 180 m to the end of the building and then turns right and runs 30 m.

(ii) What is the direction and magnitude to the straight line between start and finish ?

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19. A particle is moving in a circular path with a uniform speed.v. Show that, when the particle traverses through an angle of 120°, the change in its velocity is $\sqrt{3}v$.

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20. A force of 30 dyn is inclined to the y-axis at an angle of 60°. Find the components of the force along x and y axes respectively.

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21. The value of the resultant of two mutually perpendicular forces is 80 dyn. The resultant makes an

angle 60° with one of the forces. Find the magnitudes of the forces.

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22. Compute the resultant of three coplanar vectors P, 2P and 3P inclined at 120° with one another.

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23. Five coplanar forces, each of magnitude F, are acting on a particle. Each force is inclined at an angle 30° with the previous one. Find out the magnitude and direction of the resultant force on the particle.

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24. Coordinates of the end point of a vector $\overrightarrow{OP}$ is (4,3,-5). Express the vector in terms of its coordinates and find its absolute value.

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25. Find the magnitude of the vector $\overrightarrow{A} = \hat{i} - 2\hat{j} + 3\hat{k}$ .Also find the unit vector in the direction of $\overrightarrow{A}$.

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26. Vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ can be expressed as $\overrightarrow{A} = 10\hat{i} - 12\hat{j} + 5\hat{k}$ and $\overrightarrow{B} = 7\hat{i} + 8\hat{j} - 12\hat{k}$

where $\hat{i}, \hat{j}, \hat{k}$ are unit vectors along x,y,z axes respectively.

Find the resultant of two vectors and its magnitude.

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27. Position coordinates of A and B are (-1,5,7) and (3,2,-5) respectively. Express $\overrightarrow{AB}$ in terms of position coordinates.

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28. $3\hat{i} + 4\hat{j} + 12\hat{k}$ is a vector. Find the magnitude of the vector and the angles it makes with x,y and z axes.

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29. Two vector $\vec{A}$ and $\vec{B}$ are $\vec{A} = 5\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{B} = 5\hat{i} + 2\hat{j} + 4\hat{k}$. Find the unit vectors along $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$.

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30. Two velocities $\vec{v}_1$ and $\vec{v}_2$ are 3m/s towards north and 4m/s towards east , respectively. Find $\vec{v}_1 - \vec{v}_2$.

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31. Find out the resultant of the following three displacement vectors : $\vec{A} = 10m$, along north -west, $\vec{B} = 20m$, 30° north of east, $\vec{C} = 35m$, along south.

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32. The characteristic equation of a particle moving in a curved path are: $x = e^{-t}, y = \cos 3t$ and $z = 2\sin 3t$, where t stands for time. Find out

(i) Velocity and acceleration at any instant,

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33. The characteristic equation of a particle moving in a curved path are: $x = e^{-t}, y = \cos 3t$ and z=2 sin 3t, where t stands for time. Find out

(ii) Velocity and acceleration at t=0.

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34. The position vector $\vec{r}$ of a particle with respect to the origin changes with time t as $\vec{r} = At\hat{i} - Bt^2\hat{j}$, where A and B are positive constants. Determine

(i) the locus of the particle,

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35. The position vector $\vec{r}$ of a particle with respect to the origin changes with time t as $\vec{r} = At\hat{i} - Bt^2\hat{j}$, where A and B are positive constants. Determine

(ii) the nature of variation with time of the velocity and acceleration vectors, and also the moduli of them.

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36. The position vector of a particle is, $\vec{r} = 3t\hat{i} - 2t^2\hat{j} + 4\hat{k}$. Find out

(i) its velocity $\vec{v}$ and acceleration $\vec{a}$,

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37. The position vector of a particle is, $\vec{r} = 3t\hat{i} - 2t^2\hat{j} + 4\hat{k}$. Find out

(ii) the magnitude and direction of its velocity at t=2s.

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38. A car is moving at $80km \cdot h^{-1}$ towards north. Another car is moving at $80\sqrt{2}km \cdot h^{-1}$ towards north-west. Find

the relative velocity of the second car with respect of the first.

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39. Two bodies are moving such that the velocity of one is twice that of the other and they make an angle of 60° with each other. Find the relative velocity of one with respect to the other.

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40. An any instant of time, two ships A and B are 70 km apart along a line AB which is directed from north to south . A starts moving towards west at $25km \cdot h^{-1}$ and

at the same time B starts moving towards north at $25km \cdot h^{-1}$. Find the distance of closest approach between the two ships and the time required for this.

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41. A ship is moving towards east at $10km \cdot h^{-1}$. A boat is moving north of east making an angle of 30° with the north. What should be the velocity of the boat so that the boat always appears, from the ship , to move towards north ?

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42. A man is in a car moving with an acceleration of $5m \cdot s^{-2}$. Find the apparent value of the acceleration due to gravity and the direction of pull of the earth with respect to him.

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43. A lift is moving up with a constant acceleration a. A man standing on the lift, throws a ball vertically upwards with a velocity v, which returns to the thrower after a time t. show that $v = (a + g)\frac{t}{2}$ where g is the acceleration due to gravity.

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44. A lift is moving up with an acceleration $2m \cdot s^{-2}$ .A nail gets dislodged from the roof of the lift when its speed reaches $8m \cdot s^{-1}$. If the height of the lift cage is 3m, find the time taken by the nail to touch the floor of the lift.

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45. A simple pendulum is suspended from the roof of a car moving horizontally with an acceleration of $10m \cdot s^{-2}$. What will be the angle made by the pendulum in its equilibrium position with the vertical ? [g=$10m \cdot s^{-2}$]

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46. Two parallel rail lines are directed as north- south. A train X runs towards north with a speed of $15m \cdot s^{-1}$ and another train Y runs towards south with a speed of $25m \cdot s^{-1}$.

(i) the velocity of Y relative to X,

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47. Two parallel rail lines are directed as north- south. A train X runs towards north with a speed of $15m \cdot s^{-1}$ and another train Y runs towards south with a speed of $25m \cdot s^{-1}$.

(ii) the velocity of ground with respect to Y,

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48. Two parallel rail lines are directed as north- south. A train X runs towards north with a speed of $15m \cdot s^{-1}$ and another train Y runs towards south with a speed of $25m \cdot s^{-1}$.

(iii) velocity of a monkey running on the roof of X against its motion with a velocity of $5m \cdot s^{-1}$ relative to X, as observed by a man standing on the ground.

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49. A steamer is moving towards east with a velocity u.

A second steamer is moving a velocity 2u at angle θ north of east. The motion of the second steamer relative to the first is along north- east . Show that, $\cos\theta - \sin\theta = \frac{1}{2}$

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50. A stone is dropped from a tower 400m high. Simultaneously, another stone is thrown upwards from the earth's surface with a velocity of 100m/s. When and where would these two stones meet? (g=$9.8m/s^2$).

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51. A rubber ball is thrown downwards from the top of a tower with a velocity of 14 m/s. A second ball is dropped from the same place 1 s later. The first ball reaches the ground in 2 s and rebounds with the same magnitude of

velocity . How much later would the two balls collide with each other ?

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52. An object falling freely from a height H hits an inclined plane at a height h in its trajectory . At the instant of collision , the velocity of the object changes to become horizontal. What is the value of $\frac{h}{H}$ for which it spends maximum time to reach the ground ?

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53. A man is walking on a horizontal road at 3 $km \cdot h^{-1}$ while rain is falling vertically with a velocity of $4km \cdot h^{-1}$. Find the magnitude and direction of the velocity of rain with respect to the man.

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54. To a man, walking on a horizontal path at $2km \cdot h^{-1}$, rain appears to fall vertically at $2km \cdot h^{-1}$. Find the magnitude and the direction of the actual velocity of rainfall.

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55. To a car driver moving at $40km \cdot h^{-1}$ towards south, wind appears to blow towards east. When the speed to the car is reduced to $20km \cdot h^{-1}$ wind appears to blow from north -west . Find the magnitude and direction of the actual velocity of the wind.

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56. Velocity of a boat in still water is $5km \cdot h^{-1}$. It takes 15 min to cross a river along the width. The river is 1km wide. Find the velocity of current.

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57. A man can reach the point directly opposite on the other bank of a river by swimming across the river in time t_1 and crosses the same distance in time t_2 while swimming along the current. If the velocity of the man in still water is v and velocity of the water current is u , find the ratio between t_1 and t_2.

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58. Two boats, each with velocity $8km \cdot h^{-1}$, attempt to cross a river of width 800 m. The velocity of river current is $5km \cdot h^{-1}$. One of the boats crosses the river following the shortest path and the other follows the route in which the time taken is minimum. If they start simultaneously,

what would be the time difference between their arrivals at the other bank ?

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59. A person can swim at $4km \cdot h^{-1}$ in still water . At what angle should he set himself to cross the river in a direction perpendicular to the river current of velocity $2km \cdot h^{-1}$.

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60. The width of a river is D. A man can cross the river in time t_1 in the absence of any river current. But in presence of a certain river current, the man takes a time t_2 to cross

the river directly. Show that the velocity of the current is

$$v = D\sqrt{\frac{1}{t_1^2} - \frac{1}{t_2^2}}$$

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61. Find the magnitude of the vector $3\hat{i} - 4\hat{j} + 12\hat{k}$.

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62. Find the angle between the vectors $\hat{i} + \hat{j}$ and $\hat{i} - \hat{k}$.

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63. Find the angle between the vectors $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = -3\hat{i} + 2\hat{j}$.

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64. prove that the diagonals of a rhombus are perpendicular to each other.

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65. $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three unit vectors . Show that, $\left|\vec{a} - \vec{b}\right|^2 + \left|\vec{b} - \vec{c}\right|^2 + \left|\vec{c} - \vec{a}\right|^2 \leq 9$.

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66. Find the projection of the vector $\vec{P} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ on the vector $\vec{Q} = \hat{i} + 2\hat{j} + 2\hat{k}$.

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67. A particle is moving in a curvillinear path defined by the equations $x = 2t^2, y = t^2 - 4t$ and $z = 3t - 5$. Find out the magnitudes of the components of velocity and acceleration along $\left(\hat{i} - 3\hat{j} + 2\hat{k}\right)$ at time t=1.

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68. Prove that a right angled triangle can be formed using the vectors

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

.

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69. $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = \hat{i} - \hat{j} + \hat{k}$ are two vectors. Find $\vec{A} \times \vec{B}$.

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70. Using vector method in a triangle , prove that,

(i) $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ and

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71. Using vector method in a triangle , prove that,

(ii) $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$.

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72. If the two diagonals of a parallelogram are given by $\vec{R}_1 = 3\hat{i} - 2\hat{j} + 7\hat{k}$ and $\vec{R}_2 = 5\hat{i} + 6\hat{j} - 3\hat{k}$, find out the area of this parallelogram.

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73. Find the angle between force $\vec{F} = \left(3\hat{i} + 4\hat{j} - 5\hat{k}\right)$ and displacement $\vec{d} = \left(5\hat{i} + 4\hat{j} - 3\hat{k}\right)$. Also find the projection of $\vec{F}$ on $\vec{d}$.

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74. Prove that $\left|\vec{P} \times \vec{Q}\right|^2 = \left|\vec{P}\right|^2\left|\vec{Q}\right|^2 - \left|\vec{P} \cdot \vec{Q}\right|^2$.

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

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76. A body is projected with a velocity $20m \cdot s^{-1}$, making an angle of 45° with the horizontal. Calculate

(i) the time taken to reach the ground $\left[g = 10m \cdot s^{-2}\right]$,

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77. A body is projected with a velocity $20m \cdot s^{-1}$, making an angle of 45° with the horizontal. Calculate

the maximum height it can attain

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78. A body is projected with a velocity $20m \cdot s^{-1}$, making an angle of 45° with the horizontal. Calculate

(ii) horizontal range.

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79. A plane is flying horizontally at a height of 1960 m at $600km \cdot h^{-1}$ with respect to the ground . On reaching a point directly above A , the plane drops an object which reaches the ground at B. Find the distance AB.

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80. A particle falls from rest from the highest point of a vertical circle of radius r, along a chord without any friction . Show that the time taken by the particle to come

down is independent of the chord's length. Find the time in terms of r and g .

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81. At what angle with respect to the horizontal, should a projectile be thrown with a velocity of $19.6m \cdot^{-1}$, to just clear a wall 14.7 m high, at a distance of 19.6m ?

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82. A block of ice is sliding down the sloping roof of a house and the angle of inclination of the roof with the horizontal is 30° . The maximum and minimum heights of the roof from the ground are 8.1 m and 5.6 m. How far

from the starting point, measured horizontally , does the block land ? [ignore friction]

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83. The equation of the trajectory of a projectile on a vertical plane is y=$ax - bx^2$, where a and b are constants, and x and y respectively are the horizontal distances of the projectile from the point of projection. Find out the maximum height attained by the projectile, and the angle of projection with respect to the horizontal.

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84. A gun fires at an angle 30° with the horizontal and hits a target at a distance of 3 km . Can another target at a distance of 5km be hit by changing the angle of projection but keeping the velocity of projection unchanged ?

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85. A gun is kept on a horizontal road and is used to hit a running car. The uniform speed of the car is 72km/h . At the instant of firing at an angle of 45° with the horizontal , the car is at a distance of 500 m from the gun. Find out the distance between the gun and the car at the instant of hitting. Given, $g = 10m/s^2$.

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86. The initial velocity of a projectile is $\left(\hat{i}+2\hat{j}\right)m/s$, where $\hat{i}$ and $\hat{j}$ are unit vectors along the horizontal and vertical directions respectively. Find out the locus of the projectile , taking $g=10m/s^2$.

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87. Two objects are thrown simultaneously from the same point with the same initial velocity at angles of projection α and β respectively. If they reach the top and the bottom of a tower simultaneously, then prove that

$\tan\alpha-\tan\beta=\tan\theta$

where, θ= angle of elevation of the tower from the point of projection.

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88. A truck starts from rest and accelerates uniformly at $2m \cdot s^{-2}$. At t=10s, a stone is dropped by a person standing on the top of the truck (6 m high from the ground). What are the

(i) velocity at t=11s?

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89. A truck starts from rest and accelerates uniformly at $2m \cdot s^{-2}$. At t=10s, a stone is dropped by a person

standing on the top of the truck (6 m high from the ground). What are the

(ii) acceleration of the stone at t=11 s ? (Neglect air resistance.)

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Section Related Questions

1. Distinguish between scalar and vector quantities.

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2. State which of the following are scalars and vectors-

(i) density (ii) charge (iii) displacement (iv) energy

(v) momentum (vi) volume (vii) time (viii) magnetic field intensity (ix) electric flux (x) force.

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3. Define : (i) collinear vectors and (ii) coplanar vectors.

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4. What is meant by the term unit vector ?

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5. What are the differences between vector addition and scalar addition ?

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6. Can you get a unit vector as a sum of three unit vectors ?

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7. Show that the absolute value of the resultant of two vectors $\vec{P}$ and $\vec{Q}$ cannot be greater than P+Q or less than P-Q.

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8. Show that, in case of vector addition $\vec{A} + \vec{B} = \vec{B} + \vec{A}$

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9. Using the properties of vectors, prove that the straight line, obtained by joining the mid-poings of two sides of a triangle , is half of the length of third side.

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10. Find the magnitude and direction of the resultant of two vectors which are perpendicular to each other.

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11. Using vector properties, show that, a straight line obtained by joining the mid-points of the oblique sides of a trapezium is parallel to the parallel sides of the trapezium and is equal to half of the sum of lengths of the parallel sides.

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12. Under what condition is the magnitude of the difference of two vectors equal to their resultant ?

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13. State the necessity of introducing the zero vector .

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14. Show that, the resultant and the difference of two mutually perpendicular vectors of equal magnitude are equal in magnitude and perpendicular to each other.

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15. Define unit vector, null vector and position vector .

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16. Define position vector.

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17. Find the components of a vector $\vec{A}$ along two direction making angles α and β respectively with the vector.

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18. What is meant by relative velocity ? Velocities of two bodies are $\vec{u}$ and $\vec{v}$ respectively and they are at an angle θ. Find the magnitude and direction of the relative velocity of one with respect to the other.

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19. Two bodies A and B are moving with velocities $\overrightarrow{v}_A$ and $\overrightarrow{v}_B$ respectively, making an angle θ with each other. Find the magnitude and direction of relative velocity of B with respect to A.

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20. How can the relative velocity be determined when two particles are moving with different velocities (i) in the same direction and (ii) in opposite directions ?

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21. Two stones are releassed from the same height. One is released from rest and the other is thrown horizontally. Which stone will touch the ground first ?

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22. A boy throws a ball vertically upward from a vehicle moving at a constant acceleration . Where will the ball land ?

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23. A particle is projected with a velocity u in a direction making an angle α with the horizontal . Deduce the

equation for the path of the projected particle.

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Higher Order Thinking Skill Hots Questions

1. Under which condition will the magnitude of scalar sum be equal to the magnitude of vector sum ?

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2. If $\left|\vec{A}\right| \neq \left|\vec{B}\right|$, then is it possible that $\vec{A} + \vec{B} = 0$? Explain.

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3. Can the sum of three vectors, i.e., their resultant, be equal to zero ? Explain.

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4. A stone is allowed to fall from the top of a tower 100m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25m/s. Calculate when and where the two stones will meet. $\left(g = 10\frac{m}{s^2}\right)$

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5. A boy throws a ball vertically upward from a vehicle moving with a constant acceleration . Where would the ball land ?

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6. Can the value of a component of a vector be greater than the value of the vector itself ? Discuss the case of rectangular components in this context.

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7. At zero wind speed rain water falls vertically with velocity V$cm \cdot s^{-1}$ and is collected in a pot at a fixed rate.

How will the rate of collection of rain water change when wind is blowing with a velocity of W$cm \cdot s^{-1}$ perpendicular to V ?

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8. Are the magnitudes of the two vectors $\left(\vec{A} - \vec{B}\right)$ and $\left(\vec{B} - \vec{A}\right)$ the same ?

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9. Show that, if three forces acting on a particle can be taken sequentially to form the three sides of a triangle, their resultant is zero.

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10. If the position coordinates of the points A and B are (x_1, y_1, z_1) and (x_2, y_2, z_2) respectively , determine the magnitude and direction of the vector $\overrightarrow{AB}$.

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11. A person leans out of a train moving with uniform velocity and drops a coin. How does the path of motion of the coin appear to a co-passenger and a person standing outside the train near the rail tracks ?

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12. State whether any physical quantity having magnitude and direction is a vector ?

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13. Can the magnitude of the resultant of two vectors be less than either of them ? Explain.

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14. By adding three unit vectors is it possible to get a unit vector ?

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15. Resultant of two vectors $\vec{F}_1$ and $\vec{F}_2 is \vec{P}$. When $\vec{} 2$ is reversed, the resultant is $\vec{Q}$. Show that $(P^2 + Q^2) = 2(F_1^2 + F_2^2)$

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16. How does the change of acceleration due to gravity affect the path of a projectile ?

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17. Can four non-coplanar vectors produce equilibrium ? Give reasons.

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18. Show that a stretched wire cannot remain horizontal when a weight is suspended from its mid-point.

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19. Two wooden blocks are falling from the same height. One is falling down an inclined plane and the other is in a free fall. Out of the two which one will reach the ground first ?

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20. Two wooden blocks are falling from the same height. One is falling down an inclined plane and the other is in a

free fall. Out of the two

(ii) Which one will have higher velocity when it touches the ground ?

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21. In a circus, a joker stands on a highly elevated plank with a ball in his hand. Another joker also stands with a rifle in his hand pointing it directly at the ball.

If the fifle is fired precisely at the moment when the ball is released, will the bullet hit the ball ? Air resistance is negligible.

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22. Under which condition will the magnitude of the resultant of two vectors be equal to that of any one of the constituent vectors ?

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23. If the angle between two vectors is slowly increased from 0 then what changes in magnitude will be found in the resultant ?

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24. If $\left|\vec{a} \times \vec{b}\right| = \vec{a} \cdot \vec{b}$, then what is the angle between $\vec{a}$ and $\vec{b}$?

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25. What is the vector product of two equal vectors ?

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26. Show that the projection or component of a vector $\overrightarrow{R}$ on another vector $\overrightarrow{A}$ $is\overrightarrow{R}\cdot\widehat{a}$, where $\widehat{a}$ is a unit vector along $\overrightarrow{A}$.

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27. If $\overrightarrow{A}$ is a constant vector, then show that $\frac{\overrightarrow{dA}}{dt}$ is perpendicular to $\overrightarrow{A}$.

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28. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountain is v , then what will be the total area around the fountain that gets wet ?

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Exercise Multiple Choice Questions

1. What is the condition for $\vec{A} + \vec{B} = \vec{A} - \vec{B}$ to be valid ?

A. $\vec{A} = 0$

B. $\vec{B} = 0$

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

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

Answer: B

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2. Magnitudes of sum and difference of two vectors are equal . Angle between the vectors is

A. 0°

B. 90°

C. 120°

D. 60°

Answer: B

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3. Magnitude of each of two vectors is P. Magnitude of the resultant of the two is also P. angle between the vectors is

A. 0°

B. 60°

C. 120°

D. 90°

Answer: C

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4. Two forces of equal magnitude act simultaneously on a partical. If the resultant of the forces is equal to the magnitude of each of then the angle between the forces is

A. an acute angle

B. an obtuse angle

C. a right angle

D. of any value

Answer: B

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5. A travels 30 m to the north, then 20 m to the east and after that $30\sqrt{2}m$ to the south-west. His displacement from the starting point is

A. 15 m to the east

B. 28 m to the south

C. 10 m to the west

D. 15 m to the south west

Answer: C

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6. $0.2\hat{i} + 0.6\hat{j} + a\hat{k}$ is a unit vector. Value of a should be

A. $\sqrt{0.3}$

B. $\sqrt{0.4}$

C. $\sqrt{0.6}$

D. $\sqrt{0.8}$

Answer: C

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7. $\vec{R}$ is the resultant of the vectors $\vec{A}$ and $\vec{B}$. If R $= \dfrac{B}{\sqrt{2}}$ then the angle θ is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: B

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8. Position vector of a particle is related to time t as $\vec{r} = \left(t^2 - 1\right)\hat{i} + 2t\hat{j}$. The locus of the particle on the x-y plane is

A. parabolic

B. circular

C. straight line

D. elliptical

Answer: A

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9. Two forces of the same magnitude F are at right angles to each other. The magnitude of the net force (total force) acting on the object is

A. F

B. 2F

C. between F and 2F

D. more than 2F

Answer: C

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10. If a and b two unit vectors inclined at an angle of 60° to each other, then

A. $|a+b|>1$

B. $|a+b|<1$

C. $|a-b|>1$

D. $|a-b|<1$

Answer: A

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11. The condition $(a \cdot b)^2 = a^2 b^2$ is satisfied when

A. a is parallel to b

B. $a \neq b$

C. $a \cdot b = 1$

D. $a \perp b$

Answer: C

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12. If $\vec{P} + \vec{Q} = \vec{R}$ and $\left|\vec{P}\right| = \left|\vec{Q}\right| = \sqrt{3}$ and $\left|\vec{R}\right| = 3$, then the angle between $\vec{P}$ and $\vec{Q}$ is

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

B. $\frac{\pi}{6}$

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

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

Answer: C

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13. The angles which the vector $\overrightarrow{A} = 3\hat{i} + 6\hat{j} + 2\hat{k}$ makes with the coordinate axes are

A. $\cos^{-1}\frac{3}{7}\cos^{-1}\frac{6}{7}$ and $\cos^{-1}\frac{2}{7}$

B. $\cos^{-1}\frac{4}{7}\cos^{-1}\frac{5}{7}$ and $\cos^{-1}\frac{3}{7}$

C. $\cos^{-1}\frac{3}{7}\cos^{-1}\frac{4}{7}$ and $\cos^{-1}\frac{1}{7}$

D. None of the above

Answer: A

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14. If $\vec{a} + \vec{b} = \vec{c}$, and $a + b = c$ then the angle between $\vec{a}$ and $\vec{b}$ is

A. 90°

B. 180°

C. 120°

D. zero

Answer: D

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15. If a_1 and a_2 are two non-collinear unit vectors and if $|a_1 + a_2| = \sqrt{3}$, then the value of $(a_1 - a_2) \cdot (2a_1 + a_2)$ is

A. 2

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

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

D. 1

Answer: C

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16. Which of the following is a vector quantity ?

A. temperature

B. impulse

C. gravitational potential

D. power

Answer: B

Watch Video Solution

17. The resultant of two forces of magnitude (x+y) and (x-y) is $\sqrt{x^2+y^2}$. The angle between them is

A. $\cos^{-1}\left[-\frac{(x^2+y^2)}{2(x^2-y^2)}\right]$

B. $\cos^{-1}\left[-\frac{2(x^2-y^2)}{x^2+y^2}\right]$

C. $\cos^{-1}\left[-\frac{x^2+y^2}{x^2-y^2}\right]$

D. $\cos^{-1}\left[-\frac{x^2-y^2}{x^2+y^2}\right]$

Answer: A

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18. The sum of magnitudes of two forces acting at a point is 16 N. The resultant has a magnitude of 8N and is perpendicular to the force of lower magnitude. The two forces are

A. 6N and 10N

B. 8N and 8N

C. 4N and 12N

D. 2N and 14N

Answer: A

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19. Two men have velocities of 4 m/s towards east and 3 m/s towards south, respectively. The velocity of the first man relative to the second is

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

B. $\left(3\hat{j}+4\hat{j}\right)$

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

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

Answer: A

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20. Two forces in the ratio 1:2 act simultaneously on a particle. The resultant of these forces is three times the first force. The angle between them is

A. 0°

B. 60°

C. 90°

D. 45°

Answer: A

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21. Given $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = \hat{i} + \hat{j}$. The component of vector $\vec{A}$ along vector $\vec{B}$ is

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

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

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

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

Answer: C

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22. One of the components of a velocity vector of magnitude $50m \cdot s^{-1}$ is $30m \cdot s(-1)$. Its other orthogonal component is

A. $15m \cdot s^{-1}$

B. $20m \cdot s^{-1}$

C. $25m \cdot s^{-1}$

D. $40m \cdot s^{-1}$

Answer: D

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23. The times of flight of two projectiles are t_1 and t_2. If R be the horizontal range of each of them, then

A. $t_1 t_2 \propto R$

B. $t_1 t_2 \propto R^2$

C. $t_1 t_2 \propto R^3$

D. $t_1 t_2 \propto R^{\frac{1}{2}}$

Answer: A

Watch Video Solution

24. For angles θ and $(90^\circ - \theta)$ of projection, a projectile has the same horizontal range R. The maximum heights

attained are H_1 and H_2 respectively. Then the relation among R, H_1 and H_2 is

A. $R = \sqrt{H_1 H_2}$

B. $R = \sqrt{H_1^2 + H_2^2}$

C. $R = H_1 + H_2$

D. $R = 4\sqrt{H_1 H_2}$

Answer: D

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25. An aeroplane is flying with a velocity of 216 km/h at an altitude of 1960 m relative to the ground. It drops a bomb

when it is just above a point A on the ground . The bomb hits the ground at B. The distance AB is

A. 1.2 km

B. 0.33 km

C. 3.33 km

D. 33 km

Answer: A

Watch Video Solution

26. The initial velocity and the acceleration of a particle are $\vec{u} = 3\hat{i} + 4\hat{j}$ and $\vec{a} = 0.3\hat{i} + 0.4\hat{j}$. The magnitude of its velocity after 10 s is

A. 10 units

B. 8.5 units

C. $7\sqrt{2}$units

D. 7 units

Answer: A

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27. The equations of motion of a projectile are x=36 t and 2y=96t-$9.8t^2$. The angle of projection is

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

B. $\sin^{-1}\left(\frac{3}{5}\right)$

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

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

Answer: A

Watch Video Solution

28. Two projectiles, projected with angles $(45^\circ - \theta)$ and $(45^\circ + \theta)$ respectively, have their horizontal ranges in the ratio

A. $2:1$

B. $1:1$

C. $2:3$

D. $1:2$

Answer: B

Watch Video Solution

29. For a projectile,

$(\text{horizontal range})^2 = 48 \times (\text{maximum height})^2$

The angle of projection is

A. 45°

B. 60°

C. 75°

D. 30°

Answer: B

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30. Two railway tracks are paraller to west-east direction . Along one track train A moves with a speed of $30m \cdot s^{-1}$ from west to east, while along the second track, train B moves with a speed of $48m \cdot s^{-1}$ from east to west . The relative speed of B with respect to A is

A. $48m \cdot s^{-1}$

B. $-78m \cdot s^{-1}$

C. $30m \cdot s^{-1}$

D. zero

Answer: B

Watch Video Solution

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

A. 60°

B. 30°

C. 45°

D. 90°

Answer: A

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32. A vector is multiplied by (-2) .As a result

A. magnitude of the vector is doubled and direction is unaltered

B. magnitude of the vector remains the same and direction is reversed

C. magnitude of the vector is doubled and direction is reversed

D. no change in magnitude or direction of the vector

Answer: C

Watch Video Solution

33. In a clockwise system

A. $\hat{j} \times \hat{j} = 1$

B. $\hat{k} \cdot \hat{i} = 1$

C. $\hat{j} \times \hat{k} = \hat{i}$

D. $\hat{i} \cdot \hat{i} = 0$

Answer: C

View Text Solution

34. A vector $\overrightarrow{P} = 3\hat{i} - 2\hat{j} + a\hat{k}$ is perpendicular to the vector $\overrightarrow{Q} = 2\hat{i} + \hat{j} - \hat{k}$. The value of a is

A. 2

B. 1

C. 4

D. 3

Answer: C

Watch Video Solution

35. For any two vectors $\vec{A}$ and $\vec{B}$, if $\vec{A} \cdot \vec{B} = \left|\vec{A} \times \vec{B}\right|$, the magnitude of $\vec{C} = \vec{A} + \vec{B}$ is equal to

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

B. A+B

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

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

Answer: D

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36. $\vec{A} \cdot \vec{A} = ?$

A. 0

B. A

C. A^2

D. 1

Answer: C

Watch Video Solution

37. A vector perpendicular to both of $\left(3\hat{i}+\hat{j}+2\hat{k}\right)$ and $\left(2\hat{i}-2\hat{j}+4\hat{k}\right)$ is

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

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

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

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

Answer: B

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38. A vector normal to $a\cos\theta\hat{i}+b\sin\theta\hat{j}$ is

A. $b\sin\theta\hat{i}-a\cos\theta\hat{j}$

B. $\frac{1}{a}\sin\theta\hat{i} - \frac{1}{b}\cos\theta\hat{j}$

C. $5\hat{k}$

D. all of the above

Answer: D

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39. A vector $\vec{A}$ of magnitude 2 units is inclined at angles 30° and 60° with positive x-and y-axes, respectively. Another vector of magnitude 5 units is aligned along the positive x-axis . Then $\vec{A} \cdot \vec{B}$ is

A. $5\sqrt{3}$

B. $3\sqrt{5}$

C. $2\sqrt{3}$

D. $3\sqrt{2}$

Answer: A

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40. For what values of a and b , the vector $\left(a\hat{i}+b\hat{j}\right)$ will be a unit vector perpendicular to the vector $\left(\hat{i}+\hat{j}\right)$?

A. 1,0

B. 0,1

C. $\frac{1}{\sqrt{3}}, -\frac{2}{\sqrt{3}}$

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

Answer: D

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41. Two billiard balls, starting from the same point, have velocities $\left(\hat{i}+\sqrt{3}\hat{j}\right)$ and $\left(2\hat{i}+2\hat{j}\right)$, respectively. The angle between them is

A. 60°

B. 15°

C. 45°

D. 30°

Answer: B

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42. If $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\vec{A} \cdot \vec{B}$, then $\left|\vec{A} + \vec{B}\right| = ?$

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

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

C. $A + B$

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

Answer: A

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43. The vector product of $\vec{A}$ and $\vec{B}$ is zero . The scalar product of $\vec{A}$ and $\left(\vec{A}+\vec{B}\right)$ is

A. 0

B. A^2

C. AB

D. A^2+AB

Answer: D

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44. If $\vec{A}\cdot\vec{B}=\vec{A}\cdot\vec{C}=0$, then the vector parallel to $\vec{A}$ would be

A. $\overrightarrow{C}$

B. $\overrightarrow{B}$

C. $\overrightarrow{B} \times \overrightarrow{C}$

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

Answer: C

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Exercise Very Short Answer Type Questions

1. We usually say that time moves in forward direction', but time is not a vector quantity . Why ?

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2. What change takes place in the value of the resultant of two vectors when the angle between them is increased from 0 to 90° ?

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3. Is any physical quantity having a magnitude and a direction a vector quantity ?

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4. Can the resultant of three coplanar vector be zero ?

Watch Video Solution

5. "if the magnitudes and direction of three forces acting on a particle are represented by three sides of a triangle taken in order, the particle remains in equilibrium" state whether the statement is true or false ?

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6. What is a free vector ?

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7. what are orthogonal unit vectors ?

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8. What is the position vector of the origin of a coordinate system ?

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9. Magnitude of the resultant of two vectors is minimum when they are ..... [Fill in the blanks]

Watch Video Solution

10. The resultant of two vectors of magnitudes 3 units and 4 units 5 units. What is the angle between the vectors ?

Watch Video Solution

11. If an acceleration acts on a moving object along the direction of motion, the velocity of the object .....[Fill in the blanks]

Watch Video Solution

12. Value of the resultant of $\left(\vec{A}+\vec{B}\right)$ and $\left(\vec{A}-\vec{B}\right)$ is ..... [Fill in the blanks]

Watch Video Solution

13. If $\left|\vec{v}_1+\vec{v}_2\right|=\left|\vec{v}_1-\vec{v}_2\right|$ and $\vec{v}_1$ and $\vec{v}_2$ have finite values then $\vec{v}_1$ and $\vec{v}_2$ are..... [Fill in the blanks]

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14. Can commutative law be applied to vector subtraction ?

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15. Can apply associative law to vector subtraction ?

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16. How many components can a vector be resolved into ?

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17. Is rocket in flight an illustration of projectile ?

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18. What is the angle of projection for attaining maximum vertical height ?

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19. What is the angle between two vectors whose vector product is zero ?

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20. What is the scalar product of two vectors perpendicular to each other ?

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21. What is the angle between $\left(\vec{A}+\vec{B}\right)$ and $\left(\vec{A}\times\vec{B}\right)$?

Watch Video Solution

22. Can the value of $\vec{A}\times\vec{A}$ be 0?

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23. If $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axes respectively then the angle made by $(\hat{i}+\hat{j})$ vector with the x-axis is ..... [Fill in the blanks]

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24. What is the angle between the vectors $\vec{A}$ and $\vec{A} \times \vec{B}$?

Watch Video Solution

25. What is the angle between vector $\vec{A}$ and the resultant of $\left(\vec{A}+\vec{B}\right)$ and $\left(\vec{A}-\vec{B}\right)$?

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Exercise Short Answer Type Questions I

1. Can the magnitude of the resultant of two vectors of equal magnitude be equal to the magnitude of each vector ? Explain.

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2. A car is moving on a road through vertical rainfall . Both the windscreens at the front and the rear are vertical. The front windscreen gets wet in the rain but the rear screen remains dry . Explain the observation.

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3. If $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|$, then show that vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other.

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4. If $\vec{A}+\vec{B}=\vec{B}-\vec{A}$. Can you find out the angle between $\vec{A}$ and $\vec{B}$? Explain.

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5. Can two vectors of different magnitudes be combined to give a zero resultant ?

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6. How does a vector change when it is multiplied by a scalar ?

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7. A freely falling body reaches the ground with a velocity v. what height has it been dropped from ?

Watch Video Solution

8. Two equal forces act on a body at an angle θ between them. Show that their resultant bisectos the angle θ.

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9. Why do the raindrops appear, to a passenger on a running train in a rainy day, to be falling obliquely ?

Watch Video Solution

10. When would the magnitude of the vector sum of a few vectors be equal to their scalar sum ?

Watch Video Solution

11. A body is projected vertically upwards with an initial velocity u_1 . Another is projected with initial velocity u_2 at an angle θ with the horizontal . If both of them reach the same height ,show that $\sin\theta = \frac{u_1}{u_2}$.

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Exercise Short Answer Type Questions Ii

1. Angle between the vectors $\vec{A}$ and $\vec{B}$ is θ. By resolving them into mutually perpendicular components show that the magnitude of the resultant vector is $\left(A^2 + B^2 + 2AB\cos\theta\right)^{1/2}$.

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2. What is the result of multiplying a vector by a pure number N ? What happens if N is (i) negative, (ii) zero ?

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Problem Set I

1. Resultant of vectors 3P and 2P is vector R. When the first vector is doubled, R also doubles. Find the angle between the two vectors.

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2. If $\vec{A} = 4\hat{i} + 3\hat{j}$ is a vector, find its magnitude and direction . What is the coordinates of the terminal point of the vector ?

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3. At what angle the two forces $\left(\vec{F}_1 + \vec{F}_2\right)$ and $\left(\vec{F}_1 - \vec{F}_2\right)$ act so that the resultant is of magnitude $\sqrt{2\left(F_1^2 + F_2^2\right)}$

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4. The length of second 's hand of a watch is 1 cm , what is the change in velocity of its tip in 15 seconds ?

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5. A particle moves along a straight line by a metre and then makes an angle θ with the line and travels b metre. Find the resultant displacement of the particle.

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6. A person moves 30 m towards north, then 20 m towards east and finally $30\sqrt{2}$ m towards south-west. What is his displacement from the original position ?

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7. Two forces, each of magnitude P , are inclined at 60° .Find the magnitude and direction of their difference ?

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8. What is the magnitude of the component of a force of magnitude 50dyn at 30° to the force. What is the magnitude of the orthogonal component ?

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9. P and $\sqrt{3}$ P are two forces acting in north -west and north-east directions respectively. Find the magnitude of resultant of the forces by resolving them into perpendicular components.

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10. Two forces of magnitudes P and 2Q are inclined to each other at an angle of 150°. If the resultant force is perpendicular to P , show that $P = \sqrt{3}Q$.

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11. $\vec{R}$ is the resultant of two vectors $\vec{P}$ and $\vec{Q}$. When $\vec{Q}$ is reversed , the resultant is $\vec{S}$. Prove that $R^2 + S^2 = 2(P^2 + Q^2)$.

Watch Video Solution

12. Calculate the resultant of the following forces at a point , making use of resolution process.

(i) $100\sqrt{2}$ dyne along north-east ii) $980\sqrt{2}$dyne along north-west (iii) 1960 dyne along south.

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13. Calculate the resultant of the following forces at a point , making use of resolution process.

(ii) $980\sqrt{2}$dyn along north -west

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14. A child pulls a rope attached to a stone with a force of 60 N . The rope makes an angle of 40° with the ground .

(a) Calculate the effective value of the pull tending to move the stone along the ground.

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15. A child pulls a rope attached to a stone with a force of 60 N . The rope makes an angle of 40° with the ground .

(b) Calcutate the force tending to lift the stone vertically.

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16. A car is moving at $24km \cdot h^{-1}$ towards east and another car is moving north at $18km \cdot h^{-1}$. Find the relative velocity of the second car with respect to the first.

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17. Rain is falling vertically at $4km \cdot h^{-1}$. What will be the apparent velocity and direction of the rain to a man moving horizontally at $3km \cdot h^{-1}$?

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18. A man can swim at the rate of $4km \cdot h^{-1}$ in still water. At what angle should the man set himself relative to the current of $2km \cdot h^{-1}$ to cross the river perpendicular to the banks ?

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19. A river is 150 m wide and has a current of $1m \cdot s^{-1}$. A boat is moving directly across the river at a speed of $2m \cdot s^{-1}$. How long will the boat take to cross the river ?

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20. A boat is moving at $12km \cdot h^{-1}$ towards north and another is moving at $12\sqrt{2}km \cdot h^{-1}$ towards north -west .Find the relative velocity of the second boat with respect to the first.

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21. A ship is moving at $40km \cdot h^{-1}$ towards west. Another is proceeding southward at $30km \cdot h^{-1}$. Find the relative velocity of the second ship with respect to the first.

Watch Video Solution

22. From the top of a tower, two particles are dropped at an interval of 2 s . Find the relative velocity and relative acceleration of the particles during the fall . Acceleration due to gravity =g $cm \cdot s^{-2}$.

Watch Video Solution

23. In a harbour, wind is blowing at the speed of $72km \cdot h^{-1}$ 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 $51km \cdot h^{-1}$ to the north, what will be the direction of the flag on the mast of the boat ?

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24. To a cyclist moving at $5m \cdot s^{-1}$, rain appears to be falling vertically at a velocity of $5m \cdot s^{-1}$. Find the actual magnitude and direction of the velocity of rain.

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25. A river 1 km wides is flowing at $3km \cdot h^{-1}$. A swimmer whose velocity in still water is $4km \cdot h^{-1}$ can swim only for 15 minutes. In what direction should he swim in order to reach the opposite bank in those 15 minutes? What total distance will he swim ?

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26. A boat with a speed of $5km \cdot h^{-1}$ in still water crosses a river of width 1 km along the shortest possible path in 15 minutes. What is the velocity of the river water ?

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27. An aeroplane is flying eastward with a speed of $600km \cdot h^{-1}$ wind in blowing southward with a speed of $100km \cdot h^{-1}$. Calculate the speed and direction of the aeroplane with respect of the ground.

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28. The speed of launch is 7 m/s and of the current on a river is 3 m/s. A floating body is released from the launch when it starts along the current . It reverses its direction of motion after travelling distance of 4.2 km, and eventually meets the floating body again. What is the time spent in between by the launch ?

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29. If $\vec{a} + \vec{b} = \vec{c}$ and $a + b = c$,what is the angle between the vectors $\vec{a}$ and $\vec{b}$?

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30. $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = -3\hat{i} + 2\hat{j}$ are two vector. Find the angle between them.

Watch Video Solution

31. $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = \hat{i} - \hat{j} + \hat{k}$ are two vectors. Find $\vec{A} \times \vec{B}$.

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32. Given $\vec{A} = 3\hat{i} + 2\hat{j} - 6\hat{k}$ and $\vec{B} = 4\hat{i} - 3\hat{j} + \hat{k}$. What is the angle between $\vec{A}$ and $\vec{B}$?

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33. For what values of a and b , will the vectors $2\hat{i} - 3\hat{j} - \hat{k}$ and $a\hat{i} + b\hat{j} - 2\hat{k}$ be parallel to each other ?

Watch Video Solution

34. For what value of a ,will the vectors $a\hat{i} - 2\hat{j} + \hat{k}$ and $2a\hat{i} + a\hat{j} - 4\hat{k}$ be perpendicular to each other ?

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

Watch Video Solution

36. Determine the value of n so that the vectors $\vec{A}=2\hat{i}+4\hat{j}-n\hat{k}$ and $\vec{B}=3\hat{i}-4\hat{j}+2\hat{k}$ are perpendicular .

Watch Video Solution

37. If $\left(\vec{A}+\vec{B}\right)\cdot\left(\vec{A}-\vec{B}\right)=0$, show that the magnitude of both the vectors are equal .

Watch Video Solution

38. Find the unit vector perpendicular to both the vectors $\vec{A}=\left(2\hat{i}+2\hat{j}+2\hat{k}\right)$ and $\vec{B}=\left(\hat{i}-\hat{j}+2\hat{k}\right)$.

Watch Video Solution

39. The forces P=1 dyn and Q $=\sqrt{3}$ dyn are mutually perpendicular. Find out the angle between the vectors $(P+Q)$ and $(P-Q)$.

Watch Video Solution

40. A stone is thrown from the ground with a velocity of $14m \cdot s^{-1}$, making an angle 60° with the horizontal.

(i) What is the maximum height attained by the stone ?

Watch Video Solution

41. A stone is thrown from the ground with a velocity of $14m \cdot s^{-1}$, making an angle 60° with the horizontal.

(ii) How far from the point of projection will it touch the ground ?

Watch Video Solution

42. A stone is thrown up from the earth's surface with an initial velocity of $28m \cdot s^{-1}$, making and angle 30° with the horizontal. Find the maximum height attained and the range of the projectile motion of the stone.

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43. If the range of a projectile, projected from the surface of the earth is four times the maximum height attained, what is the angle of projection ?

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44. A soldier fires a bullet horizontally from the top a cliff with a velocity of $10m \cdot s^{-1}$. If the bullet strikes the ground after 2s , find the height of the cliff. Also calculate the velocity with which the bullet strikes the ground .

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45. Show that the maximum height attained by a projectile is one fourth of its maximum horizontal range.

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46. Find the magnitude of the vector $3\hat{i} + 4\hat{j} + 12\hat{k}$ and the angles it makes with x,y,z axes.

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47. What is the value of the resultant of three vectors $\hat{i}, \hat{j}$ and $\sqrt{2}\hat{k}$? What angle of inclination does the resultant make with x,y and z axes ?

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48. Position coordinates of the points A, B,C are (1,2,3), (2,3,1) and (3,1,2) respectively. Using vector method, find the area of the triangle .

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49. If $\vec{A} = 5\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{B} = 5\hat{i} + 2\hat{j} + 4\hat{k}$ are two vectors, find the unit vectors along $\left(\vec{A} + \vec{B}\right)$ and $\left(\vec{A} - \vec{B}\right)$.

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50. Find the magnitudes of the sum and difference of two vectors $6\hat{i} - 4\hat{j} + 2\hat{k}$ and $6\hat{i} + \hat{j} + 2\hat{k}$.

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51. Show that the magnitude of $\vec{A} \times \vec{B}$ and area of a parallelogram of sides $\vec{A}$ and $\vec{B}$ are equal.

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52. Determine the angle between $\vec{A} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{B} = 3\hat{i} + \hat{j} - 4\hat{k}$.

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53. If $\vec{A} = \hat{i} + 4\hat{j} + \hat{k}$ and $\vec{B} = 3\hat{i} - 5\hat{j} + \hat{k}$, find the unit vector along any vector parallel to the resultant of $\vec{A}$ and $\vec{B}$.

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54. Show that the vectors $\vec{a} = 3\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 3\hat{j} + 5\hat{k}$ and $\vec{c} = 2\hat{i} + \hat{j} - 4\hat{k}$

form a right angled triangle.

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55. If the mid-points of the consecutive sides of any quan riateral are connected by straight line segments , prove that the resulting quandrilateral is a parallelogram.

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56. Prove that $|a \times b|^2 = a^2b^2 - (a \cdot b)^2$.

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57. Find the magnitude and direction of $\vec{a} = 3\hat{i} + 4\hat{j}$. What are the coordinates of its end point ?

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58. Which vector is to be added with $3\hat{i} + 4\hat{j} - 5\hat{k}$ and $\hat{i} - 2\hat{j} + 7\hat{k}$ to give resultant as $\hat{i}$?

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59. Find the direction cosines for the vector $\vec{a} = 4\hat{i} + 6\hat{j} - 5\hat{k}$.

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Problem Set Ii

1. Resultant of two forces P and Q is $\sqrt{3}Q$. The resultant is inclined at 30° with P . Show that, either P =Q or P=2Q.

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2. Two billiard balls are rolling on a flat table. One has velocity components $v_x = 1m \cdot s^{-1}, v_y = \sqrt{3}m \cdot s^{-1}$ and the other has components $v_x' = 2m \cdot s^{-1}$ and $v_y' = 2m \cdot s^{-1}$. If both the balls start moving from the same point, what is the angle between their paths ?

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3. The resultant of two forces P and Q is $5\sqrt{P^2+Q^2}$ when the angle between them is α . When the angle changes to $(90^\circ - \alpha)$, the resultant becomes $3\sqrt{P^2+Q^2}$. Show that, $\tan\alpha = \frac{1}{3}$.

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4. A man is walking at $2m \cdot s^{-1}$ towards south . To him, the wind appears to blow from east. When he moves with double the velocity , the direction of the wind appears to be exactly from the sount-east. Find the velocity of the wind and the direction of blowing .

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5. A boat was steered over a flowing river in such a way that it reached the opposite bank following the shortest path. Time required in this case was double the time the boat would have taken to cross the river if there was no river current. If the velocity of the boat was $2m \cdot s^{-1}$, what was the velocity of the current?

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6. A vehicle was moving at $32km \cdot h^{-1}$ towards north. A passenger noticed that rain was striking his body from the east. When the velocity of the vehicle was increased to $64km \cdot h^{-1}$, rain appeared to come from the north-east direction. Find the actual velocity and direction of rain.

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7. The velocity of a river current is u. A man crosses the river with velocity v making an angle θ with the direction of the current. If the width of the river is d, find the time taken to cross the river and the displacement of the man in the direction of the current. What would be the minimum time required for crossing the river ? In what time could he reach exactly the opposite point ?

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8. A person is standing on a road with his umbrella open at 30° with the vertical to save himself from rain . Then he starts moving at $5km \cdot h^{-1}$. Now the finds that rain drops

are hitting his umbrella vertically. Find the speed of rain drops w.r.t(i) the road .(ii) the moving person.

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9. $\sqrt{3}$ times the velocity of a boat on still water is twice the velocity of current of a river. At what angle , with respect to the current, should the boat be steered so as to cross the river in least distance ?

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10. Each to two boats has a speed of 8 km/h . The speed of river current is 6 km/h. Starting at the same instant, the first boat cross the river in least time , and the second in

least path. How must later the second boat would arrive if the river is 2 km wide?

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11. A southward wind of speed 5 m/s affects raindrops falling vertically at 4 m/s. A cyclist moves towards south with a speed of 2m/s . What are the magnitude and direction of the speed of the raindrops relative to the cyclist ?

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12. A boat takes 6 h to travel some distance along the current on a river. It takes 10 h to travel the same distance

against the current. Find out the time taken by the boat to travel that distance in the absence of any current.

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13. Find the cross product of $\vec{r} \times \vec{F}$, given $\vec{F} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{r}$ is the distance between two points whose coordinates are (-2,3,4) and (1,2,3).

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14. Find the angle between the force $\vec{F} = \left(2\hat{i} + 3\hat{j} - \hat{k}\right)$ unit and the displacement $\vec{d} = \left(3\hat{i} + 4\hat{j} + 2\hat{k}\right)$ unit. Also find the projection of $\vec{F}$ $on \vec{d}$.

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15. If $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\vec{A} \cdot \vec{B}$, then show that $\left|\vec{A} + \vec{B}\right| = \sqrt{A^2 + B^2 + AB}.$

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16. $\vec{A}$, $\vec{B}$ and $\vec{C}$ are unit vectors, $\vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{C} = 0$, and the angle between $\vec{B}$ and $\vec{C}$ is 30°. Prove that, $\vec{A} = \pm 2\left(\vec{B} \times \vec{C}\right)$.

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17. $\vec{a}_1$ and $\vec{a}_2$ two non-collinear unit vectors and $\left|\vec{a}_1 + \vec{a}_2\right| = \sqrt{3}$. Find out the value of $\left(\vec{a}_1 - \vec{a}_2\right) \cdot \left(2\vec{a}_1 + \vec{a}_2\right)$.

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18. A body is thrown horizontally with velocity $122m \cdot s^{-1}$ from the top of a tower 122 m high . When and where does the body hit the ground ?

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19. The maximum height attained and the range of a projectile are H and R respectively. If projected with an

initial velocity of u, show that, $R^2 = 16H\left(\frac{u^2}{2g} - H\right)$.

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20. A fighter plane flying horizontally at an altitude of 1.5 km with speed $720km \cdot h^{-1}$ passes directly over an anti-aircraft gun. At what angle with the vertical should the gun be fired for the shell with muzzle speed $600m \cdot s^{-1}$ to hit the plane? At what minimum altitude should the pilot fly the plane to avoid being hit ? (Take $g = 10m \cdot s^{-2}$).

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

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22. A particle is projected with a velocity of 20 m/s at an angle of 30° with a plane of inclination 30° with respect to the horizontal . The particle hits the inclined plane at an angle of 30° . Find the (a) time of impact, (b) the height of the point of impact from the horizontal plane passing through the point of projection.

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23. A stone ,thrown with the same initial speed ,rises 20 m higher when the angle of projection changes from 30° to 60° . What was the initial speed and the increases in time spent by the stone in air in the second case ?

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24. A bullet is fired with a velocity of 900 km/h in the horizontal direction from a gun kept 20 m above the ground . Take $g = 10m/s^2$. Find out the time of flight

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25. A bullet is fired with a velocity of 900 km/h in the horizontal direction from a gun kept 20 m above the ground . Take $g = 10m/s^2$. Find out the horizontal range.

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26. A bullet is fired with a velocity of 10m/s^(2) at an angle 30^(degree) in the horizontal direction from a gun kept 20 m above the ground . Take $g = 10m/s^2$. Find out

(iii) the vertical component of the velocity of the bullet when it hits the ground.

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27. Two particles are projected simultaneously with the same initial velocity u at angles θ_1 and θ_2 with respect to the horizontal , but in opposite directions. If their paths are coplaner, what is the magnitude of their relative velocity at the time of projection ?

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28. The resultant velocity of a projectile at its highest point is $\sqrt{\frac{6}{7}}$ times that at half the maximum height. Show that the angle of projection with respect to the horizontal is 30°.

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29. Maximum and minimum values of the resultant of two forces, acting at a point, are 15 N and 7N respectively. If the value of each force is increased by 1 N and these two new forces act at 90° to each other, what would be the value of the resultant ?

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30. At 10.a.m.., a ship A is at 40 km to the east of a ship B . Ship A moves at 12 km per hour towards west and ship B moves at $16km \cdot h^{-1}$ towards south. When will the distance between them be minimum and what will be the value of this minimum distance ?

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31. Two vectors $\hat{i}+\hat{j}+2\hat{k}$ and $\hat{i}+\hat{j}-\hat{k}$ represent two sides of a triangle . Find the angle between them and the length of the third side.

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32. In a trapezium ABCD $\overrightarrow{AB}=3\hat{i}, \overrightarrow{AD}=\hat{i}+2\hat{j}, \overrightarrow{DC}=2\hat{i}.$ Find $\overrightarrow{BC}, \overrightarrow{BD}, \overrightarrow{AC}$ and $\angle BAD.$

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33. The position vector of a particle is given by

$$\vec{r} = 3.0t\hat{i} - 2.0t^2\hat{j} + 4.0\hat{k}m$$

Where t is in seconds and the coefficients have the proper units for $\vec{r}$ to be in metres.

(a) Find the $\vec{v}$ and $\vec{a}$ of the particle ?

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34. The position vector of a particle is given by

$$\vec{r} = 3.0t\hat{i} - 2.0t^2\hat{j} + 4.0\hat{k}m$$

Where t is in seconds and the coefficients have the proper units for $\vec{r}$ to be in metres.

(b) what is the magnitude of the velocity of the particle at t=2.0 s ?

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Problem Set Ii Hot Numerical Problems

1. One motor launch A is exactly 1 km north of another launch B. Both launches start from rest , at the same time, with an acceleration of $10cm \cdot s^{-2}$. The launch A proceeds towards east and B towards north. Find the distance of closest approach between them and the time taken to reach that distance.

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2. Two straight railway tracks are at right angles to each other. At 7 pm , a train, moving at $30km \cdot h^{-1}$ crosses the junction. Another train, following the other track at $40km \cdot h^{-1}$ crosses the junction at 12 midnight. When are the two trains closest to each other ?

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3. A steamer moves towards north with a velocity v. Smoke from the chimney comes out at 30° towards south with respect to the east. If wind is blowing from the west, find the speed of the wind .

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4. Two particles start their journey at the same time from the same point following two straight lines inclined with each other at an angle θ. One moves with a uniform velocity u and other, starting from rest, moves with an acceleration a. show that the relative velocity between them will be minimum after a time u $\cos\theta/a$ and its value is u $\sin\theta$.

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5. A ship moves due to east at 12km/hr for one hour and then turns towards exactly towards south to move for an hour at 5km/hr. Calculate its magnitude of average velocity for the given motion.

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6. A swimmer can swim at $3\sqrt{2}km \cdot h^{-1}$ in still water. He swims across a river when the velocity of current is $3km \cdot h^{-1}$.

(i) In what direction should he swim to cross by the shortest path ?

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7. A swimmer can swim at $3\sqrt{2}km \cdot h^{-1}$ in still water. He swims across a river when the velocity of current is $3km \cdot h^{-1}$.

(ii) In what direction should he swim to cross the river in

minimum time ? In that case how far will he be carried by the river current if the river is $\sqrt{2}$ km wide ?

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8. Width of a river is l and the velocity of its current is v . A man wants to cross the river directly on a boat . What should be the direction of motion of his boat relative to the current and in what time will he cross the river directly ? If he covers a distance D along the current , and then returns the same distance against the current how much time would be required for the total journey ?

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9. A car travels along a straight line for first half time with speed 40km/hr and the second half time with speed 60km/hr. find the average speed of the car.

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10. A bomb explodes on falling on a horizontal floor. Different parts of the bomb are scattered in different directions, each with velocity u. Find the area of the floor which is littered by the fragment.

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11. A body during its free fall from a height H, hits an inclined plane at a height h in its path. Due to collision, direction of the velocity of the body becomes horizontal. What should be the value of $\frac{h}{H}$ so that the body takes maximum time to reach the ground ?

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12. To hit a car a gun is positioned horizontally behind the car along a straight road. The car is moving on the road with a uniform velocity of $72km \cdot h^{-1}$. If the gun is fired at an angle of 45° with the horizontal , at a distance of 500 m from the car, find the distance of the car from the gun just when the bullet hits the car. Given, $g = 10\frac{m}{s^2}$.

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13. A cricket ball, thrown upwards from a height 2 m making an angle of 30° with the horizontal at velocity $20m \cdot s^{-1}$, was caught by a player 50 cm above the ground. Find the distance between the thrower and the player.

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14. A tennis ball, thrown horizontally from a height of 2m , lands after covering a horizontal distance of 20 m . On its way, the ball just touches a net 14 m from the projection point (distance measered horizontally). Find the height of the net from the ground.

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15. If for a projectile , the velocity of projection is u , range R, time of flight T and maximum height attained H show that, $g^2T^4 - 4T^2u^2 + 4R^2 = 0$ and $16gH^2 - 8u^2H + gR^2 = 0.$

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16. Locus of the path of a projectile , in a vertical plane is given by , =ax-bx^2, where a and b are constants and the horizontal and the vertical distances from the point of projection are x and y , respectively. Find the maximum

height attained and the the angle of projection with the horizontal.

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17. Show that for a projectile the angle between the velocity and the x-axis as a function of time is given by

$$\theta(t) = \tan^{-1}\left(\frac{u_y - \mathrm{gt}}{u_x}\right)$$

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18. Show that the projection angle θ_0 for a projectile launched from the origin is given by

$$\theta_0 = \tan^{-1}\left(\frac{4H}{R}\right)$$

Where the symbols have their usual meaning.

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19. A man, standing on a truck running at a uniform speed of 14.7m/s , throws a ball in such a way that after some time the ball returns exactly to his hands. In that time, the truck moves through a distance of 58.8 m. Find out the velocity and angle of projection of the ball relative to

(i) the truck,

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20. A man, standing on a truck running at a uniform speed of 14.7m/s , throws a ball in such a way that after some time the ball returns exactly to his hands. In that time, the

truck moves through a distance of 58.8 m. Find out the velocity and angle of projection of the ball relative to

(ii) the ground.

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21. Magnitudes of two forces acting at a point are in the ratio of $2:1$. If the angle between their resultant and the greater force is θ , show that, the value of θ cannot exceed $\frac{\pi}{6}$.

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22. Resulatant of two forces, P and Q acting at a point is R. On doubling Q, resultant also doubles. The magnitude of

the resultant also doubles when the direction of Q is made opposite. Show that $P:Q:R=\sqrt{2}:\sqrt{3}:\sqrt{2}$.

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23. When the angle between forces P and Q is α, magnitude of the resultant is $5\sqrt{P^2+Q^2}$. When th angle between them changes to $(90^\circ-\alpha)$, magnitude of the resultant changes to $3\sqrt{P^2+Q^2}$. Prove thet $\tan\alpha=\frac{1}{3}$.

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24. Which of the following relations are correct for any type of motion ?

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

(B) $\vec{v}_{av} = \dfrac{\vec{r}(t_2) - (t_1)}{(t_2 - t_1)}$

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

(D) $\vec{r}(t) = \vec{r}(0) + \vec{v}(0) \cdot t + \dfrac{1}{2}\vec{a}t^2$

(E) $\vec{a}_{av} = \dfrac{\vec{v}(t_2) - \vec{v}(t_1)}{(t_2 - t_1)}$

All the symbols have usual meaning. The subscript 'av' has been used to denote the average of a quantity in the time interval t_1 to t_2.

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Entrance Corner Assertion Reason Type

1. Statement I: Minimum number of unequal vectors on a plane required to give zero resultant is three.

Statement II: If $\vec{B} + \vec{A} + \vec{C} = 0$, then they must lie on the same plane.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

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2. Statement I: if ϕ is the angle between $\vec{P}$ and $\vec{Q}$, then $\tan\phi = \frac{\left|\vec{P} \times \vec{Q}\right|}{\vec{P} \cdot \vec{Q}}$

Statement II: $\vec{P} \times \vec{Q}$ is perpendicular to $\vec{P} \cdot \vec{Q}$.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: C

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3. Statement I: If two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|$, then the angle between $\vec{a}$ and $\vec{b}$ $is 90^{\circ}$.

Statement II: $\vec{a}+\vec{b}=\vec{b}+\vec{a}$.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

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4. Statement I: A physical quantity cannot be called a vector if its magnitude is zero.

Statement II: A vector has both magnitude and direction.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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5. Statement I: Finite angular displacement is not a vector quantity.

Statement II: A vector must obey the proper law of addition.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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6. Statement I: Vector sum of two vectors is always greater than their vector difference.

Statement II: If $\vec{A}$ and $\vec{B}$ are perpendicular to each other, the magnitudes of $\vec{A}+\vec{B}$ and $\vec{A}-\vec{B}$ are the same.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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7. Statement I: $(A \times B) \cdot (B \times A) is - A^2 B^2 \sin^2 \theta$. Here θ is the angle between A and B.

Statement II: $(A \times B)$ and $(B \times A)$ are two antiparallel vectors provided A and B are neither parallel nor antiparallel.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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8. Statement I: The horizontal range of a projectile is the same for angles 30° and 60° of projection.

Statement II: The horizontal range of projectile is independent of the angle of projection.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: C

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9. Statement I: During the flight of a projectile, the horizontal component of its velocity remains uniform .

Statement II: The vertical component of the velocity of a projectile becomes zero at the highest point of its path.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

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10. Statement I: Two orthogonal components of a force of magnitude 25 N may be 24 N and 7N.

Statement II: If $\left|\vec{A}\right| = \left|\vec{B}\right| = 1$ then $\left|\vec{A} \times \vec{B}\right|^2 + \left|\vec{A} \cdot \vec{B}\right|^2 = 1.$

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

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11. Statement I: The angle between the vectors $\overrightarrow{A} = \hat{i} + \hat{j}$ and $\overrightarrow{B} = \hat{j} + \hat{k} is \frac{\pi}{3}$.

Statement II: The angle between vector $\overrightarrow{A}$ and $\overrightarrow{B}$ is $\theta = \cos^{-1}\left(\frac{\overrightarrow{A} \cdot \overrightarrow{B}}{AB}\right)$.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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12. Statement I: The initial velocity of projectile $= \left(a\hat{i} + b\hat{j}\right)$. The horizontal range becomes maximum for a=b.

Statement II: for the same magnitude of initial velocity , the horizontal range of a projectile becomes maximum for the angle 45° of projection.

A. Statement I is true , statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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Entrance Corner Multiple Correct Answers Type

1. In the following figure which of the statements are correct?

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

B. the signs of the y-component of $\vec{l}_1$ and $\vec{l}_2$ are positive and negative respectively

C. the signs to x and y -components of $\vec{l}_1 + \vec{l}_2$ are both positive

D. none of these

Answer: A::C

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2. 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 is greater than that of the second, then which are the correct 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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3. For two vectors $\vec{A}$ and $\vec{B}$, $\left|\vec{A}+\vec{B}\right|$ 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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4. Given $\vec{a} + \vec{b} + \vec{c} + \vec{d} = \vec{0}$. Show that : the magnitude of $\left(\vec{a} + \vec{c}\right)$ equals the magnitude of $\left(\vec{b} + \vec{d}\right)$

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5. State which of the following statements are false. A scalar quantity is one that

A. is conserved in a process

B. can never take negative values

C. must be dimensionless

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

Answer: A::B::C

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6. If the resultant of $\vec{P}$ and $\vec{Q}$ is $\vec{R}$ and if $R^2 = P^2 + Q^2$ then find the angle between $\vec{P}$ and $\vec{Q}$.

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7. The magnitude of the vector product of $\vec{A}$ and $\vec{B}$ may be

A. greater than AB

B. equal to AB

C. less than AB

D. zero

Answer: B::C::D

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

A. $\vec{A}$ and $\vec{B}$ are perpendicular

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

C. $\vec{A}$ and $\vec{B}$ have the same magnitude

D. $\vec{A} \cdot \vec{B} = 0$

Answer: A::D

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9. Two projectiles, thrown from the same point with the same magnitude of velocity . Have angles 60° and 30° of their projection. Then their

A. maximum height attained are the same

B. horizontal ranges are the same

C. magnitudes of velocity at the instants of hitting the ground are the same

D. times of flight are the same

Answer: B::C

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10. A body is projected with a velocity u at an angle θ with the horizontal . At t= 2s , the body makes an angle 30° with the horizontal . 1 s later, it attains its maximum height . Then

A. $u = 20\sqrt{3} m/s$

B. $\theta = 60^\circ$

C. $\theta = 45^\circ$

D. $u = \frac{20}{\sqrt{3}} m/s$

Answer: A::B

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11. $\vec{A} \perp \vec{B}, \vec{C}$ is coplanar with $\vec{A}$ and $\vec{B}$. Therefore,

A. $\vec{A} = x\vec{B} + y\vec{C}$, where x and y are scalars

B. $\vec{A} \cdot \left(\vec{B} \times \vec{C}\right) = 0$

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

D. $\vec{A} \cdot \vec{B} = 0$

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

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Entrance Corner Comprehension Type

1. A farmer goes 500 m due north, 400 m due east and 200m due south to reach his field. He takes 20 min to

reach the field .

How much distance has he to walk to reach the field ?

A. 900 m

B. 1100 m

C. 1300 m

D. 700 m

Answer: B

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2. A farmer goes 500 m due north, 400 m due east and 200m due south to reach his field. He takes 20 min to

reach the field .

What is the displacement from his house to the field ?

A. 550 m

B. 700 m

C. 500 m

D. 714 m

Answer: C

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3. A farmer goes 500 m due north, 400 m due east and 200m due south to reach his field. He takes 20 min to

reach the field .

What is the average speed of the farmer during the walk?

A. $35m \cdot \min^{-1}$

B. $63m \cdot \min^{-1}$

C. $55m \cdot \min^{-1}$

D. $65m \cdot \min^{-1}$

Answer: C

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4. A farmer goes 500 m due north, 400 m due east and 200m due south to reach his field. He takes 20 min to reach the field .

What is the average velocity of the farmer during the walk ?

A. $27m \cdot \min^{-1}$

B. $30m \cdot \min^{-1}$

C. $35m \cdot \min^{-1}$

D. $25m \cdot \min^{-1}$

Answer: D

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5. A man crosses a river in a boat. If he crosses the river in minimum time he takes 10 min with a drift 120 m . If he crosses the river taking the shortest path, he takes 12.5

min.

what is the width of the river ?

A. 250 m

B. 200 m

C. 300 m

D. 230 m

Answer: C

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6. A man crosses a river in a boat. If he crosses the river in minimum time he takes 10 min with a drift 120 m . If he crosses the river taking the shortest path, he takes 12.5

min.

What is the velocity of the boat in still water ?

A. $21m \cdot \min^{-1}$

B. $24m \cdot \min^{-1}$

C. $20m \cdot \min^{-1}$

D. $18m \cdot \min^{-1}$

Answer: C

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7. A man crosses a river in a boat. If he crosses the river in minimum time he takes 10 min with a drift 120 m . If he crosses the river taking the shortest path, he takes 12.5

min.

What is the speed of the current ?

A. $13m \cdot \min^{-1}$

B. $12m \cdot \min^{-1}$

C. $14m \cdot \min^{-1}$

D. $15m \cdot \min^{-1}$

Answer: C

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8. A particle is projected from the surface of the earth with a speed of $20m \cdot s^{-1}$ at an angle 30° with the horizontal . The time of flight of that particle is

A. 3 s

B. 4 s

C. 2 s

D. 1 s

Answer: B

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9. A particle is projected from the surface of the earth with a speed of $20m \cdot s^{-1}$ at an angle 30° with the horizontal . The range of that particle is

A. 10 m

B. $12\sqrt{2}$m

C. $20\sqrt{3}$ m

D. 30 m

Answer: C

Watch Video Solution

10. A particle is projected from the surface of the earth with a speed of $20m \cdot s^{-1}$ at an angle 30° with the horizontal .

The maximum height the particle can reach is

A. 3 m

B. 7 m

C. 5 m

D. 12 m

Answer: B

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Entrance Corner Integer Answer Type

1. A projectile is launched from the ground and it returns to the ground level. The horizontal range of the projectile is R= 175 m . If the horizontal component of the projectile's velocity at any instant is $25m \cdot s^{-1}$, then determine the time of flight of the projectile.

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2. Two men are running on a straight north -south track. The person A moves north with a speed of $5m \cdot s^{-1}$ while B moves south with a speed of $2m \cdot s^{-1}$. Determint the velocity (magnitude only) of

(i) A with respect to B .

(ii) the ground with respect to A .

(iii) B with respect to A .

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Examination Archive With Solutions Wbchse

1. The angle subtended by the vector $\vec{A} = \sqrt{3}\hat{i} - \hat{j}$ with the y-axis is

A. 60°

B. 240°

C. 120°

D. 45°

Answer: C

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2. Two non-collinear unit vector $\hat{a}$ and $\hat{b}$ are such that $\left|\hat{a}+\hat{b}\right| = \sqrt{3}$. Find the angle between the two unit vectors.

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3. The ratio between the values of cross product and dot product of two vectors is $\frac{1}{\sqrt{3}}$. The angle between then is

A. 30°

B. 45°

C. 60°

D. 120°

Answer: A

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4. $\left(2\hat{i}+\hat{j}-\hat{k}\right)$ N force is acting on a body of 10 kg mass, if the body starts from rest, then after 20 sec what will be

its velocity ?

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5. A body is projected with initial velocity u making an angle θ with the horizontal direction . Find the value of θ for which the horizontal range becomes maximum . Find the maximum range also.

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6. If $\vec{A} + \vec{B} + \vec{C} = 0$ then show that $\vec{A} \times \vec{B} = \vec{B} \times \vec{C} = \vec{C} \times \vec{A}$.

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7. If $\vec{A} \cdot \vec{B} = \left|\vec{A} \times \vec{B}\right|$ then the angle between $\vec{A}$ and $\vec{B}$ is

A. π

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

C. 0

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

Answer: D

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8. $\vec{a} \times \vec{b}$ is not equal to $\vec{b} \times \vec{a}$. Why ?

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9. Find a unit vector which is perpendicular to both $\vec{A} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{B} = 2\hat{i} - 2\hat{j} + 4\hat{k}$.

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10. Determine the relation between the kinetic energy of a projectile at maximum height and at initial position for maximum range.

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11. What is null vector ?

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12. Which quantity remains unchanged in case of a projectile ?

A. momentum

B. kinetic energy

C. vertical component of velocity

D. horizontal component of velocity

Answer:

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13. Determine the unit vector along the vector $\vec{A} = \hat{i} + 3\hat{j} + 4\hat{k}$.

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14. At what angle should the two forces $\left(\vec{A} + \vec{B}\right)$ and $\left(\vec{A} - \vec{B}\right)$ act so that their resultant will be $\sqrt{3A^2 + B^2}$.

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15. What do you mean by relative velocity ?

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16. If $\vec{A} = 0.4\hat{i} + 0.3\hat{j} + c\hat{k}$ be a unit vector , then what is the value of c ?

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17. Find the angle between the two vectors $\vec{A} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{B} = 2\hat{i} + \hat{j} + 3\hat{k}$.

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18. A particle is projected with an initial velocity u, making an angle θ with the horizontal. Find the equation of the trajectory of the particle at any instant after the

projection. Find expressions for the maximum height gained by the particle and its horizontal range.

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19. What are the quantities that remain constant during the motion of the particle ? [(2+1+1)+1]

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Examination Archive With Solutions Wbjee

1. Consider three vectors $\vec{A} = \hat{i} + \hat{j} - 2\hat{k}, \vec{B} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{C} = 2\hat{i} - 3\hat{j} + 4\hat{k}$

. A vector $\vec{X}$ of the form $\alpha\vec{A} + \beta\vec{B}$ (α and β are numbers) is perpendicular to $\vec{C}$. The ratio of α and β is

A. $1:1$

B. $2:1$

C. $-1:1$

D. $3:1$

Answer: A

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2. A cricket ball thrown across a field is at heights h_1 and h_2 from the point of projection at times t_1 and t_2 respectively after the throw. The ball is caught by a fielder

at the same height as that of projection. Time of flight of the ball in this journey is

A. $\frac{h_1t_2^2 - h_2t_1^2}{h_1t_2 - h_2t_1}$

B. $\frac{h_1t_2^2 + h_2t_2^2}{h_2t_1 + h_1t_2}$

C. $\frac{h_1t_2^2 + h_2t_1^2}{h_1t_2 + h_2t_1}$

D. $\frac{h_1t_1^2 - h_2t_2^2}{h_1t_1 - h_2t_2}$

Answer: A

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3. Partical A moves along x -axis with a uniform velocity of magnitude 10 m/s . Particle B moves with uniform velocity 20 m/s along a direction making an angle of 60° with the

positive direction of x-axis as shown in the figure 2.87 . The relative velocity of B with respect of that of A is

A. 10 m/s along x-axis

B. $10\sqrt{3}m/s$ along y-axis (perpendicular to x-axis)

C. $10\sqrt{5}m/s$ along the bisection of the velocities of A and B

D. 30 m/s along negative x-axis

Answer: B

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4. The vectors $\vec{A}$ and $\vec{B}$ are such that $\left|\vec{A}+\vec{B}\right|=\left|\vec{A}-\vec{B}\right|$.

The angle between two vectors will be

A. 0°

B. 60°

C. 90°

D. 45°

Answer: C

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5. Three vectors $\vec{A} = a\hat{i} + \hat{j} + \hat{k}, \vec{B} = \hat{i} + b\hat{j} + \hat{k}$ and $\vec{C} = \hat{i} + \hat{j} + c\hat{k}$ are mutually perpendicular $\left(\hat{i}, \hat{j} \text{ and } \hat{k} \text{ are unit vectors along X, Y, and Z axis respectively}\right)$.

The respective values of a,b and c are

A. 0,0,0

B. $-\frac{1}{2}, \frac{-1}{2}, \frac{-1}{2}$

C. 1,-1,1

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

Answer: B

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6. In a triangle ABC the sides AB and AC are represented by the vectors $3\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$ respectively. Calculate the angle $\angle ABC$.

A. $\cos^{-1}\sqrt{\frac{5}{11}}$

B. $\cos^{-1}\sqrt{\frac{6}{11}}$

C. $\left(90^\circ-\cos^{-1}\sqrt{\frac{5}{11}}\right)$

D. $\left(180^\circ-\cos^{-1}\sqrt{\frac{5}{11}}\right)$

Answer: A

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Examination Archive With Solutions Aipmt

1. A projectile is fired from the surface of the earth with a velocity of $5m \cdot s^{-1}$ and angle θ with the horizontal . Another projectile fired from another planet with a velocity of $3m \cdot s^{-1}$ 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 $m \cdot s^{-2}$) (given $g = 9.8m \cdot s^{-2}$)

A. 3.5

B. 5.9

C. 16.3

D. 110.8

Answer: A

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2. 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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3. A ship A is moving Westwards with a speed of 10 km/h and a ship B 100 km South of A is moving northwards with a speed of 10 km/h . The time after which the distance between them becomes shortest is

A. 0 h

B. 5 h

C. $5\sqrt{2}$h

D. $10\sqrt{2}$h

Answer: B

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Examination Archive With Solutions Neet

1. 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. 90°

B. 45°

C. 180°

D. 0°

Answer: A

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2. A ball of mass 1 kg is thrown vertically upwards and returns to the ground after 3 seconds. Another ball, thrown at 60° with vertical also stays in air for the same time before it touches the ground . The ratio of the two heights are

A. $1:3$

B. $1:2$

C. $1:1$

D. $2:1$

Answer: C

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3. The angle between $\vec{A} - \vec{B}$ and $\vec{A} \times \vec{B}$ is $\left(\vec{A} \neq \vec{B}\right)$

A. 60°

B. 90°

C. 120°

D. 45°

Answer: B

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4. The moment of the force, $vevF = 4\hat{i} + 5\hat{j} - 6\hat{k}$ at (2,0,-3), about the point (2,-2,-2) is given by

A. $-7\hat{i}-8\hat{j}-4\hat{k}$

B. $-4\hat{i}-\hat{j}-8\hat{k}$

C. $-8\hat{i}-4\hat{j}-7\hat{k}$

D. $-7\hat{i}-4\hat{j}-8\hat{k}$

Answer: D

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Cbse Scanner

1. A body is projected horizontally from the top of a building of height h. Velocity of projection is u. Find

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2. A body is projected horizontally from the top of a building of height h. Velocity of projection is u. Find the time it will take to reach the ground ,

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3. A body is projected horizontally from the top of a building of height h. Velocity of projection is u. Find the horizontal distance between the foot of the building and the ground where it will strike.

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4. A body is projected horizontally from the top of a building of height h. Velocity of projection is u. Find velocity with which the body will reach the ground.

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5. Explain why it is easier to pull a lawn mower than to push it.

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6. On a two-lane car A is travelling with a speed of 36 $\mathrm{km.h}^{-1}$. Two cars B and C approach car A in opposite directions with a speed of 54 $\mathrm{km.h}^{-1}$ each. At a certain

instant when the distance AB is equal to AC both being 1 km, B decides to overtake A before C does. What minimum acceleration of car B is required to avoid an accident?

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7. Prove that the path of projectile is parabolic.

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8. Find the condition for which $\left|\vec{A}+\vec{B}\right|=\left|\vec{A}-\vec{B}\right|$?

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9. Two paraller rail tracks run north south . Train A moves north with a speed of $54 km / h$ and train B moves south with a speed of 90 km/h . What is the

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10. velocity of B with respect to A

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11. velocity of ground with respect to B

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12. velocity of a monkey, running on the roof of the train A against its motion with a velocity of 18 km/h with respect to the train, as observed by a man standing on the ground.

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13. What is a projectile ? Obtain an expression for: maximum height , time of flight and the horizontal range when a projectile is fired at an angle θ with the horizontal.

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14. Is it possible to have constant of change of velocity when velocity changes both in magnitude and direction ?

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15. What are two angles of projection of a projectile projected with velocity 30 m/s , so that the horizontal range is 45m . Take $g = 10\frac{m}{s^2}$.

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16. If a projectile has a constant initial speed and angle of projection, find the relation between the changes in the

horizontal range due to change in acceleration due to gravity.

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17. An old man walks 10 m due east from his house and then turns to his left at an angle of 60° with east. He then walks 10 m in that direction and falls down on the ground and got injured. His grandson observing him moves straight towards him from the initial position of his grandfaher, helped him to stand and take him safely to home .

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18. Should the boy follow the same path followed by the old man ? If not, why?

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19. What are the values you suggest for boy reply ?

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