PHYSICS

BOOKS - AAKASH SERIES

MOTION IN A PLANE

PROBLEMS

1. The speed with which a bullent can be fired is $150ms^{-1}$. Calculate the greatest distance to which it can be projected and also the maximum height to which it would rise .

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2. The horizontal range of a projectile is $2\sqrt{3}$ times its maximum height. Find the angle of projection.

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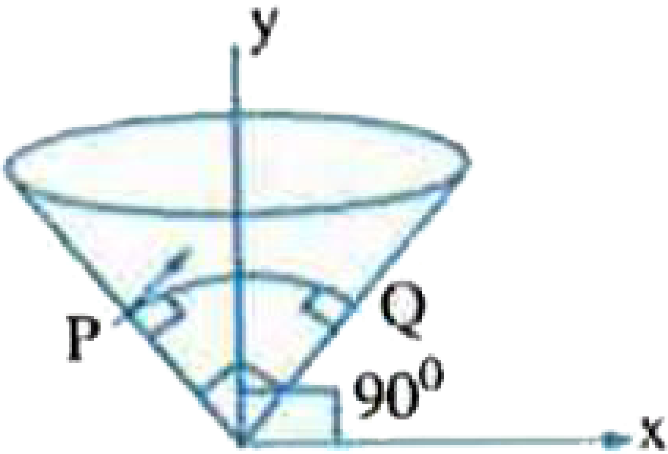
3. A particle is projected from point P with velocity $5\sqrt{2}ms^{-1}$ prependicular to the surface of a hollow right angle cone whose axis is vertical . It collides at Q normally. The time of the flight of the particle is .



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4. If at point of projection , the velcoity of particle is "u" and is direction at an angle α to the horizontal , then show that it will be moving at right angles to the its initial direction after a time $\frac{(u \operatorname{cosec} \alpha)}{g}$

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5. If $y = x - \frac{1}{2}x^2$ is the equation of a trajectory , find the time of flight.

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6. If R is the horizontal range for θ inclination and h is the maximum height reached by the projectile, show that the maximum ragne is given by $\frac{R^2}{8h} + 2h.$

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7. A cannon and a target are 5.10Km apart and located at the same level. How soon will the shell launched with the initial velocity 240m/s reach the target in the absence of air drag?

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8. A hunter aims a gun at a monkey hanging from a tree some distance away. The monkey drops from the branch at the moment he fires the gun hoping to avoid the bullet. Explain why the monkey made a wrong move.

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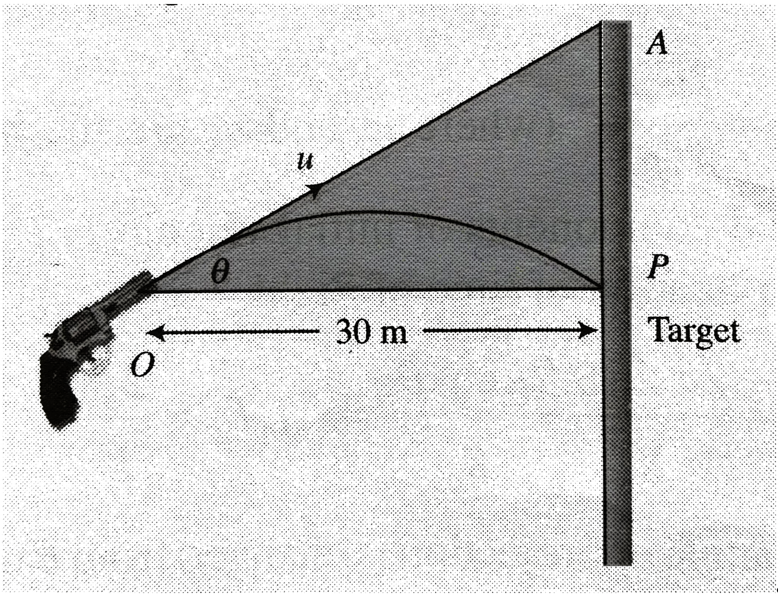
9. A bullet with muzzle velocity $100ms^{-1}$ is to be shot at a target $30m$ away in the same horizontal line. How high above the target must the rifle be aimed so that the bullet will hit the target ?



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10. A particle is projected from the ground with an initial speed u at an angle θ with the horizontal. The average velocity of the particle between its point of projection and highest point of trajectory is

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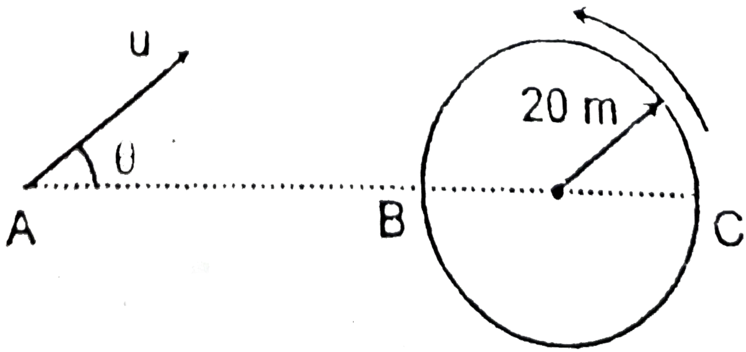
11. A particle is moving along a vertical circle of radius $R = 20m$ with a constant speed $v = 31.4m/s$ as shown in the figure. Straight line ABC is horizontal and passes through the centre of the circle. A shell is fired from point A at the instant when particle is at C. The distance AB is $20\sqrt{3}m$ and shell collides with the particle at B, if smallest possible value of the angle of projection is $k \times 10^{\circ}$ then find the value of k.



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12. The trajectory of a projectile in a vertical plane is $y = ax - bx^2$, where a and b are constant and x and y are, respectively, horizontal and vertical distances of the projectile from the point of projection. The maximum height attained by the particle and the angle of projectile from the horizontal are.

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13. A particle moves in the plane xy with constant acceleration 'a' directed along the negative y-axis. The equation of motion of the particle has the form $y = px - qx^2$ where p and q are positive constants. Find the velocity of the particle at the origin of co-ordinates.

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14. A stone is projected from the ground in such a direction so as to hit a bird on the top of a telegraph post of height h and attains the maximum height of 2h above the ground. If at the insatant of projection, the bird were to fly away horizontally with a uniform speed, find the ratio between the horizontal velocity of bird and the horizontal component of velocity of stone, if the stone hits the bird while descending.

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15. A projectile shot at angles of 45° above the horizontal strikes a building 30 m away at a point 15 m above the point of projection. Find : (a) the speed of projection . (b) the magnitude and direction of velocity of projectile when it strikes the building .

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16. A particle is projected from a point O with velocity u in a direction making an angle α upward with the horizontal. AT P , it is moving at right angles to its initial direction of projection . Its velocity at P is .

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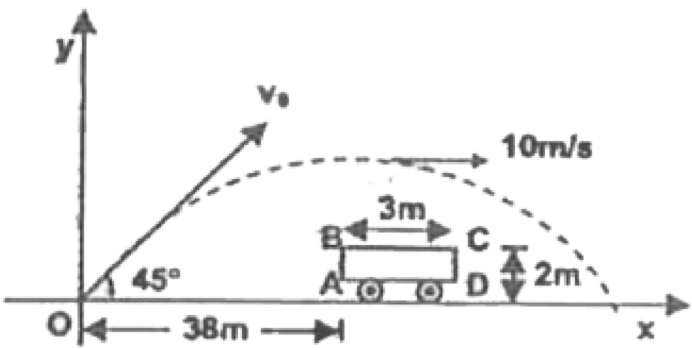
17. A ball is thrown from the origin in the x-y plane with velocity $28.28 m/s$ at an angle of 45° with x-axis.At the same instant a trolley also starts moving with uniform velocity of $10 m/s$ along the positive x-axis . Initially , the trolley is located at 38m from the origin. Determine the time at which the ball hits the trolley.



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18. A particle is projected with a velocity $\bar{v} = a\hat{i} + b\hat{j}$. Find the radius of curvature of the trajectory of the particle at (i) point of projection (ii) highest point .

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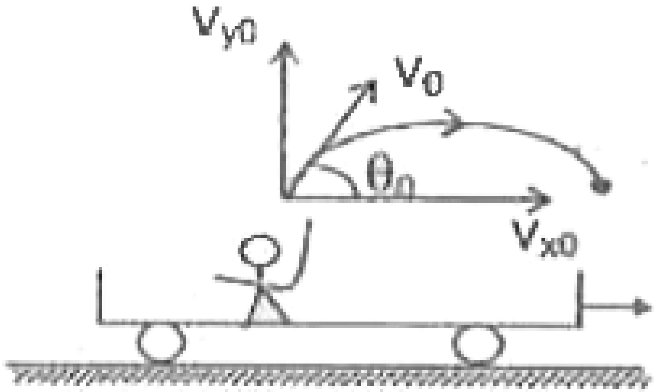
19. A boy is standing inside a train moving with a constant velocity of magnitude 10 m/s. He throws a ball vertically up with a speed 5

m/s relative to the train. Find the radius of curvature of the path of the L ball just at the time of projection.



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20. A block of ice starts sliding down from the top of an inclined roof of a along a line of the greatest slope. The inclination of the roof with the horizontal is 30°. The heights of the highest and lowerst points of the roof are 8.1 m and 5.6 m respectively.At what horizontal distance from the lowest point will the block hit the ground ? Neglect air friction . $\left[g = 9.8 m / s^{2}\right]$.

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

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22. Two particles move in a uniform gravitational field with an acceleration g. At the initial moment the particles were located over a tower at one point and moved with velocities $v_1 = 3m/s$ and $v_2 = 4m/s$ horizontally in opposite directions. Find the distance between the particles at the moment when their velocity vectors become mutually perpendicular.

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23. A ball rolls off the top of a stariway with a horizontal velocity magnitude 150 cm/sec. The steps are 20 cm high and 20 cm wide . Which step will the ball hit first ?

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24. Two bodies are projected from the same point with equal speeds in such directions that they both strike the same point on a plane whose inclination is β. If α the angle of projection of the first body with the horizontal , show that the ratio of their time of flights is

$$\frac{\sin(\alpha - \beta)}{\cos\alpha}$$

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25. A particle projected with velcoity v_0 strikes at right α plane through the point of projection .

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26. A body has maximum range R_1 when projected up the plane. The same body when projected down the inclined plane, it has maximum range R_2. Find the maximum horizontal range. Assume equal speed of projection in each case and the body is projected onto the inclined plane in the line of the greatest slope.

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27. A ball falls freely form a height onto and smooth inclined plane forming an angle a with the horizontal. Find the ratio of the distance between the points at which the jumping ball strikes the inclined plane. Assume the impacts to be elastic.

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28. A cannon fires successively two shells from the same point with velocity $V_0 = 250 m/s$, the first at the angle $\theta_1 = 60^\circ$ and the second at the angle $\theta_2 = 45^\circ$ to the horizontal, the azimuth being the same. Neglecting the air drag, find the approximate time interval between firings leading to the collision of the shells $(g = 9.8 m/s^2)$

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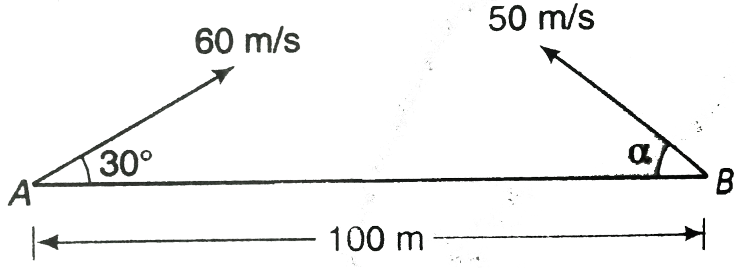
29. A particle A is projected with an initial velocity of $60 m / s$ at an angle 30° to the horizontal. At the same time a second particle B is projected in opposite direction with initial speed of $50 m / s$ from a point at a distance of 100 m from A. If the particles collide in air, find (a)the angle of projection α of particle B, (b) time when the collision takes place and (c) the distance of P from A, where collision occurs.

$(g = 10m / s^2)$



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30. Three vectors $\vec{A}, \vec{B}, \vec{C}$ are shown in the figure angle between (i) $\vec{A}$ and $\vec{B}$ (ii) $\vec{B}$ and $\vec{C}$, (iii) $\vec{A}$ and $\vec{C}$

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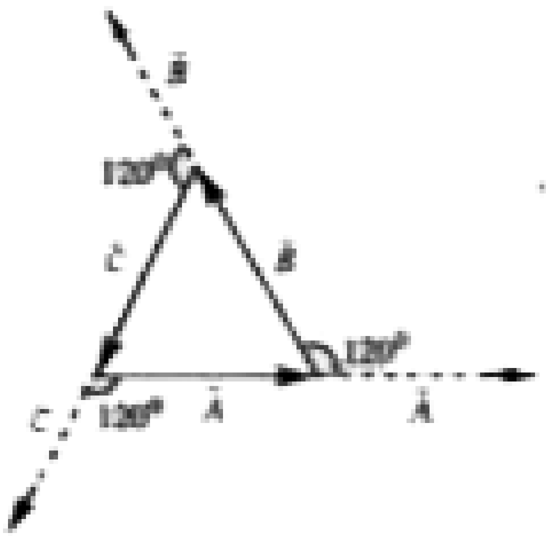
31. If A,B,C represents the three sides of an equilateral triangle taken in the same order then find the angle between i) A and B ii) B and C iii) A and C.



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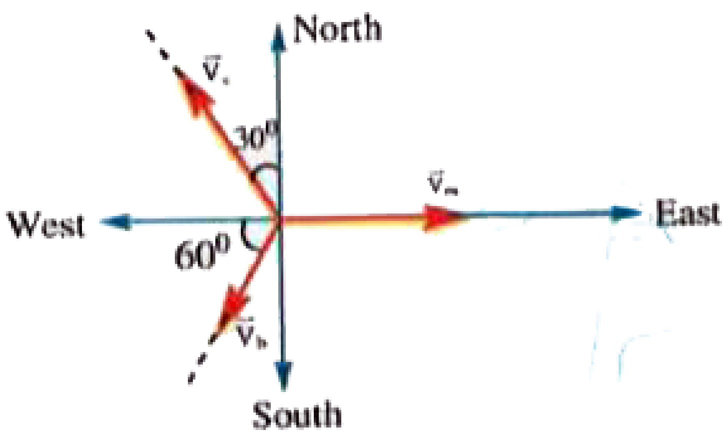
32. A man walks east with certain velocity .A car is travelling along a road which is 30° west of north . While a bus is travelling in another road which is 60° south of west . Find the angle between velocity vector of (a) man and car (b) car and bus (c) bus and man



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33. A vector A makes on angle 30º with the y-axis in anticlockwise direction. Another vector B makes on angle 30º with the x-axis in clockwise direction. Find angle between yectors A and B.

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34. A vector $\sqrt{3}\hat{i} + \hat{j}$ rotates about its tail through an angle 30° in clock wise direction then the new vector is

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35. A weight Mg is suspended from the middle of a rope whose ends are at the same level. The rope is no longer horizontal. The minimum tension required to completely straighten the rope is

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

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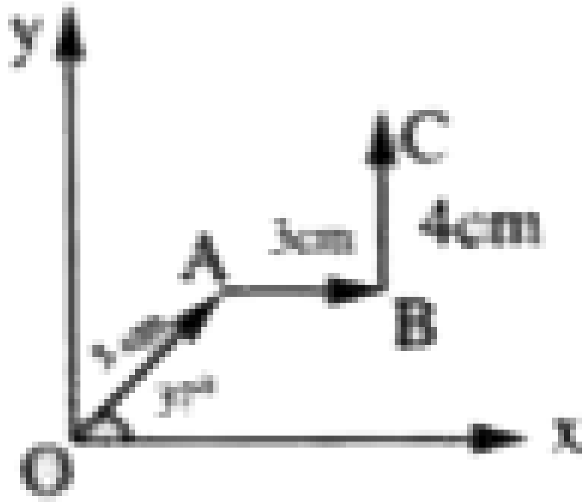
37. Find the resultant of the vectors shown in figure.



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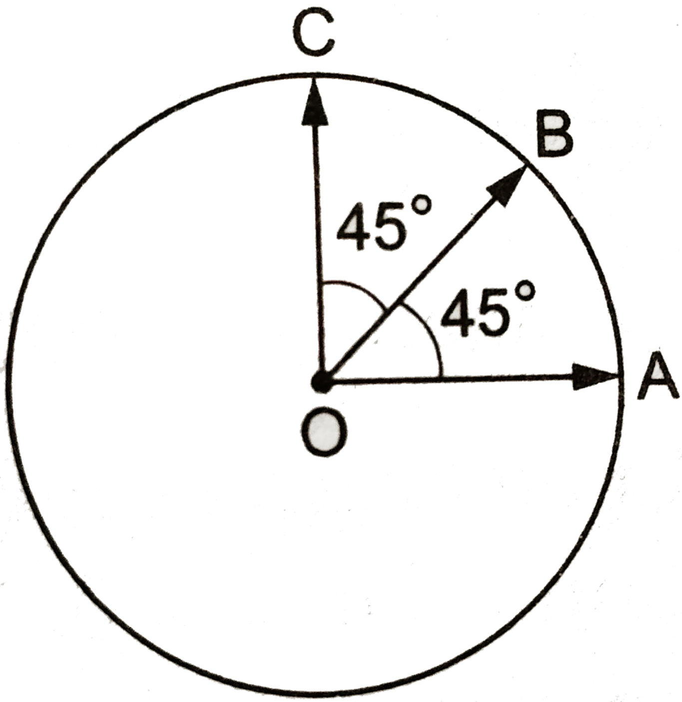
38. Find the resultant of the three vectors $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ shown in figure. Radius of the circle is R.



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

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40. Vector $\vec{A}$ is 2 cm long and is 60° above the x - axis in the first quadrant, vector $\vec{B}$ is 2cm

long and is 60º below the x - axis in the fourth quadrant. Find $\overrightarrow{A} + \overrightarrow{B}$

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41. A vector has component along the X-axis equal to 25 unit and along the Y-axis equl to 60 unit. Find the magnitude and direction of the vector.

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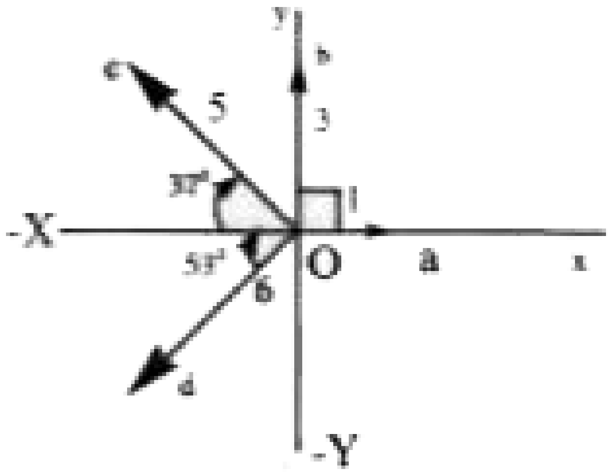
42. Find the resultant of the vectors shown in fig by the component method



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43. A particles is moving eastwards with a velocity of $5ms^{-1}$. In 10 s, the velocity changes to $5ms^{-1}$ northwards. The average acceleration in this time is

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44. Two vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ have equal magnitudes. The magnitude of $\left(\overrightarrow{A}+\overrightarrow{B}\right)$ is n times the magnitude of $\left(\overrightarrow{A}-\overrightarrow{B}\right)$. The angle between $\overrightarrow{A}$ and $\overrightarrow{B}$ is :

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45. Two forces whose magnitudes are in the ratio $3:5$ give a resultant of 28N. If the angle of their inclination is 60°, find the magnitude of each force.

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46. If vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ are $3\hat{i} - 4\hat{j} + 5\hat{k}$ and $2\hat{i} + 3\hat{j} - 4\hat{k}$ respectively then the unit vector parallel to $\overrightarrow{A} + \overrightarrow{B}$

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47. If magnitude of the resultant of two vectors equal of magnitude, is equal to the magnitude of either of the vectors, what is the angle between them ?

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

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

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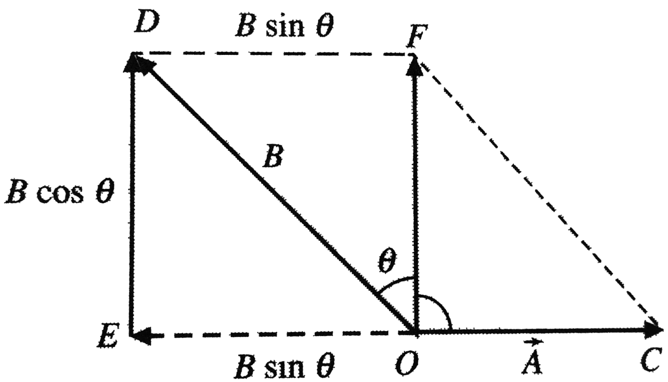
50. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to the vector $\vec{A}$ and its magnitude is equal to half of the magnitude of the vector $\vec{B}$. Find out the angles between $\vec{A}$ and $\vec{B}$.



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

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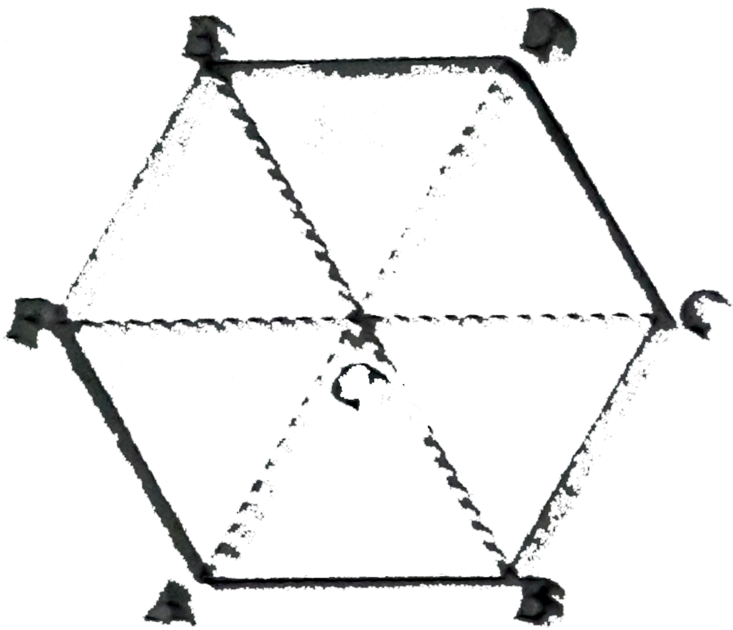
52. IN the figure shown ,ABCDEF is a regular hexagon . What is the of

$AB + AC + AD + AE + AF$?



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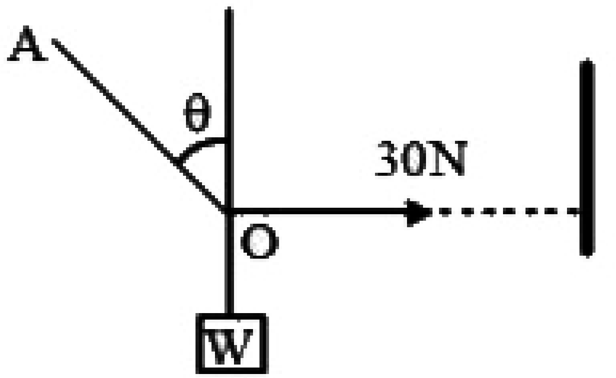
53. As shown in figure the tension in the horizontal cord is 30 N. The weight W and tension in the string OA in Newton are :



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54. The position of a particle is given by

$r = 3t\hat{i} + 2t^2\hat{j} + 8\hat{k}$

where, t is in seconds and the coefficients have the proper units for r to be in metres.

(i) Find v (t) and a(t) of the particles.

(ii) Find the magnitude and direction of v(t) and a(t) at $t = 1s$.

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55. Velocity and acceleration of a particle at time $t = 0$are $u = (2\hat{i} + 3\hat{j})m/s$ and $a = (4\hat{i} + 3\hat{j})m/s^2$ respectively. Find the velocity and displacement if particle at $t = 2s$.

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56. The coordinates of a body moving in a plane at any instant of time t are $x = \alpha t^2$ and $y = \beta t^2$. The velocity of the body is

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

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

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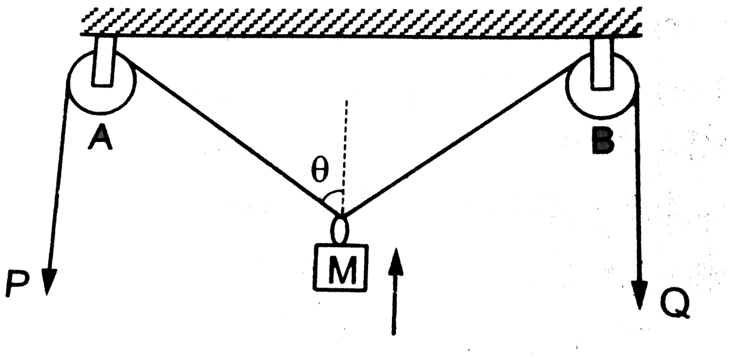
58. In the arrangement shown in figure the ends P and Q of an inextensible string move downwards with uniform speed u. Pulleys A and B are fixed. The mass M moves upwards with a speed



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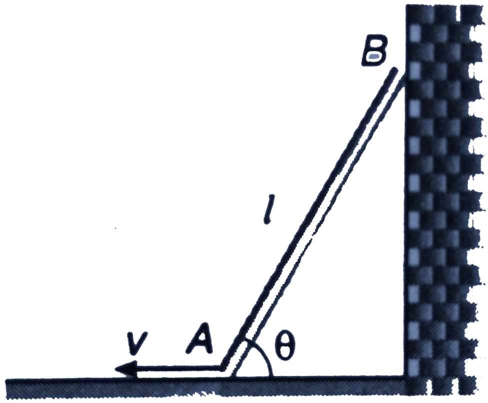
59. Figure shows a rod of length l resting on a wall and the floor. Its lower end A is pulled towards left with a constant velocity v. Find the velocity of the other end B downward when the rod makes an angle θ with the horizontal.



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60. An object A is moving with 5 m/s and B is moving with 20 m/s in the direction . (positive x-axis)

find velocity of A with respect to B .

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61. Two object A and B are moving each with velocities 10 m/s. A is moving towards East and B is moving towards North from the same point as shown. Find velocity of A relative to B $\left(\overrightarrow{V}_{AB}\right)$

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62. What are the speeds of two objects if they move uniformly towards each other, they get 4 m closer in each second and if they move uniformly in the same direction with the original speeds they get 4 m closer in each 10 sec?

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63. At a metro station, a girl walks up a stationary escalator in time t_1. If she remains stationary on the escalator, then the escalator take her up in time t_2. The time taken by her to walk up on the moving escalator will be

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64. Ship A is 10km due west of ship B. Ship A is heading directly north at a speed of 30 kmph while ship B is heading in a direction 60° west of north at a speed 20kmph. Their closest distance of approach will be........

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65. Let us consider a boat which moves with a velcity $v_{be} = 5kmh^{-1}$ relative to water, At time $t = 0$, the boat passes through a piece of cord floating in water while moving downstream. If itturns back at time $t = t_1$, when and wher does the boat meet the cork again ? Assume $t_1 = 30 \text{ min}$,

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66. A swimmer crosses a flowing stream of width ω to and fro in time t_1. The time taken to cover the same distance up and down the stream is t_2. It t_3 is the time the swimmer would take to swim a distance 2ω in still water, then

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67. Two persons P and Q crosses the river starting from point A on one side to exactly opposite point B on the other bank of the river. The person P crosses the river in the shortest path. The person Q crosses the river in shortest time and walks back to point B. Velocity of river is 3 kmph and speed of each boat is 5 kmph w.r.t river. If the two persons reach the point B in the same time, then the speed of walk of Q is

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68. Rain is falling vertically with a speed of 20 m/s relative to air. A person is running in the rain with a velocity of 5 m/s and a wind is also blowing with a speed of 15 m/s (both towards east). Find the angle with the vertical at which the person should hold his umbrella for best protection from rain

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69. To a man walking at the rate of $3km/h$ the rain appear to fall vetically douwnwards. When he increases his speed $6km/h$ it appears to meet him at an angle of 45° with vertically. Find the speed of rain.

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70. Rain is falling vertically with a speed of $1ms^{-1}$. A woman rides a bicycle with a speed of 1.732 ms^{-1} in east to west direction. What is the direction in which she should hold her umbrella ?

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

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72. A bullet fired at an angle of 30° with the horizontal hits the ground 3.0 km away. By adjusting its angle of projection, can one hope to hit a target 5.0 km away? Assume the muzzle speed to be fixed, and neglect air resistance.

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73. A cannon and a target are 5.10Km apart and located at the same level. How soon will the shell launched with the initial velocity

240m/s reach the target in the absence of air drag?

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74. The ceiling of a long hall is 25 m high. What is the maximum horizontal distance that a ball thrown with a speed of $40m/s$ can go without hitting the ceilling of the hall ? (g = $10m/s^2$)

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75. The speed with which a bullent can be fired is $150ms^{-1}$. Calculate the greatest distance to which it can be projected and also the maximum height to which it would rise .

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76. A hunter aims his gun and fires a bullet directly toward's a monkey sitting on a distance tree. At the intant the bullet leaves the barrel of the gun, the monkey drops from the tree :

(i) Will the bullet hit the aim ?

(ii) What Path of bullet will be appeared to monkey ?

(iii) If monkey does not drop from the tree will bullet hit the aim ?

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77. A particle is projected from the origin in X-Y plane. Acceleration of particle in Y direction is a. If equation of path of the particle is

$y = ax - bx^2$, then find initial velocity of the particle.

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78. A ball is throw from the top of a tower of 61 m high with a velocity $24.4ms^{-1}$ at an elevation of 30° above the horizon. What is the distance from the foot of the tower to the point where the ball hits the ground ?

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79. A particle is thrown over a triangle from one end of a horizontal base and after grazing the vertex falls on the other end of the base. If α and β be the base angles and θ the angle of projection, prove that $\tan\theta = \tan\alpha + \tan\beta$.

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80. The velocity of a projectile when it is at the greatest height is $\left(\sqrt{2/5}\right)$ times its velocity when it is at half of its greatest height. Determine its angle of projection.

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81. A foot ball is kicked of with an inirial speed of 19.6 m/sec at a projection angle 45° . A receiver on the goal line 67.4 m away in the direction of the kick starts running to meet the ball at that in stant. What must his speed be if he is to catch the ball before it hits the ground?

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82. The maximum range of a projectile is 500m. If the particle is thrown up a plane, which is inclined at an angle of 30° with the same speed, the distance covered by it along the inclined plane will be

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83. A grasshopper can jump a maximum distance $1.6m$. It spends negligible time on the ground. How far can it go in $10s$?

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84. A projectile is thrown with a velocity of $10\sqrt{2}ms^{-1}$ at an angle of 45° with the horizontal. The time interval between the moments when the speeds are $\sqrt{125}ms^{-1}$ is (g=10ms^{-2})

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85. A projectile of mass 2 kg has velocities 3 m/s and 4 m/s at two points during its flight in the uniform gravitational field of the earth. If these two velocities are perpendicular to each other, then the minimum kinetic energy of the particle during its flight is:

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86. The horizontal range and miximum height attained by a projectile are R and H, respectively. If a constant horizontal acceleration $a = g/4$ is imparted to the projectile due to wind, then its horizontal range and maximum height will be

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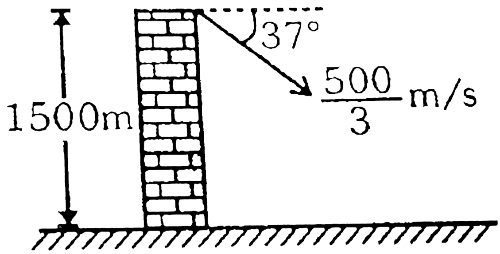
87. A particle is projected from a towaer as shown in figure, then the distance from the foot of the tower where it will strike the ground will be :- $\left(\text{take } g = 10m / s^2\right)$



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88. A golfer standing on level ground hits a ball with a velocity of $52ms^{-1}$ at an angle θ above the horizontal. If $\tan\theta = 5/12$, then find the time for which then ball is atleast $15m$ above the ground $\left(takeg = 10ms^{-2}\right)$.

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89. A particle is projected from the ground with an initial speed u at an angle θ with the horizontal. The average velocity of the particle between its point of projection and highest point of trajectory is

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90. A particle is projected horizontally with speed u from the top of a plane inclined at an

angle θ with the horizontal. How far from the point of projection will the particle strike the plane?

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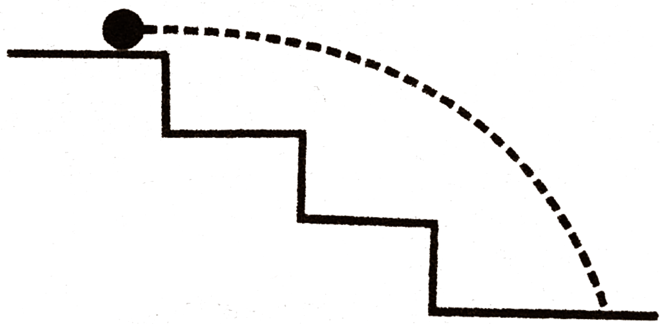
91. Two paper screens A and B are separated by a distance of 100m. A bullet pierces A and then B. the hole in B is 10 cm below the hole in A. if the bullet is travelling horizontally at the time of hitting A, then the velocity of the bullet at A is

92. Two particles move in a uniform gravitational field with an acceleration g. At the initial moment the particles were located over a tower at one point and moved with velocities $v_1 = 3m/s$ and $v_2 = 4m/s$ horizontally in opposite directions. Find the distance between the particles at the moment when their velocity vectors become mutually perpendicular.

93. A staircase contains three steps each $10 cm high$ and $20 cm$ wide. What should be the minimum horizontal velocity of the ball rolling off the uppermost plane so as to hit directly the lowest plane ? $(\text{in} ms^{-1})$.



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94. An enemy plane is flying horizontally at an altitude of 2 km with a speed of $300ms^{-1}$ An army man with an anti-aircraft gun on the ground sights hit enemy plane when it is directly overhead and fires a shell with a muzzle speed of $600ms^{-1}$. At what angle with the vertical should the gun be fired so as to hit the plane ?

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95. When a motor cyclist takes a U-turn in 4s what is the average angular velocity of the motor cyclist?

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96. A car is moving in a circular path with a uniform speed v. Find the magnitude of change in its velocity when the car rotates through an angle θ.

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97. What is the linear velocity of a person at equator of the earth due to its spinning motion? (Radius of the earth = 6400 km.)

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98. A stone is thrown horizontally with the velocity 15m/s. Determine the tangential and normal accelerations of the stone in 1 second after it begins to move.

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99. An insect trapped in a circular groove of radius 12 cm moves along the groove steadily and completes 7 revolutions in 100s. A) What is the angular speed. And the linear speed of the motion? B) is the acceleration vector a constant vector? What is the its magnitude?

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100. A ball of 200 g is at one end of a string of length 20 cm. It is revolved in a horizontal circle at an angular frequency of 6 rpm. Find (i) the angular velocity, (ii) the linear velocity, (iii) the centripetal acceleration, (iv) the centripetal force and (v) the tension in the string.

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SHORT ANSWER TYPE QUESTIONS

1. Show that the trajectory of an object thrown at certain angle with the horizontal is a parabola .

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2. Explain the terms , velocity and instantaneous velocity. When are they equal?

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3. Show that the maximum height and range of a projectile are $\frac{U^2 \sin^2 \theta}{2g}$ and $\frac{U^2 \sin 2\theta}{g}$ respectively where the terms have their ragular meanings .

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4. Discuss the motion of a body when projected horizontally from a height .

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5. Show that the maximum height reached by a projectile launched at an angle of 45° is one quarter of its range.

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6. Two boats A and B having same speed relative to river are moving in a river. Boat A moves normal to the river current as observed by an observer moving with velocity of river current. Boat B moves normal to the river as observed by the observer on the ground.

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VERY SHORT ANSWER TYPE QUESTIONS

1. What is the limitation of the first law of thermodynamics?

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2. If the trajectory of a body is parabolic in one frame, can it be parabolic in another frame that moves with a constant velocity with respect to the first frame? If not, what can it be?

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3. A ball is suspended by a cord from the ceiling of a motor car. What will be the effect on the position of the ball, if

(i) the car is moving with uniform velocity

(ii) car is accelerated

(iii) car is turning towards left?

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4. Can a body moving in two dimensional plane has a acceleration in only one dimension? Given an example.

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5. Mention the direction of motion of the projectile at the point of its maximum height .

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6. Which of the following chemical is a base analogue ?

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7. A stone is thrown horizontally and another is dropped freely from the same height . Which of the two will reach the ground early ? Explain ?

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8. What is the angle made by the trajectory of a projectile with horizontal at maximum height ?

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9. What is the angle made by the trajectory of a projectile with horizontal at maximum height ?

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10. What happens if a bomb is dropped from a moving war plane when it is exactly above the empty camp?

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NUMERICAL EXERCISE (LEVEL -1)

1. A bullet is projected upwards from the top of a tower of height 90 m with the velocity $30ms^{-1}$ making an angle 30° with the horizontal. Find the time taken by it to reach the ground is $(g = 10ms^{-2})$

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2. A body is projected with velocity u such that in horizontal range and maximum vertical heights are same.The maximum height is

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3. A stone is projected from the ground with a velocity of 20 m/s at angle 30° with the horizontal. After one second it clears a wall then find height of the wall. $(g = 10ms^{-2})$

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4. A stone is projectef from level ground such that its horizontal and vertical components of initial velocity are $u_x = 10\frac{m}{s}$ and $u_y = 20\frac{m}{s}$ respectively. Then the angle between velocity vector of stone one second before and one second after it attains maximum height is:

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5. A particle is projected from a horizontal floor with speed $10\frac{m}{s}$ at an angle 30° with the floor and striking the floor after sometime. State which is correct.

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6. A body projected with velocity 30 ms^{-1} reaches its maximum height in 1.5 s. Its range is (g=$10ms^{-2}$)

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7. The potential energy of a projectile at its maximum height is equal to its kinetic energy there. Its range for velocity of projection u is

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8. Two bodies are thrown at angles θ and (90-θ) from the same point with same velocity $25ms^{-1}$. If the difference between their maximum heights is 15m, the respective maximum heights are (g=10 ms^{-2})

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9. The minimum and maximum velocities of a projectile are $10ms^{-1}$ and $20ms^{-1}$ respectively. The horizontal range and maximum height are respectively (g=10 ms^{-2})

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10. A body is projected with a velocity of 30m/s to have to horizontal range of 45m. Find the angle of projection .

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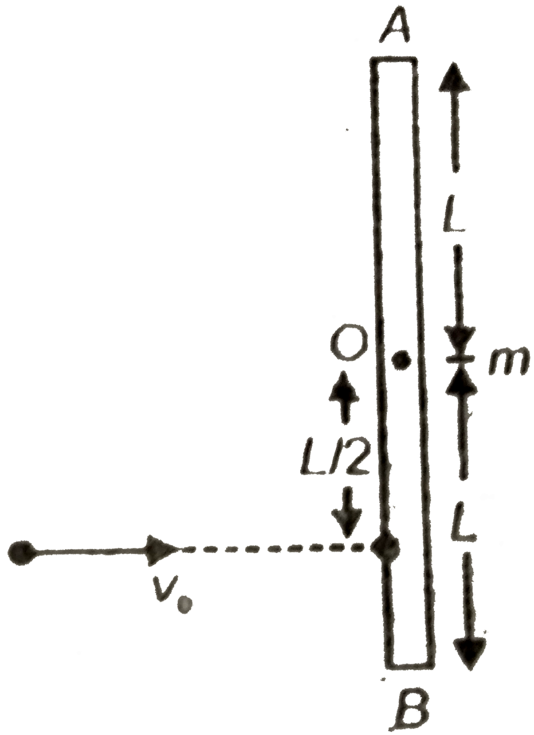
11. A rod AB of length $2L$ and mass m is lying on a horizontal frictionless surface. A particle of same mass m travelling along the surface hits the rod at distance $\frac{L}{2}$ from COM with a velocity v_0 in a direction perpendicular to rod and sticks to it.



Distance of point P on rod from B which is at rest immediately afte collision is

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12. A body is projected with an initial velocity of 58.8 m/s at angle 60º with the vertical. The vertical component of velocity after 2 sec is

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13. A call is connected between the point A and C of a circular conductor ABCD of centre O with angle $AOC = 60^\circ$. If B_1 and B_2 are the magnitudes of the magnetic field at O due ti the currents In ADC respectively, the ratio $\frac{B_1}{B_2}$ is

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14. A body is projected at 60° with the horizontal with the velocity of $10\sqrt{3}ms^{-1}$. Find the velocity of the projectile when it moves perpendicular to its initial direction.

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15. A particle is projected from a horizontal floor with speed $10\frac{m}{s}$ at an angle 30° with the floor and striking the floor after sometime. State which is correct.

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16. An object is projected vertically up from the earth's surface with velocity $\sqrt{Rg}$ where R is the radius of the earth and 'g' is the acceleration due to earth on the surface of earth. The maximum height reached by the object is nR. Find value of n.

A. its final velocity is ?

B.

C.

D.

Answer: $15ms^{-1}$

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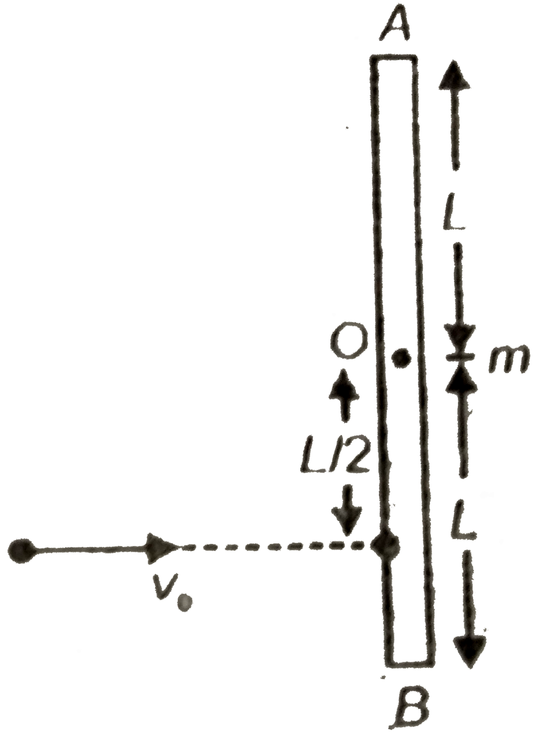
17. A rod AB of length $2L$ and mass m is lying on a horizontal frictionless surface. A particle of same mass m travelling along the surface hits the rod at distance $\frac{L}{2}$ from COM with a velocity v_0 in a direction perpendicular to rod and sticks to it.



Distance of point P on rod from B which is at rest immediately afte collision is

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18. Two tall buildings are 40 m apart. With what speed must a ball be thrown horizontally from a window 145 m above the ground in one building, so that it will enter a window 22.5 m above from the ground in the other?

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19. From the top of a cliff of height 19.6m a ball is projected horizontally. Find the time taken by the ball to reach the ground $(g = 9.8ms^{-2})$.

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20. A cricket player throws the ball to have the maximum horizontal range of 120m. If the throws the ball vertically with same velocity what is the maximum height it can reach ?

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21. A ball is projected horizontally from the top of a building 19.6 m high. If the line joining the point of projection to the point where it hits the ground makes an angle of 45° to the horizontal, the initial velocity of the ball is

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

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23. A stone is projected at angle of $\tan^{-1}(3/4)$ to the horizontal with a speed of $30ms^{-1}$. Find its position after 2 seconds. $g = 10ms^{-1}$?

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24. The equation of motion of a body are given such that horizontal displacement x = 3t meter and vertical displacement , $y = 4t - 5t^2$ meter

, where "t" is in seconds. Find the angle of projection , velcoity of projection and horizontal range?

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25. A shell is fired from a long - range gun with an intial velocity $u = 1000 ms^{-1}$ at an angle 30° to the horizontal. How long with the shell be in the air ? At what distance from the gun will it fall to ground ? The gun and the point where the shell lands are on the same horizontal line .

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26. Two bodies are thrown with the same initial speed at angle a and $(90^{\circ} - 0)$ with the horizontal. What will the ratio of maximum heights attained by them ?

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27. Two balls are projected from the same point in the direction inclined at 60° and 30° to the horizontal. If they attain the same height , what is the ratio of their velocities ? What is the ratio of their initial velocities if they have same horizontal range ?

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28. A stone is thrown horizontally with velocity g ms^{-1} from the top of a tower of height g metre. The velocity with which it hits the ground is (in ms^{-1})

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29. A body is thrown with the velocity $u = 12.0ms^{-1}$ at an angle of $\alpha = 45^{\circ}$ to the horizon. If it touches the ground at the distance s from the point where it was thrown. From what height h should stone be thrown in a horizontal direction with the same initial velocity u so that it falls at the same spot ?

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30. A ball is thrown with the velocity u at an angle of α to the horizon. Find (i) the height of which the ball will rise to (ii) the distance x from the point of projection to the point where it reaches to the ground and (iii) the time during which the ball will be in motion (neglect the air resistance).

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31. A ball is throw from the top of a tower of 61 m high with a velocity $24.4ms^{-1}$ at an elevation of 30° above the horizon. What is the distance from the foot of the tower to the point where the ball hits the ground ?

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32. A tennis ball rolls off the top of a stair case way with a horizontal velocity ms^{-1} If the steps are b metre wide and h metre high, the ball will hit the edge of the nth step, if

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33. If any point of a parabolic path of a projectile the velocity be u and the dirrection of motion be at θ with the horizon , show that the particle is moving at right angle to its former direction after an interval of time

$$t = \frac{u}{g \sin \theta}$$

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NUMERICAL EXERCISE (LEVEL -2)

1. A shot is fired with a velocity u at a vertical wall whose distance from the point of projection is x. Prove the greatest height above the level of the point of projection at which the bullet can hit the wall is $\frac{u^4 - g^2x^2}{2gu^2}$

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2. An aeroplane flies horizontally at a height h at speed v. An anti - carft gun a shell at the plane when it is vertically above the gun . Show that the minimum muzzle velocity required to hit the plane is $\sqrt{v^2 + 2gh}$ at an angle $\tan^{-1}\left(\frac{\sqrt{2gh}}{v}\right)$.

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3. Two guns situated at the top of a hill of height $10m$ fire one shot each with the same speed $5\sqrt{3}m/s$ at some interval of time. One gun fires horizontal and the other fores upwards at an angle of 60° with the horizontal. Two shots collide in air at a point P. Find (i) time-interval between the firing and (ii) coordinates of the point P. Take the origin of coordinates system at the foot of the hill right below the muzzle and trajectorise in the $x-y$ plane.

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4. A particle projected with velcoity v_0 strikes at right α plane through the point of projection .

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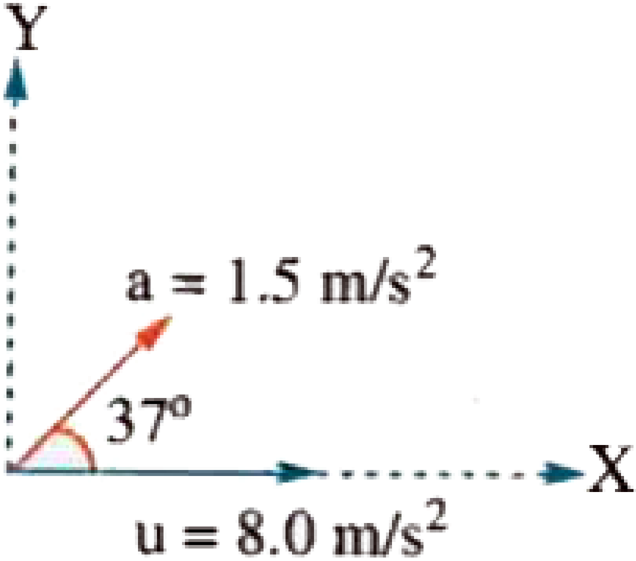
5. A particle moves in the x-y plane with a constant acceleration of $1.5m/s^2$ in the direction making an angle of 37° with the x-axis.



At t=0 the particle is at the origin and its velocity is 8.0m/s along the x- aixs . Find the velocity and the position of the particle at t = 4.0s.

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6. A particle moves in the x-y plane according to the law x=at, y=at $(1 - \alpha t)$ where a and α are positive constants and t is time. Find the velocity and acceleration vector. The moment t_0 at which the velocity vector forms angle of 90° with acceleration vector.

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7. At the same instant two boy throw balls A and B from the window with a speed v_0 and

kv_0 respectively , where k is a constant . Show that the balls with collide if $K = \cos\theta_2 / \cos\theta_1$

.

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8. A projectile aimed at a mark, which is in the horizontal plane through the point of projection, falls a cm short of it when the elevation is α and goes b cm far when the elevation is β. Show that, if the speed of projection is same in all the cases the proper elevation is

$$\frac{1}{2}\sin^{-1}\left[\frac{b\sin 2\alpha + a\sin 2\beta}{a+b}\right].$$

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9. Particles P and Q of mass 20 gm and 40 gm respectively are simultaneously projected from points A and B on the ground. The initial velocities of P and Q make 45° and 135° angles respectively with the horizontal AB as shown in the figure. Each particle has an initial speed of 49 m/s. The separation AB is 245 m.

Both particles travel in the same vertical plane and undergo a collision. After the collision, P retraces its path. How much time after the collision does the particle Q take to reach the ground?

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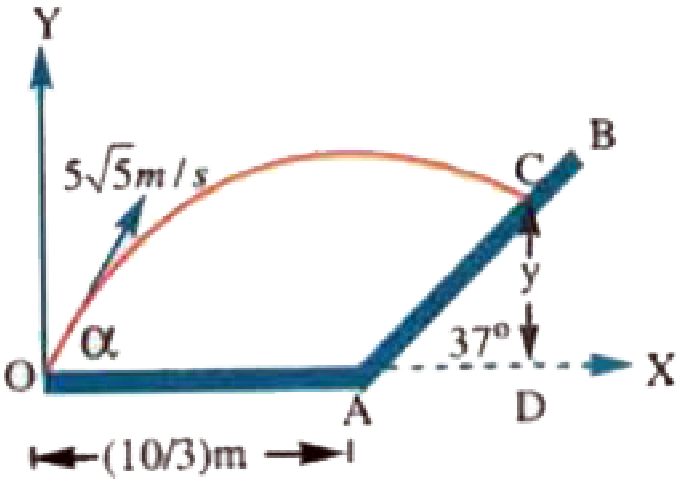
10. A particle is projected form point O on the ground with velocity $u = \sqrt{5}m/s$ at angle $\alpha = \tan^{-1}(0.5)$. It strikes at a point C on a fixed smooth plane AB having inclination of 37° with horizontal as shown is Fig. If the particle does not rebound , calculate .



(a) coordinates of point C in reference t coordinate system as shown in the figure .

(b) maximum heing from the ground to which the particle reises. $(g = 10m/s^2)$

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11. A dip circle is at right angles to the magnetic meridian. What will be the apparent dip ?

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12. A glass wind screen whose inclination with the vertical can be changed in mounted on a car. The car moves horizontal with a speed of $2m/s$. At what angle α with the vertical should the wind screen be placed so that the rain drops falling vertically downwards with velocity $6m/s$ strike the wind screen - perpendicularly?

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13. Two particles are projected from a point at the same instant with velocities whose horizontal components and vertical components and vertical components are (u_1, v_1) and (u_2, v_2) respectively. The time interval between their passing through the other common point of their path (other than origin) in

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14. Two boys simultaenously aim their guns at a brid sitting on a tower. The first boy releases his shot with a speed of 100m/s at an angle of projection of 30°. The second boy is ahead of the first by a distance of 50m and releases his shot with a speed of 80m/s. How must he aim his gun so that both the shots hit the bird simultaenously ? What is the distance of the foot of the tower from the first boy and the height of the tower ?

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15. A particle is projected with a velocity u making an angle θ with the horizontal. The instantaneous power of the gravitational force

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16. Figure shows a wire ring of radius a that is perpendicular to the general direction of a radially sysmmetric, diverging magnetic field. The magnetic field at the ring is everywhere of the same magnitude B, and its direction at the ring everywhere makes an angle θ with a normal to the plane of the ring. thge twisted lead wires have no effect on the problem. Find the magnitude of the force the field exerts on the ring if the ring carries a current i.

17. Two balls are projected from the same point in the direction inclined at 60° and 30° to the horizontal. If they attain the same height , what is the ratio of their velocities ? What is the ratio of their initial velocities if they have same horizontal range ?

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18. Two particles are projected at the same instant from the same point at inclinations α and β to the horizontal. If they simultaneously hit the top and bottom of a vertical pole subtending angle θ at the point of projection , find $(\tan\alpha - \tan\beta)$.

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19. A gun is kept on an inclined plane . The maximum ranges up and down the plane are

250 m and 750 respectively Then find the angle of inclination of the inclined plane.

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QUESTION FOR DESCRIPTIVE ANSWER

1. A particle is thrown over a triangle from one end of a horizontal base and after grazing the vertex falls on the other end of the base. If α and β be the base angles and θ the angle of projection, prove that $\tan\theta = \tan\alpha + \tan\beta$.

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2. A particle is projected at an angle alpha with horizontal from the foot of a plane whoose inclinaiton to horizontal is β. Shwo that is will strike the plane at right angles if , $\cot\beta = 2\tan(\alpha - \beta)$.

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3. A stone is projected from the ground in such a direction so as to hit a bird on the top of a telegraph post of height h and attains the maximum height of 2h above the ground. If at the insatant of projection, the bird were to fly away horizontally with a uniform speed, find the ratio between the horizontal velocity of bird and the horizontal component of velocity of stone, if the stone hits the bird while descending.

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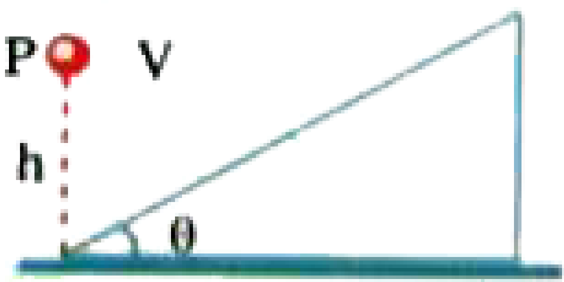
4. A stone must be projected horizontally from a point P, which is h meter above the foot of a plane inclined at an angle θ with horizontal as shown in figure . Calculate the velocity v of the stone so that in may hit the incline plane perpendiculary.



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5. A gun is mounted on a gun carriage movable on a smooth plane the gun is elevated at an angle α to the horizontal . A shot, fired leaves the gun in a direction inclined at an angle θ to the horizontal . If the mass of the gum and its carriage be n times that of short , find $\tan\theta : \tan\alpha$.

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6. A regular hexagon of side a has a charge Q at each vertex. Potential at the centres of

hexagon is (k= $\left(\frac{1}{4}\pi\varepsilon_0\right)$)

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

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EXERCISE -I

1. In Latin, the word vector means a) magnitude b) direction c) carrier d) cap

A. magnitude

B. direction

C. carrier

D. cap

Answer: C

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2. Which of the following statements is false regarding the vectors?

A. The magnitude of a vector is always a scalar

B. Each component of a vector is always a scalar.

C. Two vectors having different magnitudes cannot have their resultant zero

D. Vectors obey triangle law of addition

Answer: B

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

A. Impulse, pressure and area

B. Impulse and area

C. Area and gravitational potential

D. Impulse and pressure

Answer: B

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4. Of the following the vector quantity is

A. time

B. Electric Current

C. Velocity of light

D. gravitational force

Answer: D

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5. Of the following the scalar quantity is

A. Temperature

B. Moment of force

C. Moment of couple

D. Magnetic moment

Answer: A

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6. Choose the correct statement

A. Temperature is a scalar but temperature gradient is a vector

B. Velocity of a body is a vector but velocity of light is a scalar

C. Electric intensity and Electric current density are vectors

D. all the above

Answer: D

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7. Choose the false statement

A. Electric current is a vector because it has both magnitude and direction

B. Time is a vector which has direction always in the forward direction

C. All quantities having magnitude and direction are vector quantities

D. all the above

Answer: D

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8. The pair containing a scalar quantity and vector quantity is

A. Impulse and Angular momentum

B. work and Frequency

C. Electromotive force and force

D. Electric power and Energy

Answer: C

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9. Which one of the following statements is true

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

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

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

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

Answer: D

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10. Which of the following units could be associated with a vector quantity ?

A. newton/metre

B. newton metre/second

C. kgm^2s^2

D. newton second

Answer: D

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11. The set containing only vector quantities is

A. Thermal capacity, Magnetic susceptibility and Electric charge

B. Magnetic moment, Electric intensity and Torque

C. Magnetic flux, Electric potential and Force

D. Magnetic induction, Electric capacity and Impulse

Answer: B

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12. Which of the following is meaningful?

A. Vector/Vector

B. vector

C. Scalar + vector

D. vector / scalar

Answer: D

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13. Choose the correct statement.

A. Scalar + vector = scalar/vector vector

B. $\frac{\text{vector}}{\text{vector}}$ = scalar

C. scalar/vector = scalar or vector

D. vector- vector = vector

Answer: D

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14. If angle between $\overrightarrow{a}$ and $\overrightarrow{b}$ is $\frac{\pi}{3}$, then angle between $\overrightarrow{a}$ and $-3\overrightarrow{b}$ is

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

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

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

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

Answer: B

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15. Which of the following is a null vector

(a) velocity vector of a body moving in a circle with a uniform speed

(b) velocity vector of a body moving in a straight line with a uniform speed

(c) position vector of the origin of the rectangular coordinate system

(d) displacement vector of a stationary object

A. both a & b

B. both b & c

C. a, b & c

D. both c & d

Answer: D

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

A. Impulse, pressure and area

B. Impulse and elementary area

C. Area and gravitational potential

D. Impulse and pressure

Answer: B

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17. vector is not changed if

A. it is rotated through an arbitrary angle

B. it is multiplied by an arbitrary scalar

C. it is cross multiplied by a unit vector

D. it is slid parallel to itself.

Answer: D

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18. Find the correct statement about the component of a vector is

A. always less than its magnitude

B. always greater than its magnitude

C. always equal to its magnitude

D. Less than or equal to its magnitude

Answer: D

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19. The horizontal component of the weight of a body of mass m is

A. mg

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

C. Zero

D. infinity

Answer: C

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20. What are the maximum number of rectangular components of a vector can be split in space and in plane respectively.

A. 3,2

B. 3,3

C. 2,2

D. ∞, ∞

Answer: A

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21. The maximum number of components into which a vector can be resolved in its own plane is

A. 2

B. 3

C. 4

D. infinite

Answer: D

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

A. r is along positive Y-axis

B. r is along positive X-axis

C. r makes an angle of 45° with the X-axis

D. r is along negative Y-axis

Answer: B

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23. The x-component of the resultant of several vectors

A. only a

B. a, b & d

C. a, b, & c

D. b & d

Answer: B

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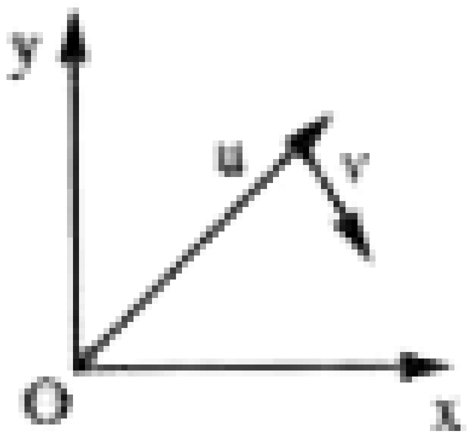
24. Figure shows the orientation of two vectors u and v in the XY-plane If $u = a\hat{i} + b\hat{j}$ and $v = p\hat{i} + q\hat{j}$



which of the following is correct ?

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

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

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

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

Answer: B

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25. (A): The direction of velocity vector remains unchanged though the coordinate system is changed

(R) : The direction of real vector is independent of coordinate system

A. Both (A) and (R) are true and (R) is the correct explanation of (A)

B. Both (A) and (R) are true and (R) is not the correct explanation of (A)

C. (A) is true but (R) is false

D. (A) is false but (R) is true

Answer: A

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26. The resultant of two forces cannot exceed

A. average of the forces

B. algebraic sum of the two forces

C. difference of the two forces

D. none

Answer: B

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27. Subtraction of vectors obeys

A. commutative law

B. Associative law

C. Distributive law

D. All the above

Answer: C

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28. Associative law is obeyed by

A. Addition of vectors

B. subtraction of vectors

C. both

D. none

Answer: A

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29. Choose the correct statement.

A. If $\vec{A} + \vec{B} = \vec{A} - \vec{B}$ then $\vec{B}$ is a null vector

B. If $\left|\vec{A} + \vec{B}\right| = \left|\vec{A} - \vec{B}\right|$, then $\vec{A}$ and $\vec{B}$ are perpendicular vectors

C. both of the above

D. none of the above

Answer: C

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30. The maximum value of magnitude of $\left(\vec{A} - \vec{B}\right)$ is

A. A-B

B. A+B

C. $A^2 + B^2$

D. $A^2 - B^2$

Answer: B

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31. When two vectors a and b of magnitudes 'a' and 'b' respectively are added, the magnitude of resultant vector is always

A. Equal to (a + b)

B. Less than (a + b)

C. Greater than (a + b)

D. Not greater than (a + b)

Answer: D

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32. If $\overrightarrow{a}$ and $\overrightarrow{b}$ are two unit vectors and θ is the angle between them, then the unit vector along the angular bisector of $\overrightarrow{a}$ and $\overrightarrow{b}$ will be given by

A. $\left|\overrightarrow{C}\right|$ is always greater than $\left|\overrightarrow{A}\right|$

B. $\left|\overrightarrow{C}\right|$ is always equal to $|\overrightarrow{A}|+|\overrightarrow{B}|$

C. $\left|\overrightarrow{C}\right|$ is never equal to $|\overrightarrow{A}|+|\overrightarrow{B}|$

D. It is possible to have $\left|\overrightarrow{C}\right| < \left|\overrightarrow{A}\right|$ and $\left|\overrightarrow{C}\right| < \left|\overrightarrow{B}\right|$

Answer: D

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

A. B=0

B. A,B are antiparallel

C. A,B are perpendicular

D. $A, B \leq 0$

Answer: D

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

A. i and ii are true

B. ii, iii and iv are true

C. i, ii and c are true

D. ii and iv are true

Answer: D

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35. Let the angle between two non zero vectors A and B be 120° and its resultant be C.

A. C must be equal to |A-B|

B. C must be less than | A - B|

C. C must be greater than |A-B|

D. C may be equal to |A - B|

Answer: C

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36. Set the following vectors in the increasing order of their magnitude.

(a) $3\hat{i} + 4\hat{j}$, (b) $2\hat{i} + 4\hat{j} + 6\hat{k}$

(c) $2\hat{i} + 2\hat{j} + 2\hat{k}$,

A. a,b,c

B. c,a,b

C. a,c,b

D. b,c,a

Answer: B

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37. Arrange the vectors subtractions so that their magnitudes are in decreasing order. If the two vectors $\vec{A}$ and $\vec{B}$ are acting at an angle $\left(\left|\vec{A}\right| > \left|\vec{B}\right|\right)$

a) 60° b) 90° c) 180° d) 120°

A. d,c,b,a

B. a,b,d,c

C. c,d,b,a

D. c,d,a,b

Answer: C

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38. The minimum number of forces of equal magnitude in a plane that can keep a particle in equilibrium is

A. 4

B. 2

C. 3

D. 5

Answer: B

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39. The minimum number of unequal forces in a plane that can keep a particle in equilibrium is

A. 4

B. 2

C. 3

D. 6

Answer: C

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40. The minimum number of non coplanar forces that can keep a particle in equilibrium is

A. 1

B. 2

C. 3

D. 4

Answer: D

Watch Video Solution

41. A driver having a definite reaction time is capable of stopping his car over a distance of 30 m on seeing a red traffic signal, when the speed of the car is 72 km/hr andover a distance of 10 m when the speed is 36 km/hr. Find the distance over which he can stop the car if it were running at a speed of 54 km/hr. Assume that his reaction time and the deceleration of the car remains same in all the three cases.

A. 50 km/h towards west

B. 70 km/h towards south - west

C. 70 km/h towards north - west

D. zero

Answer: B

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42. Which of the following four statements is false?

A. A body can have zero velocity and still be accelerated.

B. A body can have a constant velocity and still have a varying speed.

C. A body can have a constant speed and still have a varying velocity

D. The direction of the velocity of a body can change when its acceleration is constant.

Answer: B

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

A. The average velocity is not zero at any time

B. Average acceleration must always vanish.

C. Displacements in equal time intervals are equal

D. Equal path lengths are traversed in equal intervals

Answer: D

Watch Video Solution

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

A. The acceleration of the particle is zero

B. The acceleration of the particle is bounded

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

D. The particle must be undergoing a uniform circular motion

Answer: C

Watch Video Solution

45. Three different objects of masses m_1, m_2 and m_3 are allowed to fall from rest and from the same point O along three different frictionless paths. The speeds of the three objects on reaching the ground will be in the ratio of

A. $m_1 : m_2 : m_3$

B. $m_1 : 2m_2 : 3m_3$

C. $1 : 1 : 1$

D. $\frac{1}{m_1} : \frac{1}{m_2}, \frac{1}{m_3}$

Answer: C

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46. A train is moving towards East and a car is along North, both with same speed. The observed direction of car to the passenger in the train is

A. North - East

B. North - West

C. South - West

D. South - East

Answer: B

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47. A bus moves over a straight level road with a constant acceleration a. A boy in the bus drops a ball outside. The acceleration of the ball with respect to the bus and the earth are respectively

A. $\sqrt{a^2 + g^2}. g$

B. g,$\sqrt{a^2 + g^2}$

C. a,g

D. g,a

Answer: A

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48. A particle P moves with speed V along AB and BC, sides of a square ABCD. Another particle Q also starts at A and moves with the same speed but along AD and DC of the same square ABCD. Then their respective changes in velocities are

A. equal in magnitude but different in direction

B. different in magnitude but same in directions

C. different both in magnitude and direction

D. same both in magnitude and direction

Answer: A

Watch Video Solution

49. Two objects A and B are moving with velocities v_A and v_B respectively in the same direction. The magnitude of relative velocity of A w.r.t. B is

A. $x > y$

B. $x = y$

C. $x = 2y$

D. $2x = y$

Answer: B

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50. Winds is blowing west to east along two parallel tracks. Two trains moving with same speed in opposite directions have the steam track of one double than other. The speed of each train is

A. Equal to that of the wind

B. Three times that of the wind

C. Double that of the wind

D. Half that of the wind

Answer: B

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51. A boat moves relative to water with a velocity which is 'n' times the river flow

a) If $n < 1$ boat can not cross the river

b) If n = 1 boat can not cross the river without drifting

c) If $n > 1$ boat can cross the river along shortest path

d) Boat can cross the river what ever is the value of n excluding zero value

A. only a is correct

B. a, b are correct

C. c, d are correct

D. b, c & d are correct

Answer: D

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52. Set the drifts suffered by boat in increasing order

(a) d=1000 m, $V_R = 2m/s, V_b = 4m/s$

(b) $d = 500m, V_R = 1m/s, V_b = 6m/s$

(c) $d = 1000m, V_R = 6m/s, V_b = 6m/s$

($d \rightarrow$ width of river $V_R \rightarrow$ velocity of river $V_b \rightarrow$ velocity of botat). The boat moves perpendicular to width of the river

A. a,b,c

B. b,c,a

C. b,a,c

D. c,b,a

Answer: C

Watch Video Solution

53. (A): A man is on the northern bank of a river. To cross the river in a shortest time he should swim due south.

(R) : Man should move opposite to the river flow to cross in shortest time.

A. Both (A) and (R) are true and (R) is the correct explanation of (A)

B. Both (A) and (R) are true and (R) is not the correct explanation of (A)

C. (A) is true but (R) is false

D. (A) is false but (R) is true

Answer: C

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54. Keeping the velocity of projection constant, the angle of projection is increased from 0° to 90°. Then the horizontal range of the projectile

A. goes on increasing up to 90°

B. decreases up to 90°

C. increases up to 45° and decreases afterwards

D. decreases up to 45° and increases afterwards

Answer: C

Watch Video Solution

55. A projectile has

A. minimum velocity at the point of projection and maximum at the maximum height

B. maximum at the point of projection and minimum at the maximum height

C. same velocity at any point in its path

D. zero velocity at the maximum height irrespective of the velocity of projection

Answer: B

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56. Two particles are projected in air with speed u at angles θ_1 and theta_(2)` (both acute) to the horizontal, respectively. If the height reached by the first particle is greater than that of the second. Then which one of the following is correct ?

A. $\theta_1 > \theta_2$

B. $\theta_1 = \theta_2$

C. $T_1 < T_2$

D. $T_1 = T_2$

Answer: A

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57. If a body is projected with an angle θ to the horizontal then

A. its velocity is always perpendicular to its acceleration

B. its velocity becomes zero at its maximum height.

C. its velocity makes zero angle with the horizontal at its maximum height.

D. the body just before hitting the fround, the direction of velocity coincides with the acceleation.

Answer: C

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58. (A): The path followed by one projectile as observed by another projectile is a straight line in uniform gravitation field.

(R): The relative velocity between two

projectiles at a given place doesn't change with time. Because their relative acceleration is zero.

A. Both (A) and (R) are true and (R) is the correct explanation of (A)

B. Both (A) and (R) are true and (R) is not the correct explanation of (A)

C. (A) is true but (R) is false

D. (A) is false but (R) is true

Answer: A

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59. Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Which bullet will hit the ground first?

A. the faster one

B. the slower one

C. both will reach simultaneously

D. depends on the masses

Answer: C

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60. A number of bullets are fired horizontally with different velocities from the top of a tower they reach the ground

A. at same time with same velocity

B. at different times with different velocities

C. at same time with different velocities

D. at different times with same velocity

Answer: C

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61. For body thrown horizontally from the top of a tower,

A. the time of flight depends both on h and v

B. the horizontal Range depends only on v but not on h

C. the time of flight and horizontal Range depend on h but not on v

D. the horizontal Range depends on both v and h

Answer: D

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62. A stone is just dropped from the window of a train moving along a horizontal straight track with uniform speed. The path of the stone is

A. a parabola for an observer standing by the side of the track

B. a horizontal straight line for an observer inside the train

C. both of the above are true

D. none of the above is true

Answer: A

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63. If a ball is thrown upwards from the surface of earth :

A. parabola for an observer standing on the ground

B. vertical straight line for an observer in B when B is moving with the same speed in the same direction of A

C. a parabola for an observer in B when B is moving with same speed but in opposite direction

D. all the above are true

Answer: D

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64. In a projectile motion the velocity

a) is always perpendicular to the acceleration

b) is not always perpendicular to the acceleration

c) is perpendicular to the acceleration for one instant only

d) is perpendicular to the acceleration for two instants.

A. a & b are correct

B. b & c are correct

C. c & d are correct

D. a & d are correct

Answer: B

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65. A body is projected from a point with different angles of projections 20°, 35°, 45°, 60° with the horizontal but with same initial speed. Their respective horizontal ranges are R_1, R_2, R_3 and R_4. Identify the correct order in which the horizontal ranges are arranged in increasing order

A. R_1, R_4, R_2, R_3

B. R_2, R_1, R_4, R_3

C. R_1, R_2, R_4, R_3

D. R_4, R_1, R_2, R_3

Answer: A

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66. Two particles are projected from the same point with the same speed at different angles θ_1 & θ_2 to the horizontal. They have the same range. Their times of flight are t_1 & t_2 respectily

A. a, b, d are correct

B. a, c, d are correct

C. b, c, d are correct

D. a, b, c are correct

Answer: A

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67. A body is projected with an initial Velocity 20 m/s at 60° to the horizontal. Its initial velocity vector is- (g=10 m/s^2)

A. If a, b, c and d are correct

B. If a, c and d are correct

C. If b, c and d are correct

D. If a, b and d are correct

Answer: A

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68. An object is projected at an angle of 45° with the horizontal. The horizontal range and the maximum height reached will be in the ratio

A. If a, b, c and d are correct

B. If only a, b and c are correct

C. If only a and c are correct

D. If a, c and d are correct

Answer: D

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69. A ball is thrown vertically upwards from the top of tower of height h with velocity v . The ball strikes the ground after time.

A. a, d, c and d are correct

B. a, b and c are correc

C. a and d are correct

D. d only correct

Answer: B

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70. A bomber flying horizontally with constant speed releases a bomb from an aeroplane.

a) The path of bomb as seen by the observer on the ground is parabola

b) The path of the bomb as seen by a pilot is a straight line.

c) The path of the aeroplane with respect to bomb is a straight line

d) The path of the bomb as seen by pilot observed as parabola.

A. a is correct

B. a and b are correct

C. a, b and c are correct

D. only d is correct

Answer: C

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71. For a projectile 'R' is range and 'H' is maximum height

List - I	List - II
a) R = H	e) Angle of projection tan-1(1)
b) R = 2H	f) Angle of projection $\tan^{-1}(4)$
c) R = 3H	g) Angle of projection $\tan^{-1}(2)$
d) R = 4H	h) Angle of projection $\tan^{-1}(4/3)$

A. a - g , b-h, c-e, d-f

B. a-h, b-g, c-e, d-f

C. a-f, b-g, c-h, d-e

D. a - e , b-g, c-f, d-h

Answer: C

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72. The equation of motion of a projectile is $y = ax - bx^2$, where a and b are constants of motion. Match the quantities in Column I with the relations in Column II.

	Column I		Column II
(A)	The initial velocity of projection	(p)	$\frac{a}{b}$
(B)	The horizontal range of projectile	(q)	$a\sqrt{\frac{2}{bg}}$
(C)	The maximum vertical height attained by projectile	(r)	$\frac{a^2}{4b}$
(D)	The time of flight of projectile	(s)	$\sqrt{\frac{g(1+a^2)}{2b}}$

A. A - p, B - q, C - r. D - s

B. A - s, B - p, C - q, D - r

C. A - s, B - p, C - r, D - q

D. A - p, B - s, C - r, D - q

Answer: C

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73. The term centripetal acceleration was proposed by

A. Huygens

B. Kepler

C. Newton

D. Galileo

Answer: C

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74. Centripetal acceleration is

A. a constant vector

B. a constant scalar

C. a magnitude changing vector

D. not a constant vector

Answer: D

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75. Velocity vector and acceleration vector in a uniform circular motion are related as

A. both in the same direction

B. perpendiculat to each other

C. both in opposite direction

D. not related to each other

Answer: B

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76. When milk is churned, cream gets separated due to

A. centripetal force

B. centrifugal force

C. frictional force

D. gravitational force

Answer: B

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77. A disc is rotating in the anticlockwise direction in the xy plane with decreasing angular velocity: What is direction of the angular acceleration ?

A. It's angular velocity vector will be perpendicular to the page pointing up out of the page

B. It's angular velocity vector will be perpendicular to the page pointing inwards

C. It's angular velocity vector acts along the tangent to the disc.

D. none of the above is correct.

Answer: A

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78. When a particle is moving in a circle of radius (r) with changing speed (v) then centripetal acceleration and tangential acceleration respectively given by

A. $\frac{V^2}{r}$

B. $\frac{V^2}{r^2}$

C. $V^2 r$

D. zero

Answer: A

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79. A body is in pure rotation. The linear speed 'v' of a particle, the distance 'r' of the particle from the axis and the angular velocity ω of the body are related as $\omega = \frac{v}{r}$. Thus

A. $\omega \alpha \frac{1}{r}$

B. $\omega \alpha r$

C. v

D. ω is independent of r.

Answer: D

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80. A particle revolves round a circular path with uniform speed. The acceleration of the particle is

A. mass of particle

B. radius

C. velocity

D. both (1) and (2)

Answer: B

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81. The position vector of a particle is $r = a\sin\omega t\hat{i} + a\cos\omega t\hat{j}$

The velocity of the particle is

A. directed towards the origin

B. directed away from the origin

C. parallel to the position vector

D. perpendicular to the position vector.

Answer: D

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82. Two racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same time t.

The ratio of the angular speed of the first to the second car is

A. $r_1 : r_2$

B. $m_1 : m_2$

C. $1 : 1$

D. $m_1 m_2 : r_1 r_2$

Answer: C

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83. Two particles having mass 'M' and 'm' are moving in a circular path having radius R & r respectively. If their time period are same then the ratio of angular velocity will be : -

A. $\frac{r}{R}$

B. $\frac{R}{r}$

C. 1

D. $\sqrt{\frac{R}{r}}$

Answer: C

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84. A particle moves such that its position vector $\overrightarrow{r}(t) = \cos\omega\hat{i} + \sin\omega t\hat{j}$ where ω is a constant and t is time . Then which of the following statements is ture for the velocity $\overrightarrow{v}$ (t) and acceleration $\overrightarrow{a}$ (t) fo the particle:

A. Velocity and acceleration both are perpendicular to $\overrightarrow{r}$.

B. Velocity and acceleration both are parallel to $\overrightarrow{r}$

C. Velocity is perpendicular to $\overrightarrow{r}$ and acceleration is directed towards the origin.

D. Velocity is perpendicular to $\overrightarrow{r}$ and acceleration is directed away from the origin

Answer: C

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85. A particle moves along a horizontal circle with constant speed. If 'a' is its acceleration and 'E' is its kinetic energy

A) a is constant B) E is constant C) a is variable D) E is variable

A. A & B are correct

B. C & D are correct

C. A & D are correct

D. B & C are correct

Answer: D

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

a) The net acceleration of a particle in circular motimn is always along the radius of the circle towards the center.

b) The velocity vector of a particle at a point is always along the tangent to the path of the particle at that point.

c) The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null vector.

A. A Only true

B. B Only true

C. Both A & B are true

D. Both A & B are false

Answer: B

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87. The acceleration vector of a particle in uniform circular motion averaged over the cycle is a null vector. This statement is

A. A Only true

B. B Only true

C. Both A & B are true

D. Both A & B are false

Answer: C

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88. Identify the increasing order of the angular velocities of the following

1. Earth rotating about its own axis

2. Hour's hand of a clock

3. Second's hand of a clock

4. Flywheel of radius 2 m making 300 rpm

A. a, b, c, d

B. b, c, d, a

C. c, d, a, b

D. d, a, b, c

Answer: A

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

i) Magnitude of particle velocity (speed) remains constant.

ii) Particle velocity remains directed perpendicular to radius vector.

iii) Direction of acceleration keeps changing as particle moves.

iv) Angular momentum is constant in magnitude but direction keeps changing

A. i and ii

B. i, ii and iv

C. i, ii and iii

D. ii and iii

Answer: C

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90. (A) : If the speed of a body is constant, the body cannot have a path other than a circular or straight line path.

(R) : It is possible for a body to have constant speed in an accelerated motion.

A. Both (A) and (R) are true and (R) is the correct explanation of (A)

B. Both (A) and (R) are true and (R) is not the correct explanation of (A)

C. (A) is true but (R) is false

D. (A) is false but (R) is true

Answer: D

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EXERCISE -II

1. A person runs along a circular path of radius 5 m. If he completes half of the circle find the magnitude of the displacement vector, How far the person ran ?

A. 10 m, 5π m

B. $5\pi m$, 10 m

C. 5π m , 19m

D. 14 m, 17 m

Answer: A

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2. A car makes a displacement of 100 m towards east and then 200 m towards north.

Find the magnitude and direction of the resultant.

A. 223.7 m, $\tan^{-1}(2)$, N of E

B. 223.7 m, $\tan^{-1}(2)$, E of N

C. 300 m,$\tan^{-1}(2)$, N of E

D. 100 m, $\tan^{-1}(2)$, N of E

Answer: A

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3. Given below are some standard heats of reaction:

a. Heat of formation of water $= -68.3 kcal$

b. Heat of combustion of acetylene $= -301.6 kcal$

c. Heat of combistion of ethylene $= -337.2 kcal$

Calculate the heat of reaction for the hydrogenation of acetylene at constant volume at $25^{\circ} C$.

A. $\tan^{-1}(4)$ with + x- axis in clock wise

B. $\tan^{-1}(4)$ with - x- axis in clock wise

C. $\tan^{-1}(4)$ with + x- axis in anti clock wise

D. $\tan^{-1}(4)$ with - x- axis in anti clock wise

Answer: A

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4. A plane π passes through the point (1,1,1) and is parallel to the vectors $\overrightarrow{b} = (1, 0 - 1)$ and $\overrightarrow{c} = (-1, 1, 0)$. If π meets the axes in

A,B, and C, find the volume of the tetrahedron OABC.

A. 4i + 9j-13k

B. $-4i - 9j + 13k$

C. 4i-9j-13k

D. 2i-3j-13k

Answer: A

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5. One of the rectangular components of a velocity of 20 ms^{-1} is 10 ms^{-1}. Find the other component.

A. $10\sqrt{3}ms^{-1}$

B. $20\sqrt{3}ms^{-1}$

C. $5\sqrt{3}ms^{-1}$

D. $35\sqrt{3}ms^{-1}$

Answer: A

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6. A car weighing 100kg is on a slope that makes an angle 30° with the horizontal. The component of car's weight parallel to the slope is

$(g = 10ms^{-2})$

A. 500 N

B. 1000 N

C. 15,000 N

D. 20,000 N

Answer: A

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7. A particle is projected from a horizontal floor with speed $10\frac{m}{s}$ at an angle 30° with the floor and striking the floor after sometime. State which is correct.

A. 1542 km

B. 1452 km

C. 1254 km

D. 11 km

Answer: A

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8. Two vectors a and b have equal magnitudes of 12 units. These vectors are making angles $30^{\circ}$and 120° with the x axis respectively. Their sum is r . Find the x and y components of r .

A. $(6\sqrt{3}-6), (6-6\sqrt{3})$

B. $(6\sqrt{3}+6), (6+6\sqrt{3})$

C. $(6\sqrt{3}-6), (6+6\sqrt{3})$

D. $\left(6\sqrt{3}+6\right), \left(6-6\sqrt{3}\right)$

Answer: A

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9. Two vectors a and b have equal magnitudes of 12 units. These vectors are making angles 30°and 120° with the x axis respectively. Their sum is r . Find the x and y components of r .

A. $12\sqrt{2}, 75^{\circ}$

B. $12\sqrt{2}, 75^\circ$ anti clockwise

C. $12, 45^\circ$ clockwise

D. $12, 45^\circ$ anti clockwise.

Answer: B

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10. The angle made by the vector $\overrightarrow{A} = \hat{i} + \hat{j}$ with x-axis is

A. $\pi / 6$

B. $\pi / 4$

C. $\pi / 3$

D. $\pi / 4$

Answer: A

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11. A bird moves in such a way that it has a displacement of 12 m towards east, 5 m towards north and 9 m vertically upwards. Find the magnitude of its displacement.

A. $5\sqrt{2}$ m

B. $5\sqrt{10}$ m

C. $5\sqrt{5}$ m

D. 5m

Answer: B

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

If the fly were to walk, what is the length of the shortest path it can take?

A. 12 m

B. 60 m

C. $2\sqrt{5}$ m

D. $5\sqrt{2}$ m

Answer: D

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13. The direction cosines of a vector a are $\cos\alpha = \frac{4}{5\sqrt{2}}, \cos\beta = \frac{1}{\sqrt{2}}$ and $\cos\gamma = \frac{3}{5\sqrt{2}}$ then the vector $\vec{A}$ is

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

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

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

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

Answer: B

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14. Let $\overrightarrow{A} = \left(\hat{i} + \hat{j}\right)$ and , $\overrightarrow{B} = \left(2\hat{i} - \hat{j}\right)$.

The magnitude of a coplanar vector $\overrightarrow{C}$ such that $\overrightarrow{A} \cdot \overrightarrow{C} = \overrightarrow{B} \cdot \overrightarrow{C} = \overrightarrow{A} \cdot \overrightarrow{B}$, is given by :

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

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

C. $\sqrt{\frac{20}{9}}$

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

Answer: B

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15. If A = 2i - 3 j + 4k its components in yz plane and zx plane are respectively

A. $\sqrt{13}$ and 5

B. 5 and $2\sqrt{5}$

C. $2\sqrt{5}$ and $\sqrt{13}$

D. $\sqrt{13}$ and $\sqrt{29}$

Answer: B

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16. If vectors $\vec{A}$ and $\vec{B}$ are 3i -4j + 5k and 2i + 3j - 4k respectively then find the unit vector parallel to $\vec{A} + \vec{B}$

A. $\dfrac{\left(5\hat{i} - \hat{j} + \hat{k}\right)}{\sqrt{27}}$

B. $\dfrac{5\hat{i} + \hat{j} + \hat{k}}{\sqrt{27}}$

C. $\dfrac{5\hat{i} + \hat{j} + \hat{k}}{27}$

D. $\dfrac{5\hat{i} - \hat{j} - \hat{k}}{27}$

Answer: A

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17. A vector 3i + 4j rotates about its tail through an angle 37° in anticlockwise direction then the new vector is

A. $-3i+4j$

B. 3i-4j

C. 5j

D. $5\hat{i}$

Answer: C

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18. Maximum and minimum magnitudes of the resultant of two vectors of magnitudes P and Q are in the ratio 3:1. Which of the following relation is true?

A. P = Q

B. P =2Q

C. P = 4Q

D. P = Q/3

Answer: B

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19. The resultant of two equal forces is 141.4N when they are mutually perpendicular. When they are inclined at an angle 120°, then the resultant force will be

A. 100 N

B. 141.4N

C. 196 N

D. Zero

Answer: A

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20. The magnitudes of two vectors $\vec{P}$ and $\vec{Q}$ differ by 1. The magnitude of their resultant makes an angle of $\tan^{-1}(3/4)$ with P. The angle between P and Q is

A. 45°

B. 0°

C. 180°

D. 90°

Answer: D

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21. Which of the following statement is incorrect

A. a,b,c and d must each be a null vector.

B. The magnitude of (a+c) equals the magnitude of (b+d)

C. The magnitude of a can never be greater than the sum of the magnitudes of b,c and d.

D. b+c must lie in the plane of a and d if a and d are not collinear, and in the line of a and d, if they are collinear

Answer: A

Watch Video Solution

22. The resultant of two forces 2 N and 3 N is $\sqrt{19}$ N. The angle between the forces is

A. 30°

B. 60°

C. 45°

D. 90°

Answer: C

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23. Eleven forces each equal to 5N act on a particle simultaneously. If each force makes an angle 30^{o} with the next one, the resultant of all forces is

A. 15N

B. 55 N

C. 5 N

D. zero

Answer: C

Watch Video Solution

24. Which of the following sets of forces acting simultaneously on a particle keep it in equilibrium?

A. 3N, 5N,10 N

B. 3N, 5N, 12N

C. 2N, 6N, 5N

D. 5N, 8N, 1N

Answer: C

Watch Video Solution

25. The resultant of two forces 1 and P is perpendicular to ' 1' and equal to 1. What is the value of 'P' and angle between the forces

A. $\sqrt{2}N, 135^\circ$

B. $\sqrt{2}N, 150^\circ$

C. $2N, 120^\circ$

D. $2N, 150^\circ$

Answer: A

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

A. 1 unit

B. 2 units

C. $\sqrt{3}$ units

D. Zero

Answer: C

Watch Video Solution

27. If $\vec{P}+\vec{Q}=\vec{R}$ and $\vec{P}-\vec{Q}=\vec{S}$, then R^2+S^2 is equal to

A. P^2+Q^2

B. $2(P^2-Q^2)$

C. $2(P^2+Q^2)$

D. 4PQ

Answer: C

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28. $\overrightarrow{P}, \overrightarrow{Q}, \overrightarrow{R}, \overrightarrow{S}$ are vector of equal magnitude. If $\overrightarrow{P} + \overrightarrow{Q} - \overrightarrow{R} = 0$ angle between $\overrightarrow{P}$ and $\overrightarrow{Q}$ is θ_1 . If $\overrightarrow{P} + \overrightarrow{Q} - \overrightarrow{S} = 0$ angle between $\overrightarrow{P}$ and $\overrightarrow{S}$ is θ_2 . The ratio of θ_1 to θ_2 is

A. $1:2$

B. $2:1$

C. $1:1$

D. $1:\sqrt{3}$

Answer: B

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29. The greater and least resultant of two forces are 7 N and 3 N respectively. If each of the force is increased by 3N and applied at 60°. The magnitude of the resultant is

A. 7 N

B. 3 N

C. 10 N

D. $\sqrt{129}N$

Answer: D

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30. Two forces are such that the sum of their magnitudes is 18 N and their resultant which has magnitude 12 N, is perpendicular to the smaller force. Then, the magnitudes of the forces are

A. 12 N, 6 N

B. 13 N, 5 N

C. 10 N, 9 N

D. 16 N, 2 N

Answer: D

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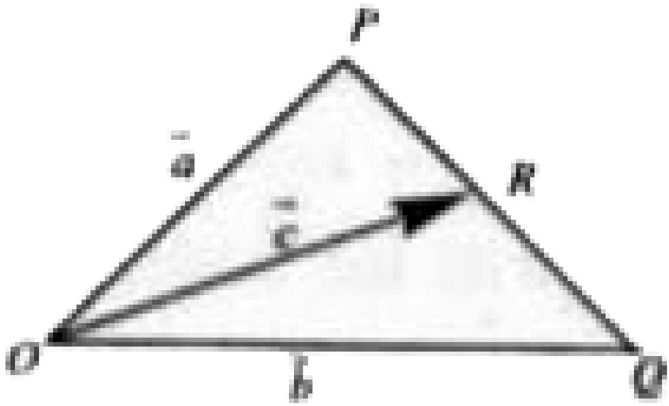
31. Figure shows three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ where R is the midpoint of PQ. Then which of the following relations is correct?



A. $\vec{a} + \vec{b} = 2\vec{c}$

B. $\vec{a} + \vec{b} = \vec{c}$

C. $\vec{a} - \vec{b} = 2\vec{c}$

D. $\vec{a} - \vec{b} = \vec{c}$

Answer: A

Watch Video Solution

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

A. 2AL

B. 2BM

C. 2CN

D. AC

Answer: B

Watch Video Solution

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

A. $\dfrac{P^2 - Q}{2PQ}$

B. $2\dfrac{P+Q}{P-Q}$

C. Q

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

Answer: C

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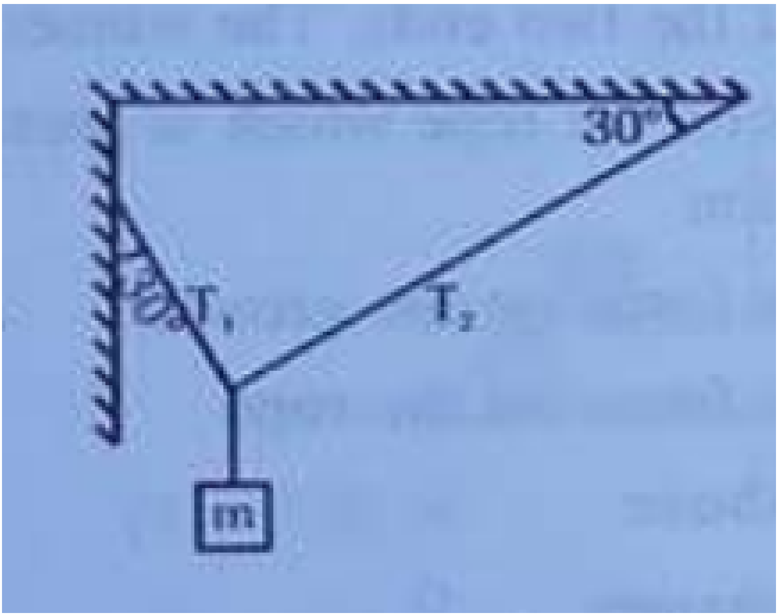
34. 

Calculate $T_1 \& T_2$.

A. 20 N, 30 N

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

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

D. 10 N, 30 N

Answer: B

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35. A body of mass $\sqrt{3}$ kg is suspended by a string to a rigid support. The body is pulled horizontally by a force F until the string makes an angle of 30° with the vertical. The value of F and tension in the string are.

A. 9.8 JN, 9.8 N

B. 9.8 N, 19.6 N

C. 19.6 N, 19.6 N

D. 19.6 N, 9.8 N

Answer: B

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36. Two light strings of length 4 cm and 3 cm are tied to a bob of weight 500 gm. The free ends of the strings are tied to pegs in the same horizontal line and separated by 5 cm. The ratio of tension in the longer string to that in the shorter string is

A. $4:3$

B. $3:4$

C. $4:5$

D. $5:4$

Answer: B

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37. A boy of mass 40 kg is hanging from the horizontal branch of a tree. The tension in his arms is minimum when the angle between the arms is:-

A. 0°

B. 30°

C. 60°

D. 120°

Answer: D

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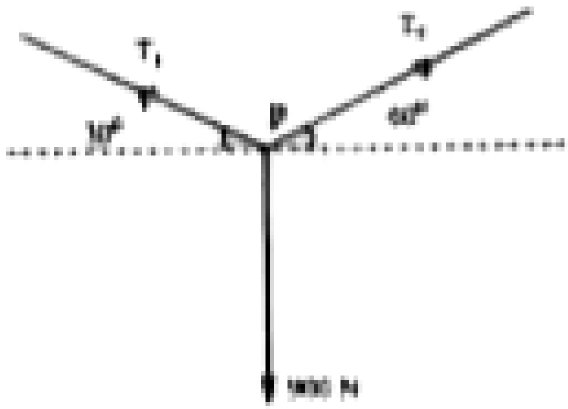
38. If 'P' is in equilibrium then T_1 / T_2 is



A. $\sqrt{3}$

B. 2

C. $1/\sqrt{3}$

D. $1/2$

Answer: C

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39. The position vector of a moving particle at't' sec is given by $\overrightarrow{r}=3\hat{i}+4t^2\hat{j}-t^3\hat{k}$. Its displacement during an interval of t = Is to 3 sec is

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

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

C. $9\hat{i} + 36\hat{j} - 27\hat{k}$

D. $32\hat{j} - 26\hat{k}$

Answer: D

Watch Video Solution

40. If $\overrightarrow{u} = 2\hat{i} - 2\hat{j} + 3\hat{k}$ and the final velocity is $\overrightarrow{v} = 2\hat{i} - 4\hat{j} + 5\hat{k}$ and it is covered in a time of 10 sec, find the acceleration vector.

A. $\dfrac{3\hat{i} - 2\hat{j} + 2\hat{k}}{10}$

B. $\dfrac{-3\hat{i} + \hat{j} + 2\hat{k}}{10}$

C. $\dfrac{-3\hat{i} - 2\hat{j} + 2\hat{k}}{10}$

D. $\dfrac{-\hat{i} + \hat{k}}{5}$

Answer: D

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41. A body starts with a velocity $2\hat{i} + 3\hat{j} + 11\hat{k}$ m/s and moves with an acceleration $10\hat{i} + 10\hat{j} + 10\hat{k} m / s^2$. What is its velocity after 0.2 seconds ?

A. $7\hat{i} + 8\hat{j} + 6\hat{k}$

B. $2\hat{i} - 3\hat{j} + 11\hat{k}$

C. $3\hat{i} - 4\hat{j} - 10\hat{k}$

D. $3\hat{i} + 4\hat{j} + 10\hat{k}$

Answer: D

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42. A train moving at a constnt velocity of 54 km/hr moves eastwards for 30 minuts, then due north with the same speed for 40 minutes. What is the average velocity of the train during this run? (in km/hr)

A. 30

B. 35

C. 38.6

D. 49.3

Answer: C

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43. A particle starts from the origin at t = 0 s with a velocity of $10.0\hat{j}$ m/s and moves in plane with a constant acceleration of $\left(8\hat{i}+2\hat{j}\right)ms^{-2}$. The y-coordinate of the particle in 2 sec is

A. 24 m

B. 16 m

C. 8 m

D. 12 m

Answer: A

Watch Video Solution

44. A train of $150m$ length is going towards North direction at a speed of $10m/s$. A parrot flies at the speed of $5m/s$ towards South direction parallel to the railways track. The time taken by the parrot to cross the train is

A. 12 sec

B. 8 sec

C. 15 sec

D. 10 sec

Answer: D

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45. The driver of a car moving towards a rocket launching with a speed of 6 ms^{-1} observed that the rocket is moving with speed of 10

ms^{-1} The upward speed of the rocket as seen by the stationary observer is nearly

A. $4ms^{-1}$

B. $6ms^{-1}$

C. $8ms^{-1}$

D. $11ms^{-1}$

Answer: C

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46. An aeroplane is flying with the velocity of V_1 =800 kmph relative to the air towards south. A wind with velocity of $V_2 = 15ms^{-1}$ is blowing from West to East. What is the velocity of the aeroplane with respect to the earth.

A. $222.7ms^{-1}$

B. $150ms^{-1}$

C. $82ms^{-1}$

D. $40ms^{-1}$

Answer: A

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47. In a harbour, wind is blowing at the speed of $72km/h$ and the flag on the mast of a boat anchored in the harbour flutters along the N-E direction. If the boat starst moving at a speed of $51km/h$ to the north. What is the direction of the flag on the mass of the boat?

A. East (approximately)

B. North - East

C. West

D. North - West

Answer: A

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48. A person is walking in rain feels the velocity of rain as twice to his velocity. At which angle he should hold the umbrella with vertical if he moves forward, if it is raining vertically downwards

A. 30°

B. 45°

C. 60°

D. 90°

Answer: A

Watch Video Solution

49. The wind is blowing from south at 10 ms^{-1}, but to a cyclist it appears blowing from the east at 10 ms^{-1}. The velocity of cyclist is

A. $10\sqrt{2}ms^{-1}$, towards S-W

B. $10\sqrt{2}ms^{-1}$, towards N-W

C. $10\sqrt{2}ms^{-1}$, towards S-E

D. $10\sqrt{2}ms^{-1}$, towards N-E

Answer: D

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50. A particles is moving eastwards with a velocity of $5ms^{-1}$. In 10 s, the velocity changes to $5ms^{-1}$ northwards. The average acceleration in this time is

A. $1/\sqrt{2}ms^{-2}$ towards north east

B. $1/2ms^{-2}$ towards north

C. Zero

D. $\frac{1}{\sqrt{2}}ms^{-2}$ towards northwest.

Answer: D

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51. A Ship A steams down north at a speed of 8 kmph. and ship B due west at a speed of 6 kmph. The velocity of A w.r.t. B is.

A. 10 kmphm, $\tan^{-1}\left(\frac{4}{3}\right)$ N of E

B. 10 kmph, $\tan^{-1}\left(\frac{4}{3}\right)$ E of N

C. 10 kmph NE

D. 2 kmph, $\tan^{-1}\left(\frac{4}{3}\right)$ N of E

Answer: A

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52. Rain drops are falling down ward vertically at 4 kmph. For a person,moving forward at 3 kmph feels the rain at

A. 7 kmph

B. 1 kmph

C. 5 kmph

D. 25 kmph

Answer: C

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53. A man is travelling at 10.8 kmph in a topless car on a rainy day. He holds an umbrella at an angle of 37° with the vertical so that he does not wet. If rain drops falls vertically downwards, what is the rain velocity ?

A. $1ms^{-1}$

B. $2ms^{-1}$

C. $3ms^{-1}$

D. $4ms^{-1}$

Answer: D

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54. A solid sphere of radius $2.45m$ is rotating with an angular speed of $10rad/s$. When this rotating sphere is placed on a rough horizontal surface then after sometime it starts pure rolling. Find the linear speed of the sphere after it starts pure rolling.

A. 3

B. 4

C. 5

D. $5\sqrt{3}$

Answer: C

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55. Two ships A and B are 10 km apart on a line running South to North. Ship A father North is streaming West at $20 km h^{-1}$ and as ship B is streaming North at $20 kmh^{-1}$. What id their distance of closest approach and how long do they take to reach it ?

A. $5\sqrt{2}$ km, 15 min

B. $5\sqrt{2}$ km, 1.5 min

C. $5\sqrt{2}$ km, 0.5 min

D. $5\sqrt{2}$ km, 15 sec

Answer: A

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56. A person walking at 4 m/s finds rain drops falling slantwise into his face with a speed of 4 m/s at an angle of 30° with the vertical . Show that the actual speed of the rain drops is 4 m/s .

A. 4 m/s

B. 8 m/s

C. 6 m/s

D. 5 m/s

Answer: A

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57. A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is 11 km s^{-1}, the escape velocity from the surface of the planet would be $x \times 11$ km/s. Find x.

A. $5\sqrt{2}ms^{-1}$, towards north-west

B. $5\sqrt{2}ms^{-1}$ towards north -east

C. $5\sqrt{2}ms^{-1}$ towards south - west

D. $5\sqrt{2}ms^{-1}$ towards south- east

Answer: B

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58. A person, standing on the roof of a 40 m high tower, throws a ball vertically upwards with speed 10 m/s. Two seconds later, he throws another ball again in vertical direction (use $g = 10\frac{m}{s^2}$). Both the balls hit the ground simultaneously.

A. At an angle of $\tan^{-1}\left(\frac{2}{5}\right)$ with the vertical towards the east.

B. At an angle of $\tan^{-1}\left(\frac{2}{5}\right)$ with the vertical towards the west

C. At an angle of $\tan^{-1}\left(\frac{5}{2}\right)$ with the vertical towards the east

D. At an angle of $\tan^{-1}\left(\frac{5}{2}\right)$ with the vertical towards the west

Answer: B

Watch Video Solution

59. Two motor boats A and B move from same point along a circle of radius 10 m in still water. The boats are so designed that they can move only with constant speeds. The boats A and B take 16 and 8 sec respectively to complete one circle in stationary water. Now water starts flowing at $t = 0$ with a speed $4\frac{m}{s}$ in a fixed direction. Find the distance between the boats after $t = 8$ sec.

A. $\dfrac{a}{\sqrt{v^2 + v_1^2}}$

B. $\dfrac{a}{v+v_1}$

C. $\dfrac{a}{v-v_1}$

D. $\sqrt{\dfrac{a^2}{v^2-v_1^2}}$

Answer: D

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60. A man can swim in still water at a speed of 6 kmph and he has to cross the river and reach just opposite point on the other bank. If the river is flowing at a speed of 3 kmph, he has to swim in the direction

A. 30° with the river flow

B. 60° with river flow

C. 135° with the river flow

D. 120° with the river flow

Answer: D

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61. A person can swim in still water at 5 m/s. He moves in a river of velocity 3 m/s. First down the stream next same distance up the steam the ratio of times taken are

A. $1:1$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: C

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62. A man can swim in still water at a speed of 6 kmph and he has to cross the river and reach just opposite point on the other bank. If the river is flowing at a speed of 3 kmph, and the width of the river is 2 km, the time taken to cross the river is (in hours)

A. $\frac{2}{27}$

B. $\frac{2}{\sqrt{27}}$

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

D. $\frac{2}{\sqrt{45}}$

Answer: B

Watch Video Solution

63. The velocity of water in a river is 2 kmph, while width is 400 m. A boat is rowed from a point rowing always aiming opposite point at 8 kmph of still water velocity. On reaching the opposite bank the drift obtained is

A. 93 m

B. 100.8 m

C. 112.4 m

D. 100 m

Answer: D

Watch Video Solution

64. A person swims at 135° to current of river, to meet target on reaching opposite point. The ratio of person's velocity to river water velocity is

A. $\sqrt{3}:1$

B. $\sqrt{2}:1$

C. $1:\sqrt{2}$

D. $1:\sqrt{3}$

Answer: B

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65. The width of a river is $2\sqrt{3}$ km. A boat is rowed in direction perpendicular to the banks of river. If the drift of the boat due to flow is 2 km, the displacement of the boat is

A. 3 km

B. 6 km

C. 5 km

D. 4 km

Answer: D

Watch Video Solution

66. A boat moves perpendicular to the bank with a velocity of 7.2 km/h. The current carries it 150 m downstream, find the velocity of the current. (The width of the river is 0.5 km).

A. $0.4ms^{-1}$

B. $1.2ms^{-1}$

C. $0.5ms^{-1}$

D. $0.6ms^{-1}$

Answer: D

Watch Video Solution

Watch Video Solution

67. Two motor boats A and B move from same point along a circle of radius 10 m in still water. The boats are so designed that they can move only with constant speeds. The boats A and B take 16 and 8 sec respectively to complete one circle in stationary water. Now water starts flowing at $t = 0$ with a speed $4\frac{m}{s}$ in a fixed direction. Find the distance between the boats after $t = 8$ sec.

A. 92.7 m

B. 40 m

C. 48 m

D. 20 m

Answer: A

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68. A stone is projected from level ground at $t = 0$ sec such that its horizontal and vertical components of initial velocity are $10\frac{m}{s}$ and $20\frac{m}{s}$ respectively. Then the instant of time at which tangential and normal components of acceleration of stone are same is: (neglect air resistance)$g = 10\frac{m}{s^2}$.

A. $10\hat{i} + 10\sqrt{3}\hat{j}$

B. $30\hat{i} + 30\sqrt{5}\hat{j}$

C. $30\sqrt{3}\hat{i} + 30\hat{j}$

D. $30\sqrt{3}\hat{i}$

Answer: C

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69. A body is projected with velocity 60m/sec at 30 degree horizontal, its initial velocity vector is ? In the above problem velocity after 3 seconds is-

A. $20\hat{i} + 20\sqrt{3}\hat{j}$

B. $30\hat{i}$

C. $10\sqrt{3}\hat{j}$

D. $30\sqrt{3}\hat{i}$

Answer: D

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70. In the above problem the displacement after 2 s is:

A. $30\sqrt{3}\hat{i} + 30\hat{j}$

B. $60\sqrt{3}\hat{i} + 40\hat{j}$

C. $10\sqrt{3}\hat{i} + 10\hat{j}$

D. $40\sqrt{3}\hat{i} + 40\hat{j}$

Answer: B

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71. A body is projected down from height of 60 m with a velocity $10ms^{-1}$ at angle 30° to horizontal. The time of flight of the body is $\left[g = 10ms^{-2}\right]$

A. 1s

B. 2s

C. 3s

D. 4s

Answer: D

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72. A body is projected with an initial elocity 20m/s at 60° to the horizontal. The displacement after 2 s is

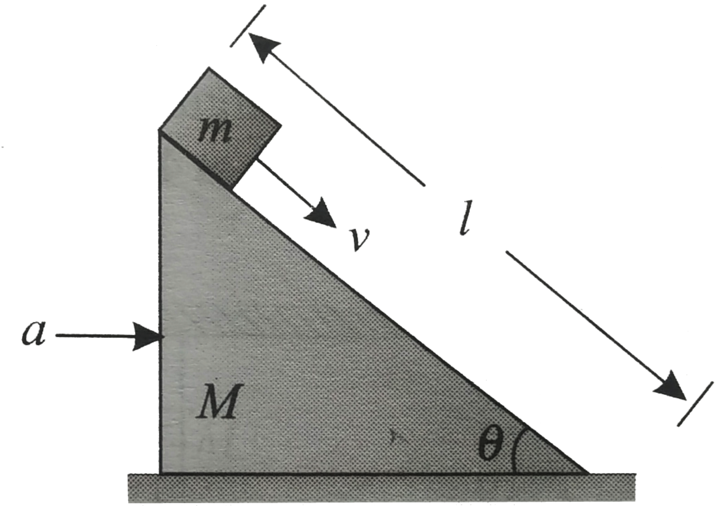
A. $20\left[i+\left(\sqrt{3}-1\right)i\right]$

B. $20\left[1-\left(\sqrt{3}-1\right)j\right]$

C. $10\left[i+\left(\sqrt{3}+1\right)j\right]$

D. $10\left[1+\left(\sqrt{3}-1\right)\right]$

Answer: A

73. 

A smooth wedge of mass M is pushed with an acceleration $a = \;> an\theta$ and a block of mass m is projected down the slant with a velocity v relative to the wedge.

`The horizontal force applied on the wedge is:

A. $\dfrac{72u^2}{145g}$

B. $\dfrac{6}{\sqrt{145}}\dfrac{u^2}{g}$

C. $\dfrac{u^2}{2g}$

D. $\dfrac{145}{72}\dfrac{u^2}{g}$

Answer: A

Watch Video Solution

74. A stone is projectef from level ground such that its horizontal and vertical components of initial velocity are $u_x = 10\frac{m}{s}$ and $u_y = 20\frac{m}{s}$

respectively. Then the angle between velocity vector of stone one second before and one second after it attains maximum height is:

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

B. $\frac{3u^2}{4g}$

C. $\frac{16u^2}{17g}$

D. $\frac{8u^2}{17g}$

Answer: D

Watch Video Solution

75. A person, standing on the roof of a 40 m high tower, throws a ball vertically upwards with speed 10 m/s. Two seconds later, he throws another ball again in vertical direction (use $g = 10\frac{m}{s^2}$). Both the balls hit the ground simultaneously.

A. 45°

B. 30°

C. 60°

D. 15°

Answer: B

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76. The height y and horizontal distance x covered by a projectile in a time t seconds are given by the equations y = $8t - 5t^2$ and x = 6t. If x and y are measured in metres, the velocity of projection is

A. $8ms^{-1}$

B. $6ms^{-1}$

C. $14ms^{-1}$

D. $10ms^{-1}$

Answer: D

Watch Video Solution

77. A body is projected at an angle of 30° with the horizontal and with a speed of $30ms^{-1}$. What is the angle with the horizontal after $1.5s$? $(g = 10ms^{-2})$.

A. zero

B. 60°

C. 45°

D. 90°

Answer: A

Watch Video Solution

78. A ball is projected obliquely with a velocity 49 ms^{-1} strikes the ground at a distance of

245 m from the point of projection. It remained in air for

A. 10 sec

B. $5\sqrt{2}$ sec

C. 3 sec

D. 2.5 sec

Answer: B

Watch Video Solution

79. A particle just clears a wall of height b at distance a and strikes the ground at a distance c from the point of projection. The angle of projection is (1) $\frac{\tan^{-1} b}{ac}$ (2) 45^o (3) $\frac{\tan^{-1}(bc)}{a(c-a)}$ (4) $\frac{\tan^{-1}(bc)}{a}$

A. 30°

B. 45°

C. 60°

D. none

Answer: C

Watch Video Solution

80. The ratio of distance of two satellites from the centre of earth is 1 : 4. The ratio of their time periods of rotation will be :

A. 50 m and 80 m

B. 47.5 m and 77.5 m

C. 30 m and 60 m

D. 25 m and 55 m

Answer: B

Watch Video Solution

81. A gun fires a bullet at a speed of 140 ms^{-1}. If the bullet is to hit a target at the same level as the gun and at 1km distance, the angle of projection may be

A. 60° or 30°

B. 40° or 50°

C. 15° or 75°

D. 20º or 70º

Answer: C

Watch Video Solution

82. A body is projected with velocity 24 ms^{-1} making an angle 30º with the horizontal. The vertical component of its velocity after 2s is (g=10ms^{-1})

A. 8 ms^{-1} upward

B. 8 ms^{-1} down ward

C. 32 ms^{-1} upward

D. 32 ms^{-1} down ward

Answer: B

Watch Video Solution

83. A particle is thrown with velocity u at an angle $\propto$ from the horizontal. Another particle is thrown with the same velocity at an angle $\propto$ from the verticle. What will be the ratio of times of flight of two particles ?

A. $\tan 2\theta : 1$

B. $\cot 2\theta : 1$

C. $\tan \theta : 1$

D. $\cot \theta : 1$

Answer: C

Watch Video Solution

84. The equation of trajectory ofa projectile is $y = 10x - \frac{5}{9}x^2$ If we assume $g = 10ms^{-2}$, the range of projectile (in metre) is

A. 36

B. 24

C. 18

D. 9

Answer: C

Watch Video Solution

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

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

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

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

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

Answer: A

Watch Video Solution

86. A particle is projected from a horizontal floor with speed $10\frac{m}{s}$ at an angle 30° with the floor and striking the floor after sometime. State which is correct.

A. $1:5$

B. $5:1$

C. $1:40$

D. $40:1$

Answer: D

Watch Video Solution

87. For a projectile, the ratio of maximum height reached to the square of flight time is (Take, $g = 10ms^{-2}$)

A. $5:4$

B. $5:2$

C. $5:1$

D. $10:1$

Answer: A

Watch Video Solution

88. The speed of a projectile at its maximum height is $\sqrt{3}/2$ times its initial speed. If the range of the projectile is P times the maximum height attained by it, P is equal to

A. $4/3$

B. $2\sqrt{3}$

C. $4\sqrt{3}$

D. $3/4$

Answer: C

Watch Video Solution

89. The velocity at the maximum height of a projectile is half of its initial velocity of projection. The angle of projection is

A. 30°

B. 45°

C. 60°

D. 76°

Answer: C

Watch Video Solution

90. A person throws a bottle into a dust-bin at the same height as he is 2 m away at an angle of 45°. The velocity of the throw is

A. g

B. $\sqrt{g}$

C. 2g

D. $\sqrt{2}g$

Answer: D

Watch Video Solution

91. A body is projected at angle 30° to horizontal with a velocity 50 ms^{-1}. Its time of flight is (g=10 m/s^2)

A. 4s

B. 5s

C. 6s

D. 7s

Answer: A

Watch Video Solution

92. A body is projected at angle 30° to horizontal with a velocity 50 ms^{-1} .In the above problem range of body is m. [g = 10 ms^{-2}]

A. $125\sqrt{3}$

B. $250\sqrt{3}$

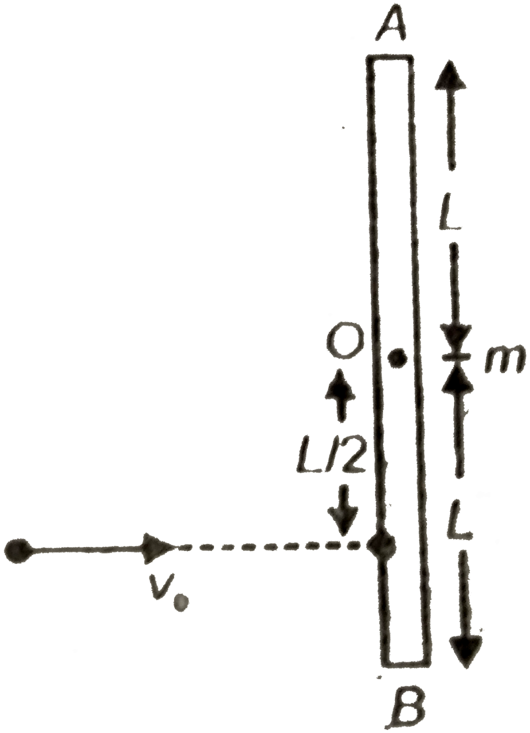
C. 125

D. 250

Answer: A

Watch Video Solution

93. A rod AB of length $2L$ and mass m is lying on a horizontal frictionless surface. A particle of same mass m travelling along the surface hits the rod at distance $\frac{L}{2}$ from COM with a velocity v_0 in a direction perpendicular to rod and sticks to it.



Distance of point P on rod from B which is at

rest immediately afte collision is

A. $\dfrac{1.6}{\sqrt{3}}s$

B. $\dfrac{4}{\sqrt{3}}s$

C. $0.6s$

D. $1.6\sqrt{3}s$

Answer: A

Watch Video Solution

94. An object is projected vertically up from the earth's surface with velocity $\sqrt{Rg}$ where R is the radius of the earth and 'g' is the acceleration due to earth on the surface of earth. The maximum height reached by the object is nR. Find value of n.

A. $2ms^{-1}$

B. $5ms^{-2}$

C. $10ms^{-2}$

D. $20ms^{-2}$

Answer: D

Watch Video Solution

95. A stone is projectef from level ground such that its horizontal and vertical components of initial velocity are $u_x = 10\frac{m}{s}$ and $u_y = 20\frac{m}{s}$

respectively. Then the angle between velocity vector of stone one second before and one second after it attains maximum height is:

A. 2.5 m

B. 0.8 m

C. 0.9 m

D. 0.45 m

Answer: D

Watch Video Solution

96. Two particles are projected with same velocity but at angles of projection 35^{o} and 55^{o}. Then their horizontal ranges are in the ratio of

A. $1:2$

B. $2:1$

C. $1:1$

D. 4:1`

Answer: C

Watch Video Solution

97. The potential energy of a projectile at its maximum height is equal to its kinetic energy there. If the velocity of projection is 20 ms^{-1}, its time of flight is (g=10 ms^{-2})

A. 2s

B. $2\sqrt{2}$ s

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

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

Answer: B

Watch Video Solution

98. If the maximum vertical height and horizontal ranges of a projectile are same, the angle of projection will be

A. 45°

B. $\tan^{-1} 4$

C. $\tan^{-1} 2$

D. 30°

Answer: B

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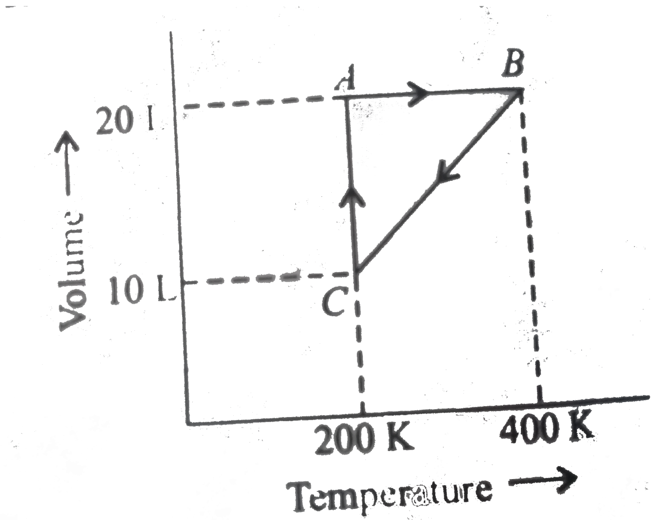
99. 

The pressures at A and B in the atmosphere are, respectively,

A. 20 m

B. 30 m

C. 60 m

D. 80 m

Answer: C

Watch Video Solution

100. A particle is moving along x-direction with a constant acceleration a. The particle starts from $x = x_0$ position with initial velocity u. We can define the position of the particle with time by the relation

$$x = x_0 + ut + \frac{1}{2}at^2$$

plot the position of the particle in relation with time is following situations

(i) If initial position of the particle is on negativ x-axis, initial velocity is positive and acceleration is negative.

(ii) If initial position is positive, initial velocity is negative and acceleration is positive.

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

B. $\frac{\sqrt{5}u}{2\sqrt{2}}$

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

D. $\frac{\sqrt{2}u}{\sqrt{5}}$

Answer: B

Watch Video Solution

101. The escape velocity at the surface of Earth is approximately 8 km/s. What is the escape velocity for a planet whose radius is 4 times and whose mass is 100 times that of Earth?

A. $-2\hat{i}+3\hat{j}$ m/s

B. $2\hat{i} - 3\hat{j}$ m/s

C. $2\hat{i} + 3\hat{j}$ m/s

D. $-\left(2\hat{i} + 3\hat{j}\right)$ m/s

Answer: B

Watch Video Solution

102. A body is projected into air with a velocity (3i + 4j + 5k)m/s. Taking x-y plane as base and Z axis as vertical, the range of projectile (g =10 m / s^2)

A. 10 m, 5π m

B. 5 m

C. 20 m

D. 15 m

Answer: B

Watch Video Solution

103. A ball is thrown at a speed of 20 m/s at an angle of 30° with the horizontal . The maximum height reached by the ball is

(Use $g = 10m/s^2$)

A. 2 m

B. 3 m

C. 4 m

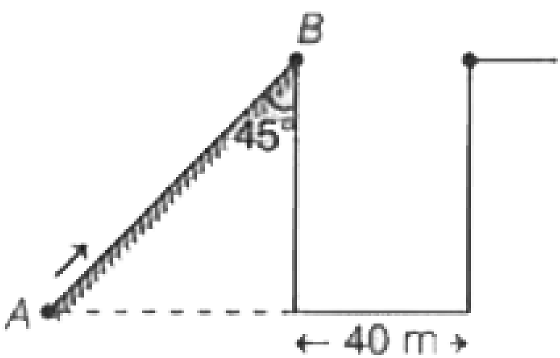
D. 5 m

Answer: D

Watch Video Solution

104. A body is projected up a smooth inclined plane of length $20\sqrt{2}m$ from point A as shown in the figure. The top of B of the inclined plane is connected to a well of diameter 40 m. If the body just manages to cross the well then the velocity of projection is

(Acceleration due to gravity, $g = 10ms^{-2}$)



A. $20ms^{-1}$

B. $20\sqrt{2}ms^{-1}$

C. $10\sqrt{2}ms^{-1}$, towards S-E

D. $15\sqrt{2}ms^{-1}$

Answer: B

Watch Video Solution

105. Ratio of minimum kinetic energies of two projectiles of same mass is 4 : 1 . The ratio of the maximum height attained by them is also $4:1$. The ratio of their ranges would be

A. $2:1$

B. $8:1$

C. $16:1$

D. $4:1$

Answer: D

Watch Video Solution

106. Equation of a projectile is given by $y = Px - Qx^2$, where P and Q are constants. The ratio of maximum height to the range of the projectile is

A. $\frac{P^2}{Q}$

B. 4P

C. $\frac{P}{4}$

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

Answer: C

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Watch Video Solution

107. A particle is projected with a velocity of $10\sqrt{2}$ m/s at an angle of 45° with the horizontal Find the interval between the moments when speed is $\sqrt{125}$ m/s

A. 0.5 s

B. 1.5 s

C. 2 s

D. 1.0 s

Answer: D

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108. A body is projected horizontally from a height of 78.4 m with a velocity 10 ms^{-1} . Its velocity after 3 seconds is [g = 10 ms^{-2}] (Take direction of projection on $\overrightarrow{i}$ and vertically upward direction on j)

A. $10\hat{i} - 30\hat{j}$

B. $10\hat{i} + 30\hat{j}$

C. $20\hat{i} - 30\hat{j}$

D. $10\hat{i} + 10\sqrt{3}\hat{j}$

Answer: A

Watch Video Solution

109. A stone is projectef from level ground such that its horizontal and vertical components of initial velocity are $u_x = 10\frac{m}{s}$ and $u_y = 20\frac{m}{s}$ respectively. Then the angle between velocity vector of stone one second before and one second after it attains maximum height is:

A. 3

B. 4

C. 5

D. 6

Answer: B

Watch Video Solution

110. A ball is projected horizontally with a velocity of $5ms^{-1}$ form the top of a tower of height 10. When it reaches the ground $(g = 10ms^{-2})$ find its velcoity?

A. Vertical component of its velocity is 15 ms^{-1}

B. Horizontal component of its velocity is 14 ms^{-1}

C. Its velocity is 15ms^{-1}

D. Its velocity is $\sqrt{29}ms^{-1}$

Answer: C

Watch Video Solution

111. A stone is thrown horizontally with velocity g ms^{-1} from the top of a tower of height g metre. The velocity with which it hits the ground is (in ms^{-1})

A. g

B. 2g

C. $\sqrt{3}$g

D. 4g

Answer: C

Watch Video Solution

112. A body is thrown horizontally from the top of a tower. It reaches the ground after 4s at an angle 45° to the ground. The velocity of projection is

A. $9.8ms^{-1}$

B. $19.6ms^{-1}$

C. $29.4ms^{-1}$

D. $39.2ms^{-1}$

Answer: D

Watch Video Solution

113. Two cliff of heights 120m and 100.4m are separated by a horizontal distance of 16m. If a car has to reach from the first cliff to the second, the horizontal velocity of the car should be

A. $16ms^{-1}$

B. $4ms^{-}$

C. $2ms^{-1}$

D. $8ms^{-1}$

Answer: D

Watch Video Solution

114. An aeroplane flying horizontally at an altitude of 490m with a speed of 180 kmph drops a bomb. The horizontal distance at which it hits the ground is

A. 500 m

B. 1000 m

C. 250 m

D. 50 m

Answer: A

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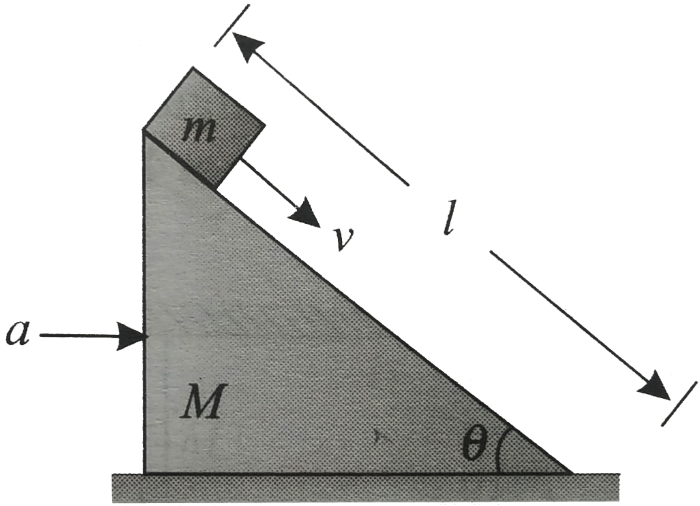
115. 

A smooth wedge of mass M is pushed with an acceleration $a = > an\theta$ and a block of mass m is projected down the slant with a velocity v relative to the wedge.

`The horizontal force applied on the wedge is:

A. 3t/4

B. t/2

C. 4t

D. 2t

Answer: D

Watch Video Solution

116. A ball thrown horizontally with velocity v from the top of a tower of height h reaches the ground in t seconds. If another ball of double the mass is thrown horizontally with velocity 3v from the top of another tower of height 4h it reaches the ground in (seconds).

In the above problem if the first ball reaches the ground at a horizontal distance d, the second ball reaches the ground at a horizontal distance

A. 6d

B. 3d

C. 12 d

D. 4d

Answer: A

Watch Video Solution

117. From the top of tower, which is 19.6 m high, a blls in thrown horizonally. If the line joining the point of projection to the point where it hits the ground makes an angle of 45° with the horizontal, then the initial velocity of the ball is

A. $4.9ms^{-1}$

B. $9.8ms^{-1}$

C. $19.6ms^{-1}$

D. $14.7ms^{-1}$

Answer: B

Watch Video Solution

118. A body is projected horizontally from the top of a hill with a velocity of 9.8 m/s. What time elapses before the vertical velocity is twice the horizontal velocity?

A. 0.5 sec

B. 1 sec

C. 2 se

D. 1.5 sec

Answer: C

Watch Video Solution

119. A object is thrown horizontally from a point A. The ball hits the ground at a point B. The line of sight from A to B makes 60° with the horizontal. If g = $10 ms^{-2}$, the velocity of projection, if the time of flight is $\sqrt{3}$ sec. is

A. $10 ms^{-1}$

B. $5 ms^{-1}$

C. $10\sqrt{3} ms^{-1}$

D. $\frac{10}{\sqrt{3}} ms^{-1}$

Answer: B

Watch Video Solution

120. A stone is projected horizontally with a velocity $9.8 ms^{-1}$ from a tower of height 100 m. Its velocity one second after projection is $(g = 9.8 ms^{-2})$.

A. $9.8 ms^{-1}$

B. $4.9 ms^{-1}$

C. $9.8\sqrt{2} ms^{-1}$

D. $4.9\sqrt{2} ms^{-1}$

Answer: C

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121. A body is thrown horizontally from the top of a tower of height 5m. It touches the ground at a distance of 10m from the foot of the tower. The initial velocity of the body is $(g = 10ms^{-2})$

A. $2.5ms^{-1}$

B. $5ms^{-1}$

C. $10ms^{-1}$

D. $20ms^{-1}$

Answer: C

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122. Two thin wood screens A and B are separated by 200m. A bullet travelling horizontally at a speed of $600ms^{-1}$ hits the screen A, penetrates through it and finally emerges out from B making holes in A and B. If the resistance of air and wood arc negligible, the difference of heights of the holes in A and B is

A. 5 m

B. $\frac{49}{90}$ m

C. $\frac{7}{\sqrt{90}}$ m

D. zero

Answer: B

Watch Video Solution

123. The height and width of each step of a staircase are 20cm and 30cm respectively. A ball rolls off the top of a stair with horizontal velocity v and hits the fifth step. The magnitude of v is (g=10 ms^{-2})

A. $1.5\sqrt{5}ms^{-1}$

B. $3\sqrt{5}ms^{-1}$

C. $7.5ms^{-1}$

D. $1.5ms^{-1}$

Answer: A

Watch Video Solution

124. A point on the rim of a wheel 3 m in diameter has linear velocity of 18 ms^{-1} . The angular velocity of the wheel is

A. 4 rad s^{-1}

B. 12 rad s^{-1}

C. 6 rad s^{-1}

D. 18 rad s^{-1}

Answer: B

Watch Video Solution

125. A car is moving with a speed of 30 ms^{-1} on a circular path of radius 500 m. If its speed is increasing at the rate of 2 ms^{-2}, the net acceleration of the car is

A. $3.6ms^{-2}$

B. $2.7ms^{-2}$

C. $1.8ms^{-2}$

D. $2ms^{-2}$

Answer: B

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126. The speed of a motor increases from 1200 rpm to 1800 rpm in 20 S. How many revolutions does it make in this period of time?

A. 400

B. 200

C. 500

D. 800

Answer: C

Watch Video Solution

127. Replum is present in the ovary of flowers of

A. $0.8ms^{-2}$

B. $0.34ms^{-2}$

C. $0.2ms^{-2}$

D. $1.2ms^{-2}$

Answer: C

Watch Video Solution

128. A satellite is launched into a circular orbit of radius R around the earth while a second satellite is launched into an orbit of radius 1.02R. The percentage difference in the time period is:

A. $0.68ms^{-2}$

B. $0.86ms^{-2}$

C. $0.56ms^{-2}$

D. $0.76ms^{-2}$

Answer: B

Watch Video Solution

129. The value of escape speed from the surface of earth is

A. 1

B. 2

C. 3

D. 4

Answer: B

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130. A point object moves along an arc of a circle of radius 'R'. Its velocity depends upon the distance covered 'S' as V = $K\sqrt{S}$ where 'K' is a constant. If ' theta' is the angle between the total acceleration and tangential acceleration, then

A. $\tan\theta = \sqrt{\frac{S}{R}}$

B. $\tan\theta = \sqrt{\frac{S}{2R}}$

C. $\tan\theta = \frac{S}{2R}$

D. $\tan\theta = \frac{2S}{R}$

Answer: D

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131. A swimmer wants to cross a 200 m wide river which is flowing at a speed of 2 m/s. the velocity of the swimmer with respect to the river is 1 m/s. how far from the point directly opposite to the starting point does the swimmer reach the opposite bank ?

A. 200 m

B. 400 m

C. 600 m

D. 800 m

Answer: B

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132. Consider the motion of a particle described by $x = a\cos t, y = a\sin t$ and $z = t$. The trajectory traced by the particle as a function of time is

A. Helix

B. Circular

C. Elliptical

D. Straight line

Answer: A

Watch Video Solution

133. A particle of mass M is moving in a horizontal circle fo radius R with unifomr speed V. When it moves from one point to a diameterically opposite point, its

A. momentum does not change

B. momentum changes by 2MV

C. kinetic energy changes by $\frac{Mv^2}{4}$

D. kinetic energy changes by Mv^2

Answer: B

Watch Video Solution

134. At high altitude , a body at rest explodes into two equal fragments with one fragment receiving horizontal velocity of $10ms^{-1}$. Time taken by the velocity of the fragments to make

90° is (Take, g= 10ms^(-2)`

A. $40\sqrt{3}m$

B. $60\sqrt{3}m$

C. $240\sqrt{3}m$

D. $480\sqrt{3}$m

Answer: B

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135. A body projected from the top of a tower with a velocity u = 3i + 4j + 5k ms^{-1}. Where $\hat{j}$ and $\hat{k}$ are unit vectors along east, north and vertically upwards respectively. If the height of the tower is 30 m, horizontal range of the body on the ground is(g = $10 ms^{-2}$)

A. 12 m

B. 9 m

C. 25 m

D. 15 m

Answer: D

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PRACTICE EXERCISE

1. A person runs along a circular path of radius 5 m. Find the magnitude of the displacement if he runs all the way around the circle ?

A. 10 m

B. 20 m

C. 3 m

D. Zero

Answer: D

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2. A car is moving 40m due east, turns towards north moves 30m. then turns 45° east of north moves $20\sqrt{2}$ m. The net displacement of car is (East is taken positive x-axis, North as positive y-axis)

A. $50\hat{i} + 60\hat{j}$

B. $60\hat{i} + 50\hat{j}$

C. $30\hat{i} + 40\hat{j}$

D. $40\hat{i} + 30\hat{j}$

Answer: B

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3. If $\vec{A} = 3\hat{i} - 4\hat{j}$ and $\vec{B} = -\hat{i} - 4\hat{j}$, calculate the direction of $\vec{A} - \vec{B}$.

A. along positive x-axis

B. along negative x-axis

C. along positive y-axis

D. along negative y-axis

Answer: A

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4. The resultant of the forces $\overrightarrow{F}_1 = 4\hat{i} - 3\hat{j}$ and $\overrightarrow{F}_2 = 6\hat{i} + 8\hat{j}$ is

A. $5\sqrt{5}$

B. $10\hat{i} - 5\hat{j}$

C. 125

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

Answer: A

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5. The horizontal and vertical components of a force are 8 N and 15 N respectively. The force is

A. 23 N

B. 20 N

C. 17 N

D. 7 N

Answer: C

Watch Video Solution

6. An aeroplane is heading north east at a speed of 141.4 ms^{-1} . The northward component of its velocity is

A. $141.4ms^{-1}$

B. $100ms^{-1}$

C. zero

D. $50ms^{-1}$

Answer: B

Watch Video Solution

7. To go from town A to town B a plane must fly about 1780 km at an angle of 30° West of North. How far north of A is B ?

A. 1542 km

B. 1452 km

C. 1254 km

D. 890 km

Answer: D

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8. A wheel of perimeter 4π is rolling on a horizontal surface. The displacement of the point of contact of wheel and ground when the wheel completes one quarter of revolution

is

A. $\sqrt{(\pi+2)^2+4}$ along $\frac{\tan^{-1}2}{\pi}$ with x-axis.

B. $\sqrt{(\pi-2)^2+4}$ along $\frac{\tan^{-1}2}{\pi}$ with x-axis

C. $\sqrt{(\pi-2)^2+4}$ along $\frac{\tan^{-1}2}{\pi-2}$ with x-axis

D. $\sqrt{(\pi+2)^2+4}$ along $\frac{\tan^{-1}2}{\pi-2}$ with x-axis

Answer: C

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9. Given two vectors A = i-2j-3k and B = 4i - 2j + 6k. The angle made by (A + B) with the X-axis is

A. 30°

B. 45°

C. 60°

D. 90°

Answer: B

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10. If the two directional cosines of a vectors are $\frac{1}{\sqrt{2}}$ and $\frac{1}{\sqrt{3}}$ then the value of third directional cosine is

A. $\frac{1}{\sqrt{6}}$

B. $\frac{1}{\sqrt{5}}$

C. $\frac{1}{\sqrt{7}}$

D. $\dfrac{1}{\sqrt{10}}$

Answer: A

Watch Video Solution

11. If $\overrightarrow{P} = \hat{i} + \hat{j} + \hat{k}$, its direction cosines are

A. 1,1,1

B. $1/\sqrt{3}, 1/\sqrt{3}, 1/\sqrt{3}$

C. $\sqrt{3}, \sqrt{3}, \sqrt{3}$

D. 0,0,0

Answer: B

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12. If A = 2i - 3j + 4k, its component in xy plane is

A. 4

B. $\sqrt{13}$

C. $\sqrt{29}$

D. 1

Answer: B

Watch Video Solution

13. The unit vector parallel to the resultant of the vectors A = 4i+3j + 6k and B = -i + 3j-8k is

A. $\frac{1}{7}\left(3\hat{i} + 6\hat{j} - 2\hat{k}\right)$

B. $\frac{1}{7}\left(3\hat{i} + 6\hat{j} + 2\hat{k}\right)$

C. $\frac{1}{49}\left(3\hat{i} + 6\hat{j} - 2\hat{k}\right)$

D. $\frac{1}{49}\left(3\hat{i} - 6\hat{j} + 2\hat{k}\right)$

Answer: A

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14. A vector $\hat{i} + \sqrt{3}\hat{j}$ rotates about its tail through an angle 60° in clockwise direction then the new vector is

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

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

C. $2\hat{j}$

D. $2\hat{i}$

Answer: D

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15. If the angle between two vectors of equal magnitude P is θ the magnitude of the difference of the vectors is

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

B. $2P\frac{\sin\theta}{2}$

C. $P\frac{\cos\theta}{2}$

D. $P\frac{\sin\theta}{2}$

Answer: B

Watch Video Solution

16. Two forces are in the ratio of 5 : 2. The maximum and minimum of their resultants are in the ratio is

A. $5:2$

B. $2:5$

C. $7:3$

D. $3:7$

Answer: C

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17. Two equal forces of magnitude 'p' each are angled first at 60° later at 120°. The ratio of magnitude of their resultants is

A. $1 : \sqrt{3}$

B. $\sqrt{3} : 1$

C. $1 : 1$

D. $1 : 2$

Answer: B

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18. Three vectors $\vec{P}, \vec{Q}, \vec{R}$ obey $P^2 + Q^2 = R^2$ angle between $\vec{P}$ & $\vec{Q}$. is

A. 0°

B. 30°

C. 60°

D. 90°

Answer: D

Watch Video Solution

19. The resultant of two forces 2 N and 3 N is $\sqrt{19}$ N. The angle between the forces is

A. 30°

B. 45°

C. 60°

D. 90°

Answer: C

Watch Video Solution

20. Twelve forces each of 5 N act on a body simultaneously. If each force makes an angle of 30^{o} with other their resultant is

A. 5N

B. 60 N

C. 5 N

D. zero

Answer: D

Watch Video Solution

21. Which of the following sets of forces acting simultaneously on a particle keep it in equilibrium?

A. 2,3,6

B. 7,8,19

C. 3,4,5

D. 1,3,7

Answer: C

Watch Video Solution

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

A. 150°

B. 90°

C. 60°

D. 120°

Answer: D

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23. If the difference of two unit vectors is also a vector of unit magnitude, the magnitude of the sum of the two unit vectors is

A. 1

B. $1/\sqrt{3}$

C. $\sqrt{3}$

D. 2

Answer: C

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24. Resultant of two vectors is of magnitude P. If $\overrightarrow{A}$ and $\overrightarrow{B}$ is reversed, then resultant is of magnitude Q. what is the value of $(P^2 + Q^2)$?

A. $C^2 + D^2 = A^2 + B^2$

B. $A^2 + C^2 = B^2 + D^2$

C. $C^2 + D^2 = 2(A^2 + B^2)$

D. $C^2 - D^2 = A^2 + B^2$

Answer: C

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25. The greater and least resultant of two forces are 9 N and 5 N respectively. If they are applied at 60^{o}. The magnitude of the resultant is

A. 100N

B. 119N

C. $\sqrt{119}$ N

D. $\sqrt{67}$ N

Answer: D

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26. The resultant of two forces at right angles is 13N. The minimum resultant of the two forces is 7 N. The forces are

A. 20 N, 6 N

B. 10 N, 20 N

C. 5 N, 12 N

D. 8 N, 15 N

Answer: C

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27. Given that $\overrightarrow{A} + \overrightarrow{B} + \overrightarrow{C} = 0$, out of three vectors two are equal in magnitude and the magnitude of third vector is $\sqrt{2}$ times that of either of two having equal magnitude. Then angle between vectors are given by

A. 30º,60º,90º

B. 45º, 135º, 150º

C. 45º, 135º, 150º

D. 90º,135º,135º

Answer: D

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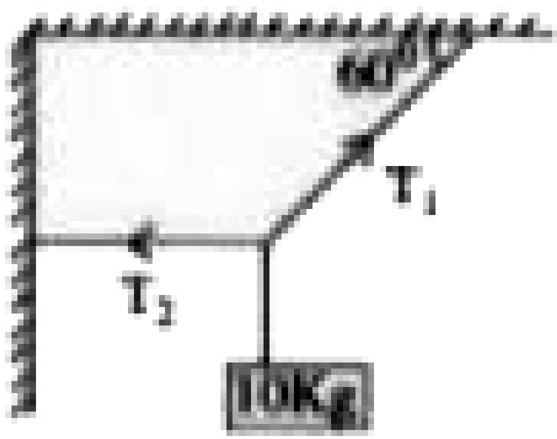
28. A 10 kg wt is suspended as shown below then tension T_1 & T_2 are



A. 20kg wt, 20kgwt

B. $\frac{20}{\sqrt{3}}$ kgwt, $\frac{20}{\sqrt{3}}$ kgwt

C. $\frac{20}{\sqrt{3}}$ kgwt $\frac{10}{\sqrt{3}}$ kgwt

D. $\frac{20}{\sqrt{3}}$ kgwt, $10\sqrt{3}$ kgwt

Answer: C

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29. A 10 kg body is suspended by a rope is pulled by means of a horizontal force to make 60° by rope to vertical. The horizontal force is

A. 10 kgwt

B. 30 kgwt

C. $10\sqrt{3}$ kgwt

D. $30\sqrt{3}$ kgwt

Answer: C

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30. 'A' and 'B' are the two pegs separated by 13 cm. A body of 169 Kgwt is suspended by thread of 17 cm connecting to A & B, such that the two segments of strings are perpendicular.

Then tensions in shorter and longer parts of string having are

A. 100 kgwt, 69 kgwt

B. 65 kgwt, 156. kgwt

C. 156 kgwt, 65 kgwt

D. 69 kgwt, 100 kgwt

Answer: C

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31. The position vector of a particle is deternined by the expression $\vec{r} = 3t^2\hat{i} + 4t^2\hat{j} + 7\hat{k}$ The distance traversed in first 10 sec is

A. 500 m

B. 400 m

C. 300 m

D. 700 m

Answer: A

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32. A car moving at a constant speed of 36kmph moves north wards for 20 minutes then due to west with the same speed for 8 minutes. What is the average velocity of the car during this run in kmph

A. 27.5

B. 40.5

C. 20.8

D. 32.7

Answer: A

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33. A person 'P' in train moving due south with 80 kmph and his friend Q moving due west at 60 kmph Q finds that P is travelling with a velocity of

A. 100 kmph, $\tan^{-1}\left(\frac{4}{3}\right)$ S of E

B. 100 kmph, $\tan^{-1}\left(\frac{4}{3}\right)$ E of S

C. 100 kmph S of E

D. 100 kmph N of E

Answer: A

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34. A person crossing a road with a certain velocity due north sees a car moving towards east The relative velocity of the car w.r.t the person is $\sqrt{2}$ times that fo the velocity of the persons. The angle made by the relative velocity with the east is

A. 30°

B. 45°

C. 60°

D. 90°

Answer: B

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35. A particle is moving east wards with a velocity of $15ms^{-1}$. In a time of 10 s, the velocity changes to $15ms^{-1}$ northwards.

Average acceleration during this time is (in ms^{-2})

A. $3/\sqrt{2}$ NE

B. $3\sqrt{2}$ NE

C. $3/\sqrt{2}$ NW

D. $3\sqrt{2}$ NW

Answer: C

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36. A ship 'A' steams down to North at 16 km/h, and ship 'B' due west at 12 km/h. at a certain instant B is 10 km north east of A . find the magnitude of velocity of A relative to B?

A. 10 kmph

B. 25 kmph

C. 6 kmph

D. 20 kmph

Answer: D

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37. When it is raining vertically down, to a man walking on road the velocity of rain appears to be 1.5 times his velocity. To protect himself from rain he should hold the umbrella at an angle θ to vertical. Then $\tan\theta =$

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

B. $\dfrac{\sqrt{5}}{2}$

C. $\dfrac{2}{3}$

D. $\dfrac{3}{2}$

Answer: A

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38. A shower of rain appears to fall vertically downwards with a velocity of 12 kmph on a person walking west wards with a velocity of 5 kmph. The actual velocity and direction of the rain are

A. 7.5 kmph, clockwise to vertical

B. 13 kmph, anti clockwise to vertical

C. 13 kmph, clockwise to vertical

D. 17 kmph, clockwise to vertical

Answer: C

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39. A boat takes 4 hr upstream and 2 hr down the stream for covering the same distance. The ratio of velocity of boat to the water in river is

A. $1:3$

B. $3:1$

C. $1:\sqrt{3}$

D. $\sqrt{3}:1$

Answer: B

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40. A man can swim in still water at a speed of 4 kmph. He desires to cross a river flowing at a speed of 3 kmph in the shortest time interval.

If the width of the river is 3km time taken to cross the river (in hours) and the horizontal distance travelled (in km) are respectively

A. $1ms^{-1}$

B. $0.25ms^{-1}$

C. $0.67ms^{-1}$

D. $3ms^{-1}$

Answer: A

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41. A person swims in a river aiming to reach exactiy opposite pouint on the bank of a an angle 120° with the direction of flow of water.The speed of water in stream is

A. $1ms^{-1}$

B. $0.25ms^{-1}$

C. $0.67ms^{-1}$

D. $3ms^{-1}$

Answer: B

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42. A boat moves perpendicular to the bank with a velocity of 7.2 km/h. The current carries it 150 m downstream, find the velocity of the current. (The width of the river is 0.5 km).

A. 4.16min

B. 2.15min

C. 3.11min

D. 5.11min

Answer: A

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43. A swimmer is capable of swimming 1.65 ms^{-1} in still water. If she swims directly across a 180m wide river whose current is 0.85 m/s, how far downstream (from a point opposite her starting point) will she reach ?

A. 1.82 min

B. 20 min

C. 4 min

D. 4.8 min

Answer: A

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44. A body is projected with an initial Velocity 20 m/s at 60° to the horizontal. Its initial velocity vector is- (g=10 m/s^2)

A. $10\hat{i} - 20\hat{j}$

B. $10\sqrt{3}\hat{i} + 10\hat{j}$

C. $10\hat{i}+10\sqrt{3}\hat{j}$

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

Answer: C

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45. A body is projected with an initial Velocity 20 m/s at 60° to the horizontal. Its velocity after 1 sec is

A. $10i+7.32j$

B. $10i - 7.32j$

C. $10i + \sqrt{3}j$

D. $10i - \sqrt{3}j$

Answer: A

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46. A bullet is projected upwards from the top of a tower of height 90 m with the velocity $30ms^{-1}$ making an angle 30° with the horizontal. Find the time taken by it to reach the ground is $\left(g = 10ms^{-2}\right)$

A. 2s

B. 3s

C. 24 s

D. 6 s

Answer: D

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47. A stone is projected from the ground with a velocity of 20 m/s at angle 30° with the horizontal. After one second it clears a wall then find height of the wall. $(g = 10ms^{-2})$

A. 10 m

B. 2 m

C. 5 m

D. 15 m

Answer: C

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48. The horizontal and vertical displacements of projectile at time " are $x = 36t$ and $y = 48 - 4.9t^2$ respectively. Find initial velocity of the projectile in ms^{-1}

A. 15

B. 30

C. 45

D. 60

Answer: D

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49. A body is projected with velcotiy $24ms^{-1}$ making angle 30° with the horizontal. Find the angle by the direction of the projectile with the horizontal at 2s from start is .

A. $\tan^{-1}\left(\frac{2}{3\sqrt{3}}\right)$

B. $\tan^{-1}\left(\frac{1}{3\sqrt{3}}\right)$

C. $\tan^{-1}\left(\frac{2}{3}\right)$

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

Answer: A

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50. A body projected with velcoity $30ms^{-1}$ reaches it maximum height in 1.5s. Find its range $(g = 10ms^{-2})$

A. 45 m

B. 108 m

C. $45\sqrt{3}$ m

D. 54 m

Answer: C

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51. The potential energy of a projectile at its maximum height is equal to its kinetic energy there. Find its range for velocity of projection u.

A. $\dfrac{u^2}{2g}$

B. $\dfrac{u^2}{g}$

C. $\dfrac{2u^2}{g}$

D. $\dfrac{2u}{g}$

Answer: B

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52. Two bodies are throw at angle θ (90-θ) from the same point with same velocity $25ms^{-1}$. If the difference between their maximum height is 15m. Find the respective maximum heights. $(g = 10ms^{-2})$.

A. $\frac{185}{8}$ m and $\frac{65}{8}$ m

B. $\frac{125}{4}$m and $\frac{65}{4}$ m

C. 40 m and 25 m

D. 25 m and 40 m

Answer: A

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53. The minimum and maximum velocities of a projectile are $10ms^{-1}$ and $20ms^{-1}$ respectively. Find the horizontal range and maximum height $(g = 10ms^{-2})$

A. $10\sqrt{3}$ and 20 m

B. $20\sqrt{3}$ m and 15 m

C. 20 m and 15 m

D. $10\sqrt{3}$ m and 10 m

Answer: B

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54. A body is projected with an initial velocity of $58.8 m/s$ at angle 60° with the vertical. Find the vertical component of velocity after 2 sec.

A. 9.8 m/s upwards

B. 9.8 m/s downwards

C. 10.3 m/s upwards

D. 19.6 m/s downwards

Answer: A

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55. A body is projected at 60° with the horizontal with the velocity of $10ms^{-1}$. Find the velocity of the projectile when it moves perpendicular to its initial direction.

A. $30ms^{-1}$

B. $\frac{10}{3}ms^{-1}$

C. $10ms^{-1}$

D. $5ms^{-1}$

Answer: C

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56. If the equation of motion of a projectile is $y = 3x - \frac{1}{8}x^2$ the range and maximum height are respectively (y and x are in metres)

A. 18 m and 24 m

B. 24 m and 18 m

C. 24 m and 6 m

D. 12 m and 9 m

Answer: B

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57. The time of flight of a projectile is related to its horizontal range by the equation $gT^2 = 2R$. The angle of projection is

A. 30°

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

C. $\sin^{-1}\left(\frac{1}{2}\right)$

D. 45°

Answer: D

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58. The velocity at the maximum height of a projectile is $\frac{\sqrt{3}}{2}$ times the initial velocity of projection. The angle of projection is

A. 60°

B. 45°

C. 30°

D. 15°

Answer: C

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59. A ball is projected at an angle 30° with the horizontal with the velocity $49 ms^{-1}$. The horizontal range is

A. 122.5 m

B. 245 m

C. $245\sqrt{3}$ m

D. $122.5\sqrt{3}$ m

Answer: D

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60. A body is projected at angle 30° to the horizontal with a velocity $50ms^{-1}$ maximum height of projectile is

A. 40m

B. 31.25m

C. 28m

D. 21m

Answer: B

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61. A boy throws a ball with a velocity of 15 m/s at an angle of 15° with the horizontal. The distance at which the ball strikes the ground is

A. 5 m

B. 20 m

C. 10 m

D. 11.25 m

Answer: D

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62. A body is projected at an angle 30^{o} with a velocity 42 ms^{-1} Its maximum height is

A. 22.5m

B. 32.5m

C. 42.5m

D. 52.5m

Answer: A

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

A. 60 m

B. 71 m

C. 100 m

D. 141 m

Answer: B

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64. The ceiling of hall is 40 m high. For maximum horizontal distance, the angle at which the ball may be thrown with a speed of

56 m s^{-1} without hitting the ceiling of the ball is

A. 25°

B. 30°

C. 45°

D. 60°

Answer: B

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65. A body is thrown with velocity (4i+3j) metre per second. Its horizontal range and time of flight are

A. 2.4 m and 0.6 s

B. 3.2 m and 0.8 s

C. 5 m and 2 s

D. 7 m and 1s

Answer: A

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66. Two particles are projected with same velocity but at angles of projection 25° and 65° with horizontal. The ratio of their horizontal ranges is

A. $1:2$

B. $1:1$

C. $2:1$

D. cannot be determined

Answer: B

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67. A body is projected with kinetic energy E such that its range is maximum. Its potential energy at the maximum height is

A. E

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

C. 2E

D. $\sqrt{2}E$

Answer: B

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68. A body is projected with velocity u such that its horizontal range and maximum vertical heights are same. The maximum heights is

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

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

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

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

Answer: D

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69. A body is projected with a certain speed at angles of projection of θ and $90-\theta$ The maximum height attained in the two cases are 20m and 10m respectively. The range for angle of projection θ is

A. $40\sqrt{2}$ m

B. $20\sqrt{2}$m

C. $80\sqrt{2}$ m

D. $200\sqrt{2}$m

Answer: A

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70. Two bodies are thrown with the same initial velocity of 30 m/s. One at 17°, other at 73° to the horizontal. The sum of the maximum heights reached by them is [g = 10 m/s^2]

A. 45 m

B. 450 m

C. 4.5 m

D. 20 m

Answer: A

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71. A body is projected horizontally from the top of a tower of height 10 m with a velocity 10m/s. Find its velocity after 1 second .

A. $10\hat{i} - 10\hat{j}$

B. $5\hat{i} + 5\sqrt{2}\hat{j}$

C. $15\hat{i} + 10\sqrt{2}\hat{j}$

D. $10\sqrt{2}\hat{i} + 5\hat{j}$

Answer: A

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72. In the above problem the angular velocity of the system after the particle sticks to it will be?

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

B. $\tan^{-1}(4)$ with - x- axis in clock wise

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

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

Answer: D

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73. Explain why the following reasoning is wrong :

"The Sun attracts all bodies on the Earth. At mid-night, when the sun is directly below, it pulls on an object in the same direction as the pull of the Earth on that object, at noon, when the Sun is directly above, it pulls on an object in a direction opposite to the pull of the Earth, Hence all objects should be heavier at mid-night (or night) than they are at noon (or day)."

A. $\frac{\sqrt{3}v}{2}$

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

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

D. $\frac{2v}{\sqrt{3}}$

Answer: A

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74. Two tall buildings are 40 m apart. With what speed must a ball be thrown horizontally from a window 145 m above the ground in one building, so that it will enter a window 22.5 m above from the ground in the other?

A. 4 m/s

B. 10 m/s

C. 8 m/s

D. 16 m/s

Answer: C

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75. A bomb is dropped from an aircraft travelling horizontally at $150 ms^{-1}$ at a height of 490m. The horizontal distance travelled by the bomb before it hits the ground is

A. 1000 m

B. 1200 m

C. 1500 m

D. 1800 m

Answer: C

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76. A body is thrown horizontally with a velocity of v m/s from the top of a tower of height 2h reaches the ground in 't' seconds. If another body double the mass is thrown horizontally with a velocity 5v m/s from the top of another tower of height 8h it reaches the ground in a time of

A. 2t

B. 4t

C. 6t

D. 8t

Answer: A

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77. A body is thrown horizontally with a velocity of v m/s from the top of a tower of height 2h reaches the ground in 't' seconds. If another body double the mass is thrown horizontally with a velocity 5v m/s from the top of another tower of height 8h. In the above problem if the first reaches the ground at a horizontal distance 'x' the second body reaches the ground at a horizontal distance

A. 5x

B. $x/10$

C. $10x$

D. $x/5$

Answer: C

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78. A body is projected horizontally from the top of a tower with a velocity of 20 m/s. After what time the vertical component of velocity is four times the horizontal component of velocity ? (g = $10m/s^2$)

A. 16 sec

B. 8 sec

C. 4 sec

D. 2 sec

Answer: B

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79. A body is projected horizontally from the top of a tower with a velocity of 30 m/s. The velocity of the body 4 seconds after projection is (g = $10ms^{-2}$)

A. $40ms^{-1}$

B. $20ms^{-1}$

C. $50ms^{-1}$

D. $100ms^{-1}$

Answer: C

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80. A body thrown horizontally from the top of a tower touches the ground at a distance of 160 m from the foot of the tower. If the velocity of projection is 40 m/s then the height of the towers is

A. 98 m

B. 9.6 m

C. 58.8 m

D. 78.4 m

Answer: D

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81. A sphere rolls off the top of a stairway with a horizontal velocity of magnitude 200 cm/sec. The steps are 10 cm high and 10 cm wide. Which step will the ball hit first?(g=10 m/s^2)

A. 8

B. 2

C. 4

D. 6

Answer: A

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82. The length of minutes hand in a pendulum clock is 10 cm. The speed of the tip of the hand is

A. $\frac{\pi}{6000}ms^{-1}$

B. $\frac{\pi}{18000}ms^{-1}$

C. $\frac{\pi}{3600} ms^{-1}$

D. $\frac{\pi}{1200} ms^{-1}$

Answer: B

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83. The speed of a motor decreases from 1200 rpm to 600 rpm in 20s. The total number of rotations it makes before coming to rest is

A. 400

B. 600

C. 800

D. 1000

Answer: A

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84. The angular frequency of a fan increases uniformly from 30 rpm to 60 rpm in π second. A dust particle is present at a distance of 20 cm from axis of rotation. The tangential acceleration of the particle is :

A. $2.8ms^{-2}$

B. $7.9ms^{-2}$

C. $9.2ms^{-2}$

D. $6.2ms^{-2}$

Answer: B

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