PHYSICS

BOOKS - GR BATHLA & SONS PHYSICS (HINGLISH)

MOTION IN TWO AND THREE DIMENSIONS

OBJECTIVE

1. A particle moves in x-y plane according to rule x $= a \sin \omega t$ and y=$a \cos \omega t$. The particles follows:

A. an elliptical path

B. a circu lar path

C. a parabolic path

D. a straight line path equally inclined to x and y-axes

Answer: b

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2. The x and y co-ordinates of a partilce at any time t are given by:

$x = 7t + 4t^2$ and $y = 5t$

The acceleration of the particle at 5s is:

A. zero

B. $8m / s^2$

C. $20m / s^2$

D. $40m / s^2$

Answer: b

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3. The height y and distance x along the horizontal plane of a projectile on a certain planet are given by $x = 6tm$ and $y = (8t^2 - 5t^2)m$. The velocity with which the projectile is projected is

A. 8m/s

B. 6m/s

C. 10m/s

D. zero

Answer: c

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4. In the above problem the direction of initial velocity with x-axis is:

A. $\tan^{-1}(3/4)$

B. $\tan^{-1}(4/3)$

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

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

Answer: b

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5. In the above problems the accelration due to gravity is:

A. $-10ms^2$

B. $5m/s^2$

C. $20m / s^2$

D. $2.5m / s^2$

Answer: a

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6. An object is projected so that it just clears two walls of height 7.5 m and with separation 50m from each other. If the time of passing between the walls is 2.5s, the range of the projectile will be (g=$10m / s^2$)

A. 35m

B. 70m

C. 140m

D. 57.5m

Answer: b

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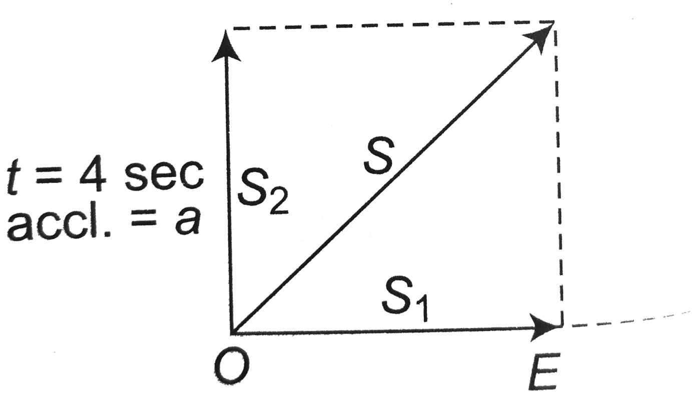
7. A body mass $2kg$ has an initial velocity of 3 metre//sec along OE and it is subject to a force of $4N$ in a direction perpendicular to OE.

The distance of body from O after 4 sec will be:



A. 12m

B. 28m

C. 20m

D. 48m

Answer: c

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8. If a force is applied at an angle to a body moving along a straight line:

A. the body continues to move in the direction of force

B. the body continues to move in its initial direction of motion

C. the body moves in a fixed direction other than that of force and initial motion.

D. the body moves in a direction other than that of force and initial motion wich varies with time.

Answer: d

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9. A particle moves along the positive branch of the curve $y = \frac{x^2}{2}$ where $x = \frac{t^2}{2}$, x and y are measured in metres and t in second. At $t = 2s$, the velocity of the particle is

A. $2\hat{i} - 4\hat{j}$

B. $4\hat{i} - 2\hat{j}$

C. $4\hat{i} + 2\hat{j}$

D. $2\hat{i} + 4\hat{j}$

Answer: d

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10. A bu llet is fired with a gun from a tower horizontally with a velocity 400m//s. at the same time a stone is droppe dform the same tower:

A. the stone will reach the ground first

B. the bullet will reach the ground first

C. both will reach the ground at the saem time

D. (a) and (b) according to the height of tower.

Answer: c

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11. Two bu llets are fired simu ltaneously, from the same level and in the horizontal direction, over a lake. The speed of one is 196m/s and of the other is 98m/s and of the other 98 m/s. Assuming that the air resistance is negligible and the lake is still the bu llet which is moving faster will, compared to the slower one, fal in the water:

A. half-time before

B. at the same time

C. twice the time after

D. thrice the time after.

Answer: b

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12. A particle moves along the parabolic path $y = ax^2$ in such a The accleration of the particle is:

A. $2a^2c\hat{j}$

B. $2ac^2\hat{j}$

C. $ac\hat{k}$

D. $a^2c^2\hat{k}$

Answer: b

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13. A ball is thrown upwards and returns to the ground describing a parabolic path. Which of the following quantities remains constant ?

A. Kinetic energy of the ball

B. The speed of the ball

C. the vertical component of velocity

D. The horizontal component of velocity.

Answer: d

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14. If a body A of mass M is thrown with velocity V at an angle of 30° to the horizontal and another body B of the same mass is thrown with the same speed at an angle of 60° to the horizontal. The ratio of horizontal range of A to B will be

A. $1:\sqrt{3}$

B. $\sqrt{3}:1$

C. $1:3$

D. $1:1$

Answer: d

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15. It was calculated that a shell when fired from a gun with a certain velocity and at an angle of elevation $5\pi / 36$ radius should strike a given target. In actual practice it was found that a hill just intervened in the trajectory. At what angle of elevation should the gun be fired to hit the target ?

A. $\frac{5\pi}{36}$ radian

B. $\frac{7\pi}{36}$ radian

C. $\frac{11\pi}{36}$ radian

D. $\frac{13\pi}{36}$ radian

Answer: d

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16. A ball of mass m is thrown vertically upwards. Another ball of same mass is thrown at an angle θ to the horizontal. If the time if

flights for both is same, the ratio of maximum height attained by them

A. $1 : 2$

B. $2 : 1$

C. $1 : 1$

D. $1 : \cos\theta$

Answer: c

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17. A particle is projected at an angle of 45° with a velocity of $9.8ms^{-1}$. The horizontal range will be (Take, $g = 9.8ms^{-2}$)

A. 9.8m

B. 4.9m

C. 9.8/ $\sqrt{2}m$

D. $9.8\sqrt{2}m$

Answer: a

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18. The range of a projectile launched at an angle of 15° with horizontal is 1.5km. The range of projectile when launched at an angle of 45° to the horizontal is

A. 1.5km

B. 3km

C. 6km

D. 0.75km

Answer: b

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19. An object is thrown along a direction inclined at an angle of 45° with the horizontal direction. The horizontal range of the particle is equal to

A. is equal to vertical height

B. is equal to twice the vertical height

C. is equal to thrice the vetical height

D. is equal to four times the vertical height.

Answer: d

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20. At what angle to the horizontal should an object be projected so that the maximum height reached is equal to the horizontal range.

A. $\tan\theta = 2$

B. $\tan\theta = 4$

C. $\tan\theta = 2/3$

D. $\theta = 3$

Answer: b

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

A. $5.9m/s^2$

B. $3.5m/s^2$

C. $16.3m/s^2$

D. $8.5m/s^2$

Answer: b

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22. A stone is thrown with a velocity V making an angle θ with the horizontal. The horizontal distance covered by it, before it falls to the ground, is maximum when θ is equal to:

A. 0°

B. 30°

C. 45°

D. 60°

Answer: c

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23. A body is projected with a speed (u) at an angle to the horizontal to have maximum range. What is its velocity at the highest point ?

A. zero

B. u

C. $u / \sqrt{2}$

D. $u\sqrt{2}$

Answer: c

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24. A grasshopper finds that he can jump a maximum horizontal distance of 0.8m. With what speed can be travel along the road if he spends a negligible time on the ground?

A. 2m/s

B. 2.8m/s

C. 104m/s

D. 1m/s

Answer: a

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25. A cricket ball is hit for a six the bat at an angle of 45° to the horizontal with kinetic energy K. At the highest point, the kinetic energy of the ball is

A. zero

B. k

C. k/2

D. $k / \sqrt{2}$

Answer: c

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26. The gretest height to which a man can throw a stone is h. the greatest distance to which he can throw will be:

A. h/2

B. h

C. 2h

D. 4h

Answer: c

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27. A bomber if flying horizontally with a constant speed of 150 m/s at a height of 78.4m. The pilot has to drop a bomb at the enemy target. AT what horizontal distance from the target shou ld be release the bomb?

A. zero

B. 300m

C. 600m

D. 1000m

Answer: c

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28. A box containing food supplies is released from an aeroplane moving horizontally at a height of 490 m with a velocity of 180 km/hr.

the box will move horizontally while falling nust before striking against the earth by:

A. 180m

B. 98m

C. 500m

D. 750m

Answer: c

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29. A particle is thrown with speed u at an angle α with horizontal from the ground. After how much time, the velocity of particle will make an angle β with horizontal.

A. $u \cos \alpha$

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

C. $u \cos \alpha \cos \beta$

D. $u \sec \alpha \cos \beta$

Answer: b

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30. A body is dropped from a plane moving with constant horizontal velociy. The path of the body as seen by a person on the plane will be

A. straight line

B. parabolic

C. hyperbolic

D. none of these

Answer: a

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31. Two particles A and B are shot from the same height at t=0 in opposite directions with horizontal velocities 3m/s and a m/s respectively. If they are subjected to the same vertical accelration due to gravity $(g = 9.8m/s^2)$, the distance between them when their velocity vectors become mutually perpendicu lar is:

A. 1.059m

B. 1.412m

C. 2.474m

D. 9.8m

Answer: c

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32. A projectile is fired horizontally with an initial speed of 20 m/s/ its horzontal speed 3 sec later is:

A. 20m/s

B. 6.67m/s

C. 60m/s

D. 29.4m/s

Answer: a

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33. A particle is projected at an angle α with the horizontal from the foot of an inclined plane making an angle β with horizontal .

Which of the following expressions holds good if the particle strikes the inclined plane normally?

A. $\cot \beta = -\tan(\alpha - \beta)$

B. $\cot \beta = 2\tan(\alpha - \beta)$

C. $\cot \alpha = \tan(\alpha - \beta)$

D. $\cot \alpha = 2\tan(\alpha - \beta)$

Answer: b

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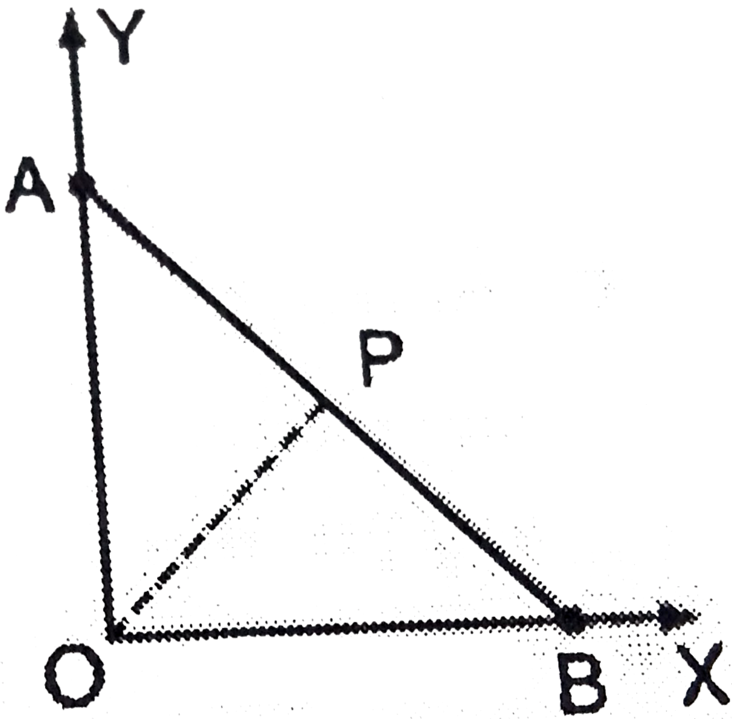
34. A rod AB moves towards the origin O of a fixed rectangu lar co-ordinate system, always perpendicu lar to the bisector of the angle XOY, with a velocity v. the speed of end B with respect to O will be.



A. v

B. 2v

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

D. $\sqrt{2v}$

Answer: d

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35. If R is the range of a projectiel on a horizontal plane and h its maximum height, the maximum horizontal range with the same velocity of projection is:

A. 2h

B. $\frac{R^2}{8h}$

C. $2R + \frac{h^2}{8R}$

D. $2h + \frac{R^2}{8h}$

Answer: d

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36. A particle is projected upwards with a velocity of $100 m / s$ at an angle of 60° with the vertical. Find the time when the particle will move perpendicular to its initial direction, taking $g = 10 m / s^{2}$.

A. 10second

B. 20second

C. 5 second

D. 10 $\sqrt{3}$ second

Answer: b

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37. A cannon ball has the same range R on a horizontal plane for two angles of projection. If h_1 and h_2 are the greatest heights in the two paths for which this is possible then:

A. $R = h_1 h_2$

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

C. $R = 3\sqrt{h_1 h_2}$

D. $R = (h_1 h_2)^{1/4}$

Answer: b

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38. Two particles A and B are thrown simu ltaneously from the same point at the same angle of projection but with the two different initial velocities $(v+u)$ and (v-u) respectively. Which of the following statements will b e true in respect of their motions?

A. The difference in their maximum heights is (2uv/g)

B. They reach their maximum heights at a time interval of $(2u \sin\theta) / g$

C. They will be separated by the distance of $\left(\frac{2uv \sin 2\theta}{g}\right)$ when they reach the ground again

D. They are never in the same horizontal level during their flights.

Answer: b

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39. Two particles are initially located at points A and B distant d apart. They start moving at time t=0 such that the velocity $\overrightarrow{u}$ of B is always along the horizontal and velocity $\overrightarrow{v}$ of A is contiunously aimed at B. At $t=0$, $\overrightarrow{u}$ is perpendicu lar to $\overrightarrow{v}$ The particles will meet after time:

A. $\dfrac{vd}{v^2-u^2}$

B. $\dfrac{v^2+u^2}{ud}$

C. $\frac{v^2 - u^2}{vd}$

D. $\frac{ud}{(v^2 - u^2)}$

Answer: a

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40. A ball rolls off top of a staircase with a horizontal velocity ums^{-1}. If the steps are h metre high and b mere wide, the ball will just hit the edge of nth step. Find the value of n.

A. $n = \frac{gx^{\circ}}{2hu^2}$

B. $n = \frac{2hu^2}{gw^2}$

C. $n = \frac{2u^2}{gw^2h}$

D. $n = \frac{2hw^2u^2}{g}$

Answer: b

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41. The x and y displacement of a particle in the x-y plane at any instant are given by $x = \alpha T^{\circ}$ and $y = 2\alpha T$ where a is a constant.

The velocity of the particle at any instant is given by:

A. $4a\sqrt{T^2+4}$

B. $2a\sqrt{T^2+1}$

C. $4a\sqrt{T^2+1}$

D. $\frac{a}{2}\sqrt{T^2+4}$

Answer: b

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42. If co-ordinates of a moving point at time t are given by x=a $(l+\sin t)$ and $y=a(1-\cos t)$, then:

A. the slope of accelration time graph is zero

B. the slope of velocity-time graph is constnat

C. the direction of motion makes an angle t/2 with x-axis

D. all of the above

Answer: d

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43. A particle moves along the positive branch of the curve $y = \frac{x^2}{2}$ where $x = \frac{t^2}{2}$, x and y are measured in metres and t in second. At $t = 2s$, the velocity of the particle is

A. $\left(2\hat{i} - 4\hat{j}\right) m / \sec$

B. $\left(2\hat{i} + 4\hat{j}\right)$ m/sec

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

D. $\left(4\hat{i} - 2\hat{j}\right)$ m/sec

Answer: b

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44. A projectile is thrown in the upward direction making an angle of 60° with the horizontal direction with a velocity of 147 ms^{-1}. Then the time after which its inclination with the horizontal is 45°, is:

A. 15s

B. 10.98s

C. 5.49s

D. 2.745s.

Answer: c

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45. The height y and the distance x along the horizontal plane of a projectile on a certain planet (with no surrounding atmospehre) are given by $y = \left(8t - 5t^2\right)$ metre and x=6t metre, where t is in seconds. The velocity of projection is:

A. 8m/s

B. 6m/s

C. 10m/s

D. not obtianed from the data

Answer: c

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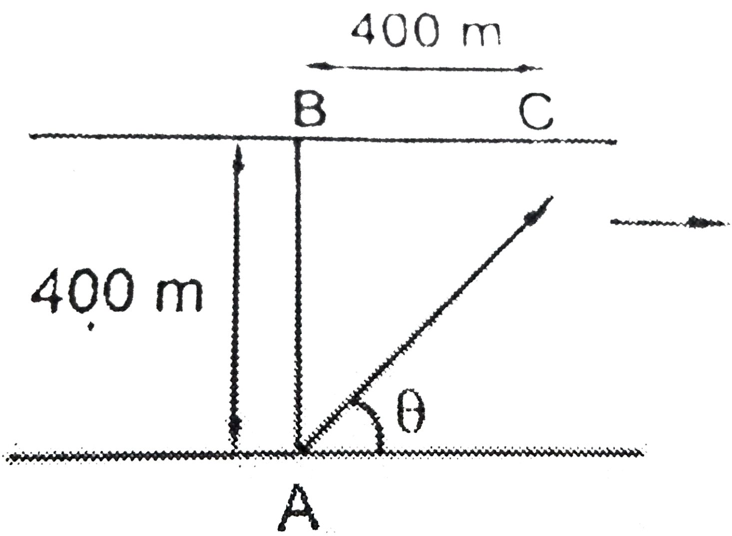
46. A river is flowing with a speed of 1 km/hr. A swimmer wants to go to point C starting from A. He swims with a speed of 5km/hr. at an angle θ. W.r.t. the river flow. If AB=BC=400m at what angle with river tank shou ld swimmer swim?



A. 37°

B. 53°

C. 0°

D. 90°

Answer: b

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47. On an incliend plane two particles A and B are projected with same speed at the same angle with the horizontal, particle A down and particle B up the plane. If the ratio of time of flight of A and B is cot θ, is the angle at which B is projected measured from. inclined plane, find the angle at which particles are projected.

A. 90°

B. 60°

C. 30°

D. 45°

Answer: d

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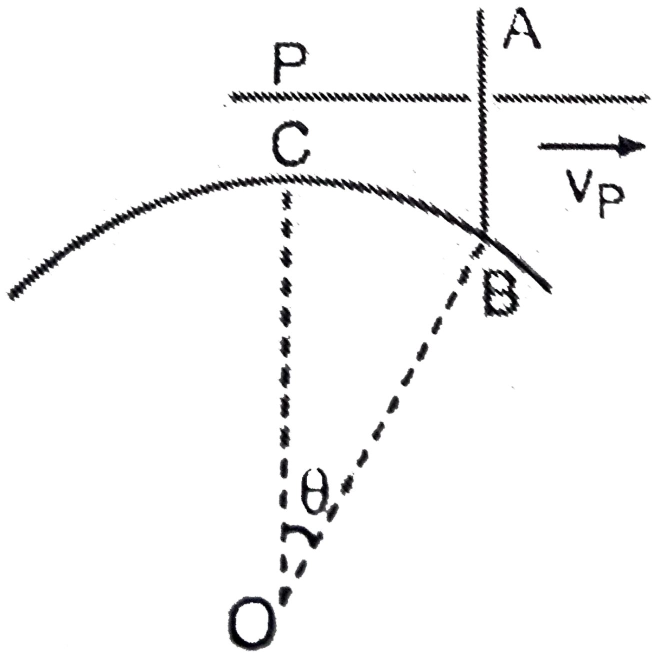
48. A platform P is moving with a velocity v_P over hemispherical shell. A vertical rod AB passing trhough a hole in the platform is moving on the shell and remains vertical. There is sufficient friction between rod and shell to stop the slip. C is the crown of the shell and O is its cenre $\angle BOC = \theta$ at any instant. find the velocity of point B in downward motion at that instnat:



A. $u_p \sin\theta$

B. $u_p \cos\theta$

C. $u_p \tan\theta$

D. $u_p \cot\theta$

Answer: c

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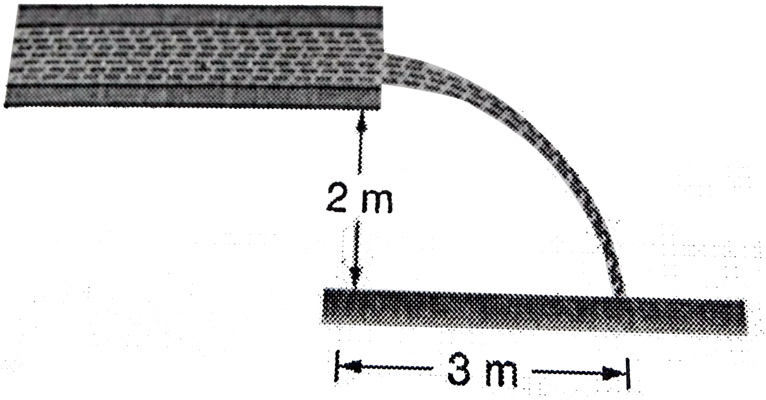
49. Water is flowing through a horizontal pipe fixed at a height of 2 m above the ground as shown in Fig. 5.90. water strikes ground at a distance of 3m from the pipe. The speed of water as it leaves the pipe is:



A. 47m/s

B. 4.7m/s

C. 9.4m/s

D. 4.9m/s

Answer: b

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50. Three vectors $\overrightarrow{P}, \overrightarrow{Q}$ and $\overrightarrow{R}$ such that $\left|\overrightarrow{Q}\right| = A\sqrt{2}$ and the angles between $\overrightarrow{P}$ and $\overrightarrow{Q}, \overrightarrow{Q}$ and $\overrightarrow{R}, \overrightarrow{R}$ and $\overrightarrow{P}$ are $90^\circ, 150^\circ, 120^\circ$ respectivlely. Find the value of $\left|\overrightarrow{P}\right| =$

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

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

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

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

Answer: b

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51. The current velocity of river grows in proportion to the distance from its bank and reaches the maximum value v_0 in the middle. Near the banks the velocity is zero. A boat is moving along the river in such a manner that the boatman rows his boat always perpendicular to the current. The speed of the boat in still water is u. Find the distance through which the boat crossing the river will be carried away by the current, if the width of the river is c. Also determine the trajectory of the boat.

A. $\frac{CV_0}{2u}$

B. $\frac{CV_0}{4u}$

C. $\frac{CV_0}{u}$

D. $\frac{2CV_0}{u}$

Answer: a

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52. A particle is project d from point A with velocity u at an angle α with horizontal. In its parabolic path, at point P the particle is moving at right angles to its initial direction of projection. Its velocity at P is:

A. $u \tan \alpha$

B. $u \cot \alpha$

C. $u \cos \alpha$

D. $u \cos ec\alpha$

Answer: b

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53. A projectille can have the same range$R$ for two angles of projection. If t_1 and t_2 be the time of flight in the two cases, then find the relation between t_1, t_2 and R .

A. $t_1 t_2 = R_2$

B. $t_1 t_2 = \frac{1}{R^2}$

C. $t_1 t_2 = R$

D. $t_1 t_2 = \frac{1}{R}$

Answer: c

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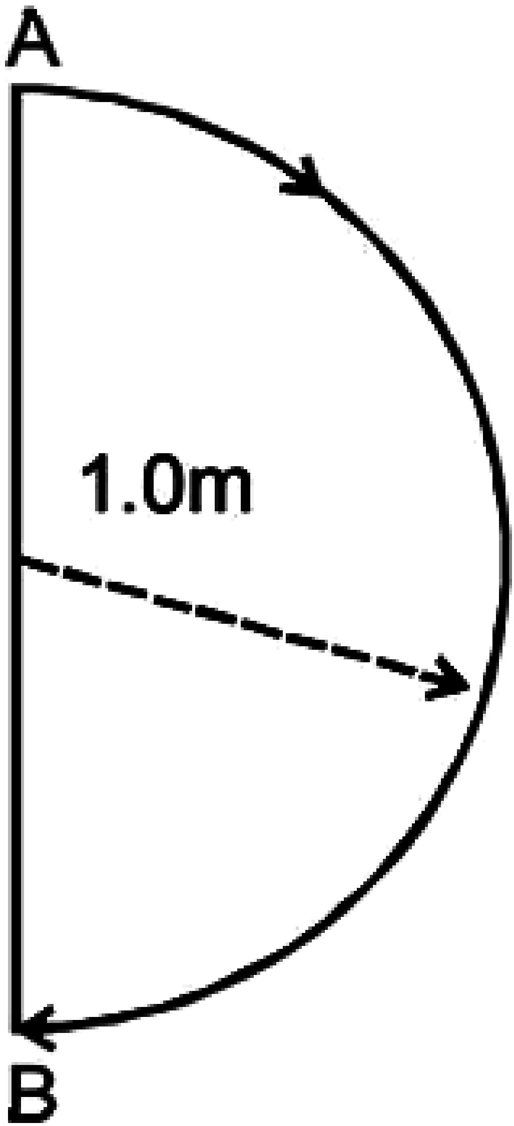
54. In $1.0s$, a particle goes from point A to point B, moving in a semicircle of radius $1.0m$ (see figure). The magnitude of the average velocity



A. 3.14m/s

B. 2.0m/s

C. 1.9m/s

D. zero

Answer: b

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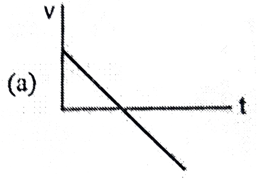
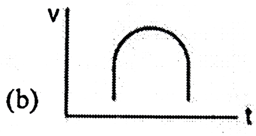
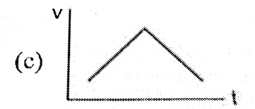
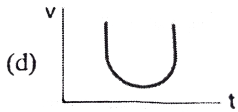
55. A particle is thrown above, then correct $v - t$ graph will be

A. 

B. 

C. 

D. 

Answer: a

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56. The position x of a particle with respect to time t along the x-axis is given by $x = 9t^2 - t^3$ where x is in meter and t in second. What will be the position of this particle when it achieves maximum speed along the positive x direction

A. 54m

B. 81m

C. 24m

D. 32m

Answer: a

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57. Two balls are dropped to the ground from different heights. One ball is dropped 2 sec after the other but they both strike the ground at the same time. If the first ball takes 5 sec to reach the ground then the diffeence in initial heights is:

A. 20m

B. 80m

C. 170m

D. 40m

Answer: b

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58. 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.

A. $\frac{2\sqrt{3}}{g}$

B. $\frac{7\sqrt{3}}{g}$

C. $\frac{14\sqrt{3}}{g}$

D. $\frac{14\sqrt{3}}{g}$

Answer: c

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59. Two trains are moving with equal speed in opposite directions along two parallel railway tracks. If the wind is blowing with speed u along the track so that the relative velocities of the trains with respect to the wind are in the ratio $1:2$, then the speed of each train must be

A. 3u

B. 2u

C. 5u

D. 4u

Answer: a

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60. An acroplane is flying horizontally with a velocity of 600 km/h and a height of 1960m. When it is vectrically above a point A on the ground a bomb is released from it. The bomb strikes the ground at point B. the distance AB is:

A. 1200m

B. 0.33km

C. 333.3km

D. 3.33km

Answer: d

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61. A ball is thrown from a point with a speed 'v^(0)' at an elevation angle of θ . From the same point and at the same instant , a person starts running with a constant speed $\frac{'v_0'}{2}$ to catch the ball . Will the person be able to catch the ball ? If yes, what should be the angle of projection θ ?

A. Yes,60°

B. Yes,30°

C. NO

D. Yes, 45°

Answer: a

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

A. 336

B. 224

C. 56

D. 34

Answer: d

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

A. 30°

B. 45°

C. 60°

D. 0°

Answer: c

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64. An artillary piece which consistently shoots its shells with the same muzzle speed has a maximum range R. To hit a target which is $R/2$ from the gun and on the same level, the elevation angle of the gun should be

A. 15°

B. 45°

C. 30°

D. 60°

Answer: a

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65. R is the range on a horizontal plane for a shot with the same velocity at two different angles of projection. If h and h' be the greatest heights attained corresponding to these angles of projection, what is R^2 equal to ?

A. hh'

B. 9hh'

C. 16hh'

D. 25hh'

Answer: c

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66. A bu llet is fired with a velocity u making an angle of 60° with the horizontal plane. The horizontal component of the velocity of the bu

llet when it reaches the maximum height is:

A. u

B. 0

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

D. $u/2$

Answer: d

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67. For an object thrown at 45° to the horizontal, the maximum height H and horizontal range R are related as

A. R=16H

B. R=8H

C. R=4H

D. R=2H

Answer: c

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

A. 10unit

B. `7sqrt(2)unit 7 unit

C. 7unit

D. 8.5unit

Answer: b

Watch Video Solution

69. A bullet is to be fired with a speed of $2000 m / s$ to hit a target $200 m$ away on a level ground. If $g = 10 m / s^2$, the gun should be aimed

A. directly at the target

B. 5cm below the target

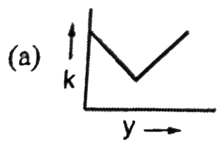
C. 5 cm above the target

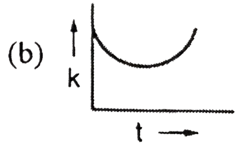
D. 2 cm above the target

Answer: c

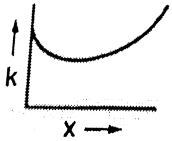
Watch Video Solution

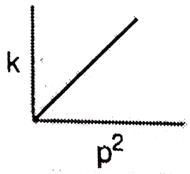
70. A particle is projected from a point of an angle with the horizontal. At any instant t, if p is the linear momentum and E the kinetic energy, then which of the following graph is/are correct?

A. 

B. 

$y \rightarrow$

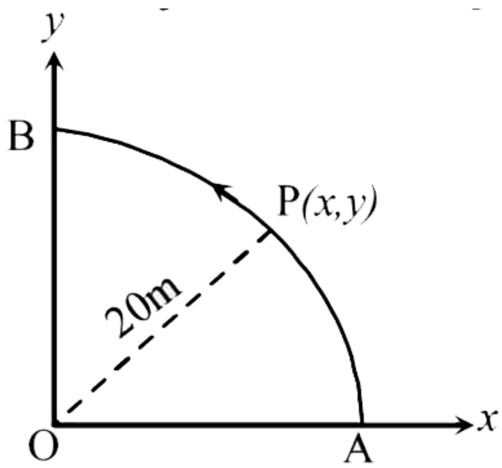
C. (c) 

D. (d) 

Answer: a

Watch Video Solution

71. A point p moves in counter - clockwise direction on a circular path as shown in the figure . The movement of 'p' is such that it sweeps out in the figure . The movement of 'p' is such that it sweeps out a length $s = t^3 + 5$, where s is in metres and t is in seconds . The radius of the path is $20m$. The acceleration of 'P' when $t = 2s$ is nearly .



A. $14m / s^2$

B. $13m / s^2$

C. $12m / s^2$

D. $7.2m / s^2$

Answer: a

Watch Video Solution

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

A. $y^2 = x^2 + \text{constant}$

B. $y = x^2 +$ constant

C. $y^2 = x +$ constant

D. xy=constant

Answer: a

Watch Video Solution

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

A. $\dfrac{\pi v^2}{g^2}$

B. $\dfrac{\pi v^2}{g}$

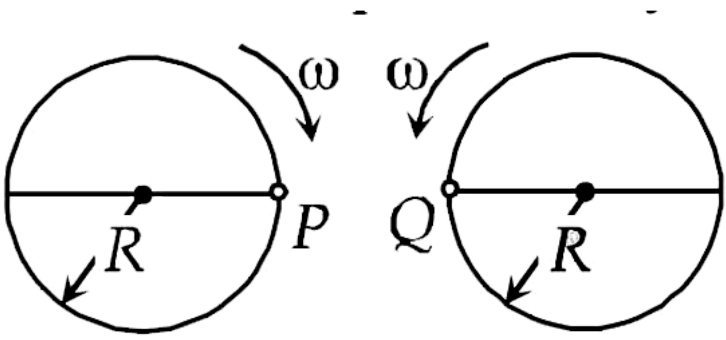
C. $\dfrac{\pi v^4}{g^2}$

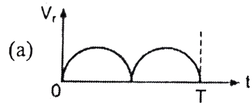
D. $\dfrac{\pi v^2}{2g}$

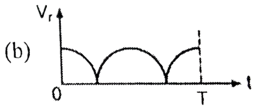
Answer: c

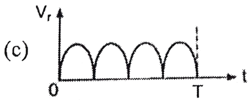
Watch Video Solution

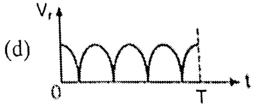
74. Two identical discs of same radius R are rotating about their axes in opposite directions with the same constant angular speed ω . The discs are in the same horizontal plane. At time $t = 0$, the points P and Q are facing each other as shown in the figure. The relative speed between the two points P and Q is v_r. In one time period (T) of rotation of the discs , v_r as a function of time is best represented by



A. 

B. 

C. 

D. 

Answer: a

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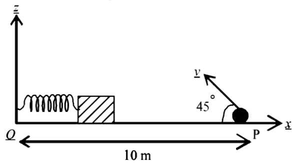
75. A small block is connected to one end of a massless spring of un - stretched length $4.9m$.

The other end of the spring (see the figure) is fixed. The system lies on a horizontal frictionless surface. The block is stretched by $0.2m$ and released from rest at $t = 0$. It then executes simple harmonic motion with angular frequency $(\omega) = (\pi / 3) rad / s$. Simultaneously at $t = 0$, a small pebble is projected with speed (v) from point (P) at an angle of 45° as shown in the figure. Point (P) is at a horizontal distance of $10momO$. If the pebble hits the block at $t = 1s$, the value of (v) is $\left(take g = 10 m / s^2\right)$.



.

A. $\sqrt{50} m / s$

B. $\sqrt{51} m / s$

C. $\sqrt{52} m / s$

D. $\sqrt{53} m / s$

Answer: a

Watch Video Solution

76. A projectile is projected at $10ms^{-1}$ by making an angle 60° to the horizontal. After sometime, its velocity makes an angle of 30° to the horzontal . Its speed at this instant is:

A. $\frac{10}{\sqrt{3}}$

B. $10\sqrt{3}$

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

D. $5\sqrt{3}$

Answer: a

Watch Video Solution

77. A circular disc is rotating about its own axis at the rate of 200 revolutions per minute. Two particles P, Q of disc are at distances $5cm, 10cm$ from axis of rotation. The ratio of angular velocities of P and Q is

A. $1:2$

B. $1:1$

C. $2:1$

D. $4:1$

Answer: b

Watch Video Solution

78. A particle is moving at uniform speed $2ms^{-1}$ along a circle of radius $0.5m$.The centripetal acceleration of particle is

A. $1ms^{-2}$

B. $2ms^{-2}$

C. $4ms^{-2}$

D. $8ms^{-2}$

Answer: d

Watch Video Solution

79. A particle P is moving in a circle of radius 'a' with a uniform speed v. C is the centre of the circle and AB is a diameter. When passing through B the angular velocity of P about A and C are in the ratio

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:3$

Answer: b

Watch Video Solution

80. A man can swim in still water at a speed of $6kmph$ 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 $3kmph$,and the width of the river is $2km$, 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

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

A. 92.7m

B. 40m

C. 48m

D. 20m

Answer: a

Watch Video Solution

82. A point size body is moving along a circle at an angular velocity $2.8 rad s^{-1}$.If centripetal acceleration of body is $7ms^{-2}$ then its speed is

A. $.125ms^{-1}$

B. $2.5ms^{-1}$

C. $3.5ms^{-1}$

D. $7ms^{-1}$

Answer: b

Watch Video Solution

83. A circular plate is rotating about its own axis at an angular velocity 100 revolutions per minute. The linear velocity of a particle P of plate at a distance $4.2cm$ from axis of rotation is

A. 0.22m/s

B. 0.44m/s

C. 2.2m/s

D. 4.4m/s

Answer: b

Watch Video Solution

84. The displacement of the point of a wheel initially in contact with the ground when the wheel rolls forward quarter revolution where perimeter of the wheel is $4\pi m$, is (Assume the forward direction as x-axis)

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

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

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

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

Answer: b

Watch Video Solution

85. A car starting from a point travels towards east with a velocity of $36 kmph$. Another car starting from the same point travels towards north with a velocity of $24 kmph$. The relative velocity of one with respect to another is

A. $12\sqrt{13}$ kmph

B. 30kmph

C. 12 kmph

D. 20kmph

Answer: a

Watch Video Solution

86. A ship is moving due east with a velocity of $12m/\sec$, a truck is moving across on the ship with velocity $4m/\sec$.A monkey is climbing the vertical pole mounted on the truck with a velocity of $3m/\sec$.Find the velocity of the monkey as observed by the man on the shore $(m/\sec)$

A. 10

B. 15

C. 13

D. 20

Answer: c

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87. A man is walking due east at the rate of $2kmph$.The rain appears to him to come down vertically at the rate of $2kmph$.The actual velocity and direction of rainfall with the vertical respectively are

A. $2\sqrt{2}$ kmph, 45°

B. $\dfrac{1}{\sqrt{2}}$ kmph, 30°

C. 2kmph, 0°

D. 1kmph. 90°

Answer: a

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

A. 93m

B. 100.8m

C. 112.4m

D. 100m

Answer: c

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89. A ball is thrown with a velocity of u making an angle θ with the horizontal. Its velocity vector normal to initial vector (u) after a time interval of

A. $\frac{u \sin \theta}{g}$

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

C. $\frac{u}{g \sin \theta}$

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

Answer: c

Watch Video Solution

90. Two projectiles A and B are thrown from the same point with velocities v and $\frac{v}{2}$ respectively. If B is thrown at an angle 45° with horizontal.What is the inclination of A .when their ranges are the same?

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

B. $\frac{1}{2}\sin^{-1}\left(\frac{1}{4}\right)$

C. $2\sin^{-1}\left(\frac{1}{4}\right)$

D. $\frac{1}{2}\sin^{-1}\left(\frac{1}{8}\right)$

Answer: b

Watch Video Solution

91. A large number of bullets are fired in all directions with the same speed v. Find the maximum area on the ground on which these bullets will spread.

A. $\pi\left(\frac{u^2}{g}\right)^2$

B. $\pi\left(\frac{u^2}{2g}\right)$

C. $\pi\left(\frac{u}{g}\right)^2$

D. $\pi\left(\frac{u}{2g}\right)^2$

Answer: a

Watch Video Solution

92. An aeroplane is flying horizontally at a height of $980m$ with velocity $100ms^{-1}$ drops a food packet.A person on the ground is $414m$ ahead horizontally from the dropping point.At what velocity should he move so that he can catch the food packet.

A. $50\sqrt{2}ms^{-1}$

B. $\frac{50}{\sqrt{2}}ms^{-1}$

C. $100ms^{-1}$

D. $200ms^{-1}$

Answer: a

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

A. $0.5m/s^2$

B. $0.8m/s^2$

C. $0.56m/s^2$

D. $1m/s^2$

Answer: c

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94. The length of minute hand in a pendu lum clock is 10cm, the speed of lip of the hand is (in m/s):

A. $\frac{\pi}{6000}$

B. $\frac{\pi}{18000}$

C. $\frac{\pi}{3600}$

D. $\frac{\pi}{1200}$

Answer: b

Watch Video Solution

95. A particle projected from the level ground just clears in its ascent a wall $30m$ high and $120\sqrt{3}$ away measured horizontally.The time since projection to clear the wall is two second.It will strike the ground in the same horizontal plane from the wall on the other side of a distance of (in metres)

A. $150\sqrt{3}$

B. $180\sqrt{3}$

C. $120\sqrt{3}$

D. $210\sqrt{3}$

Answer: b

Watch Video Solution

96. A body is projected obliquely from the ground such that its horizontal range is maximum. If the change in its linear momentum, as it moves from half the maximum height to maximum height, is P, the change in its linear momentum as it travels from the point of projection to the landing point on the ground will be:

A. P

B. $\sqrt{2}P$

C. $2P$

D. $2\sqrt{2}P$

Answer: d

Watch Video Solution

97. The maximum height attained by a projectile is increased by 5%. Keeping the angle of projection constant, what is the percentage increases in horizontal range?

A. 0.05

B. 0.1

C. 0.15

D. 0.2

Answer: a

Watch Video Solution

98. A particle is projected with speed u at angle θ to the horizontal. Find the radius of curvature at highest point of its trajectory

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

B. $\dfrac{\sqrt{3}u^2\cos^2\theta}{2g}$

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

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

Answer: c

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99. An insect trapped in a circular groove of radius $12cm$ moves along the groove steadily and complete 7 revolutions in 100 seconds.The linear speed of the motion in cm/s

A. 5.3

B. 4

C. 3

D. 5

Answer: a

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100. The distance between two moving particles P and Q at any time is a.If v_r be their relative velocity and if u and v be the components of v_r, along and perpendicular to PQ.The closest distance between P and Q and time that elapses before they arrive at their nearest distance is

A. $\dfrac{a(v+v_r)}{v}$

B. $\left(1+\dfrac{v_r}{u}\right)^2$

C. $\dfrac{av}{(v+v_r)}, a\left(1+\dfrac{u}{v_r}\right)^2$

D. $\frac{av_r}{v}, \frac{av_r}{u^2}$

Answer: d

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101. Rain, pouring down at an angle α with the vertical has a speed of $10ms^{-1}.A$ girl runs against the rain with a speed of $8ms/^{-1}$ and sees that the rain makes an angle β with the vertical, then relation between α and β is

A. $\tan\alpha = \frac{8 + 10\sin\beta}{10\cos\beta}$

B. $\tan\beta = \dfrac{8 + 10\sin\alpha}{10\cos\alpha}$

C. $\tan\alpha = \tan\beta$

D. $\tan\alpha = \cot\beta$

Answer: b

Watch Video Solution

102. The velocity of a boat in still water is $10m/s$.If water flows in the river with a velocity of $6m/s$ what is the difference in times taken to cross the river in the shortest path and the shortest time.The width of the river is $80m$.

A. 1s

B. 10s

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

D. 2s

Answer: d

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103. A boatman finds that he can save $6s$ in crossing a river by the quickest path than by the shortest path. If the velocity of the boat and the river be, respectively, $17ms^{-1}$ and $8ms^{-1}$, find the river width.

A. 675m

B. 765m

C. 567m

D. 657m

Answer: b

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104. At a given instant of time the position vector of a particle moving in a circle with a velocity $3\hat{i} - 4\hat{j} + 5\hat{k} is \hat{i} + 9\hat{j} - 8\hat{k}$.Its anglular velocity at that time is:

A. $\frac{\left(13\hat{i} - 29\hat{j} - 31\hat{k}\right)}{\sqrt{146}}$

B. $\frac{\left(13\hat{i} - 29\hat{j} - 31\hat{k}\right)}{146}$

C. $\frac{\left(13\hat{i} + 29\hat{j} - 31\hat{k}\right)}{\sqrt{146}}$

D. $\frac{\left(13\hat{i}+29\hat{j}+31\hat{k}\right)}{146}$

Answer: b

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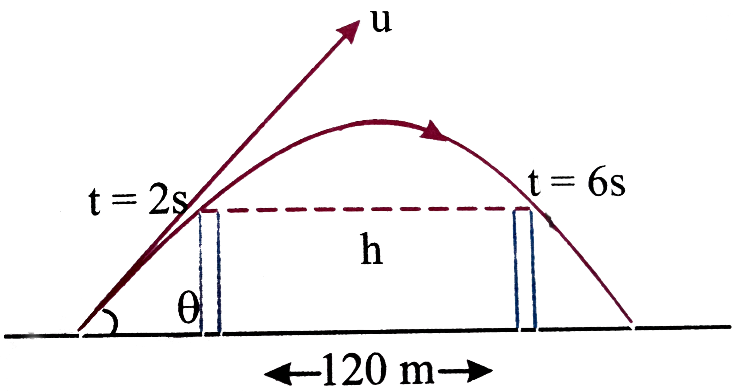
105. If a projectile crosses two walls of equal height h symmetrically as shown in the fig.Choose the correct statement (s)

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



A. The time of flight in 8sec

B. The height of each wall is 60m

C. The maximum height of projectile is 80m

D. all of the above

Answer: d

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106. A particle when fired at an angle $\theta = 60^\circ$ along the direction of the breadth of a rectangular building of dimension $9m \times 8m \times 4m$ so as to sweep the edges.Find the range of the projectile.

A. $8\sqrt{3}$

B. $4\sqrt{3}$

C. $\frac{8}{\sqrt{3}}$

D. $\frac{4}{\sqrt{3}}$

Answer: a

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107. The direction of a projectile at a certain instant is inclined at an angle $\propto$ to the horizontal , after t second, it is inclined at an angle β. Prove that the horizontal component of the velocity of the projectile is $\frac{\mathrm{gt}}{\tan \propto - \tan \beta}$.

A. $\frac{g}{\tan \alpha - \tan \beta}$

B. $\dfrac{gf}{\tan alha - \tan\beta}$

C. $\dfrac{r}{g(\tan\alpha - \tan\beta)}$

D. $\dfrac{>}{(\tan\alpha + \tan\beta)}$

Answer: b

Watch Video Solution

108. Two bodies are projected from the same point with same speed in the directions making an angle α_1 and α_2 with the horizontal and strike at same point in the horizontal plane through a point of projection. If t_1 and t_2 are their time of flights.Then $\dfrac{t_1^2 - t_2^2}{t_1^2 + t_2^2}$

A. $\left(\dfrac{\tan(\alpha_1 - \alpha_2)}{\tan(\alpha_1 + \alpha_2)}\right.$

B. $\dfrac{\sin(\alpha_1 + \alpha_2)}{\sin(\alpha_1 - \alpha_2)}$

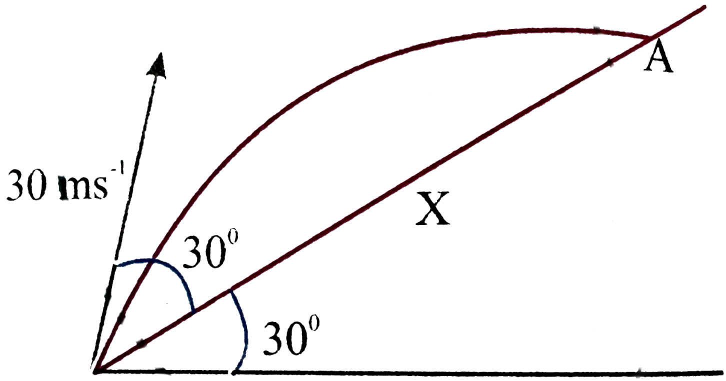
C. $\dfrac{\sin(\alpha_1 - \alpha_2)}{\sin(\alpha_1 + \alpha_2)}$

D. $\dfrac{\sin^2(\alpha_1 - \alpha_2)}{\sin^2(\alpha_1 + \alpha_2)}$

Answer: c

Watch Video Solution

109. An object in projected up the inclined at the angle shown in the figure with an initial velocity of $30ms^{-1}$.The distance x up the incline at with the object lands is



A. 600m

B. 104m

C. 60m/s

D. 208m

Answer: c

Watch Video Solution

110. A particle moves on a circle of radius r with centripetal accelration as function of time as $a_c = K^2 r t^2$ where k is a positive constant , find the resu ltant acceleration.

A. kt^2

B. kr

C. $kr\sqrt{k^2t^4+1}$

D. $kr\sqrt{k^2t^2-1}$

Answer: c

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111. A particle of mass m moves in a circle of radius R in such a way that its speed (v) varies with distance (s) as $v=a\sqrt{s}$ where a is a constant. Calcualte the acceleration and force on the particle.

A. $a^2\sqrt{\frac{1}{4}-\frac{S^2}{R^2}}$

B. $a^2\sqrt{\frac{1}{4}+\frac{S^2}{R^2}}$

C. $a\sqrt{\frac{1}{2}+\frac{S^2}{R^2}}$

D. $a^2\sqrt{\frac{1}{2}+\frac{S^2}{R^2}}$

Answer: b

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112. A man wishes to cross a river flowing with velocity u swims at an angle θ with the river flow.If the man swims with speed $v$and if the width of the river is d, then the drift travelled by him is

A. $(u+v\cos\theta)\dfrac{d}{v\sin\theta}$

B. $(u-\cos\theta)\dfrac{d}{v\sin\theta}$

C. $(u-v\cos\theta)\dfrac{d}{v\cos\theta}$

D. $(u+v\cos\theta)\dfrac{d}{v\cos\theta}$

Answer: a

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113. Consider a collection of a large number of particles each with speed v in a plane.The direction of velocity is randomly distributed in the collection.The magnitude of the average relative velocity of a particle with velocities of all other particles is

A. $> v$

B. $< v$

C. $= v$

D. none of these

Answer: a

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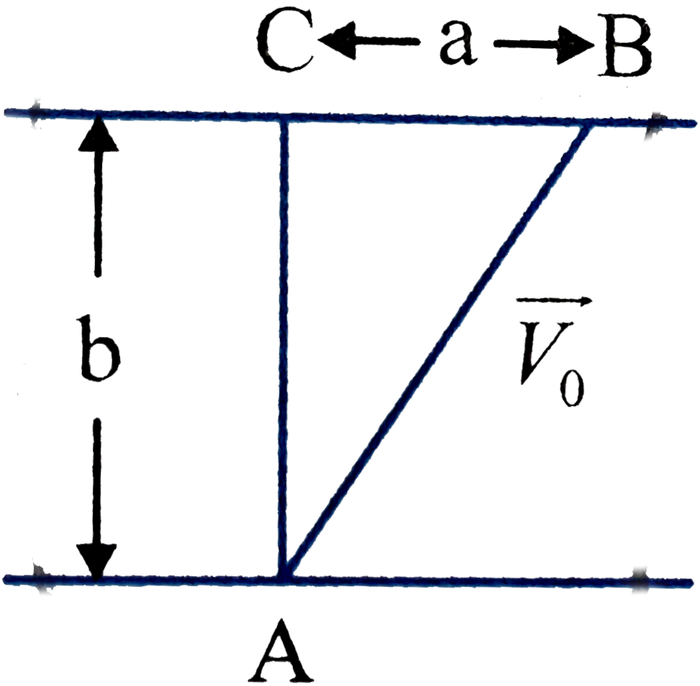
114. A man in a river boat must get from point A to point B on the opposite bank of the river (see figure).The distance $BC = a$.The width of the river $AC = b$.At what minimum speed u relative to the still water should the boat travel to reach the point B?The velocity of flow of the river is v_0



A. $\dfrac{v_0 b}{\sqrt{a^2 + b^2}}$

B. $\dfrac{v_0 a}{\sqrt{a^2 + b^2}}$

C. $\dfrac{v_0 b}{\sqrt{2}a}$

D. $\frac{v_0 a}{\sqrt{2}b}$

Answer: a

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115. A motor boat has a speed of $5m/s$.At time $t=0$,its position vector relative to a origin is $\left(-11\hat{i}+16\hat{j}\right)m$,having the aim of getting as close as possible to a steamer.At time $t=0$,the steamer is at the point $\left(4\hat{i}+36\hat{j}\right)m$ and is moving with constant velocity

$\left(10\hat{i} - 5\hat{j}\right)m/s$.Find the direction in which the motorboat must steer

A. $3\hat{i} + 3haj$

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

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

D. $4\hat{i} + 4\hat{j}$

Answer: c

Watch Video Solution

116. A $400m$ wide river is flowing at a rate of $2.0ms^{-1}$. A boat is sailing with a velocity of $10ms^{-1}$ with respect to the water, in a direction perpendicular to the river.

(a) Find the time taken by the boat to reach the opposite bank.

(b) How far from the point directly opposite to the starting point does the boat reach the opposite bank ?

(c) In what direction does the boat actually move ?

A. 40sec, 80m

B. 30sec,40m

C. 20sec,20m

D. 35sec,80m

Answer: a

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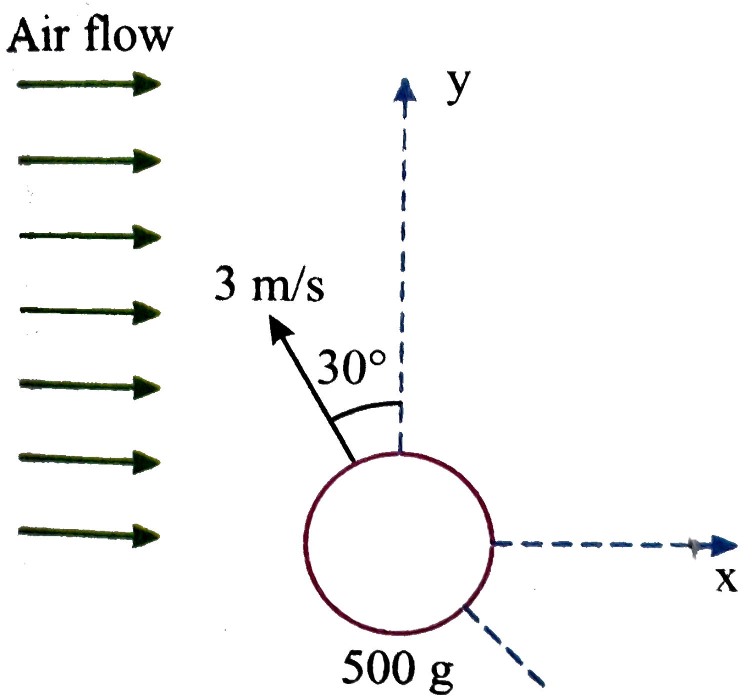
117. Figure shows a sphere moving in a steady flow of air in the x-direction on a horizontal plane.The air stream exerts an essentially constant acceleration $1.8 m / \sec^2$ on the sphere in the x-direction.If at $t = 0$ the sphere is moving as shown in figure, determine the time t required for the sphere to cross the y-axis again.



A. 1/3 sec

B. 2/3sec

C. 4/3sec

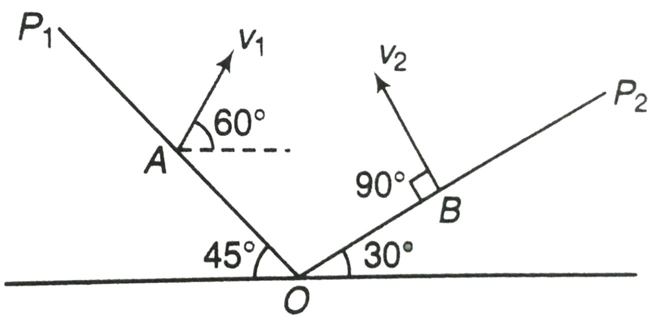
D. 5/3sec

Answer: d

Watch Video Solution

118. A particle is projected from an inclined plane OP_1 from A with velocity $v_1 = 8ms^{-1}$ at an angle 60° with horizontal. An another particle is projected at the same instant from

B with velocity $v_2 = 16ms^{-1}$ and perpendicular to the plane OP_2 as shown in figure. After time $10(\sqrt{3})$ s there separation was minimum and found to be 70m. Then find distance AB.



A. 250m

B. 500m

C. 750m

D. 1000m

Answer: a

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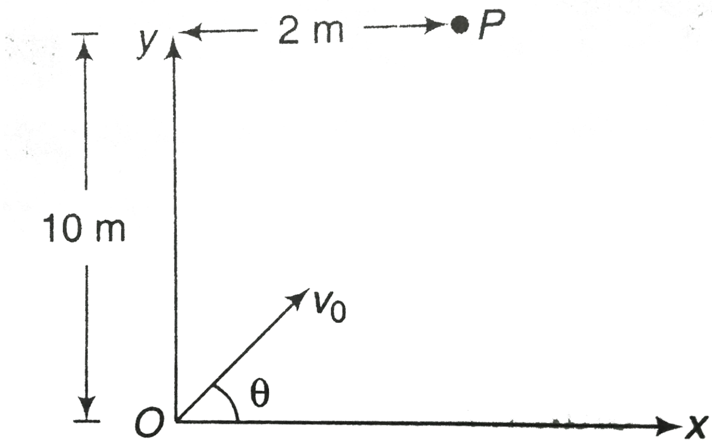
119. A particle is dropped from point P at time $t = 0$. At the same time another particle is thrown from point O as shown in the figure and it collides with the particle P. Acceleration due to gravity is along the negative y-axis. If the two particles collide 2 s after they start, find the initial velocity v_0 of the particle which was projected from O. Point O is not necessarily on ground.



A. $\sqrt{6}m/s^{-1}, \theta = \tan^{-1}(1)$ with x-axis

B. $\sqrt{26}m/s^{-10\theta = \tan^{-1}(5)}$ with x-axis

C. $\sqrt{2}m/s^{-1}, \theta = \tan^{-1}(2)$ with x-axis

D. $\sqrt{13}m/s^{-1}, \theta = \tan^{-1}(4)$ with axis

Answer: b

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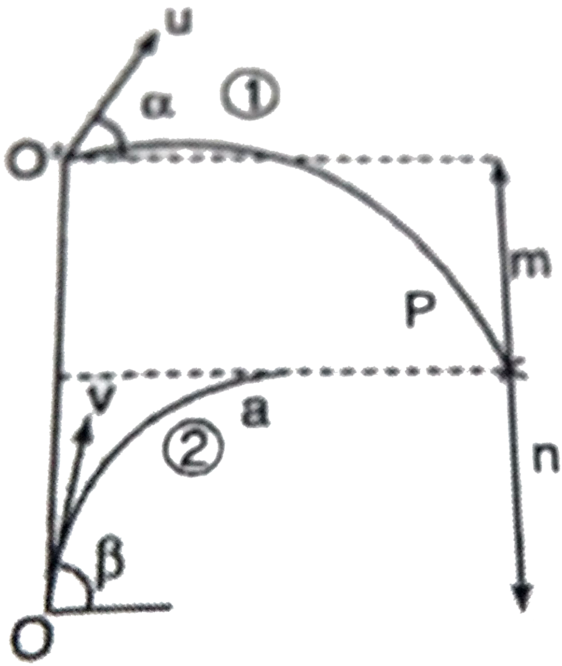
120. Shots are fired simu ltaneou ly from the top and bottom of a vertical cliff at angles α and β and they stike an object simu ltaneously at the same point. If the horizontal distance of the object from the cliff is a, the height of the dcliff is :



A. $\dfrac{a(\cot\alpha - \cot\beta)}{\cot\alpha\cot\beta}$

B. $a(\sin\beta - \tan\alpha)$

C. $\dfrac{a\tan\alpha}{\tan\beta}$

D. $a(\cot\alpha - \cot\beta)$

Answer: a

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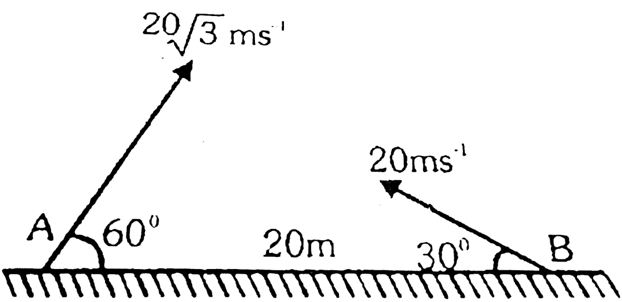
121. In the figure shown, the two projectile are fired simultaneously. Find the minimum distance between them during their flight



A. 20m

B. $10\sqrt{3}m$

C. $10m$

D. zero

Answer: b

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122. An open merry go round rotates at an angular velocity ω.A person stands in it at a distance r from the rotational axis.It is raining and the rain drops falls vertically at a velocity

v_0.How should the person hold an umbrella to protect himself from the rain in the best way.Angle made by umbrella with the vertical is

A. $\cot\alpha = \frac{v_0}{r\omega}$

B. $\tan\alpha = \frac{v_0}{r\omega}$

C. $\cot\alpha = \frac{r\omega}{v_0}$

D. $\tan\alpha = \frac{v_0}{r\omega}$

Answer: a

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123. A person standing on a road has to hold his umbrella at 60^0 with the verticcal to keep the rain away. He throws the umbrella an starts running at $20ms^{-1}$. He finds that rain drops are hitting his head vertically. Find the speed of the rain drops wigh respect to (a) the road (b) the moving person.

A. $\frac{40}{3}m/s. \frac{20}{3}m/s$

B. $\frac{40}{3}m/s. \frac{22}{3}m/s$

C. $\frac{40\sqrt{3}}{3}m/s, \frac{20\sqrt{3}}{3}m/s$

D. $\frac{40\sqrt{3}}{3}m/s.\ \frac{20}{3}m/s$

Answer: c

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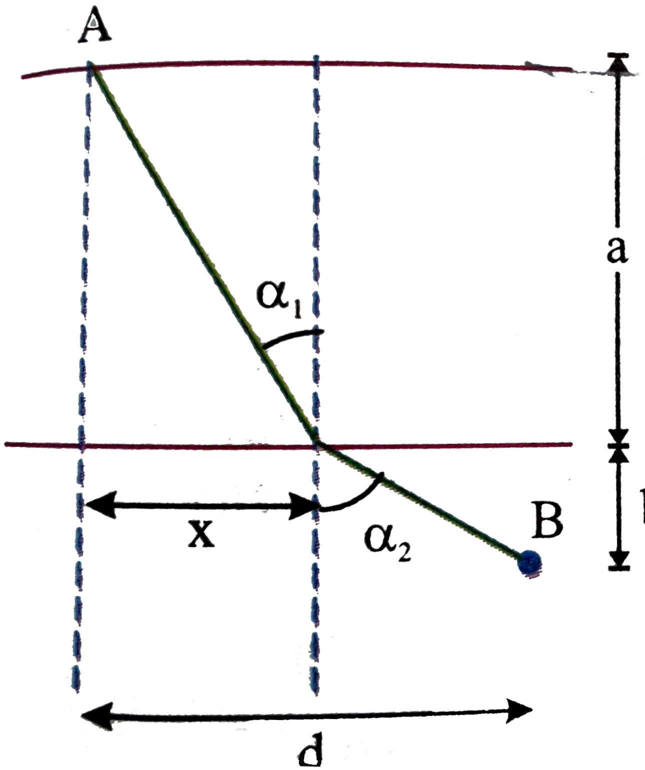
124. From a point A on bank of a channel with still water a person must get to a point B on the opposite bank.All the distances are shown in figure.The person uses a boat to travel across the channel and then walks along the bank of point B.The velocity of the boat is v_1

and the velocity of the walking person is v_2

.Prove that the fastest way for the person to

get from A to B is to select the angles α_1 and

α_2 in such a manner that



A. $\dfrac{\sin\alpha_1}{\sin\alpha_2} = \dfrac{u_2}{v_1}$

B. $\dfrac{\sin \alpha_1}{\sin \alpha_2} = \dfrac{u_1}{v_2}$

C. $\dfrac{\cos \alpha_1}{\cos \alpha_2} = \dfrac{v_2}{v_1}$

D. $\dfrac{\cos \alpha_2}{\cos \alpha_1} = \dfrac{v_1}{v_2}$

Answer: a

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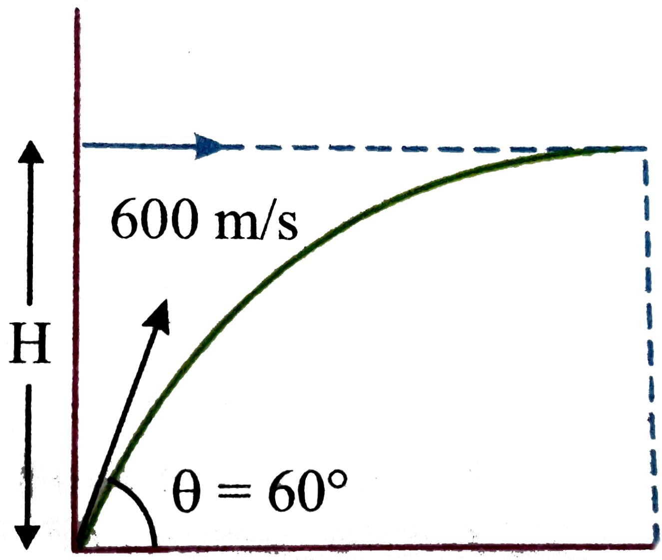
125. A fighter plane enters inside the enemy territory, at time $t = 0$, with velocity $v_o = 250m/s$ a moves horizontally with constant acceleration $a = 20m/s^2$ (see figure) An enemy tank at the border, spot the plane and fire shots at an angle $\theta = 60^2$ with the horizontal and with velocity $u = 600m/s$ .At what altitude H of the plane it can be hit by the shot?



A. 1500m

B. 2473m

C. 1650m

D. 1800m

Answer: b

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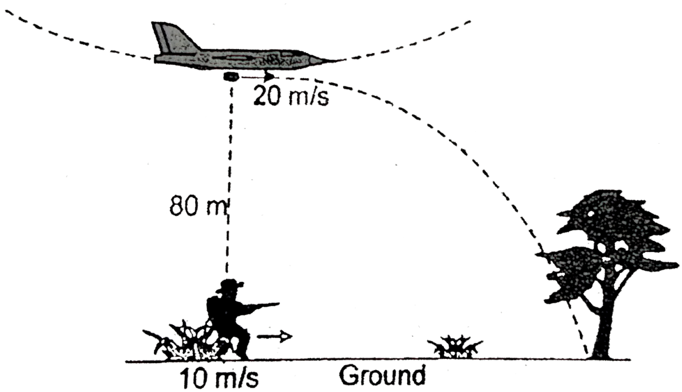
126. A bomber plane moving at a horizontal speed of $20m/s$ releases a bomb at a height of $80m$ above ground as shown. At the same instant a Hunter of negligible height starts running from a point below it, to catch the bomb with speed $10m/s$. After two seconds he relized that he cannot make it, he stops running and immediately hold his gun and fires in such direction so that just before bomb hits the ground, bullet will hit it. What should be the firing speed of bullet

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



A. 10m/s

B. $20\sqrt{10}$ m/s

C. $10\sqrt{10}$ m/s

D. None of these

Answer: b

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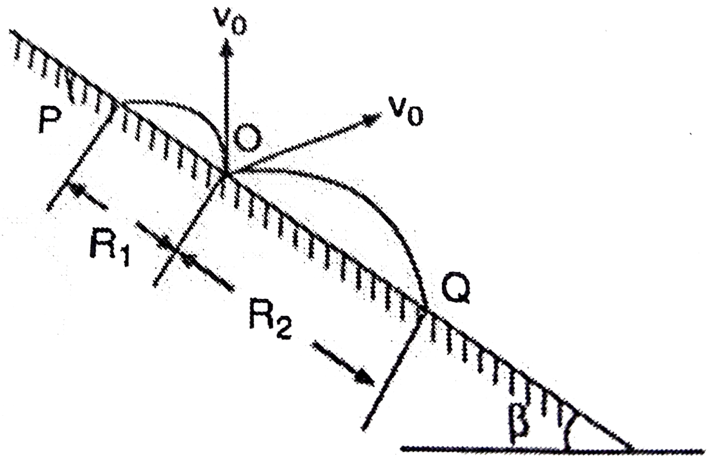
127. A body has maximum range R_1 when projected up the inclined plane. The same body when projected down, the inclined plane.

It has maximum range R_2. Find its maximum horizontal range. Assume the equal speed of projection in each case and the body is projected onto the gretest slope.



A. $R = \dfrac{2R_1R_2}{R_1 - R_2}$

B. $R = \dfrac{2R_1R_2}{R_1 + R_2}$

C. $R = \dfrac{R_1R_2}{R_1 - R_2}$

D. $R = \dfrac{4R_1R_2}{R_1 + R_2}$

Answer: c

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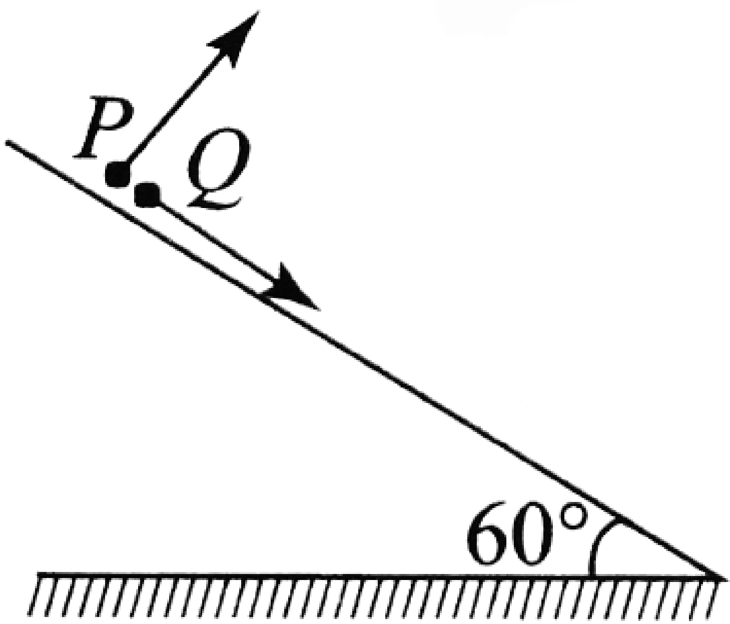
128. 

A particle P is projected from a point on the surface of smooth inclined plane (see figure). Simultaneously another particle Q is released on the smooth inclined plane from the same position. P and Q collide after$t = 4$. The speed of projection of P is

A. 5m/s

B. 10m/s

C. 15m/s

D. 20m/s

Answer: d

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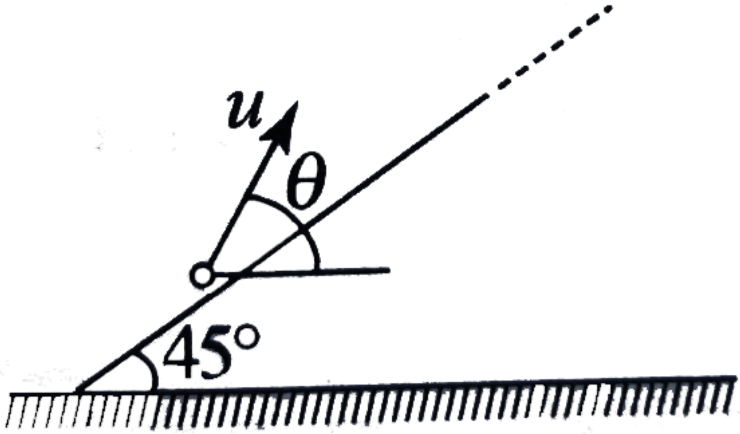
129. 

A particle is projected from surface of the inclined plane with speed u and at an angle θ with the horizontal. After some time the particle collides elastically with the smooth fixed inclined plane for the first time and subsequently moves in vertical direction.

Starting from projection, find the time taken by the particle to reach maximum height. (Neglect time of collision).

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

B. $\frac{2u\sin tehta}{2}$

C. $\frac{u(\sin\theta+\cos\theta)}{g}$

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

Answer: c

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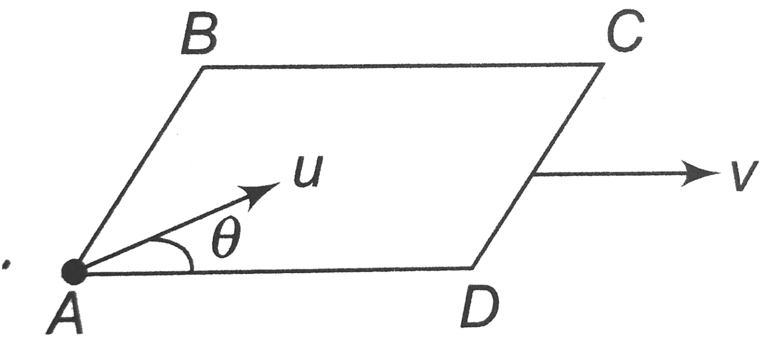
130. A smooth square plateform ABCD is moving towards right with a uniform speed v. At what angle θ must a particle be projected from A with speed u so that it strikes the point B



A. $\sin^{-1}\left(\frac{u}{v}\right)$

B. $\cos^{-1}\left(\frac{v}{u}\right)$

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

D. $\sin^{-1}\left(\frac{v}{u}\right)$

Answer: b

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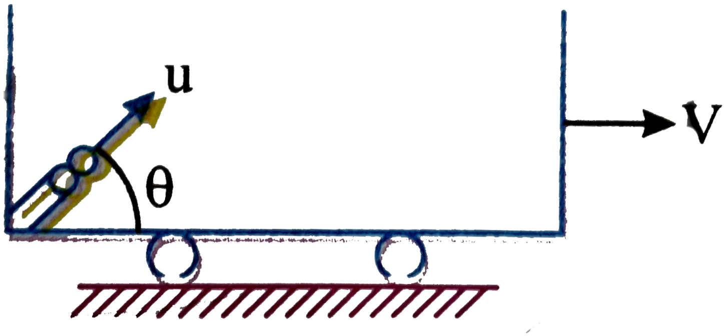
131. A shell is projected from a gun with a muzzle velocity u.The gun is fitted with a trolley car at an angle θ as shown in the fig. If the trolley car is made to move with constant velocity v towards right, find the horizontal range of the shell relative to ground.



A. $R = \frac{2u\sin\theta(u\cos\theta + v)}{g}$

B. $R = \frac{2u\sin\theta(u\cos\theta - v)}{g}$

C. $R = \frac{u\sin\theta(u\cos\theta + v)}{2g}$

D. $R = \frac{u\sin\theta(u\cos\theta + v)}{g}$

Answer: d

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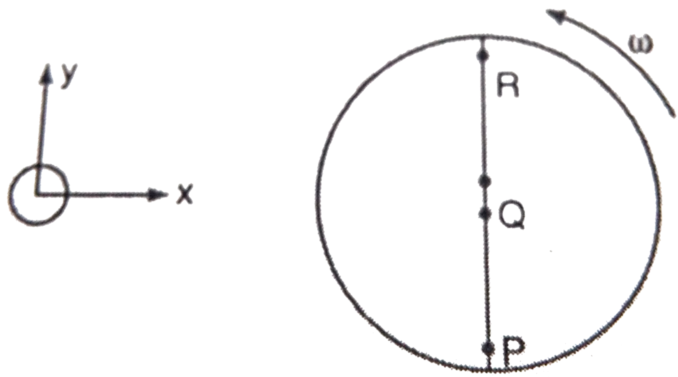
132. Consider a disc rotating in the horizontal plane with a constant angu lar speed ω about its centre O. the disc has shaded region on one side of the diameter and an unshaded region on the other side as shown in Fig. 5.111. when the disc is in the orientation as shown, two pebbles P and Q are simu ltaneously projected at an angle towards R. the velocity of projection in the y-z plane and is same for both pebbles with respect to the disc. Assume that i they land back on the disc before the disc has completed 1/8 rotation, ii their range is less than half the disc radus, and iii ω reamisn constant throughout. then



A. P lands in the shaded region and Q in the unshaded region.

B. P lands in the unshaded region and Q in the shaded region.

C. Both P and Q land in the unshaded region

D. Both P and Q land in the shaded region

Answer: c

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MORE THAN ONE

1. In case of projectle motion if two projectles A and B are projected with same speed at angles 15° and 75° respectively to the horizontal then:

A. $H_A > H_B$

B. $H_A < H_B$

C. $T_A > T_B$

D. $T_A < T_B$

Answer: b,d

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2. Two particles A and B are projected from the same point with the same velocity of projection but at different angles $\alpha$and β of projection, such that the maximum height of A is two-third of the horizontal range of B. then which of the following relations are true?

A. $3(1-\cos 2\alpha)=8\sin 2\beta$

B. Range of A=maximum height of B

C. Maximum vlaue of β is $\frac{1}{2}\frac{\sin^{-1}(3)}{4}$

D. Maximum horizontal range of A $= \dfrac{u^2}{g}$

and this occurs when $\beta = \dfrac{1}{2}\dfrac{\sin^{-1}(3)}{8}$

Answer: a,c,d

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3. Two particles are projected from the same point on level ground simu ltaneously with the same velocity u but at the angles $(\alpha + \beta)$ and $(\alpha - \beta)$ of projection $\beta < 45^\circ$ respectively.

Which of the following statements will be true?

A. They will have the same horizontal range if $\alpha = 45^\circ$

B. They will be separated by the distance of $\frac{2u^2}{g}(\sin 2\alpha \cos 2\beta)$ when they reach the ground

C. They are sever in the same horizontal level during their flights.

D. none of these

Answer: a,b,c,d

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4. Two projectile A and B located at (0,0) and (4.4) respectively start moving simu ltaneou lsy with velocities $V_A = -4\hat{i}$ and $V_B = 4\hat{j}$:

A. the shortest distance between them is $4\sqrt{2}m$

B. the shortest distance between them first decreases and then increases

C. the distance between them increases from the beginning

D. the magnitude of relative velocity of A w.r.t. B is 4m/s

Answer: a,b

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5. Two particles A and B locat at (0,0) and (4,4) respectively start moving simu lataneou ly with velocities $v_A = -4\hat{i}$ and $V_B = -4\hat{j}$:

A. the shortest distance between them is

$4\sqrt{2}m$

B. the shortest distance between them first

decreases and then increases

C. the distance between them increases

from the beginning

D. the magnitude of relative velocity of A

w.r.t. B is 4m/s

Answer: a,c

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6. Two stones are projectd simu ltaneously with equal speeds from a point on an inclined plane along the line of its greatest slope upwards and downwards respectively. The maximum distance between their points of striking the plane is double that of when they are projected on a horizontal ground with saem speed. if one strikes the plane after two seconds of the other, then:

A. the angle of inclination of plnae is 45°

B. the speeds of their projection is $12.8m/s$

C. the angle of inclination of plnae is 60°

D. the speeds of their projection is 128 m/s

Answer: a,b

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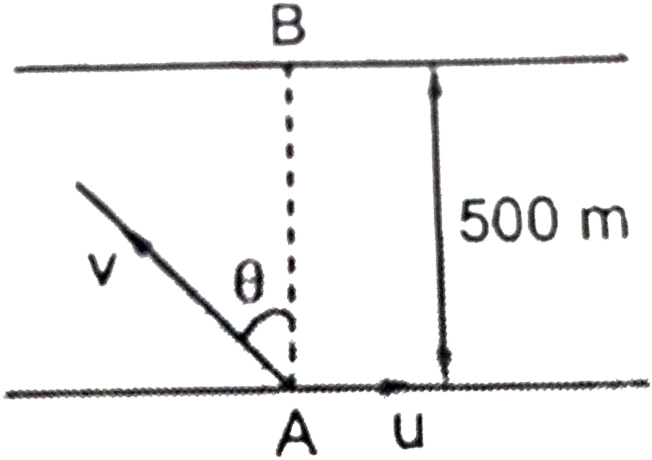
7. A swimmer wishes to cross a river 500m width flowing at a rate u. his speed w.r.t. still water is v. for this he makes an angle θ with the vertical as shown in the given figure then:



A. to cross the river in minimum time

$\theta = 0^\circ$

B. to cross the river in minumum time,

$\theta = 30^\circ$

C. for $u=3km/hr$ and $v=5km/hr$, the time taken to cross the river in minimum time will be 6min.

D. for $u=3$ km/hr and $v=5km/hr$, the time taken to cross the river in minimum time will be 3min.

Answer: a,c

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8. A particle is projected from horizontal ground with speed $5 m s^{-1}$ at 53° with horizontal. Find time after which velocity of particle will be 45° with horizontal:

A. $\frac{1}{10}$ sec

B. $\frac{3}{10}$ sec

C. $\frac{5}{10}$ sec

D. $\frac{7}{10}$ sec

Answer: a,d

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9. A particle is projected from horizontal ground at angle $'\theta'$ with speed 'u'. In same plane of motion a horizontal acceleration 'a' exists so that projected particle returns back to point of projection. Find time of flight.

A. $\dfrac{2u\sin\theta}{g}$

B. $\dfrac{3u\sin\theta}{g}$

C. $\dfrac{2u\cos\theta}{\alpha}$

D. $\dfrac{3u\cos\theta}{\alpha}$

Answer: a,c

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10. A particle is projected from horizontal XZ plane with velocity $\left(u_x\hat{i}+u_y\hat{i}+u_z\hat{k}\right)$ from origin (+ yaxis is upward). Find time when velocity of particle will be at 37° with horizontal.

A. $\dfrac{u_y\sqrt{u_x^2+u_z^2}}{g}$

B. $\dfrac{3u_y-4\sqrt{u_x^2+u_z^2}}{3g}$

C. $\dfrac{3u_y + 4\sqrt{u_x^2 + u_z^2}}{3g}$

D. $\dfrac{u_y + \sqrt{u_x^2 + u_z^2}}{3g}$

Answer: b,c

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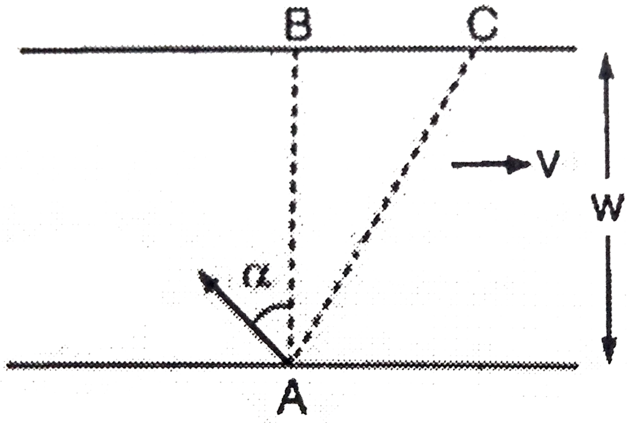
11. A man in a boat crosses a river from point A. if the rows perpendicu lar to the bank he reaches point C(BC=120m) in 10 minutes. If the the man heads at a certain angle α to the straight line AB(AB is perpendicualr to the banks) against the current be reaches point B

in12.5 minutes.



A. the width of the river is 300m

B. the width of the river is 200m

C. the rowing velocity is 20m/min

D. the rowing velocity is 30m/min.

Answer: b,c

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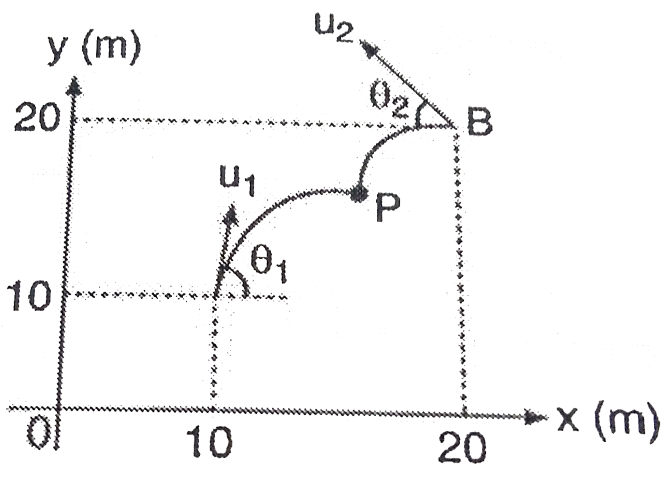
12. Two projectiles A and B are fired simu ltaneou ly as shown in Fig. 5.114. they colide in air at point at time t. then :



A. $t(u_1 \cos\theta_1 - u_2 \cos\theta_2) = 20$

B. $t(u_1 \sin\theta_1 - u_2 \sin\theta_\circ) = 10$

C. both a and b are correct

D. both a and b are wrong

Answer: b

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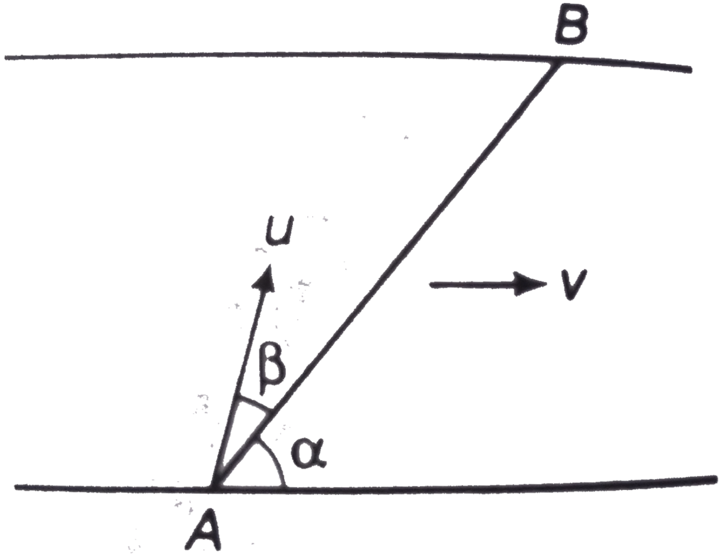
13. A launch plies between two points A and B on the opposite banks of a river always following the line AB. The distance S between points and B is 1200 m. The velocity of the river current $v = 1.9 m/s$ is constant over the entire width of the river. The line AB makes an angle $\alpha = 60^\circ$ with the direction of the current. With what velocity u and at what angle beta to the line AB should the launch move to cover the distance AB and back in a time $t = 5 \text{ min}$? The angle beta remains the same during the passage from A to B and from

B to A.



A. The velocity of the boat is 8m/s

B. The velocity of the boat is 6m/s

C. The angle made by u with the line AB is

12°

D. The angle made by u with line AB is 10°

Answer: b,d

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14. The coordinate of a particle moving in a plane are given by $x(t) = a\cos(pt)$ and $y(t) = b\sin(pt)$ where $a, b(< a)$ and P are positive constants of appropriate dimensions . Then

A. The path of the particle is an ellipse

B. The velocity and acceleration of the particles are normal to each toerh at t= $\pi / 2p$.

C. The acceleration of the particle is always directed towards a forucs

D. The distance travelled by the particle in time interval $t = 0$ to $t = \pi / 2p$ is a.

Answer: a,b

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ASSERTION

1. (A): A body is thrown with a velocity u inclined to the horizontal at some angle. It moves along a parabolic path and falls to the ground Linear momentum of the boyd, during its motion, will remains conserved.

(R): Throughout the motion of the body, a constant force sets on it.

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2. Statement-1: A river is flowing from east to west at a speed of 5m/min. A man on south bank of river, capable of swimming 10 m/min in still water, wants to swim across the river in shortest time. He should swim due north. Statement-2 : For the shortest time the man needs to swim perpendicular to the bank.

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3. (A): Rain is falling vertically downwards with velocity 6 km/hr. A man walks with a velocity of 8 km/hr. Relative velocity of rain w.r.t. the man is 10km/hr.

(R): Relative velocity is the ratio of two velocities.

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4. (A): Relative velocity of A w.r.t. B is greater than the velocity of either, when they are moving in opposite directions.

(R): The relative velocity between any two bodies is equal to the sum of the velocities of the two bodies.

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5. Statement I: An object can possess acceleration even at a time when it has uniform speed

statement II: It is possible when the direction of motion keeps changing.

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6. Assertion In projectile motion, the angle between instanteneous velocity vector and acceleration vector can be anything between o to π (excluding the limiting case)

Reason In projectile motion, acceleration vector is always pointing vertically downwards. (Neglect air friction.)

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MATRIX

1. A ball is projected from the ground with velocity v such that its ranege is maximum.

	Column - I		Column - II
(a)	Velocity at half of the maximum height in vertical direction is	(p)	$\frac{v}{2}$
(b)	Velocity at the maximum height	(q)	$\frac{v}{\sqrt{2}}$
(c)	Change in its velocity when it returns to the ground	(r)	$v\sqrt{2}$
(d)	Average velocity when it reaches the maximum height	(s)	$\frac{v}{2}\sqrt{\frac{5}{2}}$

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2. V_x and V_y are the horizontal and vertical compounds of velocity with x and y as the corresponding displacements along horizontal and vertical at any time t in a projectile motion in XY co-ordinate system, where g is the acceleration due to gravity.

Column - I		Column - II	
(a)	$(V_y - t)$ graph is a straight line with	(p)	Straight line not passing through origin
(b)	$(V_x - t)$ graph is a	(q)	Straight line passing through origin
(c)	$(x - t)$ graph is a	(r)	Straight line with positive slope and negative intercept
(d)	$(y - t)$ graph is a	(s)	None of these

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3. For component of a vector $A = \left(3\hat{i} + 4\hat{j} - 5\hat{k}\right)$, match the following table

Table-1	Table-2
(A) Along y-axis	(P) 5 unit
(B) Along another vector $(2\hat{i} + \hat{j} + 2\hat{k})$	(Q) 4 unit
(C) Along $(6\hat{i} + 8\hat{j} - 10\hat{k})$	(R) Zero
(D) Along another vector $(-3\hat{i} - 4\hat{j} + 5\hat{k})$	(S) None

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4. Trajectory of particle in projectile motion is $y = (x - x^2/80)$, x and y are in metre.

Projectile range is on horizontal plane.

Column - I		Column - II	
(a)	Angle of projection S with horizontal is	(p)	0°
(b)	Angle of velocity with horizontal at time 1 sec	(q)	$\tan^{-1}\left(\frac{1}{3}\right)$
(c)	Angle of velocity with horizontal at height 20m from ground is	(r)	45°
(d)	Angle of displacement with horizontal when velocity is perpendicular to displacement	(s)	$\tan^{-1}\left(\frac{1}{2}\right)$
		(t)	Not possible

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5. Mathch Column -I with Column-B:

Column - I		Column - II	
(a)	A body is moving along a straight line and accelerating uniformly	(p)	This will be a uniform linear motion
(b)	A body is moving along a straight line. It covers a distance 72 m during the first six seconds of its motion and another 72 m during the next six seconds	(q)	This will be a non-uniform linear motion
(c)	A body is thrown vertically upward. It rises to some height and then falls down along the same line	(r)	During the motion, linear momentum is not conserved
(d)	A bullet is fired into air from a gun	(s)	Position-time graph of the motion will be a straight line that is, parallel neither to x-axis nor the y-axis.

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6. A particle is moving along a circle of a fixed radius and gaining speed in a uniform manner. Mathc columns I and II.

	Column - I		Column - II
(a)	Tangential acceleration is	(p)	zero
(b)	Radial acceleration is	(q)	a non-zero constant value
(c)	Angular acceleration is	(r)	variable
(d)	Angular momentum is	(s)	g $(10 \, m/s^2)$

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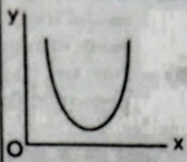
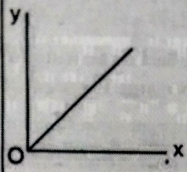
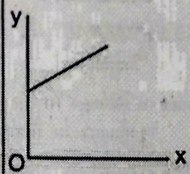
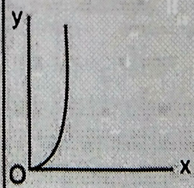
7. Column I gives a list of possible set of parameters measured in some expreriments. The variations of the parameers in the form of graphs are shown in Column II. Match the set of parameters given in Column I with the graphs given in Column II.

	Column - I		Column - II
(a)	Potential energy of a simple pendulum (y-axis) as a function of displacement (x-axis).	(p)	
(b)	Displacement (y-axis) as a function of time (x-axis) for a one dimensional motion at zero or constant acceleration when the body is moving along the positive x-direction.	(q)	
(c)	Range of a projectile (y-axis) as a function of its velocity (x-axis) when projected at a fixed angle.	(r)	
(d)	The square of the time period (y-axis) of a simple pendulum as a function of its length (x-axis).	(s)	

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INTEGER

1. A particle is moving up with balloon with constant accelration (g/8) which starts from rest from ground and at height H particle is droped from balloon. After this event, time for which particle will be in air is $\sqrt{\frac{kH}{g}}$. Find the value of k.

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2. A particle has initial velocity $\left(2\hat{i}+3\hat{j}\right)ms^{-1}$ when it was at origin and has constant acceleration $\left(3\hat{i}+2\hat{k}\right)ms^{-2}$. Find angle made by displacemnt after 2 sec with XY plane $\left\{\sin^{-1}\sqrt{\frac{k}{21}}\right\}$. Find the value of k.

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3. Two particles were projected simu ltaneously in horizontal plane with same velocity u perpendicu lar to each other. The time after which their velocities makes angle 60° with each other is $k\frac{u}{g}$. Find the value of k

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4. A paritcle is projected with velocity $\left(6\hat{i}+5\hat{j}+8\hat{k}\right)ms^{-1}$ from a vertical tower of height 10m. If the y-axis is vertical up find time of flight (in sec).

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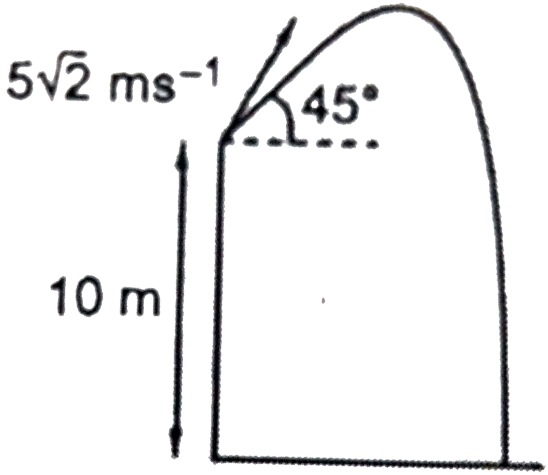
5. Particle projected from tower fo heigh 10m as shown in figure. Find the time (in sec) after which particle will hit the ground.



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6. A particle is thrown horizontally from the top of a tall tower with a speed of 10m/s. if radius of curvature of path followed is $4\sqrt{2k}$ m at t=1sec, then find the value of k.

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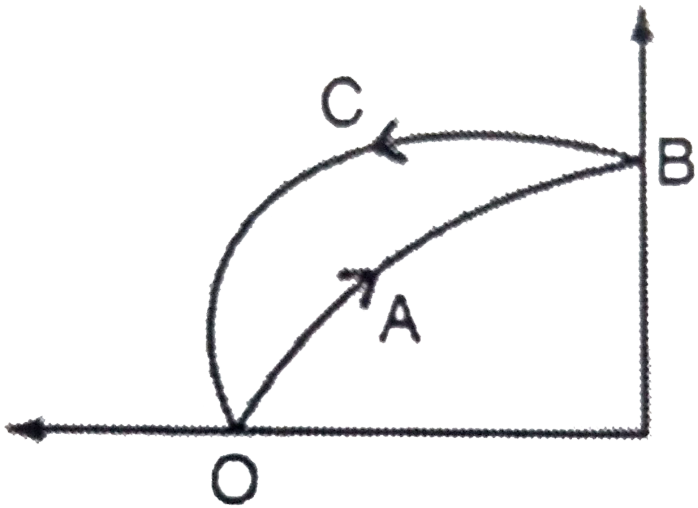
7. A ball projected from the ground with speed 10m/s at an angle of 45° with horizontal. It collides with a wall at a distance 2 m from the point of projection and returns to its original position. If the coefficient of restitution between the ball and wall is 1/x, find x.



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8. A ball is projected vertically upward with speed v. another ball of the same mass is projected at an angle of 60° with the vertical with the same speed. The ratio of their potential energy at the highest point is:

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9. The slope of wind screen of two cars are $\alpha_1 = 30^{\circ}$ and $a_2 = 15^{\circ}$ respecively. At what ratio of $\frac{v_1}{v_2}$ of the velocities of the cars will their drivers see the hall stones bounced back by the wind screen on their cars in vertical direction assume hall stones fall vertically downwards and collisions to be elastic?

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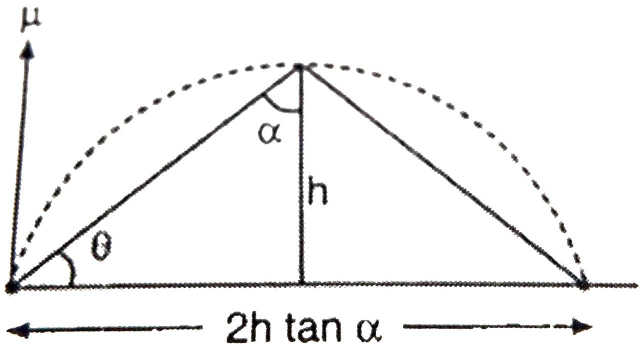
10. A projectile is fired from the base of cone shaped hill. The projectle grazes the vertex and strikes the hill again at the base. If α be the half-angle of the cone, h its height, u the initial velocity of projection and θ angle of projection, then $\tan\theta \tan\alpha$ is:



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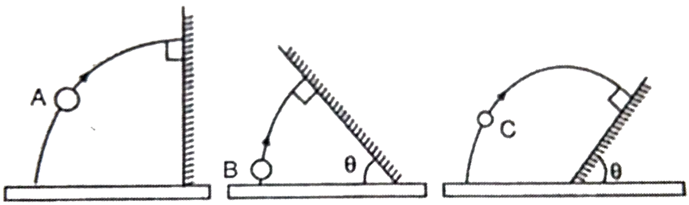
11. Three balls A,B and C are projected from ground with same speed at same angle with the horizontal. The balls A,B and C collie with the wall during a flight in air and all three collide perpendicu lary and eleastically with the wall as shown in Fig. 5.119 it the time taken by the ball A to fall back on ground is 4 seconds and that by ball B is 2 seconds. Then the time taken by the ball C to reach the ground after projection will be:



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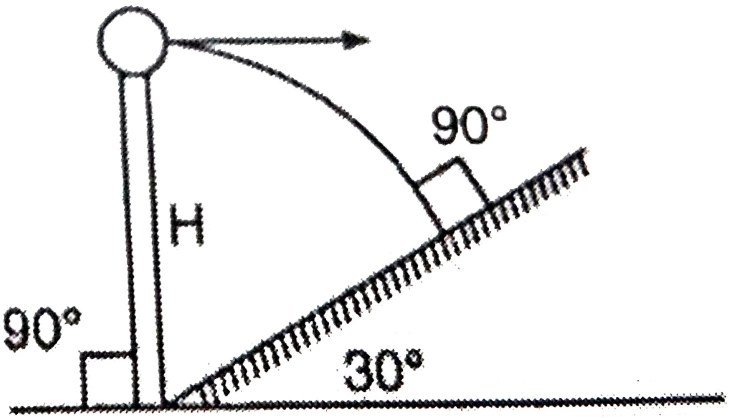
12. In the given figure , the angle of inclination of the inclined plane is 30°. A particle is projected with horizontal velocity v_0 from height H. Find the horizotnal velocity v_0 (in m/s) so that the particle hits the inclined plane perpendicu lar .Given H=4m, g $= 10m/s^2$.



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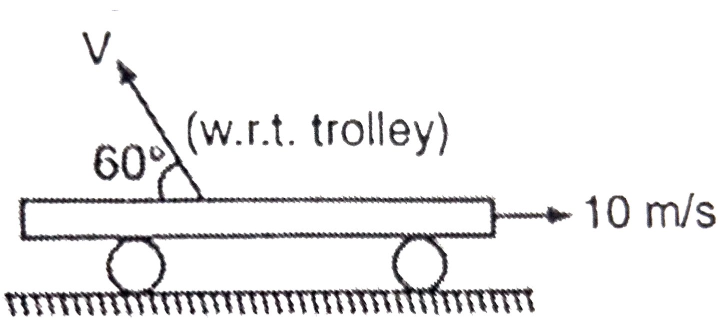
13. A particle is projected from a stationary trolley. After projection, the trolly moves with velocity $2\sqrt{15}$ m/s. for an observer on the trolley, the direction of the particle is as shown in the Fig. 5.121 while for the observer on the ground, the ball rises vertically. the maximum height reached by the abll from the trolley is h metre. The value of h will be:



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14. A train is moving along a straight line with a constant acceleration a. A body standing in the train throws a ball forward with a speed of $10ms^{-1}$, at an angle of 60° to the horizontal . The body has to move forward by 1.15 m inside the train to cathc the ball back to the initial height. the acceleration of the train. in ms^{-2}, is:

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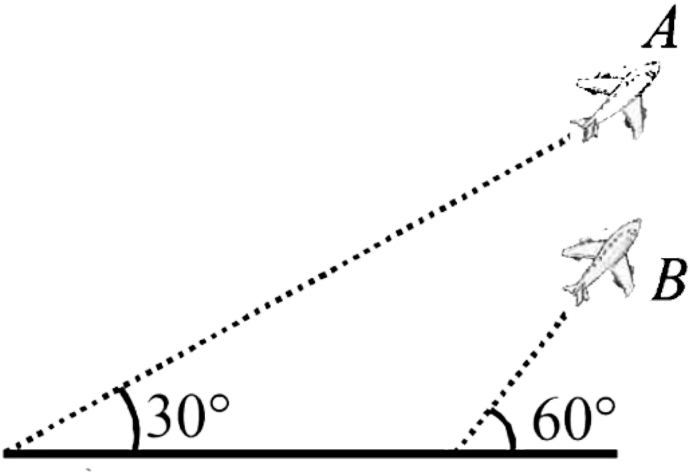
15. Airplanes A and B are flying with constant velocity in the same vertical plane at angles 30° and 60° with respect to the horizontal respectively as shown in figure . The speed of A is $100\sqrt{3} m / s$. At time $t=0 s$, an observer in A finds B at a distance of $500 m$. The observer sees B moving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



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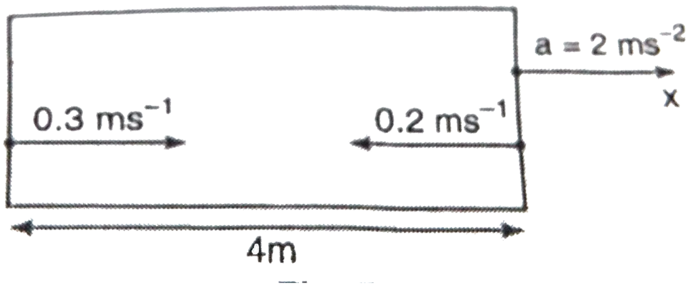
16. A rocket is moving in a gravity free space with a constant acceleration of $2ms^{-1}$ along +x direction (see Fig.5.126). The length of a chamber inside the rocket is 4m. A ball is thrown from the left end of the chamber in +x direction with a speed of 0.3 ms^{-1} relative to the rocket. At the same time , another ball is thrown in -x direction with a speed of $0.2ms^{-1}$ from its right and relative to the rocket. the time in seconds when the two balls hit each other is:



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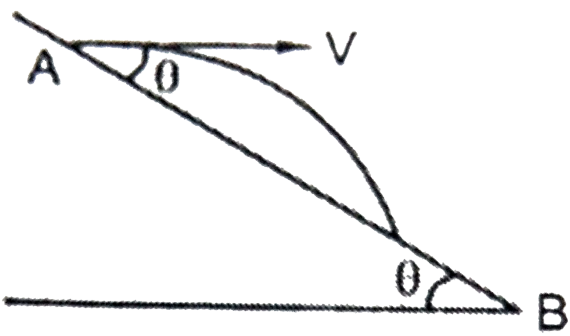
COMP.

1. A particle is projected horizontally with a speed V=5m/s from the top of a plane inclined at an angle $\theta = 37^\circ$ to the horizontal $(g = 10m / s^2)$



How far from the point of projection will the particle strike the plane?

A. 75m

B. $\frac{65}{16}m$

C. $\frac{75}{16}m$

D. $\frac{85}{9}m$

Answer: c

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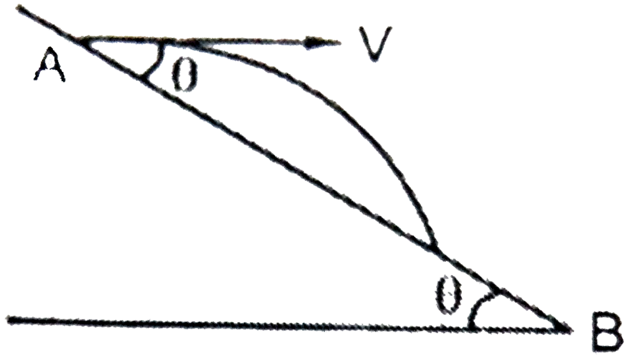
2. A particle is projected horizontally with a speed V=5m/s from the top of a plane inclined at an angle $\theta = 37^\circ$ to the horizontal

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



Find the time taken by the particle to hit the plane.

A. $\frac{3}{4}s$

B. $3s$

C. $4s$

D. $\frac{4}{3}s$

Answer: a

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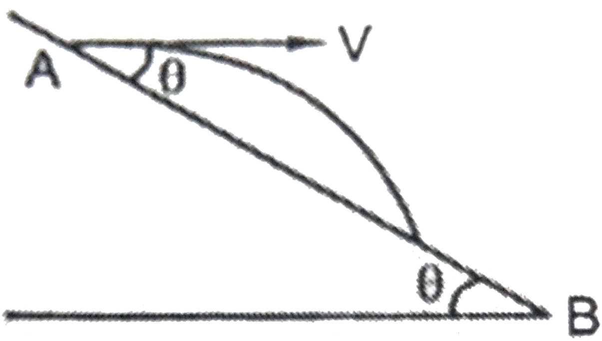
3. A particle is projected horizontally with a speed V=5m/s from the top of a plane inclined at an angle $\theta = 37^\circ$ to the horizontal $(g = 10 m / s^2)$



What is the velocity of the particle just before it hits the plane?

A. $5\sqrt{3}m/s$

B. $\frac{5}{2}\sqrt{13}m/s$

C. $10\sqrt{13}m/s$

D. $5\sqrt{26}m/s$

Answer: b

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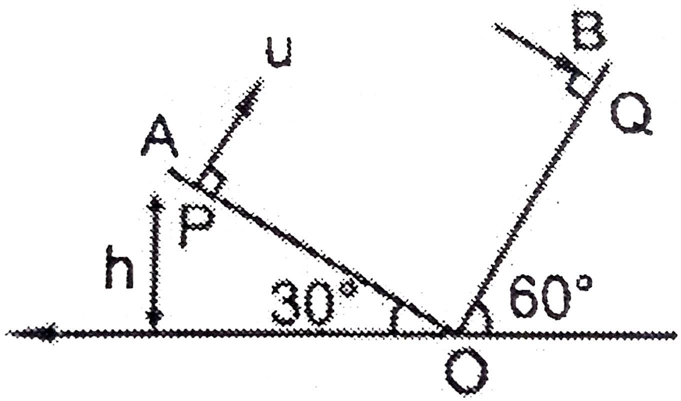
4. Two inclined planes OA and OB having inclination (with horizontal) 30° and 60° respectively , intersect each other at O. A particle is projected from point 'P' with velocity $u = 10\sqrt{3}$ m/s along a direction perpendicu lar to plane OA. If the particle strikes plane OB perpendicu lar at Q. Calcu late:



The velocity with which particle strikes the plane OB.

A. 15m/s

B. 30m/s

C. 20m/s

D. 10m/s

Answer: d

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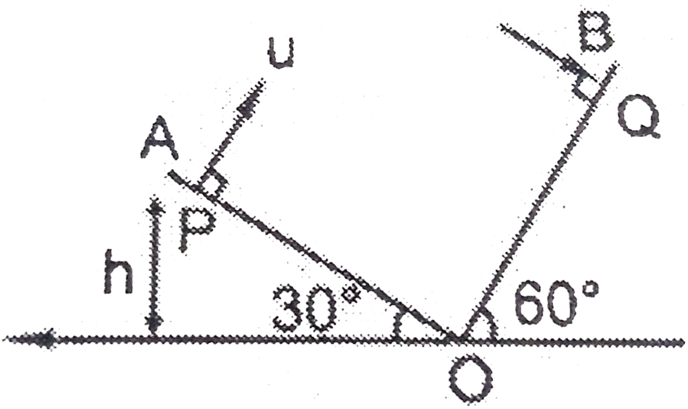
5. Two inclined planes OA and OB having inclination (with horizontal) 30° and 60° respectively , intersect each other at O. A particle is projected from point 'P' with velocity $u = 10\sqrt{3}$ m/s along a direction perpendicu lar to plane OA. If the particle strikes plane OB perpendicu lar at Q. Calcu late:



Time of flight of the particle:

A. 8s

B. 6s

C. 4s

D. 2s

Answer: d

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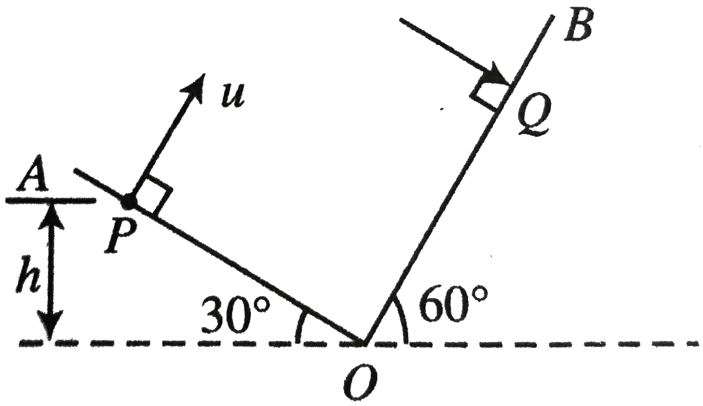
6. Two inclined planes OA and OB having inclination (with horizontal) 30° and 60°, respectively, intersect each other at O as shown in figure. A particle is projected from point P with velocity $u = 10\sqrt{3}ms^{-1}$ along a direction perpendicular to plane OA. If the particle strikes plane OB perpendicularly at Q, calculate



The vertical height h of P from O,

A. 10m/s

B. 5m

C. 15m/s

D. 20m

Answer: b

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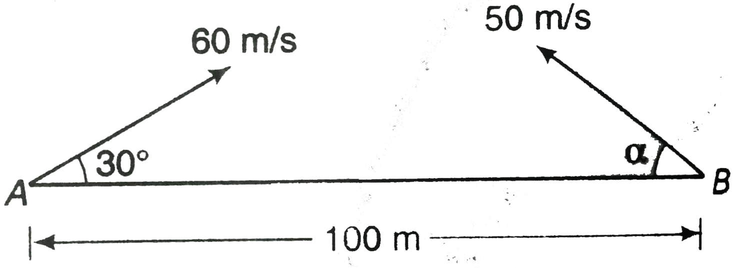
7. A particle A is projected with an initial velocity of $60m/s$ at an angle 30° to the horizontal. At the same time a second particle B is projected in opposite direction with initial speed of $50m/s$ from a point at a distance of 100 m from A. If the particles collide in air, find (a)the angle of projection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

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



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

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

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

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

Answer: b

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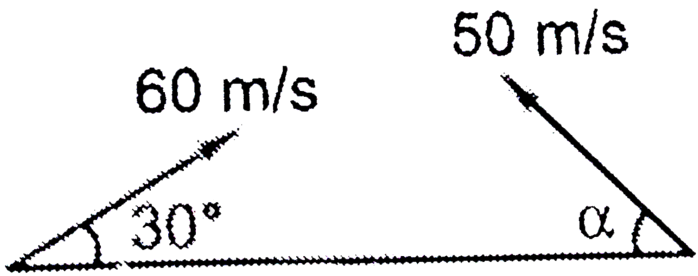
8. A particle A is projected with an initial velocity of 60m/s at angle 30° to the horizontal . At the same time a second particle B is projected in opposite directions with initial speed of 50m/s from a point at a distance of 100m from A.

if the particle collides in air,



Answer the following questions:

Time of collisions will be:

A. 1.09sec

B. 9.01sec

C. 2.09sec

D. 6sec

Answer: a

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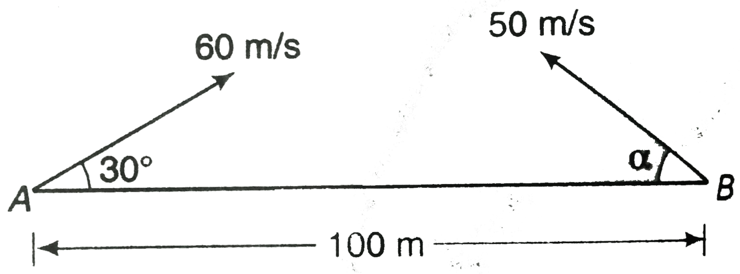
9. A particle A is projected with an initial velocity of $60 m / s$ at an angle 30° to the horizontal. At the same time a second particle B is projected in opposite direction with initial speed of $50 m / s$ from a point at a distance of 100 m from A. If the particles collide in air, find (a)the angle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

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



A. 100m

B. 50m

C. 30m

D. 63m

Answer: d

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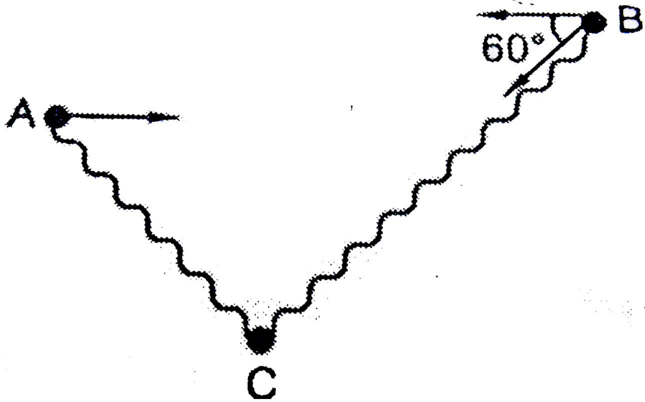
10. Two enemy guns are placed at A and B at $10\sqrt{3}km$ apart horizontally . A shell is fired from A horizontally with velocity 10m/s. At the same time a shell of double the mass of shell at A is fired from B at an angle 60° with horizontal towards A with the same magnitude of initial velocity as that of A. Moving in the same vertical plane, two shells collide in air while sticking to each other and falling at the depest point of the valley C (neglect air resistance).



Calcu late how much above is the position B than position A (in km)?

A. 5

B. $5\sqrt{3}$

C. 10

D. $10\sqrt{3}$

Answer: c

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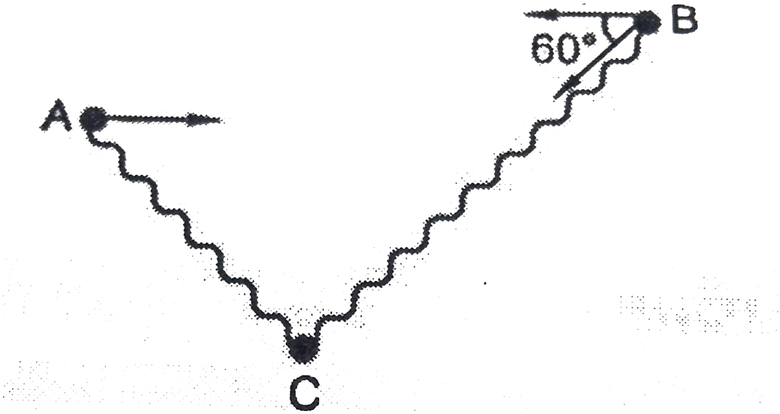
11. Two enemy guns are placed at A and B at $10\sqrt{3}km$ apart horizontally . A shell is fired from A horizontally with velocity 10m/s. At the same time a shell of double the mass of shell at A is fired from B at an angle 60° with horizontal towards A with the same magnitude of initial velocity as that of A. Moving in the same vertical plane, two shells collide in air while sticking to each other and falling at the depest point of the valley C (neglect air resistance).



Find the time of collision of the two shells (in sec).

A. $\dfrac{200}{\sqrt{3}}$

B. $\dfrac{20}{\sqrt{3}}$

C. $\dfrac{2 \times 10^3}{\sqrt{3}}$

D. $\dfrac{2 \times 10^4}{\sqrt{3}}$

Answer: c

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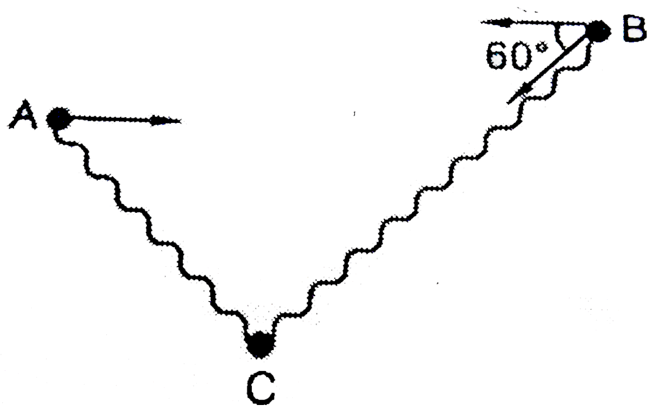
12. Two enemy guns are placed at A and B at $10\sqrt{3}km$ apart horizontally . A shell is fired from A horizontally with velocity 10m/s. At the same time a shell of double the mass of shell at A is fired from B at an angle 60° with horizontal towards A with the same magnitude of initial velocity as that of A. Moving in the same vertical plane, two shells collide in air while sticking to each other and falling at the depest point of the valley C (neglect air resistance).



Find the magnitude of horizontal component of the displacement vector $\left(\overrightarrow{BC}\right)$ (inkm).

A. 11.55

B. 5.77

C. 10.98

D. 6.12

Answer: b

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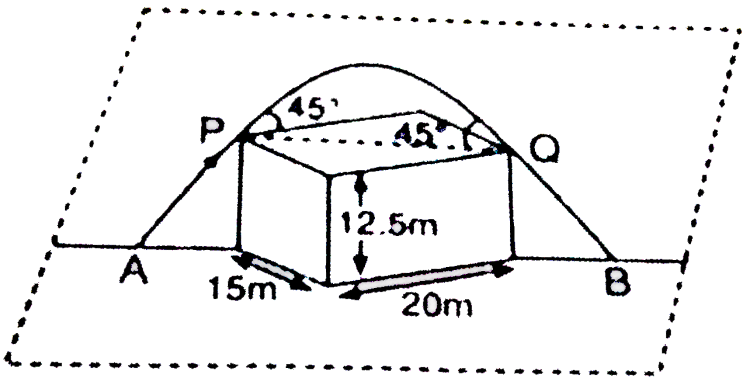
13. A particle is fired from 'A' in the diagonal plane of a building of dimension 20m (length) $\times 15m$ (breath) xx12.5m (height), just clears the roof diagonally and falls on the other side of the building at B. It is observed that the particle is travelling at an angle 45° with the horizonal when it clears the edges P and Q of the diagonal. Take $g = 10m/s^2$.



The speed of the particle at point P will be:

A. $5\sqrt{10}m/s$

B. $10\sqrt{5}m/s$

C. $5\sqrt{15}m/s$

D. $5\sqrt{5}m/s$

Answer: a

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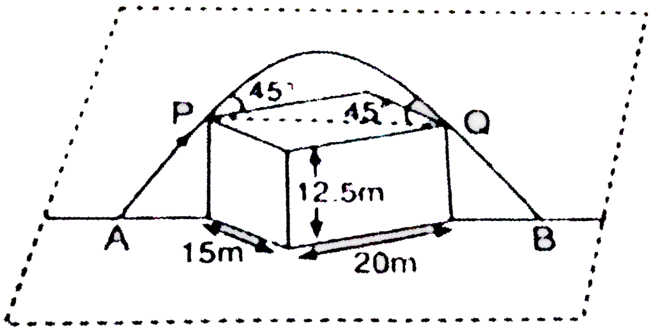
14. A particle is fired from 'A' in the diagonal plane of a building of dimension 20m (length) $\times 15m$ (breath) xx12.5m (height), just clears the roof diagonally and falls on the other side of the building at B. It is observed that the particle is travelling at an angle 45° with the horizonal when it clears the edges P and Q of the diagonal. Take $g = 10m/s^2$.



The speed of projection of the particle at A will be:

A. $5\sqrt{10}m / s$

B. $10\sqrt{5}m / s$

C. $5\sqrt{15}m / s$

D. $5\sqrt{5}m / s$

Answer: b

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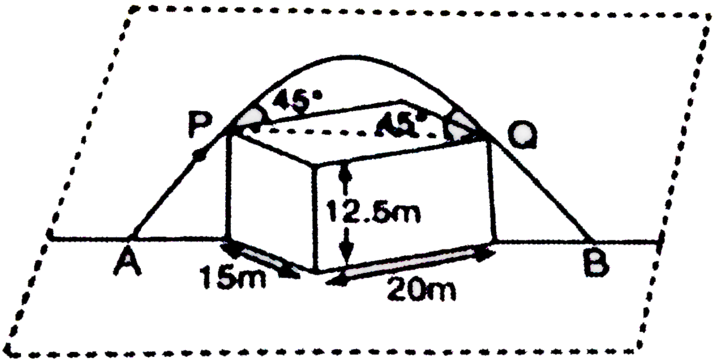
15. A particle is fired from 'A' in the diagonal plane of a building of dimension 20m (length) $\times 15m$ (breath) xx12.5m (height), just clears the roof diagonally and falls on the other side of the building at B. It is observed that the particle is travelling at an angle 45° with the horizonal when it clears the edges P and Q of the diagonal. Take $g = 10m / s^2$.



The range that is AB will be:

A. $5\sqrt{10}m$

B. $25\sqrt{3}m$

C. $5\sqrt{15}m$

D. $25\sqrt{5}m$

Answer: b

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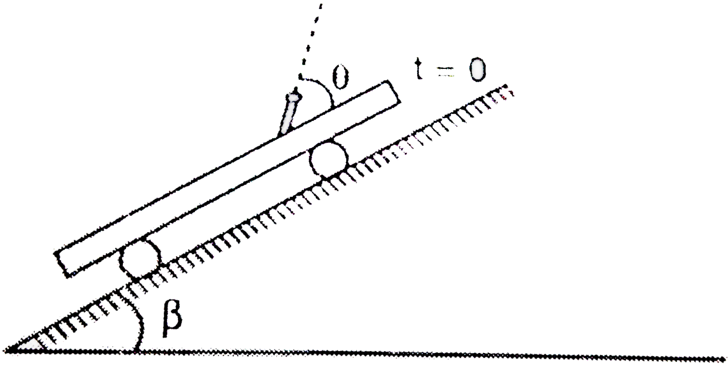
16. A cannon is fixed with a smooth massive trolley car at an angle θ as shown in the figure. The trolley te trolley car slides from rest down the inclined plane of inclimation β.

The muzzle velocity of the shell fired at $t = t_0$ from the cannon is u, such that the shell moves perpendicu lar to the inclined plane just after the firing.



The value of r_0 is:

A. $\dfrac{u\cos\theta}{g}$

B. $\dfrac{u\cos\theta}{g\cos\beta}$

C. $\dfrac{u\cos\theta}{g\sin\beta}$

D. $\dfrac{u\sin\theta}{g\cos\beta}$

Answer: c

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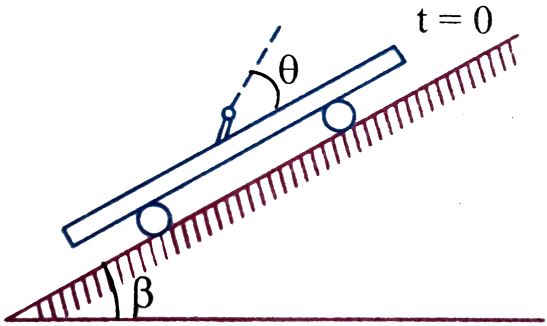
17. A cannon is fixed with a smooth massive trolley car at an angle θ as shown in the figure.The trolley car slides from rest down the inclined plane of angle of inclination β.

The muzzle velocity of the shell fired at $t = t_0$ from the cannon is u,such that the shell moves perpendicular to the inclined just after the firing.

The time of flight of the shell is:

firing.



A. $\dfrac{u\cos\theta}{g\sin\beta}$

B. $\dfrac{2u\sin\theta}{g\cos\beta}$

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

D. $\dfrac{u\sin\theta}{g\sin\beta}$

Answer: b

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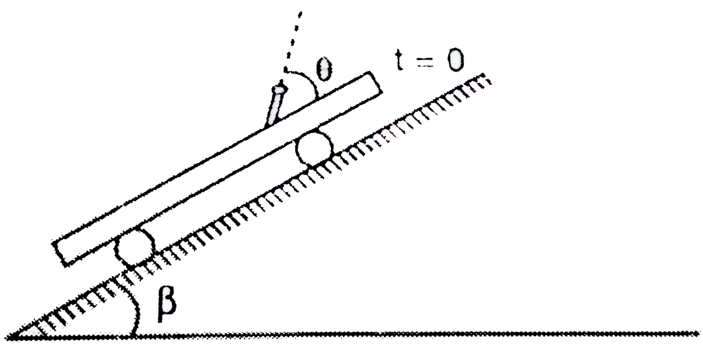
18. A cannon is fixed with a smooth massive trolley car at an angle θ as shown in the figure. The trolley te trolley car slides from rest down the inclined plane of inclimation β.

The muzzle velocity of the shell fired at $t = t_0$ from the cannon is u, such that the shell moves perpendicu lar to the inclined plane just after the firing.



The difference in range of the shell relative to the trolley car and ground is:

A. $\dfrac{u^2 \sin 2\theta}{g \cos \beta}$

B. $\dfrac{u^2 \cos^2 \theta}{2g \sin \beta}$

C. $u^2 \sin \theta \sin \beta 2g$

D. $\dfrac{2u^2 \sin \theta \cos(\theta - \beta)}{g \cos^2 \beta}$

Answer: d

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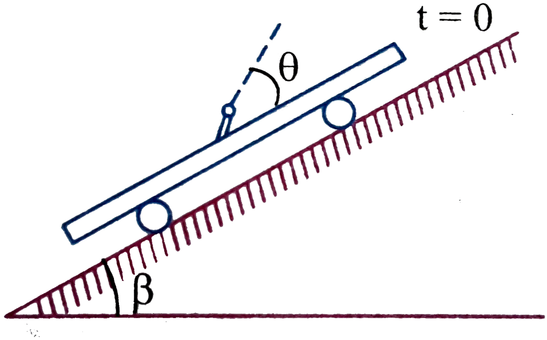
19. A cannon is fixed with a smooth massive trolley car at an angle θ as shown in the figure.The trolley car slides from rest down the inclined plane of angle of inclination β.

The muzzle velocity of the shell fired at $t = t_0$ from the cannon is u,such that the shell moves perpendicular to the inclined just after the firing.

The time of flight of the shell is:

firing.



A. $\dfrac{u\cos\theta}{g\sin\beta}$

B. $\dfrac{u\sin(\theta+\beta)}{g\cos\theta\sin\beta}$

C. $\dfrac{u\cos(\theta+\beta)}{g\cos\beta}$

D. $\dfrac{u\cos(\theta+\beta)}{g\sin\beta\cos\beta}$

Answer: d

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Others

1. A particle moves so that its coordinates vary with time as x=$\alpha \sin \omega t$, $y = \alpha \cos \omega t$ and $z = bt^2$. Find the initial:

(a) position (b) velocity (c) acceleration of the particle.

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2. The position of a particle is given as

$$\overrightarrow{r} = at\hat{i} + bt^2\hat{j}$$

Find the equation of trajectory of the particle.

3. A ball is projected horizontally in air such that it moves with a constnat horizontal accelration a due to air flow. Taking the gravitational acelration into account. Find the (a) velocity (b) accelration as the function of time till it strikes the ground.

4. An aeroplane is flying at a constant height of 1960 m with speed $600 kmh^{-1}$ above the ground towards point directly over a person struggling in flood water. At what angle of sight with the vertical should be pilot release a survival kit if it is to reach the person in water ? $(g = 9.8 ms^{-2})$

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5. At anchored enemy ship is at a distance $180\sqrt{3}m$ form the security cannon having a muzzle velocity of $60m/s$.

(a) To what angle must the cannon be elevated to hit the ship.

(b) What is the time of flight.

(c) How far should the ship be moved away from its initial position so that it becomes beyond the range of the cannon $(g = 10m/s^2)$.

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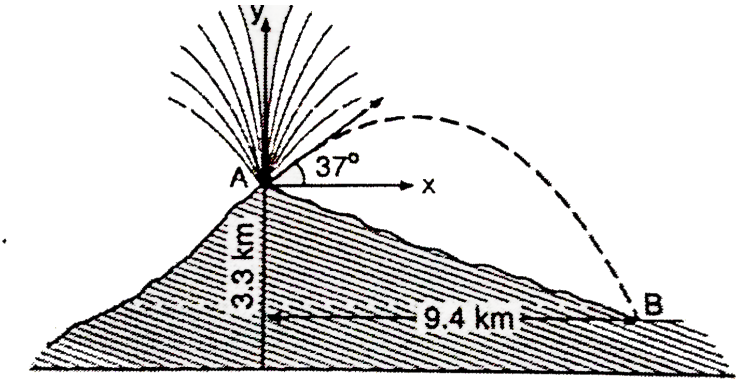
6. During volcanic eruption chunks of slid rock are blasted out of the volcano . (a) At what initial speed



Wou ld a valcanic object have to be ejected at 37° to the horizontal from the vent A in order to fall at B as shown in Fig. 5.22? (b) what is the time of flight? (g=9.8m/s^2)

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7. A gun kept on a striaght horizontal is used to hit a car, traveling along the same road away form the gun with a unfrom speed $20m/s$. The car is at a distance Of $160m$ from the gun, when the gun is fired at an angle of 45° with the horizontal Find the distance of the car from the gun when the shell hits it and the speed of projection of the shell from the gun.

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8. 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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9. A gun is fired from a moving platform and the ranges of theshot are observed to be R and S when platform is moving forward or backward respectively with velocity v prove that the elevation of the gun is

$$\tan^{-1}\left[\frac{g(R-S)^2}{4V^2(R+S)}\right]$$

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10. A rider on an open platform, which is descending at constant speed of 3 ms s^{-1}, throws a ball. Relative to platform, ball's initial velocity is horizontal at 12 m/s. The ground is 10m below the location where the ball is thrown:

(i) Where does the ball kit the ground?

(ii) How long after the ball hits the ground does the platform reach grond level?

(iii) With what velocity does the ball hit the ground?

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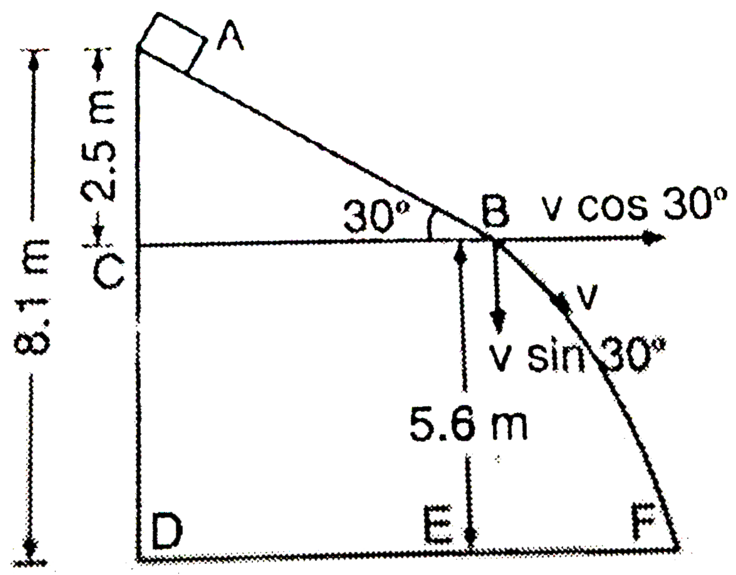
11. A block of ice starts sliding down from the top of the inclined roof of a house (angle of inclination of roof=30° with the horizontal) along aline of maximum slope. The highest and lowest points of the roof are at heights of 8.1m and 5.6 m respectively from the ground. At what horizontal distance from the starting point will the block hit the ground? Neglect friction.



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12. A stone is projected at an angle α to the horizontal from the top of a tower of height 3h. If the stone reaches a maximum height 'h', above the tower, show that it reaches the ground at a distance 6h cot α from the foot of the lower.

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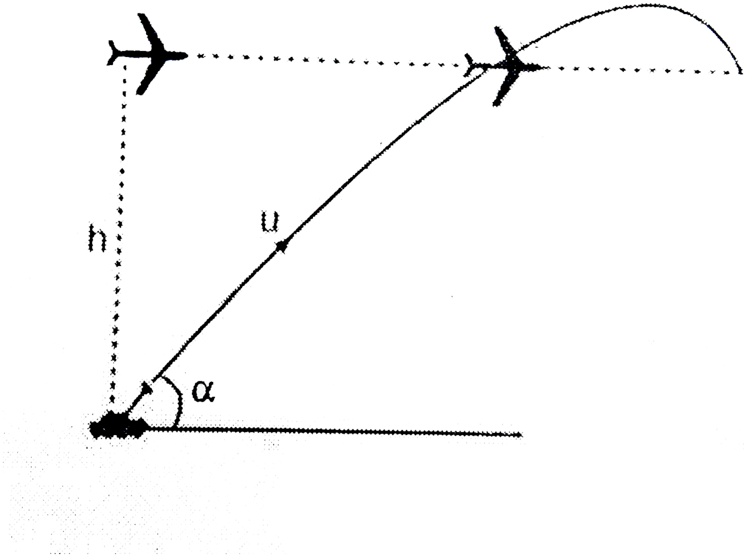
13. A jet plane files horizonally at a height h at a speed v. An anti-aircraft gun fires a shell at the plane when it is



vertically above the gun. Show that the minimum muzzle speed required to hit the plane is $\sqrt{v^2 + 2gh}$ at an angle $\frac{\tan^{-1}\sqrt{2gh}}{v}$

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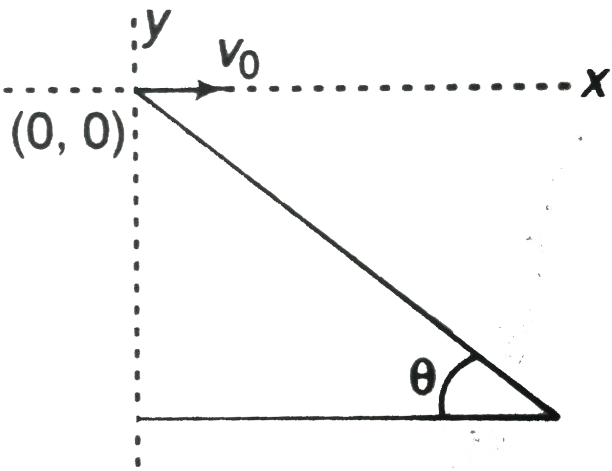
14. A man standing on a hill top projects a stone horizontally with speed v_0 as shown in figure. Taking the co-ordinate system as given in the figure. Find the co-ordinates of the point where the stone will hit the hill surface.



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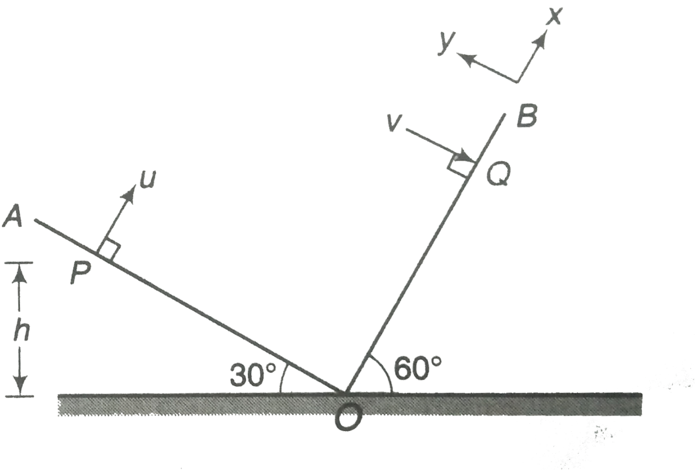
15. Two inclined planes OA and OB having inclinations 30° and 60° with the horizontal respectively intersect each other at O, as shown in figure. A particle is projected from point P with velocity $u = 10\sqrt{3}m / s$ along a direction perpendicular to plane OA. If the particle strikes plane OB perpendicular at Q. Calculate.



(a) time of flight,

(b) velocity with which the particle strikes the plane OB,

(c) height h of point P from point O,

(d) distance PQ. (Take $g = 10m/s^2$)

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16. A man can row a boat with 4km/h in still water, if he is crossing a river where the current is 2 km/h.

(a) In what direction will his boat be holded, if he wants to reach a point on the other bank, directly opposite to starting point?

(b) If width of the river 4km, how long will the man take to cross the river, with the condition in part (a)?

(c) In what direction shou ld he heat the boat if he wants to cross the river in shorest time and what is this minimum time?

(d) How long will it take him to row 2 km up the stream and then back to his starting point?

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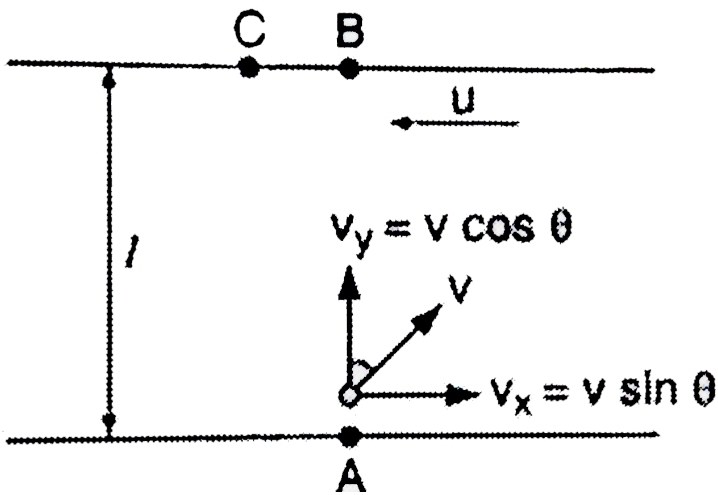
17. Two swimmers start at the same time from point A one bank of a river to reach point B on the other bank, lying directly oppostie to point A. one of them crosses the river along the straight line AB, while the other swims at right angles to the stream and then walks the distance, which he has been carried awayby the stream to get to point B. Both swimmers reach point B at the same time. what was the velocity (assumed uniform) of his walking if velocity of both the swimmers in still water is 2.5 km h^{-1} and the stream velocity is 2 km h^{-1}?



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18. An aircraft flies at $400km/h$ in still air. A wind of $200\sqrt{2}km/h$ is blowing from the south towards north. The pilot wishes to travel from A to a point B north east of A. Find the direction he must steer and time of his journey if $AB = 1000km$.

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19. 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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20. Three insects A,B and C are situated at the vertices of an equillateral triangle of side 1. the insect A heads towards B,B towards C,C towards A with constant speeds v such that they always remain at the vertices of an equilateral triangle. Find the (a) time of their meeting (b) equation of path traced by one insect relative to the other.

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21. 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 poit 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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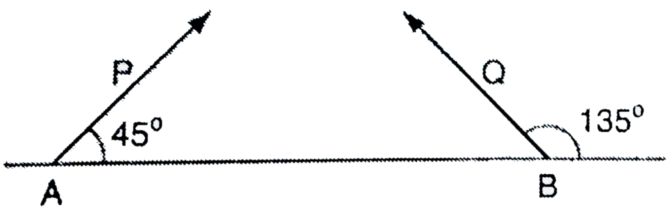
22. Particles P and Q of mass 20g and 40g respectively are simu ltaneously proejected from points A and B on the ground. The initial velocities of P and Q make 45° and 135° angles respectivley with the horizontal AB as shown in the Fig. 5.44 Each particle has an initial speed of 49m/s . the separation AB is 249m. both particles travel in the same vertical plane and undergo a collision. After collision P retraces its path. Determine the position of q when it hits the grou.d How much time after the collision does the particle Q take to reach the ground? (Take g $= 9.8m / s^2$)



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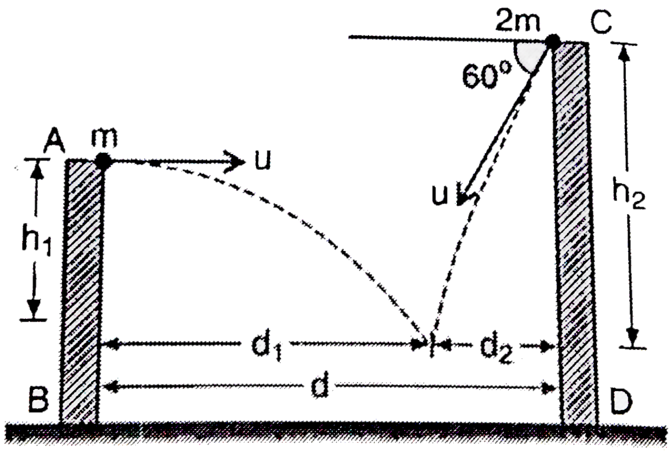
23. Two towers AB and CD are situated a distance d apart as shown in Fig. 5.45. AB is 20m high and



CD is 30m highfrom the ground . An object of mass m is thrown from the top of AB horizontally with a velocity 10m/s towards CD. simu ltaneously another object of mass 2 m is thrown from the top of CD at an angle of 60°

to the horizotnal towards AB with the same magnitude of initial velocity as that of the first object. the two objects move in the same vertical plane, clollide in mid air and stick to each other, (a) Calcu late the distance d between the towers and (b) fin the position where the objects hit the ground.

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24. An object of mass 5 kg is projecte with a velocity of $20ms^{-1}$ at an angle of 60° to the horizontal. At the highest point of its path , the projectile explodes and breaks up into two fragments of masses 1kg and 4 kg. The fragments separate horizontally after the explosion, which releases internal energy such that $K.E.$ of the system at the highest point is doubled. Calculate the separation betweent the two fragments when they reach the ground.

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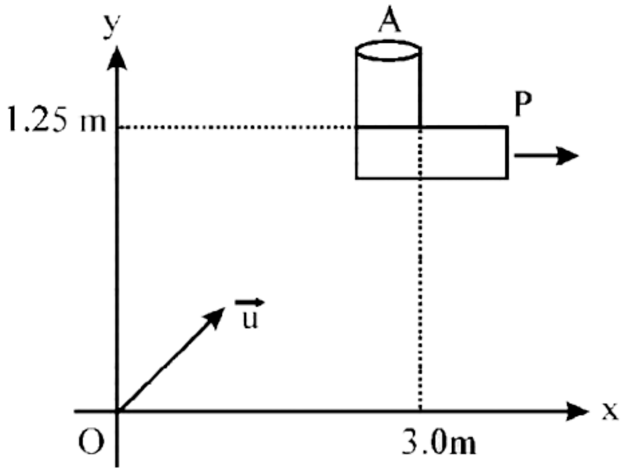
25. An object A is kept fixed at the point $x = 3m$ and $y = 1.25m$ on a plank p raised above the ground . At time $t = 0$ the plank starts moving along the $+x$ direction with an acceleration $1.5m/s^2$. At the same instant a stone is projected from the origin with a velocity $\vec{u}$ as shown . A stationary person on the ground observes the stone hitting the object during its downward motion at an angle $45(\circ)$ to the horizontal . All the motions are in the $X - Y$plane . Find $\vec{u}$ and the time after which the stone hits the object .

Take $g = 10m / s$



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26. A body falling freely from a given height H hits an inlclined plane in its path at a height h. As a result of this impact the direction of the velocity of the body becomes horizontal. For what value of h/H, the body will take the maximum time to reach the ground.

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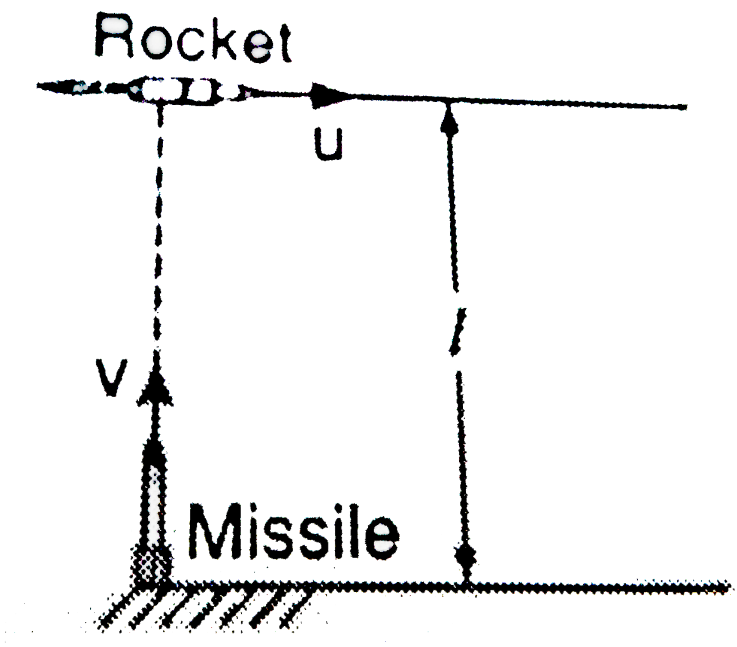
27. A rocket moves horizontally with a constant velocity u at a height 1. A gu lded missile is fired vertically with a speed v when the rocket passes above it. Assuming that the missile always aims at the rocket with the constant speed v, find the time after which the missile strikes the rocket.



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28. A man swims with avelocity v_{mw} in still water. When the water moves with a velocity

$u_w(< v_{\text{new}}^2)$ the man crosses the river to and fro in minimum time T_1. If the man intends to cross the river perpendicu larly, he takes time T_2 for to and fro journey. Now he swims in the donwstream and comes back to his initial position by swimming upstream along the shore. For to and fro journey along the shore, the man takes a time T_3. find the relation between T_1, T_2 and T_3 assuming equal distance overed by the man in each case.

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29. If the radius of earth is 6400km, calcu late (a) angu lar velocity (b) linear velocity and (c) radial accelration for a point on its equator considering its spin motion alone. What will be the values of above quantities if the pint is at the pole?

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30. An astronaout is rotating in a rotor of radius 4m. If he can withstand upto acc. Of

10g, then what is the maximum number of permissible revolutions? $(g = 10m / s^2)$

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31. Two satellites S_1 and S_2 revolve around a planet in coplanar circular orbits in the same sense their periods of revolution are 1 hour and 8hours respectively the radius of the orbit of S_1 is 10^4 km when S_1 is closest to S_2 the angular speed of S_2 as observed by an astronaut in S_1 is :

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32. A threaded rod with $12 turns / cm$ and diameter $1.18 cm$ is mounted horizontally. A bar with a threaded hole to match the rod is screwed onto the rod. The bar spins at $216 rev / \min$. How long will it take for the bar to move $1.50 cm$ along the rod ?

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33. A wheel having radius $10cm$ is coupled by a belt to another wheel of radius $30cm$. 1st wheel increases its angular speed from rest at a uniform rate of $1.57rad/s^2$. The time for 2nd wheel to reach a rotational speed of $100rev/\min$ is ...(assume that the belt does not slip)

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34. A spot light S rotates in a horizontal plane with a constant angular velocity of $0.1 rad/s$. The spot of light P move along the wall at a disatnce $3m$. What is the velocity of the spot P when $\theta = 45^{\circ}$?

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

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36. A balloon starts rising from the earth's surface. The ascension rate is constant and equal to v_0. Due to the wind. The balloon gathers the horizontal velocity component $v_x = ky$, where k is a constnat and y is the height of ascent. Find how the following quantities depednd on the height of ascent.

(a) the horizontal drift of the balloon x (y)

(b) the total tangential and normal accelrations of the balloon.

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37. Two particles of masses m_1 and m_2 are initially at rest infinite distance apart. If they approach each other under inverse square law of force $\left(F = k / r^2\right)$ find their speed of approach at the instant when they are distance d apart.

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38. A particle of mass $10^{-2} kg$ is moving along the positive x axis under the influence of a force $F(x) = -K/(2x^2)$ where $K = 10^{-2} Nm^2$. At time $t = 0$ it is at $x = 1.0m$ and its velocity is $v = 0$.

(a) Find its velocity when it reaches $x = 0.50m$.

(b) Find the time at which it reaches $x = 0.25m$.

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39. A body projected vertically upwords from the top of a tower reaches the ground in t_1 second . If it projected vertically downwards from the some top with same velocity ,it reaches the ground in $t_2$seconds . If it is just dropped from the top it reaches the ground in t second .prove that $t = \sqrt{t_1 t_2}$

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40. (a) सिद्ध कीजिए कि किसी प्रक्षेप्य के x - अक्ष तथा उसके वेग के बिच के कोण को समय के फलन के रूप में निम्न प्रकार से व्यक्त कर सकते हैं

$$\theta(t) = \tan^{-1}\left(\frac{v_{0y} - \quad >}{v_{\otimes}}\right)$$

(d) सिद्ध कीजिए कि मूल बिंदु से फेंके गए कोण का मान $\theta_0 = \tan^{-1}\left(\frac{4h_m}{R}\right)$ होगा | यहाँ प्रयुक्त प्रतीकों के अर्थ समान्य हैं |

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

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42. The horizontal and vertical distances covered by a projectile at tiem t are given by x=at and y=$bt^2 + ct$, wehre a,b and c are constants. What is the magnitude of the velocity of the projectile 1 second after it is fired?

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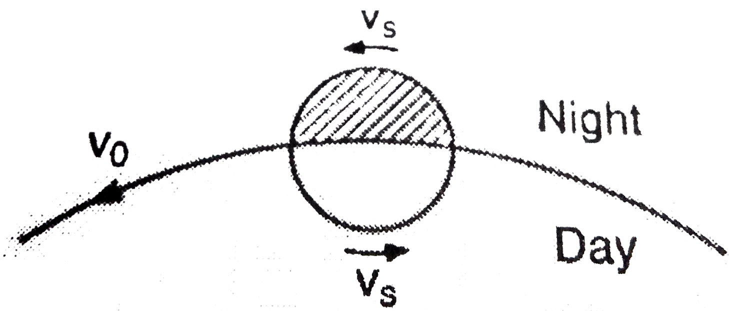
43. Taking the rotation and revolution of the earth into account, does a tree move faster during day or during night?



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44. If a ball A is dropped while B is projected vertically down. Which ball will reach the ground (a) first (b) with greater velocity?

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45. A man can throw a stone R m away:

(a) What is the maximum height to which the stone will rise?

(b) How high can the person throw the stone?

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46. Two bodies P and Q are projected with velocites $\sqrt{2}$ u and u respectively. They cover the same horizontal distance. If body P is projected at 15° will the horizontal, then calculate the angle of projection of body Q.

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47. Prove that:

The path of a projectile is a straight line.

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48. Prove that for a projectile fired from level ground at an angle θ above the horizontal, the ratio of the maximum height H to the range R is given by

$$\frac{H}{R} = \frac{1}{4}\tan\theta$$

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

$t_1 t_2 = (2R / g)$

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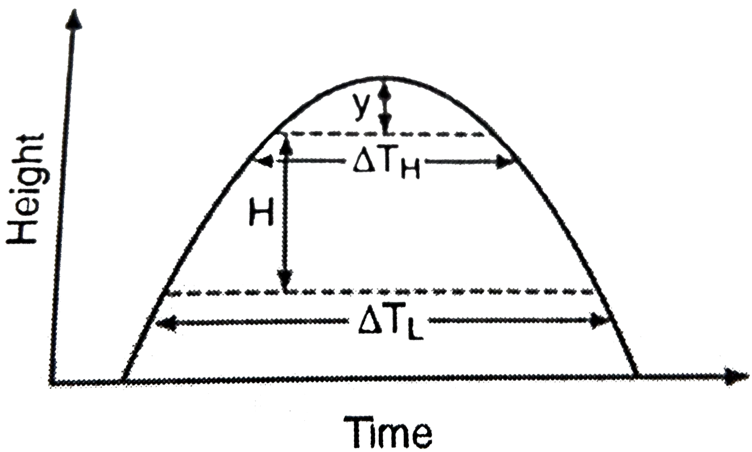
50. In an experiment for measuring 'g', a body is thrown vertically up in an evacuated tube and allowed to come back. If ΔT_L is the time interval between the two passages of the object across a lower level and ΔT_H the time interval between two passages across an upper level and H the distance between two levels as shown in Fig. 5.70 show that:

$$g = \frac{8H}{\Delta T_L^2 - \Delta T_H^2}$$



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51. A bomb is dropped on a nenmy post by an aeroplane flying. With a horizontal velocity of 60km/hr and at a height of 490 m. how far the aeroplane must be from the enemy post at the time of dropping the bomb, so that it may directly hit the target? $\left(g = 9.8m/s^2\right)$

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52. A fireman 50m away fro a burning building directs a stream of water from a firehouse at an angle 30° above the horizontal. If the velocity of the stream is 40m/s. at what height will the strea of water strike the building ? $(g = 9.8m / s^2)$

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53. An astronaut on a strange planet finds that he can jump a maximum horizontal distance of 30m if the initial speed is 9 m/s/ (a) what is the accelration of gravity on the planet? (b) what is the maximum height to which he can jump if he starts with thesame initial speed?

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54. A particle of mass 3 kg takes 2 second to move from point A to B under the action of gravity and another constant force $\overrightarrow{F}=\left(12\hat{i}-3\hat{j}+12\hat{k}\right)N$, where the unit vector $\hat{k}$ is in the direction of upward vertical. The position vector of point B is $\overrightarrow{r}_B=\left(15\hat{i}-7\hat{j}-6\hat{k}\right)m$ and velocity of the particle when it reaches B is $\overrightarrow{V}_B = \left(12\hat{i} + \hat{j} - 4\hat{k}m / s.\right.$

(a) Find the velocity, $\overrightarrow{V}_A$of the particle when it was at A.

(b) Find position vector, $\overrightarrow{r}_A$ of point A

(c) Find work done by the force $\overrightarrow{F}$ as the particle moves from A to B

(d) Find change in gravitational potential energy of the particle is it moves from A to B

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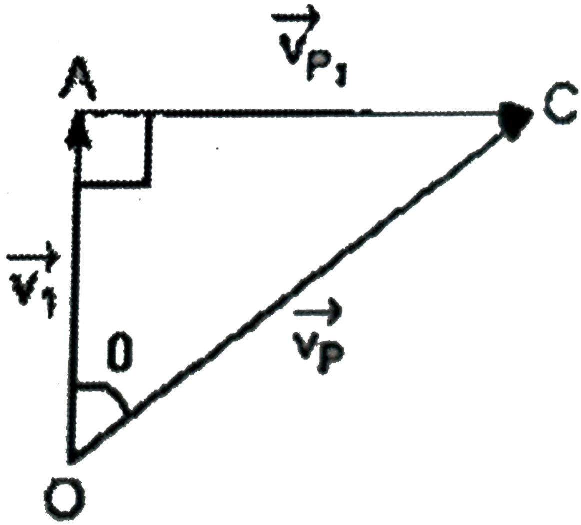
55. An airplane is observed by two persons travelling at 60 km/hour in two vehicles moving in opposite directions on a straight road. To an observer in one vehicle the plane appears to cross the road track at right angles while to the observer in the other vehicle the angle appears to be 45° . At what angle does the plane actually cross the road track and what is its speed relative to ground?



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56. A motor boat set out at 11a.m. from a position $-6\hat{i}-2\hat{j}$ relative to a marker buoy and travel at a steady spee dof magnutdue

$\sqrt{53}$ on a direc course to intercept a ship. The ship maintains a steady velocity vector $3\hat{i}+4\hat{j}$ and at 12 noon is at a postion $3\hat{i}-\hat{j}$ form the body. Find (a) the velocity vector of the motor boat, (b) the time of interecption and (c) the position vector of point of interception from the buoy if distances are measured in mkilometeres and speds i kilometre per hour.

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57. A man can row a boat at 4.0km/hr in still water. A river flows at 2.0km/hr. (a) if he is crossing the river, in what direction the oat shou ld go to reach a point directly opposite to his staring point? (b) if the river is 4.0km wide how long will it take him to cross the river? (c) How long will it take him to row 2.0km down the river and then back to his starting point? (d) How long will it take him to row 2.0 km up the river and then back to his starting point? (e) in what direction the boat shou ld go, if he wants to cross he river in teh smallest possible time?

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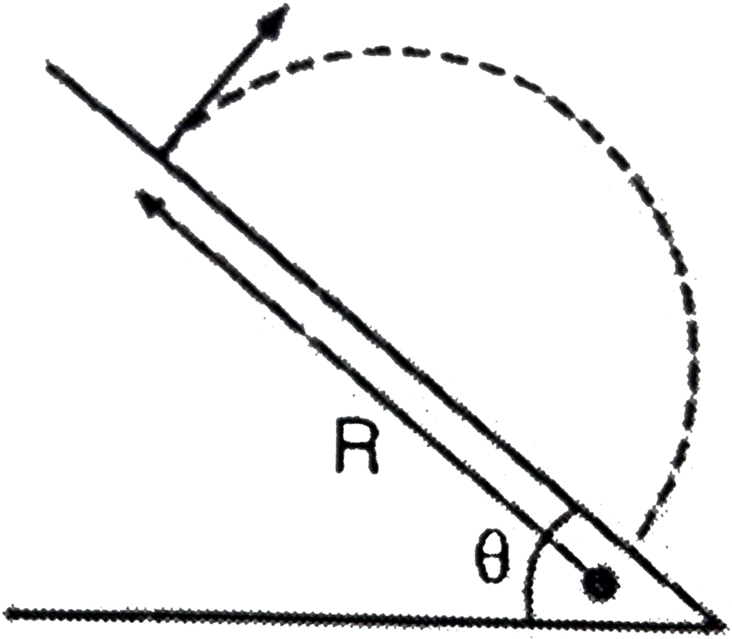
58. A projectile is lauched with a velocity u at right angles to the along, which in inclined at an angle 1 with the horizontal. Derive an expression for the distance R to the point of impact.



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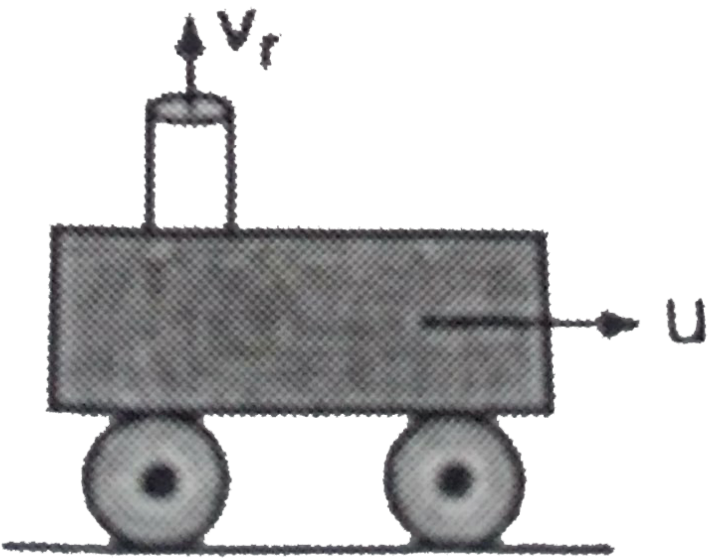
59. A shell is fired vertically from a cannon which is travelling at constant speed

u=30km/hr. the projectile leaves the connon with a velocity $v_r = 20$ m/s relative to the cannon . Show that the shell will land on the vehicle at the gun location and calcu late the distance by the vehicle during the flight of shell.



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60. At a certain two cars area each 10km from the intersection of roads that are perpendiuclar. Cat A is moving east at 30 km/hr while car B moves north at 50km/hr both toward the intersection. (a) Fnd their closest distance of approach . (B) Where are A and B when they are closest?

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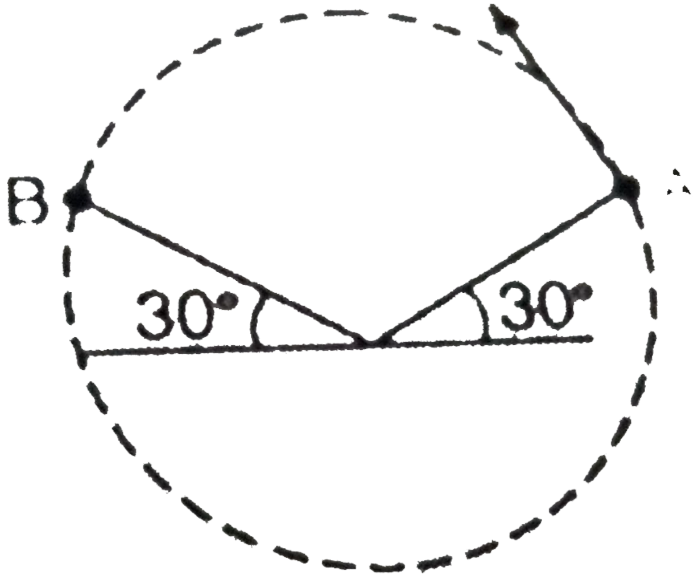
61. A stone at the end of a string is whirled in a vertical circle of radius r=1.20 m at a constant speed u=1.50m/s. the centre of the string is 1.50m above the ground. What is the range of the stone if it is released when the string is inclined at 30° with the horizotnal (a) at A(b) at B? What is the accelration of the stone: (c) just before rleaseat A (d) just after release at

A?



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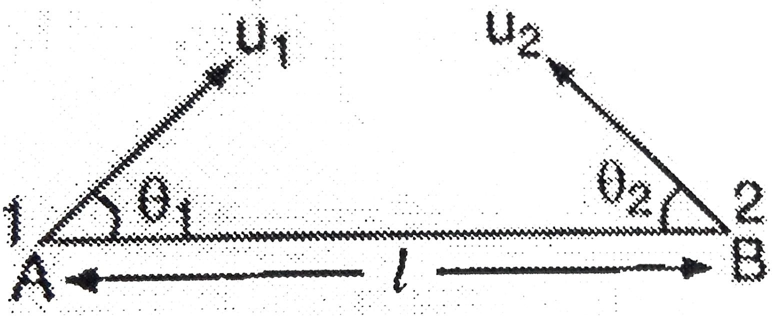
62. Two particles are projected simu ltaneously from points A and B respectively and they move in same plane. Find.



(a) the separation when they are closest to each other.

(b) the time elapsed to come closest to each other.

(c) condition that they collide in air.

(d) initial velocity of approch between the particles.

(e) initial angu lar velocity of first particle w.r.t. second particle.

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