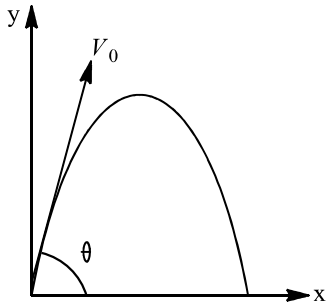
GPLUS EDUCATION

Date : **TEST ID: 622**
Time : **PHYSICS**
Marks :

MOTION IN A PLANE

Single Correct Answer Type

1. If a person can throw a stone to maximum height of h metre vertically, then the maximum distance through which it can be thrown horizontally by the same person is
   a) $\frac{h}{2}$ b) h c) $2h$ d) $3h$
2. A pendulum bob on a 2 m string is displaced 60° from the vertical and then released. What is the speed of the bob as it passes through the lowest point in its path
   a) $\sqrt{2}\ m/s$ b) $\sqrt{9.8}\ m/s$ c) $4.43\ m/s$ d) $1/\sqrt{2}\ m/s$
3. A wheel is subjected to uniform angular acceleration about its axis. Initially its angular velocity is zero. In the first 2 sec, it rotates through an angle θ_1. In the next 2 sec, it rotates through an additional angle θ_2. The ratio of $\theta_2\ /\theta_1$ is
   a) 1 b) 2 c) 3 d) 5
4. A car is moving in a circular horizontal track of radius 10m with a constant speed of $10\ \text{ms}^{-1}$. The angle made by the rod with track is
   a) Zero b) 30° c) 45° d) 60°
5. A cyclist is travelling on a circular section of highway of radius 2500 ft at the speed of 60 mile h^{-1}. The cyclist suddenly applies the brakes causing the bicycle to slown sown at constant rate. Knowing that after 8 s the speed has been reduced to 45 mileh^{-1}. The acceleration of the bicycle immediately after the brakes have been applied is
   a) $2\ \text{ft/s}^2$ b) $4.14\ \text{ft/s}^2$ c) $3.10\ \text{ft/s}^2$ d) $2.75\ \text{ft/s}^2$
6. Two stones are projected from the same speed but making different angels with the horizontal. Their horizontal ranges are equal. The angle of projection of one is $\pi/3$ and the maximum height reached by it is 102 m. Then maximum height reached by the other in metre is
   a) 336 b) 224 c) 56 d) 34
7. A particle moves in circle of radius 25 cm at the rate of two revolutions per second. The acceleration of particle is
   a) $2\pi^2\text{ms}^{-2}$ b) $4\pi^2\text{ms}^{-2}$ c) $8\pi^2\text{ms}^{-2}$ d) $\pi^2\text{ms}^{-2}$
8. A small particle of mass m is projected at an angle θ with the x-axis with an initial velocity v_0 in the x-y plane as shown in the figure. At a time $t < \frac{v_0 \sin\theta}{g}$, the angular momentum of the particle is



   a) $-mgv_0t^2\cos\theta\,\hat{\mathbf{j}}$ b) $mgv_0t\cos\theta\,\hat{\mathbf{k}}$ c) $-\frac{1}{2}mgv_0t^2\cos\theta\,\hat{\mathbf{k}}$ d) $\frac{1}{2}mgv_0t^2\cos\theta\,\hat{\mathbf{i}}$
9. When a body moves in a circular path, no work is done by the force since
   a) force and displacement are perpendicular other b) the force is always away from the center

c) there is no displacement d) there is no net force

10. Consider a vector $\vec{F} = 4\hat{i} - 3\hat{j}$. Another vector that is perpendicular to $\vec{F}$ is
    a) $4\hat{i} + 3\hat{j}$ b) $6\hat{j}$ c) $7\hat{j}$ d) $3\hat{i} - 4\hat{j}$
11. A particle is projected with a velocity 200 ms^{-1} at an angle of 60°. At the highest point, it explodes into three particles of equal masses. One goes vertically upwards with a velocity 100 ms^{-1}, the second particle goes vertically downwards. What is the velocity of third particle?
    a) 120 ms^{-1} making 60° angle with horizontal b) 200 ms^{-1} making 60° angle with horizontal
    c) 300 ms^{-1} d) 200 ms^{-1}
12. The maximum height attained by a projectile is increased by 10% by increasing its speed of projection, without changing the angle of projection. The percentage increase in the horizontal range will be
    a) 5% b) 10% c) 15% d) 20%
13. A motorcycle is going on an overbridge of radius R. The driver maintains a constant speed. As the motorcycle is ascending on the overbridge, the normal force on it
    a) Increases b) Decreases c) Remains the same d) Fluctuates
14. A car is moving on a circular level road of radius of curvature 300 m. If the coefficient of friction is 0.3 and acceleration due to gravity 10 ms^{-2}, the maximum speed the car can have is (in km h^{-1})
    a) 30 b) 81 c) 108 d) 162
15. A body of mass 5 kg is moving in a circle of radius 1 m with an angular velocity of 2 $radian$/sec. The centripetal force is
    a) 10 N b) 20 N c) 30 N d) 40 N
16. If the sum of the two unit vectors is also a unit vector, then magnitude of their difference is
    a) $\sqrt{2}$ b) $\sqrt{3}$ c) $\sqrt{4}$ d) $\sqrt{7}$
17. A force $\vec{F} = -K(y\hat{i} + x\hat{j})$ (where K is a positive constant) acts on a particle moving in the $x - y$ plane. Starting from the origin, the particle is taken along the positive x-axis to the point $(a, 0)$ and then parallel to the y-axis to the (a, a). The total work done by the force $\vec{F}$ on the particle is
    a) $-2Ka^2$ b) $2Ka^2$ c) $-Ka^2$ d) Ka^2
18. A projectile can have the same range R for two angles of projection. If T_1 and T_2 be the times of flights in the two cases, then the product of the two times of flights is directly proportional to
    a) $\frac{1}{R^2}$ b) $\frac{1}{R}$ c) R d) R^2
19. A projectile shot into air at some angle with the horizontal has a range of 200 m. If the time of flight is 5 s, then the horizontal component of the velocity of the projectile at the highest point of trajectory is
    a) 40 ms^{-1} b) 0 ms^{-1}
    c) 9.8 ms^{-1} d) Equal to the velocity of projection of the projectile
20. If $\vec{A}=2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = 4\hat{i} + 3\hat{j} + 2\hat{k}$, then angle between $\vec{A}$ and $\vec{B}$ is
    a) $\sin^{-1}(25/29)$ b) $\sin^{-1}(29/25)$ c) $\cos^{-1}(25/29)$ d) $\cos^{-1}(29/25)$
21. A body slides down a frictionless track which ends in a circular loop of diameter D. Then the minimum height h of the body in terms of D so that it may just complete the loop, is
    a) $h = \frac{5}{2}D$ b) $h = \frac{3}{2}D$ c) $h = \frac{5}{4}D$ d) $h = 2D$
22. A particle moves in a circular path with decreasing speed. Choose the correct statement
    a) Angular momentum remains constant
    b) Acceleration $(\vec{a})$ is towards the centre
    c) Particle moves in a spiral path with decreasing radius
    d) The direction of angular momentum remains constant
23. A stone of mass 1 kg tied to a light inextensible string of length $L = \frac{10}{3}m$ is whirling in a circular path of radius L in a vertical plane. If the ratio of the maximum tension in the string to the minimum tension in the string is 4 and if g is taken to be $10m/\sec^2$, the speed of the stone at the highest point of the circle is

a) $20m/sec$ b) $10\sqrt{3}m/sec$ c) $5\sqrt{2}m/sec$ d) $10m/sec$

24. A body moves along a circular path of radius 5 m. The coefficient of friction between the surface of path and the body is 0.5. The angular velocity, in radians/sec, with which the body should move so that it does not leave the path is ($g = 10ms^{-2}$)
a) 4 b) 3 c) 2 d) 1
25. Two particles of equal mass are connected to a rope AB of negligible mass such that one is at end A and other dividing the length of rope in the ratio $1:2$ from B. The rope is rotated about end B in a horizontal plane. Ratio of tensions in the smaller part to the other is (ignore effect of gravity)
a) $4:3$ b) $1:4$ c) $1:2$ d) $1:3$
26. The velocity of projection of an oblique projectile is $\vec{\mathbf{v}} = 3\hat{\mathbf{i}} + 2\hat{\mathbf{j}}$ (in ms^{-1}). The speed of the projectile at the highest point of the trajectory is
a) 3 ms^{-1} b) 2 ms^{-1} c) 1 ms^{-1} d) Zero
27. The centripetal acceleration of a body moving in a circle of radius 100 m with a time period of 2 s will be
a) 98.5 ms^{-2} b) 198.5 ms^{-2} c) 49.29 ms^{-2} d) 985.9 ms^{-2}
28. A particle of mass m is moving in a horizontal circle of radius r, under a centripetal force $= \frac{k}{r^{2'}}$ where k is a constant.
a) The potential energy of the particle is zero
b) The potential energy of the particle is $\frac{k}{r}$
c) The total energy of the particle is $-\frac{k}{2r}$
d) The Kinetic energy of the particle is $-\frac{k}{r}$
29. A plumb line is suspended from a ceiling of a car moving with horizontal acceleration of$a$. What will be the angle of inclination with vertical?
a) $\tan^{-1}\left(\frac{a}{g}\right)$ b) $\tan^{-1}\left(\frac{g}{a}\right)$ c) $\cas^{-1}\left(\frac{a}{g}\right)$ d) $\cas^{-1}\left(\frac{g}{a}\right)$
30. A monkey can jump a maximum horizontal distance of 20 m. Then the velocity of the monkey is
a) 10 ms^{-1} b) 14 ms^{-1} c) 20 ms^{-1} d) 24 ms^{-1}
31. A ball is projected with kinetic energy K at an angle of 45° to the horizontal. At the highest point during its flight, its kinetic energy will be
a) K b) $K/\sqrt{2}$ c) $K/2$ d) Zero
32. A bullet fired at an angle of 30° with the horizontal hits the ground 3 km away. By adjusting its angle of projection, one can hope to hit a target 5 km away. Assume the muzzle speed to be same and the air resistance is negligible
a) possible to hit a target 5 km away
b) not possible to hit a target 5 km away
c) prediction is not possible
d) None of the above
33. A particle undergoes uniform circular motion. About which point on the plane of the circle, will the angular momentum of the particle remain conserved?
a) center of the circle
b) on the circumference of the circle
c) inside the circle
d) outside the circle
34. When a ceiling fan is switched on, it makes 10 rotations in the first 4 s. How many rotations will it make in the next 4 s? (Assuming uniform angular acceleration)
a) 10 b) 20 c) 40 d) 30
35. The adjacent sides of a parallelogram are represented by co-initial vectors $2\hat{\imath} + 3\hat{\jmath}$ and $\hat{\imath} + 4\hat{\jmath}$. The area of the parallelogram is
a) 5 units along z-axis
b) 5 units in $x - y$ plane
c) 3 units in $x - z$ plane
d) 3 units in $y - z$ plane
36. A body of mass m thrown horizontally with velocity v, from the top of tower of height h touches the level

ground at distance of 250 m from the foot of the tower. A body of mass $2m$ thrown horizontally with velocity $\frac{v}{2}$, from the top of tower of height $4h$ will touch the level ground at a distance x from the foot of tower. The value of x is

a) 250 m b) 500 m c) 125 m d) $250\sqrt{2}$ m

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

a) $R = 16H$ b) $R = 8H$ c) $R = 4H$ d) $R = 2H$

38. A stone is just released from the window of a train moving along a horizontal straight track. The stone will hit the ground following

a) Straight path b) Circular path c) Parabolic path d) Hyperbolic path

39. For a particle in uniform circular motion the acceleration **a** at a point $P(R, \theta)$ on the circle of the radius R is (here θ is measured from the x −axis)

a) $-\frac{v^2}{R}\cos\theta\,\hat{\mathbf{i}} + \frac{v^2}{R}\sin\theta\,\hat{\mathbf{j}}$ b) $-\frac{v^2}{R}\sin\theta\,\hat{\mathbf{i}} + \frac{v^2}{R}\cos\theta\,\hat{\mathbf{j}}$

c) $-\frac{v^2}{R}\cos\theta\,\hat{\mathbf{i}} - \frac{v^2}{R}\sin\theta\,\hat{\mathbf{j}}$ d) $-\frac{v^2}{R}\,\hat{\mathbf{i}} + \frac{v^2}{R}\,\hat{\mathbf{j}}$

40. A body is thrown with a velocity of $9.8\ m/s$ making an angle of 30° with the horizontal. It will hit the ground after a time

a) 1.5 s b) 1 s c) 3 s d) 2 s

41. A particle rests on the top of a hemisphere of radius R. Find the smallest horizontal velocity that must be imparted to the particle if it is to leave the hemisphere without sliding down it

a) $\sqrt{g\,R}$ b) $\sqrt{2g\,R}$ c) $\sqrt{3g\,R}$ d) $\sqrt{5g\,R}$

42. A small object placed on a rotating horizontal turn table just slips when it is placed at a distance of 4 cm from the axis of rotation, if the angular velocity of the turn table is doubled the object slips when its distance from the axis of rotation is

a) 1 cm b) 2 cm c) 4 cm d) 8 cm

43. A particle is projected with velocity $2\sqrt{gh}$ so that it just clears two walls of equal height h, which are at a distance of $2h$ from each other. What is the time interval of passing between the two walls?

a) $\frac{2h}{g}$ b) $\sqrt{\frac{2h}{g}}$ c) $\sqrt{\frac{h}{g}}$ d) $2\sqrt{\frac{h}{g}}$

44. A can filled with water is revolved in a vertical of radius 4 m and the water does not fall down. The time period for a revaluation is about

a) 2 s b) 4 s c) 8 s d) 10 s

45. The angular velocity of a wheel is 70 rad/sec. If the radius of the wheel is 0.5 m, then linear velocity of the wheel is

a) 70 m/s b) 35 m/s c) 30 m/s d) 20 m/s

46. A stone is projected from the ground with velocity 50 m/s at an angle of 30°. It crosses a wall after 3 sec. How far beyond the wall the stone will strike the ground ($g = 10\ m/\sec^2$)

a) 90.2 m b) 89.6 m c) 86.6 m d) 70.2 m

47. The co-ordinates of a moving particle at time t are given by $x = ct^2$ and $y = bt^2$. The instantaneous speed of the particle is

a) $2t(b + c)$ b) $2t(b + c)^{1/2}$ c) $2t(c^2 - b^2)$ d) $2t(c^2 + b^2)^{1/2}$

48. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane it follows that

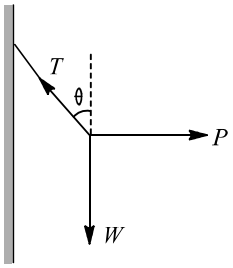
a) Its velocity is constant b) Its acceleration is constant

c) Its kinetic energy is constant d) It moves in a straight line

49. A circular road of radius 1000 m has banking angle 45°. The maximum safe speed of a car having mass 2000 kg will be, if the coefficient of friction between tyre and road is 0.5

a) $172\ m/s$ b) $124\ m/s$ c) $99\ m/s$ d) $86\ m/s$

50. A small sphere is hung by a string fixed to a wall. The sphere is pushed away from the wall by a stick. The force acting on the sphere are shown in figure. Which of the following statements is wrong?

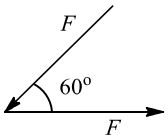


a) $P = W tan\theta$ b) $\vec{T} + \vec{P} + \vec{W} = 0$ c) $T^2 = P^2 + W^2$ d) $T = P + W$

51. An aircraft executes a horizontal loop with a speed of $150\ m/s$ with its wings banked at an angle of 12°. The radius of the loop is ($g = 10\ m/s^2$, $\tan 12° = 0.2126$)

a) $10.6\ km$ b) $9.6\ km$ c) $7.4\ km$ d) $5.8\ km$

52. Two forces, each equal to F, act as shown in figure. Their resultant is



a) $\frac{F}{2}$ b) F c) $\sqrt{3}\,F$ d) $\sqrt{5}\,F$

53. Radius of the curved road on national highway is R. Width of the road is b. The outer edge of the road is raised by h with respect to inner edge so that a car with velocity v can pass safe over it. The value of h is

a) $\frac{v^2 b}{Rg}$ b) $\frac{v}{Rgb}$ c) $\frac{v^2 R}{g}$ d) $\frac{v^2 b}{R}$

54. A particle is moving along a circular path with a uniform speed. How does its angular velocity change when it completes half of the circular path?

a) No change b) Increases c) Decreases d) Cannot say

55. A body moving along a circular path of radius R with velocity v, has centripetal acceleration a. If its velocity is made equal to $2v$, then its centripetal acceleration is

a) $4a$ b) $2a$ c) $\frac{a}{4}$ d) $\frac{a}{2}$

56. A body of mass 1 kg is rotating in a vertical circle of radius 1m. What will be the difference in its kinetic energy at the top and bottom of the circle? (Take g = 10 ms^{-2})

a) 10 J b) 20 J c) 30 J d) 50 J

57. In the case of an oblique projectile, the velocity is perpendicular to acceleration

a) Once only b) Twice c) Thrice d) Four times

58. A body of mass $m\ kg$ is rotating in a vertical circle at the end of a string of length r metre. The difference in the kinetic energy at the top and bottom of the circle is

a) $\frac{mg}{r}$ b) $\frac{2mg}{r}$ c) $2mgr$ d) mgr

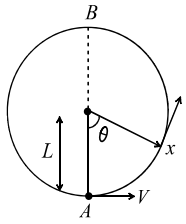
59. A body of mass 1 kg thrown with a velocity of 10 ms^{-1} at an angle of 60° with the horizontal. Its momentum at the highest point is

a) 2 kg ms^{-1} b) 3 kg ms^{-1} c) 4 kg ms^{-1} d) 5 kg ms^{-1}

60. A stone is projected from the ground with velocity 50 ms^{-1} and angle of 30°. It crosses a wall after 3 s. How far beyond the wall the stone will strike the ground?

a) 80.5 m b) 85.6 m c) 86.6 m d) 75.2 m

61. A bob of mass M is suspended by a massless string of length L. The horizontal velocity V at position A is just sufficient to make it reach the point B. The angle θ at which the speed of the bob is half of that at A, satisfies



a) $\theta = \frac{\pi}{4}$ b) $\frac{\pi}{4} < \theta < \frac{\pi}{4}$ c) $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$ d) $\frac{3\pi}{4} < \theta < \pi$

62. For a particle in uniform circular motion, thee acceleration $\vec{a}$ at a point $P(R, \theta)$ on the circle of radius R is (Here θ is measured from the x-axis)

a) $\frac{v^2}{R}\hat{\imath} + \frac{v^2}{R}\hat{\jmath}$ b) $-\frac{v^2}{R}\cos\theta\,\hat{\imath} + \frac{v^2}{R}\sin\theta\,\hat{\jmath}$

c) $-\frac{v^2}{R}\sin\theta\,\hat{\imath} + \frac{v^2}{R}\cos\theta\,\hat{\jmath}$ d) $-\frac{v^2}{R}\cos\theta\,\hat{\imath} - \frac{v^2}{R}\sin\theta\,\hat{\jmath}$

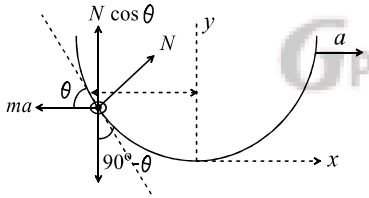
63. A man can thrown a stone 100 m away. The maximum height to which he can throw vertically is

a) 200 m b) 100 m c) 50 m d) 25 m

64. Roads are banked on curves so that

a) The speeding vehicles may not fall outwards
b) The frictional force between the road and vehicle may be decreased
c) The wear and tear of tyres may be avoided
d) The weight of the vehicle may be decreased

65. A piece of wire is bent in the shape of a parabola $y = kx^2$ (y-axis vertical) with a bead of mass m on it. The bead can side on the wire without friction. It stays at the lowest point of the parabola when the wire is at rest. The wire is now accelerated parallel to the x-axis with a constant acceleration a. The distance of the new equilibrium position of the bead, where the bead can stay at rest with respect to the wire, from the y-axis is



a) a/gk b) $a/2gk$ c) $2a/gk$ d) $a/4gk$

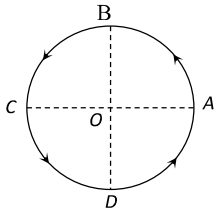
66. 

Figure shows a body of mass m moving with a uniform speed v along a circle of radius r. The change in velocity in going from A to B is

a) $v\sqrt{2}$ b) $v/\sqrt{2}$ c) v d) zero

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

a) Variable b) $\sqrt{\frac{2\alpha}{\beta}}$ c) $\frac{\alpha}{2\beta}$ d) $\sqrt{\frac{\alpha}{2\beta}}$

68. A body is revolving with a uniform speed v in a circle of radius r. The tangential acceleration is

a) $\frac{v}{r}$ b) $\frac{v^2}{r}$ c) Zero d) $\frac{v}{r^2}$

69. A project is projected with a velocity of 20 m/s making an angle of 45° with horizontal. The equation for the trajectory is $h = Ax - Bx^2$ where h is height, x is horizontal distance, A and B are constants. The ratio $A : B$ is ($g = 10\ ms^{-2}$)
a) 1 : 5 b) 5 : 1 c) 1 : 40 d) 40 : 1

70. If the equation for the displacement of a particle moving on a circular path is given by $(\theta) = 2t^3 + 0.5$, where θ is in radians and t in seconds, then the angular velocity of the particle after 2 sec from its start is
a) 8 rad/sec b) 12 rad/sec c) 24 rad/sec d) 36 rad/sec

71. Two masses M and m are attached to a vertical axis by weightless threads of combined length l. They are set in rotational motion in a horizontal plane about this axis with constant angular velocity ω . If the tensions in the threads are the same during motion, the distance of M from the axis is
a) $\frac{Ml}{M+m}$ b) $\frac{ml}{M+m}$ c) $\frac{M+m}{M}l$ d) $\frac{M+m}{m}l$

72. A bomber plane moves horizontally with a speed of 500 m/s and a bomb released from it, strikes the ground in 10 sec. Angle at which it strikes the ground will be ($g = 10\ m/s^2$)
a) $\tan^{-1}\left(\frac{1}{5}\right)$ b) $\tan^{-1}\left(\frac{1}{2}\right)$ c) $\tan^{-1}(1)$ d) $\tan^{-1}(5)$

73. An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 $r.p.m$.The acceleration of a point on the tip of the blade is about
a) 1600 $m/\sec^2$ b) 4740 $m/\sec^2$ c) 2370 $m/\sec^2$ d) 5055 $m/\sec^2$

74. A particle moves in a plane with constant acceleration in a direction different from the initial velocity. The path of the particle will be
a) A straight line b) An arc of a circle c) A parabola d) An ellipse

75. A force is inclined at 60° to the horizontal. If its rectangular component in the horizontal direction is 50 N, then magnitude of the force in the vertical direction is
a) 25 N b) 75 N c) 87 N d) 100 N

76. The maximum speed with which a car is driven round a curve of radius 18 m without skidding (where, g = 10ms^{-2} and the coefficient of friction between rubber tyres and the roadway is 0.2) is
a) 36.0 km h^{-1} b) 18.0 km h^{-1} c) 21.6 km h^{-1} d) 14.4 km h^{-1}

77. The equation of trajectory of a projectile is $y = 10x - \left(\frac{5}{9}\right)x^2$. if we assume $g = 10\text{ms}^{-2}$, the range of projectile (in metre) is
a) 36 b) 24 c) 18 d) 9

78. The minimum velocity at the lowest point, so that the string just slack at the highest point in a vertical circle of radius l
a) $\sqrt{gl}$ b) $\sqrt{3gl}$ c) $\sqrt{5gl}$ d) $\sqrt{7gl}$

79. The maximum height attained by a projectile when thrown at an angle θ with the horizontal is found to be half the horizontal range. Then θ is equal to
a) $\tan^{-2}(2)$ b) $\frac{\pi}{6}$ c) $\frac{\pi}{4}$ d) $\tan^{-1}\left(\frac{1}{2}\right)$

80. The magnitude of the centripetal force acting on a body of $mass\ m$ executing uniform motion in a circle of radius r with speed v is
a) mvr b) mv^2/r c) v/r^2m d) v/rm

81. The kinetic energy K of a particle moving along a circle or radius R depends on the distance covered s as $K = a\ s^2$. The force acting on the particle is
a) 2 $a\ s\ R$ b) 2 $a\ s[1 + s^2/R^2]^{1/2}$ c) 2 $a\ s$ d) 2 as^2/R

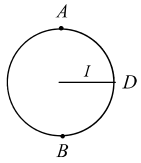
82. A body is projected at an angle θ to the horizontal with kinetic energy E_k. The potential energy at the highest point of the trajectory is
a) E_k b) $E_k \cos^2\theta$ c) $E_k \sin^2\theta$ d) $E_k \tan^2\theta$

83. In a loop-the-loop, a body starts at a height $h = 2R$. The minimum speed with which the body must be pushed down initially in order that it may be able to complete the vertical circle is
a) $\sqrt{2gR}$ b) $\sqrt{gR}$ c) $\sqrt{3gR}$ d) $2\sqrt{gR}$

84. A stone is swinging in a horizontal circle 0.8 m in diameter, at 30rev/min. A distant light causes a shadow of the stone to be formed on a nearby wall. What is the amplitude of the motion of the shadow? What is the frequency?
a) 0.4 m, 1.5 Hz b) 0.4 m, 0.5 Hz c) 0.8 m, 0.5 Hz d) 0.2 m, 0.5 Hz

85. A particle is projected at an angle of 60° above the horizontal with a speed of 10 ms^{-1}. After some time the direction of its velocity makes an angle of 30° above the horizontal. The speed of the particle at this instant is
a) $\frac{5}{\sqrt{3}} ms^{-1}$ b) $5\sqrt{3}\ ms^{-1}$ c) $5\ ms^{-1}$ d) $\frac{10}{\sqrt{3}} ms^{-1}$

86. A particle of mass m attracted with a string of length l is just revolving on the vertical circle without slacking of the string. If v_A, v_B and v_D are speed at position A, B and D then



a) $v_B > v_D > v_A$ b) Tension in string at $D = 3\ mg$
c) $v_D = \sqrt{3gl}$ d) All of the above

87. A car is travelling with linear velocity v on a circular road of radius r. If it is increasing its speed at the rate of $'a' m/s^2$, then the resultant acceleration will be
a) $\sqrt{\left\{\frac{v^2}{r^2} - a^2\right\}}$ b) $\sqrt{\left\{\frac{v^4}{r^2} + a^2\right\}}$ c) $\sqrt{\left\{\frac{v^4}{r^2} - a^2\right\}}$ d) $\sqrt{\left\{\frac{v^2}{r^2} + a^2\right\}}$

88. The acceleration of a vehicle travelling with speed of 400ms^{-1} as it goes round a curve of radius 160 m, is
a) 1 kms^{-2} b) 100 ms^{-2} c) 10 ms^{-2} d) 1 ms^{-2}

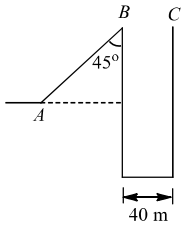
89. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km h^{-1}. The centripetal force, is
a) 250 N b) 750 N c) 1000 N d) 1200 N

90. If a cyclist moving with a speed of 4.9 m/s on a level road can take a sharp circular turn of radius 4 m, then coefficient of friction between the cycle tyres and road is
a) 0.41 b) 0.51 c) 0.61 d) 0.71

91. If $\vec{A} \cdot \vec{B} = AB$, then the angle between $\vec{A}$ and $\vec{B}$ is
a) 0° b) 45° c) 90° d) 180°

92. The angular amplitude of a simple pendulum is θ_0. The maximum tension in its string will be
a) $mg(1 - \theta_0)$ b) $mg(1 + \theta_0)$ c) $mg(1 - \theta_0^2)$ d) $mg(1 + \theta_0^2)$

93. A body is projected up a smooth inclined plane with a velocity v_0 from the point A as shown in figure. The angle of inclination is 45° and top B of the plane is connected to a well of diameter 40 m. If the body just manages to cross the well, what is the value of v_0? Length of the inclined plane is $20\sqrt{2}$m, and g = 10ms^{-2}



a) 20 ms^{-1} b) $20\sqrt{2} ms^{-1}$ c) 40 ms^{-1} d) $40\sqrt{2}\ ms^{-1}$

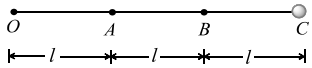
94. A sphere of mass m is tied to end of a string of length l and rotated through the other end along a horizontal circular path with speed v. The work done in full horizontal circle is

a) 0 b) $\left(\frac{mv^2}{l}\right).2\pi l$ c) $mg.2\pi$ d) $\left(\frac{mv^2}{l}\right).(l)$

95. A bucket filled with water is tied to a rope of length 0.5 m and is rotated in a circular path in vertical pane. The least velocity it should have at the lowest point of circle so that water dose not spill is, $(g = 10\ \text{ms}^{-2})$
a) $\sqrt{5}\ \text{ms}^{-1}$ b) $\sqrt{10}\ \text{ms}^{-1}$ c) $5\ \text{ms}^{-1}$ d) $2\sqrt{5}\ \text{ms}^{-1}$

96. An object is projected at an angle of $45°$ with the horizontal. The horizontal range and the maximum height reached will be in the ratio
a) 1 : 2 b) 2 : 1 c) 1 : 4 d) 4 : 1

97. Three identical particles are joined together by a thread as shown in figure. All the three particles are moving in a horizontal plane. If the velocity of the outermost particle is v_0, then the ratio of tensions in the three sections of the string is

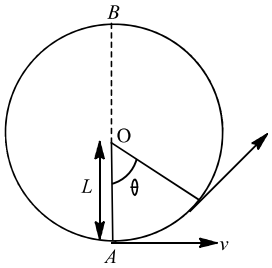


a) 3 : 5 : 7 b) 3 : 4 : 5 c) 7 : 11 : 6 d) 3 : 5 : 6

98. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectile is
a) $\theta = \tan^{-1}\left(\frac{1}{4}\right)$ b) $\theta = \tan^{-1}(4)$ c) $\theta = \tan^{-1}(2)$ d) $\theta = 45°$

99. A man can throw a stone to a maximum distance of 80 m. The maximum height to which it will rise in metre, is
a) 30 m b) 20 m c) 10 m d) 40 m

100. A bob of mass M is suspended by a massless string of length L. The horizontal velocity v at position A is just sufficient to make it reach the point B. The angle θ at which the speed of the bob is half of that at A, satisfies



a) $\theta = \frac{\pi}{4}$ b) $\frac{\pi}{4} < \theta < \frac{\pi}{2}$ c) $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$ d) $\frac{3\pi}{4} < \theta < \pi$

101. Given that centripetal force$F = -k/r^2$. The total energy is
a) $-k/r^2$ b) k/r c) $-k/2r^2$ d) $-k/2r$

102. The wheel of toy car rotates about axis. It slows down from 400 rps to 200 rps in 2s. Then its angular retardation in rads^{-2} is
a) $200\,\pi$ b) 100 c) $400\,\pi$ d) None of these

103. The magnitude of resultant of three vectors of magnitude 1, 2 and 3 whose directions are those of the sides of an equilateral triangle taken in order is
a) zero b) $2\sqrt{2}$ unit c) $4\sqrt{3}$ unit d) $\sqrt{3}$ unit

104. The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. Its angle of projection will be
a) 45° b) 60° c) 90° d) 30°

105. When a body moves in a circular path, no work is done by the force since,
a) There is no displacement
b) There is no net force
c) Force and displacement are perpendicular to each other
d) The force is always away from the centre

106. A particle is moving on a circular path with constant speed, then its acceleration will be

a) Zero
b) External radial acceleration
c) Internal radial acceleration
d) Constant acceleration

107. When the road is dry and coefficient of friction is μ, the maximum speed of a car in a circular path is 10 ms^{-1}. If the road becomes wet and $\mu' = \mu/2$, what is the maximum speed permitted?
a) 5 ms^{-1} b) 10 ms^{-1} c) $10\sqrt{2}$ ms^{-1} d) $5\sqrt{2}$ ms^{-1}

108. A particle is moving with a constant speed v in a circle. What is the magnitude of average after half rotation?
a) $2v$ b) $2\frac{v}{\pi}$ c) $\frac{v}{2}$ d) $\frac{v}{2\pi}$

109. A projectile is fired with a velocity v at an angle θ with the horizontal. The speed of the projectile when its direction of motion makes an angle β with the horizontal is
a) $v\cos\theta$ b) $v\cos\theta\cos\beta$ c) $v\cos\theta\sec\beta$ d) $v\cos\theta\tan\beta$

110. The radio of angular speeds of minute hand and hour hand of a watch is
a) 1 : 12 b) 12 : 1 c) 6 : 1 d) 1 : 6

111. Three vectors $\vec{A}, \vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A}\cdot\vec{B} = 0$ and $\vec{A}\cdot\vec{C} = 0$. If $\vec{B}$ and $\vec{C}$ are not lying in the same plane then $\vec{A}$ is parallel to
a) $\vec{B}$ b) $\vec{C}$ c) $\vec{B}\times\vec{C}$ d) $\vec{B}\cdot\vec{C}$

112. A car of mass 2000 kg is moving with a speed of 10 ms^{-1} on a circular path of radius 20 m on a level road. What must be the frictional force between the car and the road so that the car does not slip?
a) 10^4 N b) 10^3 N c) 10^5 N d) 10^2 N

113. The vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a}+\vec{b}| = |\vec{a}-\vec{b}|$. What is the angle between $\vec{a}$ and $\vec{b}$?
a) 0° b) 90° c) 60° d) 180°

114. The maximum horizontal range of a projectile is 400 m. The maximum value of the height attained by it will be
a) 100 m b) 200 m c) 400 m d) 800 m

115. The second's hand of a watch has length 6 cm. Speed of end point and magnitude of difference of velocities at two perpendicular positions will be
a) 6.28 and 0 mm/s b) 8.88 and 4.44 mm/s c) 8.88 and 6.28 mm/s d) 6.28 and 8.88 mm/s

116. A cane filled with water is revolved in a vertical circle of radius 4 m and the water just does not fall down. The time period of revolution will be
a) 1 sec b) 10 sec c) 8 sec d) 4 sec

117. A heavy small sized sphere is suspended by a string of length l. The sphere is rotated uniformly in a horizontal circle with the string making an angle θ with the vertical. The time period of this conical pendulum is
a) $2\pi\sqrt{\frac{l\tan\theta}{g}}$ b) $2\pi\sqrt{l\sin\theta/g}$ c) $2\pi\sqrt{\frac{l}{g}}$ d) $2\pi\sqrt{\frac{l\cos\theta}{g}}$

118. The angular speed of seconds needle in a mechanical watch is
a) $\frac{\pi}{30}$ rad/s b) 2π rad/s c) π rad/s d) $\frac{60}{\pi}$ rad/s

119. The minimum speed for a particle at the lowest point of a vertical circle of radius r, to describe the circle is v. If the radius of the circle is reduced to one-fourth its value, the corresponding minimum speed will be
a) $v/4$ b) $v/2$ c) $2v$ d) $4v$

120. A particle of mass m is projected with a velocity v making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is
a) $\frac{\sqrt{3}}{2}\frac{mv^2}{g}$ b) Zero c) $\frac{mv^3}{\sqrt{2g}}$ d) $\frac{\sqrt{3}}{16}\frac{mv^3}{g}$

121. A cyclist moves in such a way that he track 60° turn after 100 m. What is the displacement when to takes

seventh turn?

a) 100 m b) 200 m c) $100\sqrt{3}$ m d) $100\sqrt{3}$ m

122. A body is moving in a circular path with acceleration a. If its velocity gets doubled, find the ratio of acceleration after and before the change

a) 1 : 4 b) $\frac{1}{4}:2$ c) 2 : 1 d) 4 : 1

123. A weightless thread can bear tension upto 37 N. A. stone of mass 500 g is tied to it and revolved in a circular path of radius 4 m in a vertical plane. If g = 10 ms^{-2}, then the maximum angular velocity of the stone will be

a) 2 rad s^{-1} b) 4 rad s^{-1} c) 8 rad s^{-1} d) 16 rad s^{-1}

124. A ball is projected with velocity V_o at an angle of elevation 30° . Mark the correct statement

a) Kinetic energy will be zero at the highest point of the trajectory
b) Vertical component of momentum will be conserved
c) Horizontal component of momentum will be conserved
d) Gravitational potential energy will be minimum at the highest point of the trajectory

125. What is the unit vector along $\hat{i}+\hat{j}$?

a) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$ b) $\sqrt{2}(\hat{i}+\hat{j})$ c) $\hat{i}+\hat{j}$ d) $\hat{k}$

126. A child travelling in a train throws a ball outside with a speed V. According to a child who is standing on the ground, the speed of the ball is

a) Same as V b) Greater than V c) Less than V d) None of these

127. A weightless thread can bear tension upto 3.7 kg wt. A stone of mass 500 gms is tied to it and revolved in a circular path of radius 4 m in a vertical plane. If $g = 10\ ms^{-2}$, then the maximum angular velocity of the stone will be

a) 4 $radians/sec$ b) 16 $radians/sec$ c) $\sqrt{21}$ $radians/sec$ d) 2 $radians/sec$

128. A car of mass 800 kg moves on a circular track of radius 40 m. If the coefficient of friction is 0.5, then maximum velocity with which the car can move is

a) 7 m/s b) 14 m/s c) 8 m/s d) 12 m/s

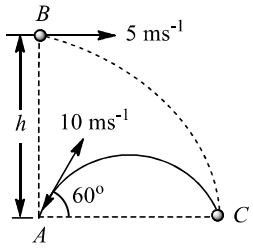
129. Which of the following statements is false for a particle moving in a circle with a constant angular speed?

a) The velocity vector is tangent to the circle
b) The acceleration vector is tangent to the circle
c) The acceleration vector point to the center of the circle
d) The velocity and acceleration vectors are perpendicular to each other

130. A particle moves in a circular orbit under the action of a central attractive force inversely proportional to the distance $'r'$. The speed of the particle is

a) Proportional to r^2 b) Independent of r c) Proportional to r d) Proportional to $1/r$

131. A particle A is projected from the ground with an initial velocity of 10 ms^{-1}at an angle of 60° with horizontal. From what height h should an another particle B be projected horizontally with velocity 5ms^{-1} so that both the particles collide in ground at point C if both are projected simultaneously? (g = 10 ms^{-2})



a) 10 m b) 30 m c) 15 m d) 25 m

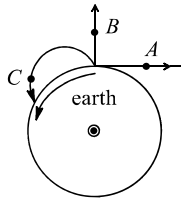
132. A body is moving with a certain velocity in a circular path. Now, the body reverses its direction, then

a) the magnitude of centripetal force remains same

b) the direction of centripetal force remains same
c) the direction of centripetal acceleration remains same
d) the of centripetal force does not change

133. An aeroplane is flying horizontally with a velocity of 216 kmh^{-1} and at a height of 1960 m. When it is vertically 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 (ignoring air resistance)
a) 1200 m b) 0.33 km c) 3.33 km d) 33 km

134. A body 'A' moves with constant velocity on a straight line path tangential to the earth's surface. Another body 'B' is thrown vertically upwards, it goes to a height and falls back on earth. A third body 'C' is projected to an angle and follows a parabolic path as shown in figure



The bodies whose angular momentum relative to the center of the earth is conserved are
a) B only b) B and C c) A, B, C d) None of the above

135. A cart is moving horizontally along a straight line with constant speed 30 m/s. A projectile is to be fired from the moving cart in such a way that it will return to the cart after the cart has moved 80 m. At what speed (relative to the cart) must the projectile be fired (Take $g = 10\ m/s^2$)
a) 10 m/s b) $10\sqrt{8}\ m/s$ c) $\frac{40}{3}\ m/s$ d) None of these

136. If $\vec{A}, \vec{B}$ and $\vec{C}$ are the unit vectors along the incident ray, reflected ray and outward normal to the reflecting surface, then
a) $\vec{B} = \vec{A} - \vec{C}$ b) $\vec{B} = \vec{A} + (\vec{A} \cdot \vec{C})\vec{C}$ c) $\vec{B} = 2\vec{A} - \vec{C}$ d) $\vec{B} = \vec{A} - 2(\vec{A} \cdot \vec{C})\vec{C}$

137. The string of a pendulum of length l is displaced through 90° from the vertical and released. Then the minimum strength of the string in order to withstand the tension as the pendulum passes through the mean position is
a) mg b) 6 mg c) 3 mg d) 5 mg

138. A particle reaches its highest point when it has covered exactly one half of its horizontal range. The corresponding point on the displacement time graph is characterised by
a) Negative slope and zero curvature b) Zero slope and negative curvature
c) Zero slope and positive curvature d) positive slope and zero curvature

139. If the vector $\vec{A} = 2\hat{i} + 4\hat{j}$ and $\vec{B} = 5\hat{i} + p\hat{j}$ are parallel to each other, the magnitude of $\vec{B}$ is
a) $5\sqrt{5}$ b) 10 c) 15 d) $2\sqrt{5}$

140. An arrow is shot into air. Its range is 200 m and its time of flight is 5s. If $g = 10 m/s^2$, then the horizontal component of velocity of the arrow is
a) 12.5 m/s b) 25 m/s c) 31.25 m/s d) 40 m/s

141. A stone of mass 2kg is tied to a string of length 0.5 m. If the breaking tension of the string is 900 N, then the maximum angular velocity, the stone can have in uniform circular motion is
a) 30 rad s^{-1} b) 20 rad s^{-1} c) 10 rad s^{-1} d) 25 rad s^{-1}

142. Four bodies P, Q, R and S are projected with equal velocities having angles of projection 15°, 30°, 45° and 60° with the horizontal respectively. The body having shortest range is
a) P b) Q c) R d) S

143. A plane surface is inclined making an angle θ with the horizontal. Form the bottom of this inclined plane, a bullet is fired with velocity v. The maximum possible range of the bullet on the inclined plane is
a) $\frac{v^2}{g}$ b) $\frac{v^2}{g(1+\sin\theta)}$ c) $\frac{v^2}{g(1-\sin\theta)}$ d) $\frac{v^2}{g(1+\sin\theta)^2}$

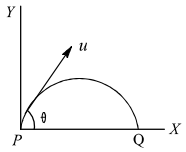
144. A body of mass 0.4 kg is whirled in a vertical circle making 2 rev/sec. If the radius of the circle is 2 m, then tension in the string when the body is at the top of the circle, is
a) 41.56 N b) 89.86 N c) 109.86 N d) 115.86 N

145. For a particle in non-uniform accelerated circular motion
a) Velocity is radial and acceleration is transverse only
b) Velocity is transverse and acceleration is radial only
c) Velocity is radial and acceleration has both radial and transverse components
d) Velocity is transverse and acceleration has both radial and transverse components

146. An aeroplane is flying horizontally with a constant velocity of 100 kmh^{-1} at a height of 1 km from the ground level. At $t = 0$, it starts dropping packets at constant time intervals of T_0. If R represents the separation between two consecutive points of impact on the ground, then for the first three packets, R_1/R_2 is
a) 1 b) >1
c) <1 d) Sufficient data is not given

147. The angle which the bicycle and its rider must make with the vertical when going round a curve of 7 m radius at 5 ms^{-1} is
a) 20° b) 15° c) 10° d) 5°

148. Average torque on a projectile of mass m, initial speed u and angles of projection θ, between initial and final position P and Q as shown in figure about the point of projection is



a) $mu^2 \sin\theta$ b) $mu^2 \cos\theta$ c) $\frac{1}{2} mu^2 \sin 2\theta$ d) $\frac{1}{2} mu^2 \cos 2\theta$

149. Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Which bullet will hit the ground first?
a) The faster bullet b) The slower bullet
c) Both will hit simultaneously d) Depends on the masses

150. A stone of mass m is tied to a string and is moved in a vertical circle of radius r making n revolutions per $minute$. The total tension in the string when the stone is at its lowest point is
a) mg b) $m(g + \pi nr^2)$
c) $m(g + \pi nr)$ d) $m\{g + (\pi^2 n^2 r)/900\}$

151. A projectile is thrown with velocity v making an angle θ with the horizontal. It just crosses the tops of two poles, each of height h, after 1s and 3s respectively. The time of flight of the projectile is
a) 1 s b) 3 s c) 4 s d) 7.8 s

152. A coin placed on a rotating turn table just slips if it is placed at a distance of 8 cm from the centre. If angular velocity of the turn table is doubled, it will just slip at a distance of
a) 1 cm b) 2 cm c) 4 cm d) 8 cm

153. A bomb is dropped from an aeroplane moving horizontally at constant speed. When air resistance is taken into consideration, the bomb
a) Falls to earth exactly below the aeroplane b) Fall to earth behind the aeroplane
c) Falls to earth ahead of the aeroplane d) Flies with the aeroplane

154. One end of a string of length l is connected to a particle of mass m and the other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed v, the net force on the particle (directed towards the centre) is
a) T b) $T - \frac{mv^2}{l}$ c) $T + \frac{mv^2}{l}$ d) Zero

155. Two bodies are projected from the same point with equal speeds in such directions that they both strike

the same point on a plane whose inclination is β. If α be the angle of projection of the first body with the horizontal the ratio of their times of flight is

a) $\frac{\cos\alpha}{\sin(\alpha+\beta)}$ b) $\frac{\sin(\alpha+\beta)}{\cos\alpha}$ c) $\frac{\cos\alpha}{\sin(\alpha-\beta)}$ d) $\frac{\sin(\alpha-\beta)}{\cos\alpha}$

156. A car is circulating on the path of radius r and at any time its velocity is v and rate of increases of velocity is a. The resultant acceleration of the car will be

a) $\sqrt{\frac{v^2}{a^2}+r^2}$ b) $\sqrt{\frac{v^2}{r}+a}$ c) $\sqrt{\frac{v^4}{r^2}+a^2}$ d) $\left(\frac{v^2}{r}+a\right)$

157. Two bodies are projected from the same point with equal speeds in such directions that they both strike the same point on a plane whose inclination isβ. If $\propto$ be the angle of projection of the first body with the horizontal the ratio of their times of flight is

a) $\frac{\cos\propto}{\sin(\propto+\beta)}$ b) $\frac{\sin(\propto+\beta)}{\cos\propto}$ c) $\frac{\cos\propto}{\sin(\propto-\beta)}$ d) $\frac{\sin(\propto-\beta)}{\cos\propto}$

158. An athlete completes one round of a circular track of radius 10 m in 40 sec. The distance covered by him in 2 min 20 sec is

a) 70 m b) 140 m c) 110 m d) 220 m

159. A long horizontal rod has a bead which can slide along its length, and initially placed at a distance L from one end A of the rod. The rod is set in angular motion about A with constant angular acceleration α. If the coefficient of friction between the rod and the bead is μ, and gravity is neglected, then the time after which the bead starts slipping is

a) $\sqrt{\frac{\mu}{\alpha}}$ b) $\frac{\mu}{\sqrt{\alpha}}$ c) $\frac{1}{\sqrt{\mu\alpha}}$ d) Infinitesimal

160. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap respectively is

a) 0,0 b) $0, 10\ ms^{-1}$ c) $10\ ms^{-1}, 10\ ms^{-1}$ d) $10\ ms^{-1}, 0$

161. A 500 kg crane takes a turn of radius 50 m with velocity of 36 km/hr. The centripetal force is

a) 1200 N b) 1000 N c) 750 N d) 250 N

162. The relation between the time of flight of a projectile T_f and the time to reach the maximum height t_m is

a) $T_f = 2t_m$ b) $T_f = t_m$ c) $T_f = \frac{t_m}{2}$ d) $T_f = \sqrt{2}(t_m)$

163. A particle P is moving in a circle of radius r with a uniform speed v. C is the centre of the circle and AB is the diameter. The angular velocity of P about A and C is in ratio

a) 1 : 1 b) 1 : 2 c) 2 : 1 d) 4 : 1

164. Two cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that they make complete circles in the same time t. The ratio of their centripetal acceleration is

a) $m_1r_1 : m_2r_2$ b) $m_1 : m_2$ c) $r_1 : r_2$ d) 1 : 1

165. In a circus stuntman rides a motorbike in a circular track of radius R in the vertical plane. The minimum speed at highest point of track will be

a) $\sqrt{2gR}$ b) $2gR$ c) $\sqrt{3gR}$ d) $\sqrt{gR}$

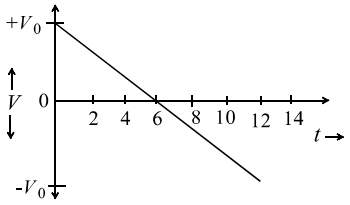
166. A particle describes a horizontal circle in a conical funnel whose inner surface is smooth with speed of 0.5 m/s. What is the height of the plane of circle from vertex of the funnel

a) 0.25 cm b) 2 cm c) 4 cm d) 2.5 cm

167. A road of 10 m width has radius of curvature 50 m. Its outer edge is raised above the inner edge by a distance of 1.5 m. The road is most suited for vehicles moving with velocity of

a) $8.5\ ms^{-1}$ b) $6.5\ ms^{-1}$ c) $5.5\ ms^{-1}$ d) None of these

168. Consider the given velocity-time graph



It represents the motion of

a) A projectile projected vertically upward, from a point
b) An electron in the hydrogen atom
c) A car with constant acceleration along a straight road
d) A bullet fired horizontally from the top of a tower

169. The maximum and minimum tensions in the string whirling in a circle of radius 2.5 m are in the ratio 5:3, then its velocity is

a) $\sqrt{98}$ ms^{-1} b) 7 ms^{-1} c) $\sqrt{490}$ ms^{-1} d) $\sqrt{4.9}$ ms^{-1}

170. A particle of mass m is circulating on a circle of radius r having angular momentum L, then the centripetal force will be

a) L^2/mr b) L^2m/r c) L^2/mr^3 d) L^2/mr^2

171. Two forces, each of magnitude F, have a resultant of the same magnitude F. The angle between the two forces is

a) 45° b) 120° c) 150° d) 180°

172. Given $\vec{c} = \vec{a} \times \vec{b}$. The angle which $\vec{a}$ makes with $\vec{c}$ is

a) 0° b) 45° c) 90° d) 180°

173. A helicopter is flying horizontally at an altitude of 2 km with a speed of 100 ms^{-1}. A packet is dropped from it. The horizontal distance between the point where the packet is dropped and the point where it hits the ground is (g = 10 ms^{-2})

a) 2 km b) 0.2 km c) 20 km d) 4 km

174. A ball is projected with kinetic energy E at an angle of 45° to the horizontal. At the highest point during its flight, its kinetic energy will be

a) Zero b) $E/2$ c) $E/\sqrt{2}$ d) E

175. A body is acted upon by a constant force directed towards a fixed point. The magnitude of the force varies inversely as the square of the distance from the fixed point. What is the nature of the path?

a) Straight line b) Parabola c) Circle d) Hyperbola

176. A ball of mass 0.25 kg attached to the end of a string of length 1.96 m is moving in a horizontal circle. The string will break if the tension is more than 25N. What is the maximum speed with which the ball can be moved?

a) 14 ms^{-1} b) 3 ms^{-1} c) 3.92 ms^{-1} d) 5 ms^{-1}

177. In a projectile motion, velocity at maximum height is

a) $\frac{u\cos\theta}{2}$ b) $u\cos\theta$ c) $\frac{u\sin\theta}{2}$ d) None of these

178. A particle of mass m is projected with a velocity v making an angle of 45° with the horizontal. The magnitude of angular momentum of projectile about the point of projection when the particle is at its maximum height h is

a) Zero b) $\frac{mvh}{\sqrt{2}}$ c) $\frac{mvh^2}{\sqrt{2}}$ d) None of these

179. An object is moving in a circle of radius 100 m with a constant speed of 31.4 ms^{-1}. What is its average speed for one complete revolution?

a) Zero b) 31.4 ms^{-1} c) 3.14 ms^{-1} d) $\sqrt{2} \times 31.4$ ms^{-1}

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

a) 20 m b) 40 m c) 50 m d) 60 m

181. What is the angular velocity of earth?

a) $\frac{2\pi}{86400}$ rad s^{-1} b) $\frac{2\pi}{3600}$ rad s^{-1} c) $\frac{2\pi}{24}$ rad s^{-1}l d) $\frac{2\pi}{6400}$ rad s^{-1}

182. A stone of mass 1 kg is tied at one end of string of length 1 m. It is whirled in a vertical circle at constant speed of 4 ms^{-1}. The tension in the string is 6 N when the stone is at ($g = 10ms^{-2}$)

a) Top of the circle b) Bottom of the circle c) Half way down d) None of these

183. What should be the coefficient of friction between the tyres and the road, when a car travelling at 60 km h^{-1} makes a level turn of radius 40 m?

a) 0.5 b) 0.66 c) 0.71 d) 0.80

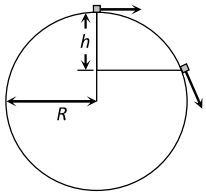
184. A body of mass 2 kg attached to a string is whirled in a vertical circle of radius 5 m. The minimum speed of the body at lowest point so that the cord does not slacken even at the highest point is

a) 15.65 ms^{-1} b) 6.75 ms^{-1} c) 20.87 ms^{-1} d) 45.83 ms^{-1}

185. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 $seconds$ for every circular loop. The average velocity and average speed for each circular loop respectively is

a) $10m/s, 10m/s$ b) 10 m/s,0 c) 0, 0 d) 0,10 m/s

186. A particle originally at rest at the highest point of a smooth vertical circle is slightly displaced. It will leave the circle at a vertical distance h below the highest point such that



a) $h = R$ b) $h = \frac{R}{3}$ c) $h = \frac{R}{2}$ d) $h = \frac{2R}{3}$

187. The bob of a pendulum of mass m and length L is displaced, 90° from the vertical and gently released. In order that the string may not break upon passing through the lowest point, its minimum strength must be

a) mg b) 2 mg c) 3 mg d) 4 mg

188. Projection of $\vec{P}$ on $\vec{Q}$ is

a) $\vec{P} \cdot \hat{Q}$ b) $\hat{p} \cdot \vec{Q}$ c) $\vec{P} \times \hat{Q}$ d) $\vec{P} \times \vec{Q}$

189. When a body moves with a constant speed along a circle

a) No work is done on it b) No acceleration is produced in the body
c) No force acts on the body d) Its velocity remains constant

190. A cyclist moves in such a way that he track 60° turn after 100 m. What is the displacement when to takes seventh turn?

a) 100 m b) 200 m c) $100\sqrt{3}$ m d) $100\sqrt{3}$ m

191. A ball of mass 0.1 kg. Is whirled in a horizontal circle of radius 1 m. By means of a string at an initial speed of 10 $R.P.M$. Keeping the radius constant, the tension in the string is reduced to one quarter of its initial value. The new speed is

a) 5 $r.p.m.$ b) 10 $r.p.m.$ c) 20 $r.p.m.$ d) 14 $r.p.m.$

192. A fan is making 600 revolutions per $minute$. If after some time it makes 1200 revolutions per $minute$, then increase in its angular velocity is

a) 10 π rad/sec b) 20 π rad/sec c) 40 π rad/sec d) 60 π rad/sec

193. A particle moves in a circular path with decreasing speed. Choose the correct statement.

a) Angular momentum remains constant
b) Acceleration **(a)** is towards the center
c) Particle moves in a spiral path with decreasing radius
d) The direction of angular momentum remains constant

194. At what point of a projectile motion acceleration and velocity and velocity are perpendicular to each other

a) At the point of projection
b) At the point of drop
c) At the topmost point
d) Any where in between the point of projection and topmost point

195. The centripetal acceleration of a particle of mass m moving with a velocity v in a circular orbit of radius r is
a) v^2/r along the radius, towards the center
b) v^2/r along the radius, away from the center
c) mv^2/r along the redius, away from the center
d) mv^2/r along the radius, towards the center

196. Two projectiles A and B thrown with speed in the ratio $1:\sqrt{2}$ acquired the same heights. If A is thrown at an angle of 45° with the horizontal, the angle of projection of B will be
a) 0° b) 60° c) 30° d) 45°

197. A boy playing on the roof of a 10 m high building throws a ball with a speed of 10 ms^{-1} at an angle of 30° with the horizontal. How far from the throwing point will the ball be at the height of 10 m from the ground?
$(g = 10\ ms^{-2}, \sin 30° = 1/2, \cos 30° = \sqrt{3}/2$
a) 5.20 m b) 4.33 m c) 2.60 m d) 8.66 m

198. A stone is tied to one end of a string and rotated in a horizontal circle with a uniform angular velocity. Let T be the tension in the string. If the length of the string is halved and its angular velocity is doubled, tension in the string will be
a) $T/4$ b) $T/2$ c) $2T$ d) $4T$

199. A stone thrown at an angle θ to the horizontal a projectile makes an angle $\pi/4$ with the horizontal, then its initial velocity and angle of projection are, respectively
a) $\frac{\sqrt{2h\sin\theta}}{g}$ b) $\frac{2\sqrt{2h\sin\theta}}{g}$ c) $2\sqrt{\frac{2h}{g}}$ d) $\sqrt{\frac{2h}{g}}$

200. A sphere is suspended by a thread of length l. What minimum horizontal velocity has to be imparted the ball for it to reach the height of the suspension
a) gl b) $2gl$ c) $\sqrt{gl}$ d) $\sqrt{2gl}$

201. If retardation produced by air resistance of projectile is one-tenth of acceleration due to gravity, the time to reach maximum height
a) Decreases by 11 percent
b) Increases by 11 percent
c) Decreases by 9 percent
d) Increases by 9 percent

202. A particle is projected from the ground with an initial speed of v at an angle θ with horizontal. The average velocity of the particle between its point of projection and highest point of trajectory is
a) $\frac{v}{2}\sqrt{1+2\cos^2\theta}$ b) $\frac{v}{2}\sqrt{1+\cos^2\theta}$ c) $\frac{v}{2}\sqrt{1+3\cos^2\theta}$ d) $v\cos\theta$

203. There are two forces each of magnitude 10 units. One inclined at an angle of 30° and the other at an angle of 135° to the positive direction of x −axis. The x and y components of the resultant are respectively.
a) 1.59î and 12.07ĵ b) 10î and 10ĵ c) 1.59î d) 15.9î and 12.07ĵ

204. A particle is moving in a circle of radius R in such a way that at any instant the normal and tangential components of its acceleration are equal. If its speed at $t = 0$ is v_0, the time taken to complete the first revolution is
a) $\frac{R}{v_0}$ b) $\frac{R}{v_0}(1-e^{-2\pi})$ c) $\frac{R}{v_0}e^{-2\pi}$ d) $\frac{2\pi R}{v_0}$

205. The tension in the string revolving in a vertical circle with a mass m at the end which is the lowest position
a) $\frac{mv^2}{r}$ b) $\frac{mv^2}{r}-mg$ c) $\frac{mv^2}{r}+mg$ d) mg

206. The ratio of the angular speed of minutes hand and hour hand of a watch is

a) 6 : 1 b) 12 : 1 c) 1 : 6 d) 1 : 12

207. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap is

a) 0, 0 b) 0,10 ms^{-1} c) 10 ms^{-1}, 10ms^{-1} d) 10 ms^{-1}, 0

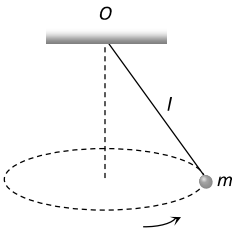
208. An aeroplane moving horizontally with a speed of 720 km/h drops a food pocket, while flying at a height of 396.9 m. The time taken by a food pocket to reach the ground and its horizontal range is (Take $g = 9.8\ m/sec^2$)

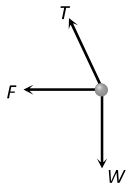
a) 3 sec and 2000 m b) 5 sec and 500 m c) 8 sec and 1500 m d) 9 sec and 1800 m

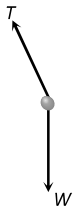
209. A cyclist turns around a curve at 15 miles/hour. If the turns at double the speed, the tendency to overturn is

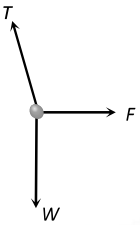
a) Doubled b) Quadrupled c) Halved d) Unchanged

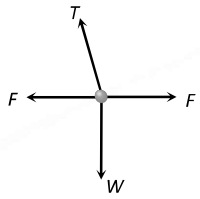
210. A point mass m is suspended from a light thread of length l, fixed at$O$, is whirled in a horizontal circle at constant speed as shown. From your point of view, stationary with respect to the mass, the forces on the mass are



a) 

b) 

c) 

d) 

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

a) 5 ms^{-1} b) 8 ms^{-1} c) 10 ms^{-1} d) 16 ms^{-1}

212. A wheel rotates with a constant angular velocity of 300 rpm. The angle through which the wheel rotates in one second is

a) π rad b) 5 π rad c) 10 π rad d) 20 π rad

213. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is

a) $\frac{ML\omega^2}{2}$ b) $ML\omega^2$ c) $\frac{ML\omega^2}{4}$ d) $\frac{ML^2\omega^2}{2}$

214. A stone is thrown with a velocity v making an angle θ with the horizontal. At some instant, its velocity V is perpendicular to the initial velocity v. Then V is

a) $v \sin\theta$ b) $v \cos\theta$ c) $v \tan\theta$ d) $v \cot\theta$

215. If the length of the second's hand in a stop-clock is 3 cm, the angular velocity and linear velocity of the tip is

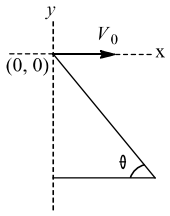
a) 0.2047 $rads^{-1}$, 0.0314 ms^{-1} b) 0.2547 $rads^{-1}$, 0.0314 ms^{-1}

c) 0.1472 $rads^{-1}$, 0.06314 ms^{-1} d) 0.1047 $rads^{-1}$, 0.00314 ms^{-1}

216. A cylindrical vessel partially filled with water is rotated about its vertical central axis. It's surface will

a) Rise equally b) Rise from the sides c) Rise from the middle d) Lowered quality

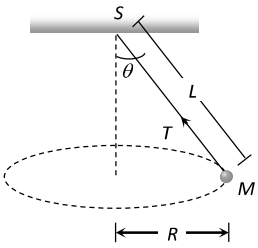
217. A man standing on a hill top projects a stone horizontally with speed v_0 as shown in figure. Taking the coordinate system as given in the figure. The coordinates of the point where the stone will hit the hill surface



a) $\left(\frac{2v_0^2\tan\theta}{g}, \frac{-2v_0^2\tan^2\theta}{g}\right)$ b) $\left(\frac{2v_0^2}{g}, \frac{2v_0^2\tan^2\theta}{g}\right)$

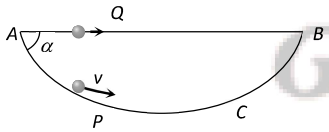
c) $\left(\frac{2v_0^2\tan\theta}{g}, \frac{2v_0^2}{g}\right)$ d) $\left(\frac{2v_0^2\tan^2\theta}{g}, \frac{2v_0^2\tan\theta}{g}\right)$

218. A string of length L is fixed at one end and carries a mass M at the other end. The string makes $2/\pi$ revolutions per *second* around the vertical axis through the fixed end as shown in figure , then tension in the string is



a) ML b) $2\,ML$ c) $4\,ML$ d) $16\,ML$

219. A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at $t = 0$. At this instant of time, the horizontal component of its velocity v. A bead Q of the same mass as P is ejected from A to $t = 0$ along the horizontal string AB (see figure) with the speed v. Friction between the bead and the string may be neglected. Let t_p and t_Q be the respective time taken by P and Q to reach the point B. Then



a) $t_p < t_Q$ b) $t_p = t_Q$ c) $t_p > t_Q$ d) All of these

220. The string of a pendulum of length l is displaced through 90° from the vertical and released. Then the minimum strength of the string in order to withstand the tension as the pendulum passes through the mean position is

a) mg b) $6\,mg$ c) $3\,mg$ d) $5\,mg$

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

a) Both in the same direction b) Perpendicular to each other

c) Both in opposite direction d) No related to each other

222. Two projectiles thrown from the same point at angles 60° and 30° with the horizontal attain the same height. The ratio of their initial velocities is

a) 1 b) 2 c) $\sqrt{3}$ d) $\frac{1}{\sqrt{3}}$

223. An aeroplane flying at a velocity of 900 kmh^{-1} loops the loop. If the maximum force pressing the pilot against the seat is five times its weight, the loop radius should be

a) 1594 m b) 1402 m c) 1315 m d) 1167 m

224. If KE of the particle of mass m performing UCM in a circle of radius r is E. Find the acceleration of the particale

a) $\frac{2E}{mr}$ b) $\left(\frac{2E}{mr}\right)^2$ c) $2\,Emr$ d) $\frac{4E}{mr}$

225. A particle of mass 100 g tied to a string is rotated along circle of radius 0.5 m. The breaking tension of

string is 10 N. The maximum speed with which particle can rotated without breaking the string is

a) 10 ms^{-2} b) 9.8 ms^{-2} c) 7.7 ms^{-2} d) 7.07 ms^{-2}

226. A boy is hanging from a horizontal branch of a tree. The tension in the arms will be maximum when the angle between the arms is

a) 0° b) 60° c) 90° d) 120°

227. A particle P is at the origin starts with velocity $\vec{\mathbf{v}} = (2\hat{\mathbf{i}} - 4\hat{\mathbf{j}})ms^{-1}$ with constant acceleration $(3\hat{\mathbf{i}} - 5\hat{\mathbf{j}})ms^{-2}$. After travelling for 2 s, its distance from the origin is

a) 10 m b) 10.2 m c) 9.8 m d) 11.7 m

228. An object of mass 5 kg is whirled round in a vertical circle of radius 2 m with a constant speed of 6 ms^{-1}. The maximum tension in the string is

a) 152 N b) 139 N c) 121 N d) 103 N

229. For a projectile the ratio of maximum height reached to the square of time of flight is ($g = 10\ ms^{-1}$)

a) 5 : 1 b) 5 : 2 c) 5 : 4 d) 1 : 1

230. If the body is moving in a circle of radius r with a constant speed v, its angular velocity is

a) v^2/r b) vr c) v/r d) r/v

231. One end of a string of length l is connected to a particle of mass m and other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed v, the net force on the particle (directed towards the centre) is

a) T b) $T - \frac{mv^2}{l}$ c) $T + \frac{mv^2}{l}$ d) zero

232. A body of mass m is projected at an angle of 45° with the horizontal. If air resistance is negligible, then total change in momentum when it strikes the ground is

a) $2mv$ b) $\sqrt{2}\,mv$ c) mv d) $mv/\sqrt{2}$

233. At the point of a projectile motion, acceleration and velocity are perpendicular to each other?

a) At the point of projection
b) At the point of drop
c) At the top most point
d) Anywhere in between the point of projection and two most point

234. A ball rolls of the top of stair-way with a horizontal velocity of magnitude 1.8 ms^{-1}. The steps are 0.20 m high and 0.20 m wide. Which step will the ball hit first?

a) First b) Second c) Third d) Fourth

235. A particle moves along a circle of radius $\left(\frac{20}{\pi}\right)$ m with constant tangential acceleration. If the velocity of the particle is 80 ms^{-1}, at the end of seconds revolution after motion has begun, the tangential acceleration is

a) 40 ms^{-2} b) 640 π ms^{-2} c) 1609 π ms^{-2} d) 40 π ms^{-2}

236. Tom and Dick are running forward with the same speed. They are throwing a rubber ball to each other at a constant speed v as seen by the thrower. According to Sam who is standing on the ground the speed of the ball is

a) Same as v b) Greater than v c) Less than v d) None of these

237. Two paper screens A and B are separated by a distance of 200 m. A bullet pierces A and then B. The hole in B is 40 cm below the hole in A. If the bullet is travelling horizontally at the time of hitting A, then the velocity of the bullet at A is

a) 200 ms^{-1} b) 400 ms^{-1} c) 600 ms^{-1} d) 700 ms^{-1}

238. A 2 kg stone tied at the end of a string 1 m long is whirled along a vertical circle at a constant speed of 4 ms^{-1}. The tension in the string has a value of 52 N when the stone is

a) At the top of the circle b) Half way down
c) At the bottom of the circle d) None of the above

239. A stone of mass m is tied to a string of length l and rotated in a circle with a constant speed v. If the string is released, the stone flies

a) Radially outwards b) Radially inwards
c) Tangentially outwards d) With an acceleration mv^2/l

240. If a cycle wheel of radius 4 m completes one revolution in two seconds. Then acceleration of a point on the cycle wheel will be
a) $\pi^2 m/s^2$ b) $2\pi^2 m/s^2$ c) $4\pi^2 m/s^2$ d) $8\pi m/s^2$

241. A projectile is thrown at angle β with vertical. It reaches a maximum height H. The time taken to reach the highest point of its path is
a) $\sqrt{\frac{H}{g}}$ b) $\sqrt{\frac{2H}{g}}$ c) $\sqrt{\frac{H}{2g}}$ d) $\sqrt{\frac{2H}{g\cos\beta}}$

242. The radius vector and linear momentum are respectively given by vector $2\hat{i}+2\hat{j}+\hat{k}$ and $2\hat{i}-2\hat{j}+\hat{k}$. Their angular momentum is
a) $2\hat{i}-4\hat{j}$ b) $4\hat{i}-8\hat{k}$ c) $2\hat{i}-4\hat{j}+2\hat{k}$ d) $4\hat{i}-8\hat{j}$

243. A fighter plane is moving in a vertical circle of radius $'r'$. Its minimum velocity at the highest point of the circle will be
a) $\sqrt{3\,g\,r}$ b) $\sqrt{2\,g\,r}$ c) $\sqrt{g\,r}$ d) $\sqrt{g\,r/2}$

244. A particle moves in a circle of radius 30cm. Its liner speed is given by $v=2t$, where t is in second and v in ms^{-1}. Find out its, radial and tangential acceleration at $t=3$s, respectively,
a) $220\ \text{ms}^{-2}, 50\ \text{ms}^{-2}$ b) $100\ \text{ms}^{-2}, 5\ \text{ms}^{-2}$ c) $120\ \text{ms}^{-2}, 2\ \text{ms}^{-2}$ d) $110\ \text{ms}^{-2}, 10\ \text{ms}^{-2}$

245. When a simple pendulum is rotated in a vertical plane with constant angular velocity, centripetal force is
a) Maximum at highest point b) Maximum at lowest point
c) Same at all lower point d) Zero

246. A particle is projected with velocity V_0 along x-axis. The deceleration on the particle is proportional to the square of the distance from the origin i.e. $a=\alpha x^2$, the distance at which the particle stops is
a) $\sqrt{\frac{3V_0}{2\alpha}}$ b) $\left(\frac{3V_0}{2\alpha}\right)^{\frac{1}{3}}$ c) $\sqrt{\frac{2V_0^2}{3\alpha}}$ d) $\left(\frac{3V_0^2}{2\alpha}\right)^{\frac{1}{3}}$

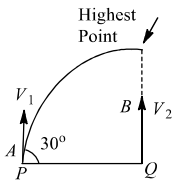
247. A particle leaves the origin with an initial velocity $\vec{\mathbf{v}}=(3.00\hat{\mathbf{i}})\text{ms}^{-1}$ and a constant acceleration $\vec{\mathbf{a}}=(-1.00\hat{\mathbf{i}}-0.50\hat{\mathbf{j}})\ \text{ms}^{-2}$. When the particle reaches it maximum x-coordinate, what is its y-component a velocity?
a) $-2.0\ \text{ms}^{-1}$ b) $-1.0\ \text{ms}^{-1}$ c) $-1.5\ \text{ms}^{-1}$ d) $1.0\ \text{ms}^{-1}$

248. What is the angular velocity of earth
a) $\frac{2\pi}{86400}\ rad/sec$ b) $\frac{2\pi}{3600}\ rad/sec$ c) $\frac{2\pi}{24}\ rad/sec$ d) $\frac{2\pi}{6400}\ rad/sec$

249. The area o the parallelogram represented by the vectors. $\vec{A}=4\hat{i}+3\hat{j}$ and $\vec{B}=2\hat{i}+4\hat{j}$ is
a) 14 units b) 7.5 units c) 10 units d) 5 units

250. A cricket ball is hit at 30° with the horizontal with kinetric energy E_k. What is the kinetic energy at the highest point?
a) $E_k/2$ b) $3E_k/4$ c) $E_k/4$ d) Zero

251. A projectile A is thrown at an angle of 30° to the horizontal from point P. At the same time, another projectile B is thrown with velocity v^2 upwards from the point Q vertically below the highest point. For B to collide with A, $\frac{v_2}{v_1}$ should be



a) 1 b) 2 c) $\frac{1}{2}$ d) 4

252. A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time as $a_c = k^2rt^4$, where k is a constant. The power delivered to the particle by the forces acting on its is

a) Zero b) $mk^2r^2t^2$ c) $\frac{1}{3}mk^2r^2t^2$ d) $2mk^2r^2t^3$

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

a) $45°$ b) $\theta = \tan^{-1}(0.25)$

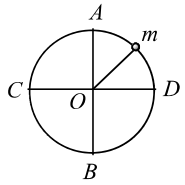
c) $\theta = \tan^{-1} 4$ or $(\theta = 76°)$ d) $60°$

254. For motion in a plane with constant acceleration $\vec{a}$, initial velocity $\vec{v}_0$ and final velocity $\vec{v}$ after time t, we have

a) $\vec{v}.(\vec{v} - \vec{a}t) = \vec{v}_0.(\vec{v}_0 + \vec{a}t)$ b) $\vec{v}.\vec{v}_0 = at^2$

c) $\vec{v}.\vec{v}_0 = \vec{v}.\vec{v}_0 t$ d) $\vec{v}_0.\vec{v}_0 = \vec{a}.\vec{v}_0 t$

255. A small sphere is attached to a cord and rotates in a vertical circle about a point O. If the average speed of the sphere is increased, the cord is most likely to break at the orientation when the mass is at



a) Bottom point B b) Top point A c) The point D d) The point C

256. 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

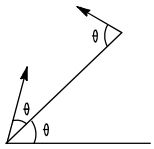
a) 15 s b) 10.98 s c) 5.49 s d) 2.745 s

257. If the length of the second's hand in a stop clock is 3 cm the angular velocity and linear velocity of the tip is

a) $0.2047\ rad/sec., 0.0314\ m/sec$ b) $0.2547\ rad/sec., 0.314\ m/sec$

c) $0.1472\ rad/sec., 0.06314\ m/sec$ d) $0.1047\ rad/sec., 0.00314\ m/sec$

258. From an inclined plane two particles are projected with same speed at same angle θ, one up and other down the plane as shown in figure. Which of the following statements (s) is/are correct?



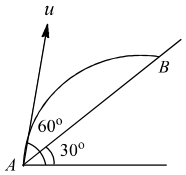
a) The time of flight of each particle is the same.

b) The particles will collide the plane with same speed

c) Both the particles strike the plane perpendicularly

d) The particles will collide in mid air if projected simultaneously and time of flight of each particle is less than the time of collision

259. The time taken by the projectile to reach from A to B is t, then the distance AB is equal to



a) $2\ ut$ b) $\sqrt{3}\ ut$ c) $\frac{\sqrt{3}}{2}ut$ d) $\frac{ut}{\sqrt{3}}$

260. An arrow is projected into air. Its time of flight is 8 s and range 200 m. What is the maximum height reached by it? (Take g $=$ 10 ms^{-2})

a) 31.25 m b) 24.5 m c) 18.25 m d) 46.75 m

261. A particle of mass $= 5$ is moving with a uniform speed $v = 3\sqrt{2}$ in the XOY plane along the line $Y = X + 4$.

The magnitude of the angular momentum of the particle about the origin is

a) 60 units b) $40\sqrt{2}$ units c) 7.5 units d) zero

262. A shell is fired from a cannon with a velocity v at angle θ with horizontal. At the highest point, it explodes into two pieces of equal mass. One of the pieces retraces its path to the cannon. The speed of the other piece just after explosion is

a) $3\,v\cos\theta$ b) $2\,v\cos\theta$ c) $\frac{3}{2}v\cos\theta$ d) $\frac{\sqrt{3}}{2}v\cos\theta$

263. Given $\vec{A} = \hat{\imath} + 2\hat{\jmath} - 3\hat{k}$. When a vector $\vec{B}$ is added to $\vec{A}$, We get a unit vector along X=axis. Then, $\vec{B}$ is

a) $-2\hat{\jmath} + 3\hat{k}$ b) $-\hat{\imath} - 2\hat{\jmath}$ c) $-\hat{\imath} + 3\hat{k}$ d) $2\hat{\jmath} - 3\hat{k}$

264. A hollow sphere has radius 6.4 m. Minimum velocity required by a motor cyclist at bottom to complete the circle will be

a) 17.7 m/s b) 10.2 m/s c) 12.4 m/s d) 16.0 m/s

265. $\vec{A} = 3\hat{\imath} - \hat{\jmath} + 7\hat{k}$ and $\vec{B} = 5\hat{\imath} - \hat{\jmath} + 9\hat{k}$ the direction cosine m of the vector $\vec{A} + \vec{B}$ is

a) Zero b) $\frac{3}{\sqrt{31}}$ c) $\frac{9}{\sqrt{107}}$ d) 5

266. A car sometimes overturns while taking a turn. When it overturns, it is

a) The inner wheel which leaves the ground first
b) The outer wheel which leaves the ground first
c) Both the wheels leave the ground simultaneously
d) Either wheel leaves the ground first

267. A car of mass 1000 kg moves on a circular track of radius 20 m. If the coefficient of friction is 0.64, then the maximum velocity with which the car can move is

a) 22.4 ms^{-1} b) 5.6 ms^{-1} c) 11.2 ms^{-1} d) None of these

268. A projectile is thrown with a speed u at an angle θ to the horizontal. The radius of curvature of its trajectory when the velocity vector of the projectile makes an angle α with the horizontal is

a) $\frac{u^2\cos^2\alpha}{g\cos^2\theta}$ b) $\frac{2u^2\cos^2\alpha}{g\cos^2\theta}$ c) $\frac{u^2\cos^2\theta}{g\cos^3\alpha}$ d) $\frac{u^2\cos^2\theta}{g\cos^2\alpha}$

269. A stone of mass 1 kg is tied to a string 4 m long and is rotated at constant speed of 40 ms^{-1} in a vertical circle. The ratio of the tension at the top and the bottom is

a) 11 : 12 b) 39 : 41 c) 41 : 39 d) 12 : 11

270. The magnitudes of the two vectors $\vec{a}$ and $\vec{b}$ are a and b respectively. The vector product of $\vec{a}$ and $\vec{b}$ cannot be

a) equal to zero b) less than ab c) equal to ab d) greater than ab

271. A projectile is thrown at angle β with vertical. It reaches a maximum height H. The time taken to reach the highest point of its path is

a) $\sqrt{\frac{H}{g}}$ b) $\sqrt{\frac{2H}{g}}$ c) $\sqrt{\frac{H}{2g}}$ d) $\sqrt{\frac{H}{g\cos\beta}}$

272. A boy on a cycle pedals around a circle of 20 $metres$ radius at a speed of 20 $metres/sec$. The combined mass of the boy and the cycle is 90 kg.The angle that the cycle makes with the vertical so that it may not fall is ($g = 9.8\ m/sec^2$)

a) 60.25° b) 63.90° c) 26.12° d) 30.00°

273. A stone is thrown at an angle θ to the horizontal reaches a maximum height H. Then the time of flight of stone will be

a) $\sqrt{\frac{2H}{g}}$ b) $2\sqrt{\frac{2H}{g}}$ c) $\frac{2\sqrt{2H\sin\theta}}{g}$ d) $\frac{\sqrt{2H\sin\theta}}{g}$

274. A body crosses the topmost point of a vertical circle with critical speed. Its centripetal acceleration, when the string is horizontal will be

a) $6\,g$ b) $3\,g$ c) $2\,g$ d) g

275. A particle revolves around a circular path. The acceleration of the particle is
   a) Along the circumference of the circle b) Along the tangent
   c) Along the radius d) Zero

276. If a particle covers half the circle of radius R with constant speed then
   a) Change in momentum is mvr b) Change in $K.E.$ is $1/2\,mv^2$
   c) Change in $K.E.$ is mv^2 d) Change in $K.E.$ is zero

277. If $\vec{A}+\vec{B}=\vec{C}$ and $A=\sqrt{3}$, $B=\sqrt{3}$ and $C=3$, then the angle between $\vec{A}$ *and* $\vec{B}$ is
   a) $0°$ b) $30°$ c) $60°$ d) $90°$

278. The angle turned by a body undergoing circular motion depends on time as $\theta=\theta_0+\theta_1 t+\theta_2 t^2$. Then the angular acceleration of the body is
   a) θ_1 b) θ_2 c) $2\theta_1$ d) $2\theta_2$

279. Given $\vec{A}=4\hat{i}+6\hat{j}$ and $\vec{B}=2\hat{i}+3\hat{j}$. Which of the following is correct?
   a) $\vec{A}\times\vec{B}=\vec{0}$ b) $\vec{A}\cdot\vec{B}=24$
   c) $\frac{|\vec{A}|}{|\vec{B}|}=\frac{1}{2}$ d) $\vec{A}$ and $\vec{B}$ are anti-parallel

280. A bullet is fired with a velocity u making an angle of $60°$ with the horizontal plane. The horizontal component of the velocity of the bullet when it reaches the maximum height is
   a) u b) 0 c) $\frac{\sqrt{3u}}{2}$ d) $u/2$

281. A cart is moving horizontally along a straight line with constant speed30 ms^{-1}. A projectile is to be fired from the moving cart in such a way that it will return to the cart has moved 80 m. At what speed (relative to the cart) must the projectile be fired? (Take $g=10\ \text{ms}^{-2}$)
   a) $10\ \text{ms}^{-1}$ b) $10\sqrt{8}\text{ms}^{-1}$ c) $\frac{40}{3}\text{ms}^{-1}$ d) None of the above

282. A car is moving with high velocity when it has a turn. A force acts on it outwardly because of
   a) Centripetal force b) Centrifugal force c) Gravitational force d) All the above

283. The area of parallelogram formed from the vectors $\vec{A}=\hat{i}-2\hat{j}+3\hat{k}$ and $\vec{B}=3\hat{i}-2\hat{j}+\hat{k}$ as adjacent sides is
   a) $8\sqrt{3}$ units b) 64 units c) 32 units d) $4\sqrt{6}$ units

284. The maximum velocity (in ms^{-1}) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is
   a) 60 b) 30 c) 15 d) 25

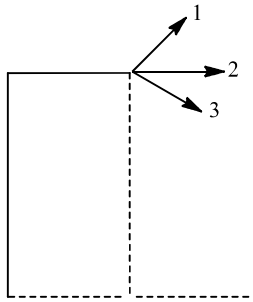
285. The maximum and minimum tension in the string whirling in a circle of radius 2.5 m with constant velocity are in the ratio 5: 3 the the velocity is
   a) $\sqrt{98}\,m/s$ b) $7\,m/s$ c) $\sqrt{490}\,m/s$ d) $\sqrt{4.9}$

286. A body is projected from the earth at angle $30°$ with the horizontal with some initial velocity. If its range is 20 m, the maximum height reached by its is (in metre)
   a) $5\sqrt{3}$ b) $\frac{5}{\sqrt{3}}$ c) $\frac{10}{\sqrt{3}}$ d) $10\sqrt{3}$

287. Neglecting the air resistance, the time of flight of a projectile is determined by
   a) $U_{vertical}$ b) $U_{horizontal}$
   c) $U=U^2_{vertical}+U^2_{horizontal}$ d) $U=U\left(U^2_{vertical}+U^2_{horizontal}\right)^{1/2}$

288. If the magnitudes of scalar and vector products of two vectors and are 6 and $6\sqrt{3}$ respectively, then the angle between two vectors is
   a) $15°$ b) $30°$ c) $60°$ d) $75°$

289. Three balls are dropped from the top of a building with equal speed at different angles. When the balls strike ground their velocities are v_1, v_2 and v_3 respectively, then



a) $v_1 > v_2 > v_3$ b) $v_3 > v_2 > v_1$ c) $v_1 = v_2 = v_3$ d) $v_1 < v_2 < v_3$

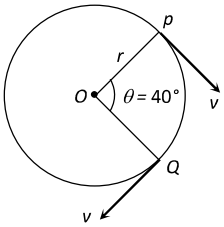
290. An object is projected at an angle of 45° with the horizontal. The horizontal range and maximum height reached will be in the ratio

a) 1:2 b) 2:1 c) 1:4 d) 4:1

291. A coin, placed on a rotating turn-table slips, when it is placed at a distance of 9 cm from the centre. If the angular velocity of the turn-table is tripled, it will just slip, if its distance from the centre is

a) 27 cm b) 9 cm c) 3 cm d) 1 cm

292. A particle is moving on a circular path of radius r with uniform velocity v. The change in velocity when the particle moves from P to Q is ($\angle POQ = 40°$)



a) $2v\cos 40°$ b) $2v\sin 40°$ c) $2v\sin 20°$ d) $2v\cos 20°$

293. A coin is placed on a gramophone record rotating at a speed of 45 rpm. It flies away when the rotational speed is 50 rpm. If two such coins are placed over the other on the same record, both of them will fly away when rotational speed is

a) 100 rpm b) 25 rpm c) 12.5 rpm d) 50 rpm

294. A body is whirled in a horizontal circle of radius 20 cm. It has angular velocity of 10 rad/s. What is its linear velocity at any point on circular path

a) 10 m/s b) 2 m/s c) 20 m/s d) $\sqrt{2}\ m/s$

295. For a given velocity, a projectile has the same range R for two angles of projection if t_1 and t_2 are the times of flight in the two cases then

a) $t_1 t_2 \propto R^2$ b) $t_1 t_2 \propto R$ c) $t_1 t_2 \propto \frac{1}{R}$ d) $t_1 t_2 \propto \frac{1}{R^2}$

296. A projectile is fired with a velocity v at right angle to the slope which is inclined at an angle θ with the horizontal. What is the time of flight?

a) $\frac{2v^2}{g}\tan\theta$ b) $\frac{v^2}{g}\tan\theta$ c) $\frac{2v^2}{g}\sec\theta$ d) $\frac{2v^2}{g}\tan\theta\sec\theta$

297. The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. Its angle of projection will be

a) 45° b) 60° c) 90° d) 30°

298. A boy whirl is a stone in a horizontal circle of radius 1.5 m and at height 2.0 m above level ground. The string breaks and the stone flies off tangentially and strikes the ground after traveling a horizontal distance of 10 m. What is the magnitude of the centripetal acceleration of the stone while in circular motion?

a) 163 ms^{-2} b) 64 ms^{-2} c) 15.63 ms^{-2} d) 125 ms^{-2}

299. Two vectors $\vec{A}$ and $\vec{B}$ are inclined to each other at an angle θ. Which of the following is the unit vector perpendicular to both $\vec{A}$ and $\vec{B}$?

a) $\frac{\vec{A}\times\vec{B}}{\vec{A}\cdot\vec{B}}$ b) $\frac{\hat{A}\cdot\hat{B}}{\sin\theta}$ c) $\frac{\vec{A}\times\vec{B}}{AB\sin\theta}$ d) $\frac{\hat{A}\times\hat{B}}{AB\cos\theta}$

300. It was calculated that a shell when fired from a gun with a certain velocity and at an angle of elevation $\frac{5\pi}{36}$ rad should strike a given target. In actual practice, it was found that a hill just prevented the trajectory. At what angle of elevation should the gun be to hit the target?

a) $\frac{5\pi}{36}$ rad b) $\frac{11\pi}{36}$ rad c) $\frac{7\pi}{36}$ rad d) $\frac{13\pi}{36}$ rad

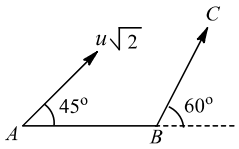
301. A particle does uniform circular motion in a horizontal plane. The radius of the circle is 20 cm. The centripetal force acting on the particle is 10 N. It's kinetic energy is

a) 0.1 J b) 0.2 J c) 2.0 J d) 1.0 J

302. The condition of apparent weightlessness can be created momentarily when a plane flies over the top of a vertical circle. At a speed of 900 kmh^{-1}, the radius of the vertical circle that the pilot must use is

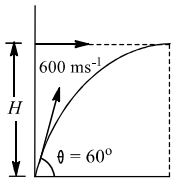
a) 10.6 km b) 8.5 kg c) 6.4 km d) 4.0 km

303. A particle is projected from a point A with velocity $u\sqrt{2}$ at an angle of 45° with horizontal as shown in figure. It strikes the plane BC at right angles. The velocity of the particle at the time of collision is



a) $\frac{\sqrt{3u}}{2}$ b) $\frac{u}{2}$ c) $\frac{2u}{\sqrt{3}}$ d) u

304. A fighter plane enters inside the enemy territory, at time $t = 0$ with velocity $v_0 = 250\ ms^{-1}$ and moves horizontally with constant acceleration $a = 20 ms^{-2}$ (see figure). An enemy tank at the border, spot the plane and fire shots at an angle $\theta = 60°$ with the horizontal and with velocity $u = 600\ ms^{-1}$. At what altitude H of the plane it can be hit by the shot?



a) $1500\sqrt{3}$m b) 125 m c) 1400 m d) 2473 m

305. At the height 80 m, an aeroplane is moving with 150 m/s. A bomb is dropped from it so as to hit a target. At what distance from the target should be bomb be dropped (Given $g = 10\ m/s^2$)

a) 605.3 m b) 600 m c) 80 m d) 230 m

306. An object moves at a constant speed along a circular path in a horizontal XY plane, with the centre at the origin. When the object is at $x = -2m$, its velocity is $-(4m/s)\hat{j}$. What is the object's acceleration when it is $y = 2m$

a) $-(8m/s^2)\hat{j}$ b) $-(8m/s^2)\hat{\imath}$ c) $-(4m/s^2)\hat{j}$ d) $(4m/s^2)\hat{\imath}$

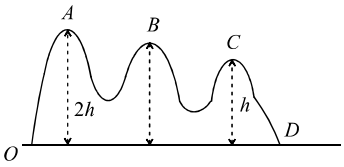
307. The momentum of a particle is $\vec{P}$=2cost$\hat{\imath}$ + 2sint$\hat{j}$. What is the angle between the force $\vec{F}$ acting on the particle and the momentum $\vec{P}$

a) 65° b) 90° c) 150° d) 180°

308. If the angle of projection of a projectile is 30°, then how many times the horizontal range is larger than the maximum height?

a) 2 b) 3 c) $3\sqrt{4}$ d) $4\sqrt{3}$

309. A small roller coaster starts at point A with a speed u on a curved track as shown in figure



The friction between the roller coaster and the track is negligible and it always remains in contact with the track. The speed of the roller coaster at point D on the track will be

a) $(u^2+gh)^{\frac{1}{2}}$ b) $(u^2+2gh)^{\frac{1}{2}}$ c) $(u^2+4gh)^{\frac{1}{2}}$ d) u

310. The vectors $2\hat{i}+3\hat{j}-2\hat{k}, 5\hat{i}+a\hat{j}+\hat{k}$ and $-\hat{i}+2\hat{j}+3\hat{k}$ are coplanar when a is

a) -9 b) 9 c) -18 d) 18

311. Centripetal acceleration is

a) A constant vector b) A constant scalar
c) A magnitude changing vector d) Not a constant vector

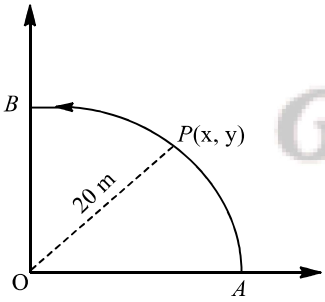
312. The trajectory of a projectile in vertical plane in $y=ax-bx^2$, where a and b are constant and x and y are respectively horizontal and vertical distances of the projectile from the point of projection. The maximum height attained by the particle and the angle of projection from the horizontal are

a) $\frac{b^2}{4b}, \tan^{-1}(b)$ b) $\frac{a^2}{b}, \tan^{-1}(2b)$ c) $\frac{a^2}{4b}, \tan^{-1}(a)$ d) $\frac{2a^2}{b}, \tan^{-1}(a)$

313. A body of mass 100 g is rotating in a circular path of radius r with constant velocity. The work done in one complete revolution is

a) 100 rJ b) $(r/100)J$ c) $(100/r)J$ d) Zero

314. 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 length $s=t^3+5$, where s is in metre and t is in second. The radius of the path is 20 m. The acceleration of P when t=2s is nearly



a) 13 ms $^{-2}$ b) 12 ms $^{-2}$ c) 7.2 ms $^{-2}$ d) 14 ms $^{-2}$

315. 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) 15 s b) 10.98 s c) 5.49 s d) 2.745 s

316. The kinetic energy k of a particle moving along a circle of radius R depends on the distance covered s as $k=as^2$ where a is a constant

a) $2a\frac{s^2}{R}$ b) $2as\left(1+\frac{s^2}{R^2}\right)^{1/2}$ c) $2as$ d) $2a\frac{R^2}{s}$

317. A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break

a) When the mass is at the highest point of the circle b) When the mass is the lowest point of the circle
c) When the wire is horizontal d) At an angle of $\cos^{-1}(1/3)$ from the upward vertical

318. Three particles A, B and C are projected from the same point with the same initial speeds making angles30°, 45° and 60° respectively with the horizontally. Which of the following statements is correct?

a) A,B and C have unequal ranges
b) Range of A and C are less than that of B
c) Range of A and C are equal and greater than that of B

d) A,B and C have equal ranges

319. If $\vec{A} = \vec{B}$, then which of the following is not correct

a) $\hat{A} = \hat{B}$ b) $\hat{A} \cdot \hat{B} = AB$ c) $|\vec{A}| = |\vec{B}|$ d) $A\hat{B} \,||\, B\hat{A}$

320. A bomb is dropped on an enemy post by an aeroplane flying horizontally with a velocity of 60 kmh^{-1} and at a height of 490 m. At the time of dropping the bomb, how far the aeroplane should be from the enemy post so that the bomb may directly hit the target?

a) $\frac{400}{3}$ m b) $\frac{500}{3}$ m c) $\frac{1700}{3}$ m d) 498 m

321. Two stones thrown at different angles have same initial velocity and same range. If H is the maximum height attained by one stone thrown at an angle of 30°, then the maximum height attained by the other stone is

a) $\frac{H}{2}$ b) H c) $2H$ d) $3H$

322. A ball of mass m is thrown vertically upwards. Another ball of mass $2m$ is thrown at an angle θ with the vertical. Both of them stay in air for same period of time. The heights attained by the two balls are in the ratio of

a) 2: 1 b) 1: $\cos\theta$ c) 1: 1 d) $\cos\theta$: 1

323. A projectile of mass m is thrown with a velocity v making an angle of 45° with the horizontal. The change in momentum from departure to arrival along vertical direction, is

a) $2mv$ b) $\sqrt{2}\,mv$ c) mv d) $\frac{mv}{2}$

324. The resultant of two forces at right angle is 5N. When the angle between them is 120°, the resultant is $\sqrt{13}$. Then the force are

a) $\sqrt{12}$N, $\sqrt{13}$N b) $\sqrt{20}$N, $\sqrt{5}$N c) 3 N, 4 N d) $\sqrt{40}$N, $\sqrt{15}$N

325. A bridge is in the form of a semi-circle of radius $40m$. The greatest speed with which a motor cycle can cross the bridge without leaving the ground at the highest point is ($g = 10\ ms^{-2}$)
(frictional force is negligibly small)

a) 40 ms^{-1} b) 20 ms^{-1} c) 30 ms^{-1} d) 15 ms^{-1}

326. A particle crossing the origin of co-ordinates at time $t = 0$, moves in the xy-plane with a constant acceleration a in the y-direction. If its equation of motion is $y = bx^2$ (b is a constant), its velocity component in the x-direction is

a) $\sqrt{\frac{2b}{a}}$ b) $\sqrt{\frac{a}{2b}}$ c) $\sqrt{\frac{a}{b}}$ d) $\sqrt{\frac{b}{a}}$

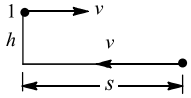
327. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/hr. The centripetal force is

a) 250 N b) 750 N c) 1000 N d) 1200 N

328. A body is thrown with a velocity of 10 ms^{-1} at an angle of 60° with the horizontal. Its velocity at the highest point is

a) 7 ms^{-1} b) 9 ms^{-1} c) 18.7 ms^{-1} d) 5 ms^{-1}

329. Two particles 1 and 2 are projected with same speed v as shown in figure. Particle 2 is on the ground and particle 1 is at a height h from the ground and at a horizontal distance s from particle 2. If a graph is plotted between v and s for the condition of collision of the two then (v on y-axis and s on x-axis)



a) It will be a parabola passing through the origin

b) It will be straight line passing through the origin and having a slope of $\sqrt{\frac{g}{8h}}$

c) It will be a straight line passing through the origin and having a slope of $\sqrt{\frac{g}{4h}}$

d) It will be a straight line not passing through the origin

330. A stone tied to one end of rope and rotated in a circular motion. If the string suddenly breaks, then the stone travels
   a) in perpendicular direction
   b) in direction of centrifugal force
   c) towards centripetal force
   d) in tangential direction

331. A particle moves in a circle of radius 30 cm. Its linear speed is given by $v = 2t$ where t in second and v in m/s. Find out its radial and tangential acceleration at $t = 3\ sec$ respectively
   a) $220\ m/\sec^2$, $50\ m/\sec^2$
   b) $100\ m/\sec^2$, $5\ m/\sec^2$
   c) $120\ m/\sec^2$, $2\ m/\sec^2$
   d) $110\ m/\sec^2$, $10\ m/\sec^2$

332. A particle moves with constant speed v along a circular path of radius r and completes the circle in time T. The acceleration of the particle is
   a) $2\pi v/T$ b) $2\pi r/T$ c) $2\pi r^2/T$ d) $2\pi v^2/T$

333. A particle is projected up an inclined plane with initial speed $v = 20\text{ms}^{-1}$ at an angle $\theta = 30°$ with plane. The component of its velocity perpendicular to plane when it strikes the plane is
   a) $10\sqrt{3}\ \text{ms}^{-1}$
   b) $10\ \text{ms}^{-1}$
   c) $5\sqrt{3}\ \text{ms}^{-1}$
   d) Data is insufficient

334. An aircraft is flying at a height of 3400 m above the ground. If the angle subtended at a ground observation point by the aircraft position 10 s apart is 30°, then the speed of the aircraft is
   a) $19.63\ \text{ms}^{-1}$ b) $1963\ \text{ms}^{-1}$ c) $108\ \text{ms}^{-1}$ d) $196.3\ \text{ms}^{-1}$

335. A body constrained to move in Y direction, is subjected to a force given by $\vec{F} = (-2\hat{i} + 15\hat{j} + 6\hat{k})$N done by this force in moving the body through a distance of 10m along Y axis?
   a) 190 J b) 160 J c) 150 J d) 20 J

336. A body moves with constant angular velocity on a circle. Magnitude of angular acceleration
   a) $r\omega^2$ b) Constant c) Zero d) None of the above

337. The sum of two vectors $\vec{A}$ and $\vec{B}$ is at right angles to their difference. Then
   a) $A = B$
   b) $A = 2B$
   c) $B = 2A$
   d) $\vec{A}$ and $\vec{B}$ have the same direction

338. A projectile is projected with kinetic energy K. If it has the maximum possible horizontal range, then its kinetic energy at the highest point will be
   a) 0.25 K b) 0.5 K c) 0.75 K d) 1.0 K

339. Two particles of equal masses are revolving in circular paths of radii r_1 and r_2 respectively with the same speed. The ratio of their centripetal forces is
   a) $\frac{r_2}{r_1}$ b) $\sqrt{\frac{r_2}{r_1}}$ c) $\left(\frac{r_1}{r_2}\right)^2$ d) $\left(\frac{r_2}{r_1}\right)^2$

340. A scooter is going round a circular road of radius 100 m at a speed of 10 m/s. The angular speed of the scooter will be
   a) 0.01 rad/s b) 0.1 rad/s c) 1 rad/s d) 10 rad/s

341. A car rounds an unbanked curve of radius 92 m without skidding at a speed of 26 ms^{-1}. The smallest possible coefficient of static friction between the tyres and the road is
   a) 0.75 b) 0.60 c) 0.45 d) 0.30

342. A body of mass 5 kg is whirled in a vertical circle by a string 1 m long. Calculate velocity at the top of the circle for just looping the vertical loop
   a) $3.1\ \text{ms}^{-1}$ b) $7\ \text{ms}^{-1}$ c) $9\ \text{ms}^{-1}$ d) $7.3\ \text{ms}^{-1}$

343. A cricketer can throw a ball to a maximum horizontal distance of 100 m. The speed with which he throws

the ball is (to the nearest integer)

a) 30 ms^{-1} b) 42 ms^{-1} c) 32 ms^{-1} d) 35 ms^{-1}

344. A cyclist riding the bicycle at a speed of $14\sqrt{3}\ ms^{-1}$ takes a turn around a circular road of radius $20\sqrt{3}\ m$ without skidding. Given $g = 9.8\ ms^{-2}$, what is his inclination to the vertical

a) 30^o b) 90^o c) 45^o d) 60^o

345. Two projectile are thrown with the same initial velocity at angles α and $(90° - \alpha)$ with the horizontal. The maximum heights attained by them are h_1 and h_2 respectively. Then $\frac{h_1}{h_2}$ is equal to

a) $\sin^2 \alpha$ b) $\cos^2 \alpha$ c) $\tan^2 \alpha$ d) 1

346. The average acceleration vector for a particle having a uniform circular motion is

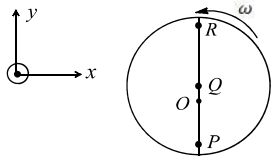
a) A constant vector of magnitude v^2/r

b) A vector of magnitude v^2/r directed normal to the plane of the given uniform circular motion

c) Equal to the instantaneous acceleration vector at the start of the motion

d) A null vector

347. Consider a disc rotating in the horizontal plane with a constant angular speed ω about its centre O. The disc has a shaded region on one side of the diameter and an unshanded region on the other side as shown in the figure. When the disc is in the orientation as shown, two pebbles P and Q are simultaneously projected at an angle towards R. The velocity of projection is 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 $\frac{1}{8}$ rotation. (ii) their range is less than half the disc radius, and (iii) ω remains 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

348. A ball is moving to and fro about the lowest point A of a smooth hemispherical bowl. If it is able to rise up to a height of 20 cm on either side of A, its speed at A must be ($Take\ g = 10\ m/s^2$, massof the body 5 g)

a) 0.2 m/s b) 2 m/s c) 4 m/s d) 4.5 ms^{-1}

349. What is the angle between $(\hat{i} + 2\hat{j} + 2\hat{k})$ and $\hat{i}$

a) 0° b) $\pi/6$ c) $\pi/3$ d) None of these

350. A force of $(10\hat{i} - 3\hat{j} + 6\hat{k})$ N acts on a body of mass 100 g and displaces it from $(6\hat{i} + 5\hat{j} - 3\hat{k})$ m to $(10\hat{i} - 2\hat{j} + 7\hat{k})$ m. The work done is

a) 21 J b) 121 J c) 361 J d) 1000 J

351. A bridge is in the form of a semi-circle of radius 40 m. The greatest speed with which a motor cycle can cross the bridge without leaving the ground at the highest point is ($g = 10\text{ms}^{-2}$) (frictional force is negligibly small)

a) 40 ms^{-1} b) 20 ms^{-1} c) 30 ms^{-1} d) 15 ms^{-1}

352. A body is projected at such angle that the horizontal range is three times the greatest height. The angel of projection is

a) $42°8'$ b) $53°7'$ c) $33°7'$ d) $25°8'$

353. The maximum and minimum tension in the string whirling in a circle of radius 2.5 m with constant velocity are in the ratio 5 : 3 then its velocity is

a) $\sqrt{98}$ ms^{-1} b) 7 ms^{-1} c) $\sqrt{490}$ ms^{-1} d) $\sqrt{4.9}$ ms^{-1}

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

a) 19.6 N; 19.6 N b) 9.8 N; 9.8 N c) 9.8 N, 19.6 N d) 19.6 N, 9.8 N

355. A sphere of mass 0.2 kg is attached to an inextensible string of length 0.5 m whose upper end is fixed to the ceiling. The sphere is made to describe a horizontal circle of radius 0.3 m. The speed of the sphere will be
a) 1.5 m s^{-1} b) 2.5 m s^{-1} c) 3.2 m s^{-1} d) 4.7 m s^{-1}

356. A bullet is fired from a cannon with velocity 500 m/s . If the angle of projection is 15° and $g = 10\ m/s^2$. Then the range is
a) $25 \times 10^3\ m$ b) $12.5 \times 10^3\ m$ c) $50 \times 10^2\ m$ d) $25 \times 10^2\ m$

357. Find the maximum speed at which a car can turn round a curve of 30 m radius on a level road if the coefficient of friction between the tyres and the road is 0.4
(Acceleration due to gravity = 10 ms^{-2})
a) 12 ms^{-2} b) 10 ms^{-2} c) 11 ms^{-2} d) 15 ms^{-2}

358. A simple pendulum oscillates in a vertical plane. When it passes through the mean position, the tension in the string is 3 times the weight of the pendulum bob. What is the maximum displacement of the pendulum with respect to the vertical
a) 30° b) 45° c) 60° d) 90°

359. A particle is moving in a circle of radius R with constant speed$v$. If radius is doubled, then its centripetal force to keep the same speed gets
a) twice as great as before b) half
c) one-fourth d) remains constant

360. A ball is projected with kinetic energy E at an angle of 45° to the horizontal. At the highest point during its flight, its kinetic energy will be
a) Zero b) $E/2$ c) $E/\sqrt{2}$ d) E

361. Given that A and B are greater than 1. The magnitude of $(\vec{A} \times \vec{B})$ can not be
a) equal to AB b) less than AB c) more than AB d) equal to A/B

362. The string of pendulum of length l is displaced through 90° from the vertical and released. Then the minimum strength of the string in order to withstand the tension, as the pendulum passes through the mean position is
a) mg b) $3mg$ c) $5\ mg$ d) $6\ mg$

363. A car is moving on a circular road of diameter 50 m with a speed of 5 ms^{-1}. It is suddenly accelerated at rate 1 ms^{-2}. If the mass is 500 kg, find the net force acting on the car
a) 5 N b) 1000 N c) $500\sqrt{2}$ N d) $500/\sqrt{2}$ N

364. A bomb is dropped from an aeroplane flying horizontally with a velocity 469 ms^{-1} at an altitude of 980 m. The bomb will hit the ground after a time
a) 2 s b) $\sqrt{2}$ s c) $5\sqrt{2}$ s d) $10\sqrt{2}$ s

365. Following forces start acting on a particle at rest at the origin of the co-ordinate system simultaneously
$\vec{F}_1 = 5\hat{i} - 5\hat{j} + 5\hat{k}$, $F_2 = 2\hat{i} + 8\hat{j} + 6\hat{k}$, $F_3 = -6\hat{i} + 4\hat{j} - 7\hat{k}$,
$F_4 = -\hat{i} - 3\hat{j} - 2\hat{k}$. The particle will move
a) in $x - y$ plane b) in $y - z$ plane c) in $x - z$ plane d) along x-axis

366. If $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$ is a unit vector, then the value of c is
a) $\sqrt{0.11}$ b) $\sqrt{0.22}$ c) $\sqrt{0.33}$ d) $\sqrt{0.89}$

367. A cyclist goes round a circular path of circumference 34.3 m in $\sqrt{22}$ s, the angle made by him with the vertical will be
a) 45° b) 40° c) 42° d) 48°

368. The simple sum of two co-initial vectors is 10 units. Their vector sum is 8 units. The resultant of the vectors is perpendicular to the smaller vector. The magnitudes of the two vectors are
a) 2 units and 14 units
b) 4 units and 12 units
c) 6 units and 10 units

d) 8 units and 8 units

369. A particle is projected with a velocity v such that its range on the horizontal plane is twice the greatest height attained by it. The range of the projectile is (where g is acceleration due to gravity)

a) $\frac{4v^2}{5g}$ b) $\frac{4g}{5v^2}$ c) $\frac{v^2}{g}$ d) $\frac{4v^2}{\sqrt{5}g}$

370. A mass of 2 kg is whirle'd in a horizontal circle by means of a string at an initial speed of 5 revolutions per minute. Keeping the radius constant, the tension in the string is double. The new speed is nearly

a) 2.25 rpm b) 7 rpm c) 10 rpm d) 14 rpm

371. A point of application of a force $\vec{F} = 5\hat{i} - 4\hat{j} + 2\hat{k}$ is moved from $\overrightarrow{r_1} = 2\hat{i} + 7\hat{j} + 4\hat{k}$ to $\overrightarrow{r_2} = 5\hat{i} + 2\hat{j} + 3\hat{k}$ the work done is

a) 22 units b) -22 units c) 33 units d) -33 units

372. A particle performing uniform circular motion has

a) Radial velocity and radial acceleration
b) A radial velocity and transverse acceleration
c) Transverse velocity and radial acceleration
d) Transverse velocity and transverse acceleration

373. The velocity of projection of an oblique projectile is $(6\hat{\mathbf{i}} + 8\hat{\mathbf{j}})\text{ms}^{-1}$. The horizontal range of the projectile is

a) 4.9 m b) 9.6 m c) 19.6 m d) 14 m

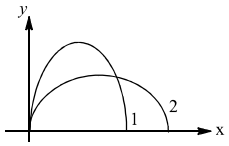
374. One o the rectangular components of a velocity of 60kmh^{-1} is 30 kmh^{-1}. The other rectangular component is

a) 30 kmh^{-1} b) $30\sqrt{3}$ kmh^{-1} c) $30\sqrt{2}\,\text{kmh}^{-1}$ d) Zero

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

a) 2 N b) 4 N c) 6 N d) 7 N

376. Trajectories of two projectiles are shown in figure. Let T_1 and T_2 be the time periods and u_1 and u_2 their speeds of projection. Then



a) $T_2 > T_1$ b) $T_1 = T_2$ c) $u_1 > u_2$ d) $u_1 < u_2$

377. A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m/sec. A plumb bob is suspended from the roof of the car by a light rigid rod of length 1.00 m. The angle made by the rod with track is

a) Zero b) 30° c) 45° d) 60°

378. The horizontal and vertical displacement x and y of a projectile at a given time t are given by $x = 6t$ metre and $y = 8t - 5t^2$ metre. The range of the projectile in metre is

a) 9.6 b) 10.6 c) 19.2 d) 38.4

379. A projectile is projected with a speed u making an angle 2θ with the horizontal. What is the speed when its direction of motion makes an angle θ with the horizontal

a) $(u\cos 2\theta)/2$ b) $u\cos\theta$ c) $u(2\cos\theta - \sec\theta)$ d) $u(\cos\theta - \sec\theta)$

380. Two stones are projected with the same velocity in magnitude but making different angles with the horizontal. Their ranges are equal. If the angel of projection of one is $\pi/3$ and its maximum height is y_1, the maximum height of the other will be

a) $3y_1$ b) $2y_1$ c) $\frac{y_1}{2}$ d) $\frac{y_1}{3}$

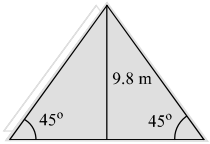
381. A glass marble projected horizontally from the top of a table falls at a distance x from the edge of the table. If h is the height of the table, then the velocity of projection is

a) $h\sqrt{\frac{g}{2x}}$ b) $x\sqrt{\frac{g}{2h}}$ c) gxh d) $gx + h$

382. A bucket full of water is revolved in vertical circle of radius $2m$. What should be the maximum time-period of revolution so that the water doesn't fall of the bucket
a) $1\ sec$ b) $2\ sec$ c) $3\ sec$ d) $4\ sec$

383. Which of the following sets of factors will affect the horizontal distance covered by an athlete in a long-jump event
a) Speed before he jumps and his weight
b) The direction in which he leaps and the initial speed
c) The force with which he pushes the ground and his speed
d) None of these

384. Two inclined planes are located as shown in figure. A particle is projected from the foot of one frictionless plane along its line with a velocity just sufficient to carry it to top after which the particle slides down the other frictionless inclined plane. The total time it will take to reach the point C is



a) 2 s b) 3 s c) $2\sqrt{2}$ s d) 4 s

385. A ball rolls of the top of a stair way with a horizontal velocity u ms^{-1}. If the steps are h metre and b metre wide, the ball hits the edge of nth step, the time taken by the ball is
a) $\frac{hu}{gb}$ b) $\frac{2hu}{gb}$ c) $\frac{2hu^2}{gb}$ d) $\frac{hu^2}{2gb}$

386. An airplane, diving at an angle of 53.0° with the vertical releases a projectile at an altitude of 730 m. The projectile hits the ground 5.00 s after being released. What is the speed of the aircraft?
a) 282 ms^{-1} b) 202 ms^{-1} c) 182 ms^{-1} d) 102 ms^{-1}

387. A body of mass m hangs at one end of a string of length l, the other end of which is fixed. It is given a horizontal velocity so that the string would just reach where it makes an angle of 60° with the vertical. The tension in the string at mean position is
a) $2\ mg$ b) mg c) $3mg$ d) $\sqrt{3}mg$

388. A cyclist goes round a circular path of circumference 34.3 m in $\sqrt{22}\ sec$. the angle made by him, with the vertical, will be
a) 45° b) 40° c) 42° d) 48°

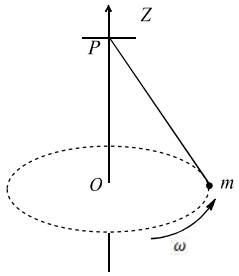
389. A1 kg stone at the end of 1 m long string is whirled in a vertical circle at constant speed of 4 m/sec. The tension in the string is 6 N, when the stone is at ($g = 10\ m/\sec^2$)
a) Top of the circle b) Bottom of the circle c) Half way down d) None of the above

390. A curved road of diameter 1.8 km is banked so that no friction is required at a speed of 30 ms^{-1}. What is the banking angle?
a) 6° b) 16° c) 26° d) 0.6°

391. A stone tied to the end of a string $1m$ long is whirled in a horizontal circle with a constant speed. If the stone makes 22 revolution in 44 seconds, what is the magnitude and direction of acceleration of the stone
a) $\pi^2/4\ ms^{-2}$ and direction along the radius towards the centre
b) $\pi^2 ms^{-2}$ and direction along the radius away from the centre
c) $\pi^2 ms^{-2}$ and direction along the radius towards the centre
d) $\pi^2 ms^{-2}$ and direction along the tangent to the circle

392. A fly wheel rotates about a fixed axis and slows down from 300 rpm to 100 rpm in 2 min. Then its angular retardation in rad/min^2 is
a) $\frac{100}{\pi}$ b) 100 c) $100\ \pi$ d) $200\ \pi$

393. A small mass m is attached to a massless string whose other end is fixed at P as shown in the figure. The mass is undergoing circular motion in the $x-y$ plane with centre at O and constant angular speed ω. If the angular momentum of the system, calculated about O and P are denoted by $\vec{L}_O$ and $\vec{L}_P$ respectively, then



a) $\vec{L}_O$ and $\vec{L}_P$ do not vary with time
b) $\vec{L}_O$ varies with time while $\vec{L}_P$ remains constant
c) $\vec{L}_O$ remains constant while $\vec{L}_P$ varies with time
d) $\vec{L}_O$ and $\vec{L}_P$ both vary with time

394. A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as, $a_c = k^2rt^2$, The power delivered to the particle by the forces acting on it is

a) $2\pi mk^2r^2t$
b) mk^2r^2t
c) $\frac{mk^4r^2t^5}{3}$
d) Zero

395. A man projects a coin upwards from the gate of a uniformly moving train. The path of coin for the man will be

a) Parabolic
b) Inclined straight line
c) Vertical straight line
d) Horizontal straight line

396. A piece of marble is projected from earth's surface with velocity of 50ms^{-1}. 2 s later, it just clears a wall 5 m high. What is the angle of projection?

a) 45°
b) 30°
c) 60°
d) None of these

397. A ball rolls off the top of a stairway with horizontal velocity $v_0 ms^{-1}$. If the steps are h metre high and w metre wide, the ball will hit the edge of nth step if

a) $n = \frac{2hv_0}{gw^2}$
b) $n = \frac{2hv_0^2}{gw}$
c) $n = \frac{hv_0^2}{gw^2}$
d) $n = \frac{2hv_0^2}{gw^2}$

398. A particle is projected from the ground at an angle of 60° with horizontal with speed $u = 20\ \text{ms}^{-1}$. The radius of curvature of the path of the particle, when its velocity makes an angle of 30° with horizontal is $(g = 10\ \text{ms}^{-2})$

a) 10.6 m
b) 12.8 m
c) 15.4 m
d) 24.2 m

399. A particle moves along the parabolic path $y = ax^2$ in such a way that the x-component of the velocity remains constant, say c. The acceleration of the particle is

a) $ac\hat{\mathbf{k}}$
b) $2ac^2\hat{\mathbf{j}}$
c) $ac^2\hat{\mathbf{k}}$
d) $a^2c\hat{\mathbf{j}}$

400. An aeroplane is flying horizontally with a velocity of 600 km/h at a height of 1960 m. When it is vertically at 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) 1200 m
b) 0.33 km
c) 3.33 km
d) 33 km

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

a) 45°, 45°, 90°
b) 90°, 135°, 135°
c) 30°, 60°, 90°
d) 45°, 60°, 90°

402. The magnitude of the X and Y components of $\vec{A}$ are 7 and 6. Also the magnitudes of X and Y components of $\vec{A}+\vec{B}$ are 11 and 9 respectively. What is the magnitude of $\vec{B}$?

a) 5
b) 6
c) 8
d) 9

403. For what value of a, $\vec{A} = 2\hat{i} + a\hat{j} + \hat{k}$ will be perpendicular to $\vec{B} = 4\hat{i} - 2\hat{j} - \hat{k}$

a) 4 b) zero c) 3 d) 1

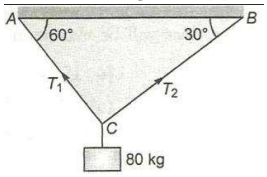
404. A particle is thrown with a speed u at an angle θ with the horizontal. When the particle makes an angle α with the horizontal, its speed becomes v, whose values is

a) $u \cos\theta$ b) $u \cos\theta \cos\alpha$ c) $u \cos\theta \sec\alpha$ d) $u \sec\theta \cos\alpha$

405. A cyclist is moving on a circular track of radius 80 m with a velocity$v = 36\text{kmh}^{-1}$. He has to lean from the vertical approximately through an angle
(take $g = 10\ \text{ms}^{-2}$

a) $\tan^{-1}(4)$ b) $\tan^{-1}\left(\frac{1}{3}\right)$ c) $\tan^{-1}\left(\frac{1}{4}\right)$ d) $\tan^{-1}\left(\frac{1}{8}\right)$

406. A man 80 kg is supported by two cables as shown in the figure. Then the ratio of tensions T_1 and T_2 is



a) 1:1 b) $1:\sqrt{3}$ c) $\sqrt{3}:1$ d) 1:3

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

a) 30° b) 45° c) 150° d) 120°

408. The horizontal range is four times the maximum height attained by a projectile. The angle of projection is

a) 90° b) 60° c) 45° d) 30°

409. An object is projected so that its horizontal range R is maximum. If the maximum height attained by the object is H, then the ratio of R/H is

a) 4 b) $\frac{1}{4}$ c) 2 d) $\frac{1}{2}$

410. An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 rpm, the acceleration of a point on the tip of the blade is about

a) $1600\ \text{ms}^{-2}$ b) $4740\ \text{ms}^{-2}$ c) $2370\ \text{ms}^{-2}$ d) $5055\ \text{ms}^{-2}$

411. The x and y components of a force are 2 N and −3N. The force is

a) $2\hat{i} - 3\hat{j}$ b) $2\hat{i} + 3\hat{j}$ c) $-2\hat{i} - 3\hat{j}$ d) $3\hat{i} + 2\hat{j}$

412. A projectile fired with initial velocity u at some angle θ has a range R. If the initial velocity be doubled at the same angle off projection, then the range will be

a) $2R$ b) $R/2$ c) R d) $4R$

413. A particle of mass m is executing uniform circular motion on a path of radius r. If p is the magnitude of its linear momentum. The radial force acting on the particle is

a) pmr b) $\frac{rm}{p}$ c) $\frac{mp^2}{r}$ d) $\frac{p^2}{rm}$

414. Two forces, each equal to $\frac{P}{2}$, act at right angles. Their effect may be neutralized by a third force acting along their bisector in the opposite direction with a magnitude of

a) P b) $\frac{P}{2}$ c) $\frac{P}{\sqrt{2}}$ d) $\sqrt{2}\,P$

415. Two projectiles A and B thrown with speeds in the ratio $1:\sqrt{2}$ acquired the same heights. If A is thrown at an angle of 45° with the horizontal, the angle of projection of B will be

a) 0° b) 60° c) 30° d) 45°

416. Two particles are projected simultaneously in the same vertical plane, from the same point, both with different speeds and at different angles with horizontal. The path followed by one, as seed by the other, is

a) A vertical line
b) A parabola
c) A hyperbola

d) A straight line making a constant angle ($\neq 90°$) with the horizontal

417. A vector $\vec{A}$ when added to the vector $\vec{B} = 3\hat{i} + 4\hat{j}$ yields a resultant vector that is in the positive y direction and has a magnitude equal to that of $\vec{B}$. Find the magnitude of $\vec{A}$

a) $\sqrt{10}$ b) 10 c) 5 d) $\sqrt{15}$

418. A boy throws a ball upwards with velocity $u = 15\text{ms}^{-1}$. The wind imparts a horizontal acceleration of $3\text{ms}^{-1}$to the left. The angel θ at which the ball must be thrown so that the ball returns to the boy's hand is (use $g = 10\ \text{ms}^{-2}$)

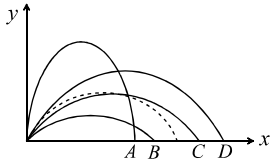
a) $\tan^{-1}(0.4)$ b) $\tan^{-1}(0.2)$ c) $\tan^{-1}(0.3)$ d) $\tan^{-1}(0.15)$

419. A proton of velocity $(3\hat{i} + 2\hat{j}) \times 10^5\text{ms}^{-1}$ enters a magnetic field $(2\hat{i} + 3\hat{k})$T. If the specific charge is $9.6 \times 10^7\text{C kg}^{-1}$. The acceleration of the proton in ms^{-2} is

a) $(6\hat{i} - 9\hat{j} + 4\hat{k}) \times 9.6 \times 10^{12}$ b) $(6\hat{i} + 9\hat{j} + 4\hat{k}) \times 9.6 \times 10^{12}$

c) $(6\hat{i} - 9\hat{j} - 4\hat{k}) \times 9.6 \times 10^{12}$ d) $(6\hat{i} + 9\hat{j} - 4\hat{k}) \times 9.6 \times 10^{12}$

420. The path of a projectile in the absence of air drag is shown in the figure by dotted line. If the air resistance is not ignored then which one of the path is shown in the figure is appropriate for the projectile



a) B b) A c) D d) C

421. A cannon on a level plane is aimed at an angle θ above the horizontal and a shell is fired with a muzzle velocity v_0 towards a vertical cliff a distance D away. Then the height from the bottom at which the shell strikes the side walls of the cliff is

a) $D\sin\theta - \frac{gD^2}{2v_0^2\sin^2\theta}$ b) $D\cos\theta - \frac{gD^2}{2v_0^2\cos^2\theta}$ c) $D\tan\theta - \frac{gD^2}{2v_0^2\cos^2\theta}$ d) $D\tan\theta - \frac{gD^2}{2v_0^2\sin^2\theta}$

422. Which of the following statements is false for a particle moving in a circle with a constant angular speed

a) The velocity vector is tangent to the circle

b) The acceleration vector is tangent to the circle

c) The acceleration vector points to the centre of the circle

d) The velocity and acceleration vectors are perpendicular to each other

423. A mass of 100 gm is tied to one end of a string 2 m long. The body is revolving in a horizontal circle making a maximum of 200 revolutions per min. The other end of the string is fixed at the centre of the circle of revolution. The maximum tension that the string can bear is (approximately)

a) 8.76 N b) 8.94 N c) 89.42 N d) 87.64 N

424. A gramophone disc is set revolving in a horizontal plane and reaches a steady state of motion of two revolutions per second. It is found that a small coin placed on the disc will remain there if its centre is not more than 5 cm from the axis of rotation; the coefficient of friction between the coin and the disc is

a) 0.2 b) 0.4 c) 0.6 d) 0.8

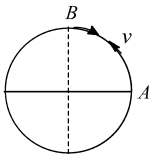
425. A body is projected with a speed u m/s at an angle β with the horizontal. The kinetic energy at the highest point is $\frac{3}{4}$ th of the initial energy. The values of β is

a) 30° b) 45° c) 60° d) 120°

426. Four persons K, L, M and N are initially at the corners of a square of side of length d. If every person starts moving, such that K is always headed towards L, L towards M, M is headed directly towards N and N towards K, then the four persons will meet after

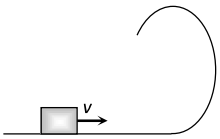
a) $\frac{d}{v}$ sec b) $\frac{\sqrt{2d}}{v}$ sec c) $\frac{d}{\sqrt{2v}}$ sec d) $\frac{d}{2v}$ sec

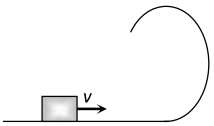
427. A body of mass m is moving with a uniform speed v along a circle of radius r, what is the average acceleration in going from A to B?

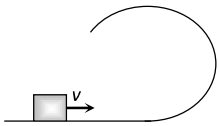


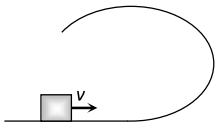
a) $2v^2/\pi r$ b) $2\sqrt{2}v^2/\pi r$ c) $v^2/\pi r$ d) None of these

428. A small block is shot into each of the four tracks as shown below. Each of the tracks rises to the same height. The speed with which the block enters the track is the same in all cases. At the highest point of the track, the normal reaction is maximum in

a) 

b) 

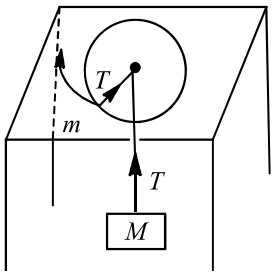
c) 

d) 

429. An unbanked curve has a radius of $60m$. The maximum speed at which car can make a turn if the coefficient of static friction is 0.75, is

a) $2.1\ m/s$ b) $14\ m/s$ c) $21\ m/s$ d) $7\ m/s$

430. A particle of mass m is rotating in a horizontal circle of radius R and is attached to a hanging mass M as shown in the figure. The speed of rotation required by the mass m keep M steady is



a) $\sqrt{\frac{mgR}{M}}$ b) $\sqrt{\frac{mgR}{m}}$ c) $\sqrt{\frac{mg}{MR}}$ d) $\sqrt{\frac{mR}{Mg}}$

431. Two bodies are projected from ground with equal speed 20 ms^{-1} from the same position in the same vertical plane to have equal range but at different angles above the horizontal. If one of the angle is 30° the sum of their maximum heights is (assume $g = 10\ \text{ms}^{-2}$)

a) 400 m b) 20 m c) 30 m d) 40 m

432. A particle is projected with velocity v_0 along x-axis. The deceleration on the particle is proportional to the square of the distance from the origin *ie* $a = \propto x^2$ the distance at which the particle stops is

a) $\sqrt{\frac{3v_0}{2\propto}}$ b) $\left(\frac{3v_0}{2\propto}\right)^{\frac{1}{3}}$ c) $\sqrt{\frac{2v_0^2}{3\propto}}$ d) $\left(\frac{3v_0^2}{2\propto}\right)^{\frac{1}{3}}$

433. A wheel completes 2000 revolutions to cover the 9.5 km distance, then the diameter of the wheel is

a) 1.5 m b) 1.5 cm c) 7.5 cm d) 7.5 m

434. A body can throw a stone up to a maximum height of $10m$. The maximum horizontal distance that the boy can throw the same stone up to will be

a) $20\sqrt{2}m$ b) $10m$ c) $10\sqrt{2}m$ d) $20m$

435. If the resultant of $\vec{A}$ and $\vec{B}$ makes angle α with $\vec{A}$ and β with $\vec{B}$ then

a) $\alpha < \beta$ always b) $\alpha < \beta$, if $A < B$ c) $\alpha < \beta$, if $A > B$ d) $\alpha < \beta$, if $A = B$

436. A body is projected at an angle θ with respect to horizontal direction with velocity u. The maximum range of the body is

a) $R = \frac{u^2 \sin 2\theta}{g}$ b) $R = \frac{u^2 \sin^2 \theta}{2g}$ c) $R = \frac{u^2}{g}$ d) $R = u^2 \sin\theta$

437. A curved road of 50 m radius is banked at correct angle for a given speed. If the speed is to be doubled keeping the same banking angle, the radius of curvature of the road should be changed to
a) 25 m b) 100 m c) 150 m d) 200 m

438. A ball of mass 0.1 kg is suspended by a string. It is displaced through an angle of 60° and left. When the ball passes through the mean position, the tension in the string is
a) 19.6 N b) 1.96 N c) 9.8 N d) Zero

439. Galileo writes that for angles of projection of a projectile at angles $(45+\theta)$ and $(45-\theta)$, the horizontal ranges described by the projectile are in the ratio of (if $\theta \leq 45$)
a) 2 : 1 b) 1 : 2 c) 1 : 1 d) 2 : 3

440. A tennis ball rolls off the top of a stair case way with a horizontal velocity u ms^{-1}. If the steps are b metre wide and h metre high, the ball will hit the edge of the nth step,
if
a) $n=\frac{2hu}{gb^2}$ b) $n=\frac{2hu^2}{gb^2}$ c) $n=\frac{2hu^2}{gb}$ d) $n=\frac{hu^2}{gb^2}$

441. 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 : 3 b) 1 : 1 c) $1:\sqrt{3}$ d) $\sqrt{3}:1$

442. A pallet of mass 1 g is moving with an angular velocity of 1 rads^{-1} along a circle of radius 1 m the centrifugal force is
a) 0.1 dyne b) 12 dyne c) 10 dyne d) 100 dyne

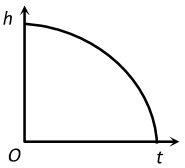
443. What will be the maximum speed of a car on a road-turn of radius 30m if the coefficient of friction between the tyres and the road is 0.4?
a) 10.84 ms^{-1} b) 9.84 ms^{-1} c) 8.84 ms^{-1} d) 6.84 ms^{-1}

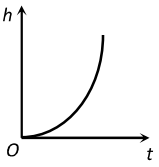
444. Two particles A and B are projected with same speed so that ratio of their maximum heights reached is 3:1. If the speed of A is doubled without altering other parameters, the ratio of horizontal ranges attained by A and B is
a) 1:1 b) 2:1 c) 4:1 d) 3:2

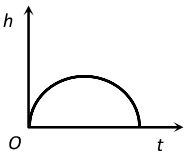
445. When a ceiling fan is switched off its angular velocity reduces to 50% while it makes 36 rotations. How many more rotation will it make before coming to rest (Assume uniform angular retardation)
a) 18 b) 12 c) 36 d) 48

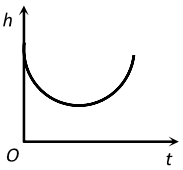
446. An object is tied to a string and rotated in a vertical circle of radius r. Constant speed is maintained along the trajectory. If $T_{max}/T_{min}=2$, then v^2/rg is
a) 1 b) 2 c) 3 d) 4

447. What is the angle between $\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}$
a) 0° b) $\pi/6$ c) $\pi/3$ d) None of these

448. Which of the following is the graph between the height (h) of a projectile and time (t), when it is projected from the ground
a) 

b) 

c) 

d) 

449. In a vertical circle of radius r, at what point in its path a particle has tension equal to zero if it is just able to complete the vertical circle
a) Highest point b) Lowest point
c) Any point d) At a point horizontally from the centre of circle of radius r

450. In the above question, if the angular velocity is kept same but the radius of the path is halved, the new

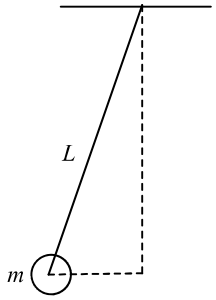
force will be

a) $2F$ b) F^2 c) $F/2$ d) $F/4$

451. An unbanked curve has a radius of 60 m. The maximum speed at which the car make a turn is (Take $\mu = 0.75$)

a) 7 ms^{-1} b) 14 ms^{-1} c) 21 ms^{-1} d) 2.1 ms^{-1}

452. A ball of mass(m)0.5 kg is attached to the end of a string having length (L) 0.5 m. The ball is rotated on a horizontal circular path about vertical axis. The maximum tension that the string can bear is 324 N. The maximum possible value of angular velocity of ball (in rad/s) is



a) 9 b) 18 c) 27 d) 36

453. In resultant of which of the following sets of forces can not be zero

a) 10,20 and 40 b) 10,10 and 20 c) 10,20 and 20 d) 10,10 and 10

454. A particle of mass m is tied to one end of a string of length l and rotated through the other end along a horizontal circular path with speed v. The work done in half horizontal circle is

a) Zero b) $\left(\frac{mv^2}{l}\right)2\pi l$ c) $\left(\frac{mv^2}{l}\right)\pi l$ d) $\left(\frac{mv^2}{l}\right)l$

455. A particle moves with constant angular velocity in circular path of certain radius and is acted upon by a certain centripetal force F. If the angular velocity is doubled keeping radius the same, the new force will be

a) $2F$ b) F^2 c) $4F$ d) $F/2$

456. A projectile is fired at an angle of 30° to the horizontal such that the vertical component of its initial velocity is 80 ms^{-1}. Its time of flight is T. Its velocity at $t = \frac{T}{4}$ has a magnitude of nearly

a) 200 ms^{-1} b) 300 ms^{-1} c) 140 ms^{-1} d) 100 ms^{-1}

457. If a particle of mass m is moving in a horizontal circle of radius r with a centripetal force $(-K/r^2)$ the total energy is

a) $-\frac{K}{2r}$ b) $-\frac{K}{r}$ c) $-\frac{2K}{r}$ d) $-\frac{4K}{r}$

458. Two particles A and B are projected with same speed so that the ratio of their maximum heights reached is $3:1$. If the speed of A is doubled without altering other parameters, the ratio of the horizontal ranges attained by A and B is

a) $1:1$ b) $2:1$ c) $4:1$ d) $3:2$

459. A gun is aimed at a target in a line of its barrel. The target is released and allowed to fall under gravity at the same instant the gun is fired. The bullet will

a) Pass above the target b) Pass below the target

c) Hit the target d) Certainly miss the target

460. A grass hopper finds that he can jump a maximum horizontal distance of 1 m. With what speed can be travel along the path if he speeds a negligible time on the ground

a) 9.8 ms^{-1} b) 4.42 ms^{-1} c) 2.21 ms^{-1} d) 3.13 ms^{-1}

461. A body of mass m is moving in a circle of radius r with a constant speed v. The force on the body is $\frac{mv^2}{r}$ and is directed towards the centre. What is the work done by this force in moving the body over half the circumference of the circle

a) $\frac{mv^2}{r} \times \pi r$ b) Zero c) $\frac{mv^2}{r^2}$ d) $\frac{\pi r^2}{mv^2}$

462. Given $\vec{P} \cdot \vec{Q} = 0$, then $|\vec{P} \times \vec{Q}|$ is

a) $|\vec{P}||\vec{Q}|$ b) Zero c) 1 d) $\sqrt{PQ}$

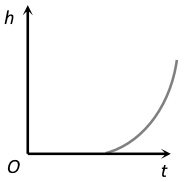
463. A car wheel is rotated to uniform angular acceleration about its axis. Initially its angular velocity is zero. It rotates through an angle θ_1 in the first 2 s , in the next 2 s, it rotates through an additional angle θ_2, the ratio of $\frac{\theta_2}{\theta_1}$ is

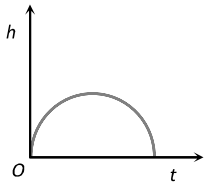
a) 1 b) 2 c) 3 d) 5

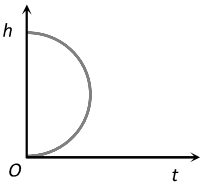
464. A mass of 2 kg is whirled in a horizontal circle by means of a string at an initial speed of 5 $revolutions\ per\ minute$. Keeping the radius constant the tension in the string is doubled. The new speed is nearly

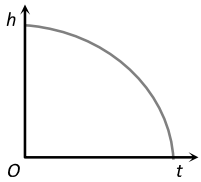
a) 14 rpm b) 10 rpm c) 2.25 rpm d) 7 rpm

465. Which of the following is the altitude-time graph for a projectile thrown horizontally from the top of the tower

a) 

b) 

c) 

d) 

466. A car takes a turn around a circular curve. If it turns at double the speed, the tendency to overturn is

a) Halved b) Doubled c) Quadrupled d) Unchanged

467. A body is projected with speed v ms^{-1} at angle θ. The kinetic energy at the highest point is half of the initial kinetic energy. The value of θ is

a) 30° b) 45° c) 60° d) 90°

468. A ball of mass 0.25 kg attached to the end of string of length 1.96 m moving in a horizontal circle. The string will break if the tension is more than 25 N. What is the maximum speed with which the ball can be moved

a) 14 m/s b) 3 m/s c) 3.92 m/s d) 5 m/s

469. An aeroplane moving horizontally at a speed of 200 ms^{-1} and at a height of 8×10^3m is to drop a bomb on a target. At what horizontal distance from the target should the bomb be released? (Take g = 10 ms^{-2})

a) 9124 m b) 8714 m c) 8000 m d) 7234 m

470. The horizontal range of an oblique projectile is equal to the distance through which a projectile has to fall freely from rest to acquire a velocity equal to the velocity of projection in magnitude. The angle of projection is

a) 75° b) 60° c) 45° d) 30°

471. A body of mass m tied to a string is moved in a vertical circle of radius r. The difference in tensions at the lowest point and the highest point is

a) 2 mg b) 6 mg c) 4 mg d) 8 mg

472. The speed of projection of a projectile is increased by 10%, without changing the angel of projection. The percentage increase in the range will be

a) 10% b) 20% c) 15% d) 5%

473. If $\vec{A} = 2\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{B} = 3\hat{i} - 6\hat{j} + 2\hat{k}$, then vector perpendicular to both $\vec{A}$ and $\vec{B}$ has magnitude k times that $(6\hat{i} + 2\hat{j} - 3\hat{k})$. That k is equal to

a) 1 b) 4 c) 7 d) 9

474. For a body moving in a circular path, a condition for no skidding if μ is the coefficient of friction, is

a) $\frac{mv^2}{r} \leq \mu mg$ b) $\frac{mv^2}{r} \geq \mu mg$ c) $\frac{v}{r} = \mu g$ d) $\frac{mv^2}{r} = \mu mg$

475. Given, $\vec{P} = \vec{A} + \vec{B}$ and $P = A + B$. The angle between $\vec{A}$ and $\vec{B}$ is

a) $0°$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{2}$ d) π

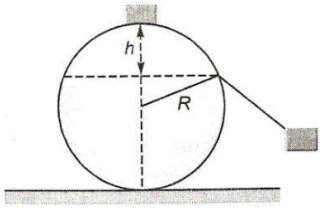
476. A particle covers 50 m distance when projected with an initial speed. On the same surface it will cover a distance, when projected with double the initial speed
a) 100 m b) 150 m c) 200 m d) 250 m

477. A particle is moving in a vertical circle. The tensions in the string when passing through two positions at angles 30° and 60° from vertical (lowest position) are T_1 and T_2 respectively. then
a) $T_1 = T_2$ b) $T_2 > T_1$
c) $T_1 > T_2$ d) Tension in the string always remains the same

478. A ball is projected upwards from the top of tower with a velocity 50 ms^{-1} making an angle 30° with the horizontal. The height of tower is 70m. After how many seconds from the instant of throwing will the ball reach the ground?
a) 2 s b) 5 s c) 7 s d) 9 s

479. In the above question, the percentage increase in the time of flight of the projectile will be
a) 5% b) 10% c) 15% d) 20%

480. A particle originally at a rest at the highest point of a smooth circle in a vertical plane, is gently pushed and starts sliding along the circle. It will leave the circle at a vertical distance h below the highest point such that



a) $h = 2R$ b) $h = \frac{R}{2}$ c) $h = R$ d) $h = \frac{R}{3}$

481. A projectile is fired at an angle of 45° with the horizontal. Elevation angle of the projectile at its highest point as seen from the point of projection, is:
a) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ b) 45° c) 60° d) $\tan^{-1}\frac{1}{2}$

482. A roller coaster is designed such that riders experience 'weightlessness' as they go round the top of a hill whose radius of curvature is 20 m. The speed of the car at the top the hill is between
a) 14 ms^{-1} and 15 ms^{-1} b) 15 ms^{-1} and 16 ms^{-1} c) 16 ms^{-1} and 17 ms^{-1} d) 13 ms^{-1} and 14 ms^{-1}

483. A wheel of radius 1m rolls forward half a revolution on a horizontal ground. The magnitude to the displacement of the point of the wheel initially in contact with the ground is
a) 2π b) $\sqrt{2\pi}$ c) $\sqrt{\pi^2 + 4}$ d) π

484. A motor cyclist moving with a velocity of 72 $km/hour$ on a flat road takes a turn on the road at a point where the radius of curvature of the road is 20 m. The acceleration due to gravity is 10 $m/\sec^2$. In order to avoid skidding, he must not bend with respect to the vertical plane by an angle greater than
a) $\theta = \tan^{-1} 6$ b) $\theta = \tan^{-1} 2$ c) $\theta = \tan^{-1} 25.92$ d) $\theta = \tan^{-1} 4$

485. A body of mass 0.4 kg is whirled in a vertical circle making 2rev/s. If the radius of the circle is 2m, then tension in the string when the body is at the top of the circle is
a) 41.56 N b) 89.86 N c) 109.86 N d) 115.86 N

486. A particle is kept at rest at the top of a sphere of diameter 42 m. When disturbed slightly, it slides down. At what height 'h' from the bottom, the particle will leave the sphere
a) 14 m b) 28 m c) 35 m d) 7 m

487. In case of uniform circular motion which of the following physical quantity do not remain constant
a) Speed b) Momentum c) Kinetic energy d) Mass

488. The magnitude of the vectors product o two vectors is $\sqrt{3}$ times their scalar product. The angle between the two vectors is

a) 90° b) 60° c) 45° d) 30°

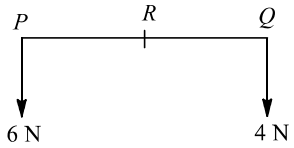
489. A projectile is thrown in the upward direction making an angle of 60° with the horizontal direction with velocity of147 ms^{-1}. Then the time after which its inclination with the horizontal is 45°, is
a) 25 s b) 10.98 s c) 5.49 s d) 2.745 s

490. If α is angular acceleration, ω is angular velocity and a is the centripetal acceleration then, which of the following is true?
a) $\alpha = \frac{\omega a}{v}$ b) $\alpha = \frac{v}{\omega a}$ c) $\alpha = \frac{va}{\omega}$ d) $\alpha = \frac{a}{\omega v}$

491. A car of mass 1000 kg negotiates a banked curve of radius 90 m on a frictionless road. If the banking angle is 45°, the speed of the car is
a) $20ms^{-1}$ b) $30ms^{-1}$ c) $5ms^{-1}$ d) $10ms^{-1}$

492. In uniform circular motion of a particle
a) Velocity is constant but acceleration is variable
b) Velocity is variable but acceleration in constant
c) Both speed and acceleration are constant
d) Speed is constant but acceleration is variable

493. The resultant of a system of forces shown in figure is a force of 10 N parallel to given forces through R, where PR equals



a) $(2/5)R\ \ Q$ b) $(3/5)R\ \ Q$ c) $(2/3)R\ \ Q$ d) $(1/2)R\ \ Q$

494. The angle of banking is independent of
a) speed of vehicle b) radius of curvature of road
c) height of inclination d) None of the above

495. In an atom for the electron to revolve around the nucleus, the necessary centripetal force is obtained from the following force exerted by the nucleus on the electron
a) Nuclear force b) Gravitational force c) Magnetic force d) Electrostatics force

496. The resultant of two forces, each P, acting at an angle θ is
a) $2P\sin\frac{\theta}{2}$ b) $2P\cos\frac{\theta}{2}$ c) $2P\cos\theta$ d) $P\sqrt{2}$

497. The resultant of two vectors of magnitudes $2A$ and $\sqrt{2}A$ acting at an angle θ is $\sqrt{10}A$. The correct value of θ is
a) 30° b) 45° c) 60° d) 90°

498. A ball is projected upwards from the top of a tower with a velocity of 50 ms^{-1} making an angle of 60° with the vertical. If the height of the tower is 70 m, then the ball will reach the ground in (Take g = 10 ms^{-2})
a) 2 s b) 3 s c) 5 s d) 7 s

499. A projectile is given an initial velocity of $\hat{\mathbf{i}} + 2\hat{\mathbf{j}}$. The cartesian equation of its path is (g = 10 ms^{-2})
a) $y = x - 5x^2$ b) $y = 2x - 5x^2$ c) $y = 2x - 15x^2$ d) $y = 2x - 25\,x^2$

500. A ball thrown by a boy is caught by another after 2 sec some distance away in the same level. If the angle of projection is 30°, the velocity of projection is
a) 19.6 m/s b) 9.8 m/s c) 14.7 m/s d) None of these

501. On an unbanked road, a cyclist negotiating a bend of radius r at velocity v leans inwards by an angle
a) $\tan^{-1}\left(\frac{v^2}{2gr}\right)$ b) $\tan^{-1}\left(\frac{v^2}{gr}\right)$ c) $\tan^{-1}\left(\frac{rg}{v^2}\right)$ d) $\tan^{-1}\left(\frac{v}{gr}\right)$

502. A particle is moving in a circle of radius R with constant speed v, if radius is double then its centripetal force to keep the same speed should be
a) Doubled b) Halved c) Quadrupled d) Unchanged

503. The coordinates of a moving particle at any time $'t'$ are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time $'t'$ is given by

a) $\sqrt{\alpha^2 + \beta^2}$ b) $3t\sqrt{\alpha^2 + \beta^2}$ c) $3t^2\sqrt{\alpha^2 + \beta^2}$ d) $t^2\sqrt{\alpha^2 + \beta^2}$

504. A string of length l is fixed at one end and caries a mass m at the other end. The string makes $2/\pi$ rps around a vertical axis through the fixed end. What is the tension in string?

a) $m\ l$ b) $16\ m\ l$ c) $4\ m\ l$ d) $2\ m\ l$

505. A particle of mass m moves with constant speed along a circular path of radius r under the action of a force F. Its speed is

a) $\sqrt{\frac{rF}{m}}$ b) $\sqrt{\frac{F}{r}}$ c) $\sqrt{Fmr}$ d) $\sqrt{\frac{F}{mr}}$

506. A stone is thrown at an angle θ to the horizontal reaches a maximum heights H. then the time of flight of stone will be

a) $\sqrt{\frac{2H}{g}}$ b) $2\sqrt{\frac{2H}{g}}$ c) $\frac{2\sqrt{2H\sin\theta}}{g}$ d) $\frac{\sqrt{2H\sin\theta}}{g}$

507. What should be the angular velocity of earth so that a body on its equator is weightless?

a) $\frac{1}{8000}\,\text{rad s}^{-1}$ b) $\frac{1}{8}\,\text{rad s}^{-1}$ c) $\frac{1}{800}\,\text{rad s}^{-1}$ d) $\frac{1}{80}\,\text{rad s}^{-1}$

508. $(\vec{P} + \vec{Q})$ is a unit vector along X-axis. If $\vec{P} = \hat{i} - \hat{j} + \hat{k}$, then what value is $\vec{Q}$?

a) $\hat{i} + \hat{j} - \hat{k}$ b) $\hat{j} - \hat{k}$ c) $\hat{i} + \hat{j} + \hat{k}$ d) $\hat{j} + \hat{k}$

509. A ball is projected from the ground at a speed of 10ms^{-1} making an angle of 30° with the horizontal. Another ball is simultaneously released from a point on the vertical line along the maximum height of the projectile. The initial height of the second ball is $(g = 10\text{ms}^{-2})$

a) 6.25 m b) 2.5 m c) 3.75 m d) 5 m

510. A particle is moving in a circle with uniform speed$v$. In moving from a point to another diametrically opposite point

a) the momentum changes by mv b) the momentum changes by $2\ mv$

c) the kinetic energy changes by $(1/2)\ mv^2$ d) the kinetic energy changes by mv^2

511. If the range of a gun which fires a shell with muzzle speed V is R, then the angle of elevation of the gun is

a) $\cos^{-1}\left(\frac{V^2}{Rg}\right)$ b) $\cos^{-1}\left(\frac{gR}{V^2}\right)$ c) $\frac{1}{2}\left(\frac{V^2}{Rg}\right)$ d) $\frac{1}{2}\sin^{-1}\left(\frac{gR}{V^2}\right)$

512. On the centre of a frictionless table a small hole is made, through which a weightless string of length $2l$ is inserted. On the two ends of the string two balls of the same mass m are attached. Arrangement is made in such a way that half of the string is on the table top and half is hanging below. The ball on the table top is made to move in a circular path with a constant speed v. What is the centripetal acceleration of the moving ball

a) mvl b) g c) Zero d) $2mvl$

513. A body of mass 1 kg is moving in a vertical circular path of radius 1 m. The difference between the kinetic energies at its highest and lowest point is

a) 20 J b) 10 J c) $4\sqrt{5}$ J d) $10\sqrt{5}$ J

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

a) $\tan^{-1}(2)$ b) $\tan^{-1}(4)$ c) $\cot^{-1}(2)$ d) 60°

515. A stone of mass 1 kg tied to the end of a string of length 1 m, is whirled in a horizontal circle with a uniform angular velocity 2 rads^{-1}. The tension of the string is (in newton)

a) 2 b) $\frac{1}{3}$ c) 4 d) $\frac{1}{4}$

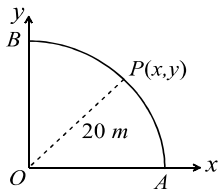
516. A tachometer is a device to measure

a) Gravitational pull b) Speed of rotation c) Surface tension d) Tension in a spring

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

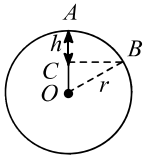
a) 2.5 ms^{-1} b) 5 ms^{-1} c) 10 ms^{-1} d) 20 ms^{-1}

518. 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 a length $s = t^3 + 5$, where s is in metres and t is in seconds. The radius of the path is 20 m. The acceleration of $''P''$ when $t = 2s$ is nearly



a) 14 m/s^2 b) 13 m/s^2 c) 12 m/s^2 d) 7.2 m/s^2

519. In figure, a particle is placed at the highest point A of a smooth sphere of radius r. It is given slight push, and it leaves the sphere at B, at a depth h vertically below A such that h is equal to



a) $\frac{r}{6}$ b) $\frac{1}{4}r$ c) $\frac{1}{3}r$ d) $\frac{1}{2}r$

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

a) $\pi\frac{v^2}{g}$ b) $\pi\frac{v^4}{g^2}$ c) $\pi^2\frac{v^4}{g^2}$ d) $\pi^2\frac{v^2}{g^2}$

521. For a projectile thrown into space with a speed v, the horizontal range is $\frac{\sqrt{3}v^2}{2g}$. The vertical range is $\frac{v^2}{8g}$. The angle which the projectile makes with the horizontal initially is

a) 15° b) 30° c) 45° d) 60°

522. A string breaks if its tension exceeds 10 $newtons$. A stone of mass 250 gm tied to this string of length 10 cm is rotated in a horizontal circle. The maximum angular velocity of rotation can be

a) 20 rad/s b) 40 rad/s c) 100 rad/s d) 200 rad/s

523. Which one of the following statements is not correct in uniform circular motion

a) The speed of the particle remains constant b) The acceleration always points towards the centre
c) The angular speed remains constant d) The velocity remains constant

524. A stone is tied to one end of a string 50 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 10 revolutions in 20 s, what is the magnitude of acceleration of the stone

a) 493 cm/s^2 b) 720 cm/s^2 c) 860 cm/s^2 d) 990 cm/s^2

525. An aeroplane flying horizontally with a speed of 360 kmh^{-1} releases a bomb at a height of 490 m from the ground. When will the bomb strike the ground?

a) 8 s b) 6 s c) 7 s d) 10 s

526. The horizontal range of a projectile $4\sqrt{3}$ times the maximum height achieved by it, then the angle of projection is

a) 30° b) 45° c) 60° d) 90°

527. With what minimum speed a particle be projected from the origin so that it is able to pass through a given point (30 m, 40 m)?

a) 30 ms^{-1} b) 40 ms^{-1} c) 50 ms^{-1} d) 60 ms^{-1}

528. What is the value of linear velocity, if $\vec{\omega} = 3\hat{\imath} - 4\hat{\jmath} + \hat{k}$ and $\vec{r} = 5\hat{\imath} - 6\hat{\jmath} + 6\hat{k}$

a) $6\hat{\imath} + 2\hat{\jmath} - 3\hat{k}$ b) $-18\hat{\imath} - 13\hat{\jmath} + 2\hat{k}$ c) $4\hat{\imath} - 13\hat{\jmath} + 6\hat{k}$ d) $6\hat{\imath} - 2\hat{\jmath} + 2\hat{k}$

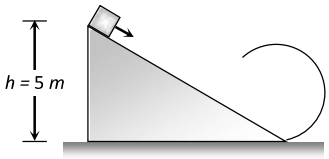
529. A particle is moving with velocity $\mathbf{v} = k(y\hat{\mathbf{i}} + x\,\hat{\mathbf{j}})$, where k is a constant. The general equation for its path is
a) $y = x^2 + \text{constant}$ b) $y^2 = x + \text{constant}$
c) $xy = \text{constant}$ d) $y^2 = x^2\text{constant}$

530. The angular speed of a car increases from 600 rpm to 1200 rpm in 10 s. What is the angular acceleration of the car?
a) 600 rad s^{-1} b) 60 rad s^{-1} c) 60 π rad m s^{-1} d) 2 π rad s^{-1}

531. What is the numerical value of the vector $3\hat{\imath} + 4\hat{\jmath} + 5\hat{k}$?
a) $3\sqrt{2}$ b) $5\sqrt{2}$ c) $7\sqrt{2}$ d) $9\sqrt{2}$

532. A 500 kg car takes a round of radius 50 m with a velocity of 36 kmh^{-1}. The centripetal force is
a) 250 N b) 750 N c) 1000 N d) 1200 N

533. As per given future to complete the circular loop what should be the radius if initial height is 5 m



a) 4 m b) 3 m c) 2.5 m d) 2 m

534. A projectile moves from the ground such that its horizontal displacement is $x = Kt$ and vertical displacement is $y = Kt(1 - \alpha t)$, where K and α are constants and t is time. Find out total time of flight (T) and maximum height attained (Y_{max}) its
a) $T = \alpha, Y_{\max} = \frac{K}{2\alpha}$ b) $T = \frac{1}{\alpha}, Y_{\max} = \frac{2K}{\alpha}$ c) $T = \frac{1}{\alpha}, Y_{\max} = \frac{K}{6\alpha}$ d) $T = \frac{1}{\alpha}, Y_{\max} = \frac{K}{4\alpha}$

535. Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are the same. Then the ratio between their centripetal acceleration is
a) R/r b) r/R c) R^2/r^2 d) r^2/R^2

536. A particle is projected with a speed v at 45° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is
a) Zero b) $\frac{mvh^2}{\sqrt{2}}$ c) $\frac{mvh}{\sqrt{2}}$ d) $\frac{mvh^3}{\sqrt{2}}$

537. If $\vec{P} = 2\hat{\imath} - 3\hat{\jmath} + \hat{k}$ and $\vec{Q} = 3\hat{\imath} - 2\hat{\jmath}$, then $\vec{P} \cdot \vec{Q}$ is
a) Zero b) 6 c) 12 d) 15

538. A body of mass m moves in a circular path with uniform angular velocity. The motion of the body has constant
a) Acceleration b) Velocity c) Momentum d) Kinetic energy

539. A ball is projected up an incline of 30° with a velocity of 30 ms^{-1} at an angle of 30° with reference to the inclined plane from the bottom of the inclined plane. If $g = 10ms^{-2}$, then the range on the inclined plane is
a) 12 m b) 60 m c) 120 m d) 600 m

540. Two bodies are thrown up at angles of 45° and 60°, respectively with the horizontal. If both bodies attain same vertical height , then the ratio of velocities with which these are thrown is
a) $\sqrt{\frac{2}{3}}$ b) $\frac{2}{\sqrt{3}}$ c) $\sqrt{\frac{3}{2}}$ d) $\frac{\sqrt{3}}{2}$

541. A proton in a cyclotron changes its velocity from $30kms^{-1}$ north to $40kms^{-1}$ east in 20 s. what is the average acceleration during this time
a) 2.5 kms^{-2}at 37° E of S b) 2.5 kms^{-2}at 37° N of E
c) 2.5 kms^{-2}at 37° N of S d) 2.5 kms^{-2}at 37° E of N

542. The minimum velocity (in ms^{-1}) with which a car driver must traverse a flat curve of radius of 150 m and coefficient of friction 0.6 to avoid skidding is
a) 60 b) 30 c) 15 d) 25

543. A bullet is to be fired with a speed of 20 ms^{-1} to hit a target 200m away on a level ground. If $g = 10\ ms^{-2}$, the gun should be aimed
a) directly at the target
b) 5 cm below the target
c) 5 cm above the target
d) 2 cm above the target

544. A projectile is projected with velocity kv_e in vertically upward direction from the ground into the space (v_e is the escape velocity and$k < 1$). If air resistance is considered to be negligible then the maximum height from the center of earth to which it can go will be (R = radus of earth)
a) $\frac{R}{k^2+1}$
b) $\frac{R}{k^2-1}$
c) $\frac{R}{1-k^2}$
d) $\frac{R}{k+1}$

545. A ball thrown by one player reaches the other in 2 s. The maximum height attained by the ball above the point of projection will be ($g = 10\ ms^{-2}$)
a) 2.5 m
b) 5 m
c) 7.5 m
d) 10 m

546. A stone tied to a string of length L is whirled in a vertical circle, with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position, and has a speed u. The magnitude of change in its velocity as it reaches a position, where the string is horizontal is
a) $\sqrt{u^2 - 2\,g\,L}$
b) $\sqrt{2\,g\,L}$
c) $\sqrt{u^2 - g\,L}$
d) $\sqrt{2(u^2 - g\,L)}$

547. A cycle wheel of radius 0.4 m completes one revolution in one $second$ then the acceleration of a point on the cycle wheel will be
a) 0.8 m/s^2
b) 0.4 m/s^2
c) 1.6 $\pi^2 m/s^2$
d) 0.4 $\pi^2 m/s^2$

548. Two projectiles A and B are thrown with velocities v and $\frac{v}{2}$ respectively. They have the same range. If B is thrown at an angle of 15° to the horizontal, a must have been thrown at an angle
a) $\sin^{-1}\left(\frac{1}{16}\right)$
b) $\sin^{-1}\left(\frac{1}{4}\right)$
c) $2\sin^{-1}\left(\frac{1}{4}\right)$
d) $\frac{1}{2}\sin^{-1}\left(\frac{1}{8}\right)$

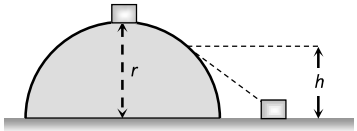
549. A ball is projected from a certain point on the surface of a planet at a certain angel with the horizontal surface. The horizontal and vertical displacement x and y vary with time t in second as
$x = 10\sqrt{3}t$ and $y = 10t - t^2$
The maximum height attained by the ball is
a) 100 m
b) 75 m
c) 50 m
d) 25 m

550. The angular speed of a fly wheel making 120 $revolutions/minute$ is
a) $2\pi\ rad/s$
b) $4\pi^2\ rad/s$
c) $\pi\ rad/s$
d) $4\pi\ rad/s$

551. An object moves along a straight line path from P to Q under the action of a force $(4\hat{i} - 3\hat{j} + 3\hat{k})$N. If the coordinates of P and Q, in metres, are $(3,3,-1)$ and $(2,-1,4)$ respectively, then the work done by the force is
a) +23 J
b) −23 J
c) 1015 J
d) $\sqrt{35}(4\hat{i} - 3\hat{j} + 2\hat{k})$ J

552. A particle has velocity $\sqrt{3rg}$ at the highest pint in vertical circle. Find the ratio of tensions at the highest and lowest point
a) 1 : 6
b) 1 : 4
c) 1 : 3
d) 1 : 2

553. A small body of mass m slides down from the top of a hemisphere of radius r. The surface of block and hemisphere are frictionless. The height at which the body lose contact with the surface of the sphere is



a) $\frac{3}{2}r$
b) $\frac{2}{3}r$
c) $\frac{1}{2}gt^2$
d) $\frac{v^2}{2g}$

554. A body is thrown upward from the earth surface with velocity 5 m/s and from a planet surface with velocity 3 m/s. Both follow the same path. What is the projectile acceleration due to gravity on the planet
a) 2 m/s^2
b) 3.5 m/s^2
c) 4 m/s^2
d) 5 m/s^2

555. The maximum range of a gun on horizontal terrain is 16 km. If $g = 10\ m/s^2$. What must be the muzzle

velocity of the shell

a) 200 m/s b) 400 m/s c) 100 m/s d) 50 m/s

556. Ratio between maximum range and square of time of flight in projectile motion is

a) 10 : 49 b) 49 : 10 c) 98 : 10 d) 10 : 98

557. A body of mass m is suspended from a string of length l. What is minimum horizontal velocity that should be given to the body in its lowest position so that it may complete one full revolution in the vertical plane with the point of suspension as the centre of the circle

a) $v = \sqrt{2lg}$ b) $v = \sqrt{3lg}$ c) $v = \sqrt{4lg}$ d) $v = \sqrt{5lg}$

558. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is

a) $\frac{ML\omega^2}{2}$ b) $ML\omega^2$ c) $\frac{ML\omega^2}{4}$ d) $\frac{ML^2\omega^2}{2}$

559. An object is being weighed on a spring balance moving around a curve of radius 100 m at a speed 7 ms^{-1}. The object has a weight of 60 kg-wt. The reading registered on the spring balance would be

a) 60.075 kg-wt b) 60.125 kg-wt c) 60.175 kg-wt d) 60.225 kg-wt

560. A vector $\overrightarrow{F_1}$ is along the positive Y-axis. If its vector product with another vector $\overrightarrow{F_1}$ is zero, then $\overrightarrow{F_2}$ could be

a) $4\hat{j}$ b) $\hat{j} + \hat{k}$ c) $\hat{j} - \hat{k}$ d) $-4\hat{i}$

561. Two stones are projected with same velocity v at an angle θ and $(90° - \theta)$. If H and H_1 are greatest heights in the two paths, what is the relation between R, H and H_1?

a) $R = 4\sqrt{HH_1}$ b) $R = \sqrt{HH_1}$ c) $R = 4HH_1$ d) None of these

562. A sphere is suspended by a thread of length l. The minimum horizontal velocity which has to be imparted to the sphere for it to reach the height of suspension is

a) $2\sqrt{gR}$ b) $\sqrt{2gl}$ c) 2 g l d) g l

563. After one second the velocity of a projectile makes an angle of 45° with the horizontal. After another one second it is travelling horizontally. The magnitude of its initial velocity and angle of projection are (g = 10 ms^{-2})

a) 14.02 $ms^{-1}, \tan^{-1}(2)$ b) 22.36 $ms^{-1}, \tan^{-1}(2)$ c) 14.62 ms^{-1}, 60° d) 22.36 ms^{-1}, 60°

564. A particle (A) is dropped from a height and another particle (B) is thrown in horizontal direction with speed of 5 m/sec from the same height. The correct statement is

a) Both particles will reach at ground simultaneously

b) Both particles will reach at ground with same speed

c) Particle (A) will reach at ground first with respect to particle (B)

d) Particle (B) will reach at ground first with respect to particle (A)

565. A car is travelling at a velocity of 10 kmh^{-1} on a straight road. The driver of the car throws a parcel with a velocity of $10\sqrt{2}$ kmh^{-1} when the car is passing by a man standing on the side of the road. If the parcel is to reach the man, the direction of throw makes the following angle with direction of the car

a) 135° b) 45° c) $\tan^{-1}(\sqrt{2})60°$ d) $\tan\left(\frac{1}{\sqrt{2}}\right)$

566. Angle between $\vec{A}$ and $\vec{B}$ is θ. What is the value of $\vec{A}.(\vec{B} \times \vec{A})$?

a) $A^2B\cos\theta$ b) $A^2B\sin\theta\cos\theta$ c) $A^2B\sin\theta$ d) zero

567. A car is moving with speed 30 m/sec on a circular path of radius 500 m. Its speed is increasing at the rate of $2m/\sec^2$, What is the acceleration of the car

a) $2m/\sec^2$ b) $2.7m/\sec^2$ c) $1.8m/\sec^2$ d) $9.8m/\sec^2$

568. The $x - y$ plane is the boundary between two transparent media. A medium I has a refractive index $\mu_1 = \sqrt{2}$ and medium II has a refractive index $\mu_2 = \sqrt{3}$. A ray of light in medium I, given by vector, $\vec{A} = \sqrt{3}\hat{i} - \hat{k}$ is incident on the plane of separation. The unit vector in the direction of the refracted ray in medium II is

a) $\frac{1}{\sqrt{2}}(\hat{\imath}+\hat{k})$ b) $\frac{1}{\sqrt{2}}(\hat{\imath}+\hat{\jmath})$ c) $\frac{1}{\sqrt{2}}(\hat{k}-\hat{\imath})$ d) $\frac{1}{\sqrt{2}}(\hat{\imath}-\hat{k})$

569. The equation of motion of a projectile are given by $x = 36\,t\ metre$ and $2y = 96\,t - 9.8\,t^2\ metre$. The angle of projection is

a) $\sin^{-1}\left(\frac{4}{5}\right)$ b) $\sin^{-1}\left(\frac{3}{5}\right)$ c) $\sin^{-1}\left(\frac{4}{3}\right)$ d) $\sin^{-1}\left(\frac{3}{4}\right)$

570. What happens to the centripetal acceleration of a particle, when its speed is doubled and angular velocity is halved?

a) Doubled b) Halved
c) Remains unchanged d) Becomes 4 times

571. A boy playing on the roof of a 10 m high building throws a ball with a speed of 10ms^{-1} at an angle of 30° with the horizontal. How far from the throwing point will the ball be at the height of 10 m from the ground? [g $= 10\text{ms}^{-2}, \sin 30° = 1/2, \cos 60° = \sqrt{3}/2$]

a) 5.20 m b) 4.33 m c) 2.60 m d) 8.66 m

572. A body is fired vertically upward. At half the maximum height, the velocity of the body is 10 m/s. The maximum height raised by the body is

a) 0 m b) 10 m c) 15 m d) 20 m

573. A stone tied with string, is rotated in a vertical circle. The minimum speed with which the string has to be rotated

a) Is independent of the mass of the stone b) Is independent of the length of the string
c) Decreases with increasing mass of the stone d) Decreases with increasing length of the string

574. A body of mass 0.5 kg is projected under gravity with a speed of 98 m/s at an angle of 30° with the horizontal. The change in momentum (in magnitude) of the body is

a) 24.5 $N-s$ b) 49.0 $N-s$ c) 98.0 $N-s$ d) 50.0 $N-s$

575. At the height 80 m, an aeroplane is moving with 150 ms^{-1}. A bomb is dropped from it, so as to hit a target. At what distance from the target should bomb be dropped? ($g = 10\ \text{ms}^{-2}$)

a) 605.3 m b) 600m c) 80 m d) 230m

576. A ball is projected horizontally with a velocity of 5 m/s from the top of a building 19.6 m high. How long will the ball take to hit the ground

a) $\sqrt{2}\ s$ b) 2 s c) $\sqrt{3}\ s$ d) 3 s

577. The maximum speed of a car on a road-turn of radius 30 m, if the coefficient of friction between the tyres and the road is 0.4, will be

a) 10.84 m/sec b) 9.84 m/sec c) 8.84 m/sec d) 6.84 m/sec

578. A stone projected with a velocity u at an angle θ with the horizontal reaches maximum height H_1. When it is projected with velocity u at an angle $\left(\frac{\pi}{2}-\theta\right)$ with the horizontal, it reaches maximum height H_2. The relation between the horizontal range R of the projectile, H_1 and H_2 is

a) $R = 4\sqrt{H_1H_2}$ b) $R = 4(H_1 - H_2)$ c) $R = 4(H_1 + H_2)$ d) $R = \frac{H_1^2}{H_2^2}$

579. A body of mass m is thrown upwards at an angle θ with the horizontal with velocity v. While rising up the velocity of the mass after t seconds will be

a) $\sqrt{(v\cos\theta)^2 + (v\sin\theta)^2}$ b) $\sqrt{(v\cos\theta - v\sin\theta)^2 - gt}$
c) $\sqrt{v^2 + g^2t^2 - (2v\sin\theta)gt}$ d) $\sqrt{v^2 + g^2t^2 - (2v\cos\theta)gt}$

580. A car round an unbanked curve of radius 92 m without skidding at a speed of 26 ms^{-1}. The smallest possible coefficient of static friction between the tyres and the road is

a) 0.75 b) 0.60 c) 0.45 d) 0.30

581. The coefficient of friction between the tyres and the road is 0.25. The maximum speed with which a car can be driven round a curve a radius 40 m without skidding is (assume $g = 10\ ms^{-2}$)

a) 40 ms^{-1} b) 20 ms^{-1} c) 15 ms^{-1} d) 10 ms^{-1}

582. A body executing uniform circular motion has at any instant its velocity vector and acceleration vector
a) along the same direction
b) in opposite direction
c) normal to each other
d) not related to each other

583. A man throws a ball vertically upwards and it rises through 20 m and returns to his hands. What was the initial velocity (u) of the ball and for how much time (T) it remained in the air? ($g = 10\ ms^{-2}$)
a) $u = 10\ ms^{-1}; T = 2\ s$ b) $u = 10\ ms^{-1}; T = 4\ s$ c) $u = 20\ ms^{-1}; T = 2\ s$ d) $u = 20\ ms^{-1}; T = 4\ s$

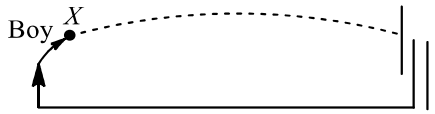
584. An object is moving in a circle of radius 100 m with a constant speed of 31.4 m/s. What is its average speed for one complete revolution
a) Zero b) 31.4 m/s c) 3.14 m/s d) $\sqrt{2} \times 31.4\ m/s$

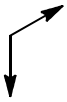
585. A force of $(7\hat{i} + 6\hat{k})$ N makes a body move on a rough plane with a velocity of $(3\hat{j} + 4\hat{k})ms^{-1}$. Calculate the power in watt
a) 24 b) 34 c) 21 d) 45

586. A 2 kg stone at the end of a string 1 m long is whirled in a vertical circle at a constant speed. The speed of the stone is 4 m/sec. The tension in the string will be 52 N, when the stone is
a) At the top of the circle
b) At the bottom of the circle
c) Halfway down
d) None of the above

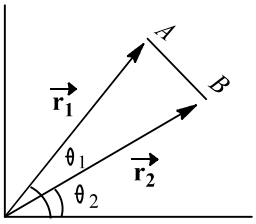
587. If $\vec{A} \cdot \vec{B} = 0$ and $\vec{A} \times \vec{B} = 1$, then $\vec{A}$ and $\vec{B}$ are
a) Perpendicular unit vectors
b) Parallel unit vectors
c) Parallel
d) Perpendicular.

588. A boy throws a cricket ball from the boundary to the wicket-keeper. If the frictional force due to air cannot be ignored, the forces acting on the ball at the position X are respected by



a)  b)  c)  d) 

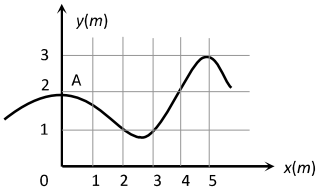
589. In a two dimensional motion of a particle, the particle moves from point A, position vector $\vec{r}_1$. If the magnitudes of these vectors are respectively, r_1=3 and $r_2 = 4$ and the angles they make with the x-axis are $\theta_1 = 75°$ and 15°, respectively, then find the magnitude of the displacement vector



a) 15 b) $\sqrt{13}$ c) 17 d) $\sqrt{15}$

590. A body moves along a circular path of radius 10 m and the coefficient of friction is 0.5. What should be its angular speed in rad s^{-1}, if it is not to slip from the surface? ($g = 9.8\ ms^{-2}$)
a) 5 b) 10 c) 0.1 d) 0.7

591. The trajectory of a particle moving in vast maidan is as shown in the figure. The coordinates of a position A are (0,2). The coordinates of another point at which the instantaneous velocity is same as the average velocity between the points are



a) $(1,4)$ b) $(5,3)$ c) $(3,4)$ d) $(4,1)$

592. A particle is moving with velocity $\vec{v} = K(y\hat{\imath} + x\hat{\jmath})$, where K is a constant. The general equation for its path is

a) $y^2 = x^2 + \text{constant}$ b) $y = x^2 + \text{constant}$ c) $y^2 = x + \text{constant}$ d) $xy = \text{constant}$

593. A bucket tied at the end a 1.6 m long string is whirled in a vertical circle with constant speed. What should be the minimum speed so that the water from the bucket does not spill, when the bucket is at the highest position (Take $g = 10m/\sec^2$)

a) $4\ m/sec$ b) $6.25\ m/sec$ c) $16\ m/sec$ d) None of the above

594. A particle moves in a circle of radius 5 cm with constant speed and time period 0.2 πs. The acceleration of the particle is

a) $5\ m/s^2$ b) $15\ m/s^2$ c) $25\ m/s^2$ d) $36\ m/s^2$

595. A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has speed u. The magnitude of the change in its velocity as it reaches a position where the string is horizontal is

a) $\sqrt{u^2 - 2gL}$ b) $\sqrt{2gL}$ c) $\sqrt{u^2 - gl}$ d) $\sqrt{2(u^2 - gL)}$

596. If time of flight of a projectile is 10 seconds. Range is 500 $meters$. The maximum height attained by it will be

a) $125\ m$ b) $50\ m$ c) $100\ m$ d) $150\ m$

597. A force $\vec{F} = 2\hat{\imath} + 2\hat{\jmath}$ N displaces a particle through $\vec{S} = 2\hat{\imath} + 2\hat{k}$ m in 16 s. The power developed by $\vec{F}$ is

a) $0.25\ \text{J s}^{-1}$ b) $25\ \text{J s}^{-1}$ c) $225\ \text{J s}^{-1}$ d) $450\ \text{J s}^{-1}$

598. A vector $\vec{A}$ points vertically upwards and $\vec{B}$ points upwards North. The vector product $\vec{A} \times \vec{B}$ is

a) Zero b) along East

c) along West d) vertically downwards

599. A body is projected horizontally with speed $20\ \text{ms}^{-1}$. The approximate displacement of the body after 5 s is

a) 80 m b) 120 m c) 160 m d) 320 m

600. A particle moves along a parabolic path $y = 9x^2$ in such a way that the x-componentes of velocity remains constant and has a value $\frac{1}{3}\ \text{ms}^{-1}$. The acceleration of the projectile is

a) $\frac{1}{2}\hat{\mathbf{j}}\ \text{ms}^{-2}$ b) $3\hat{\mathbf{j}}\ \text{ms}^{-2}$ c) $\frac{2}{3}\hat{\mathbf{j}}\ \text{ms}^{-2}$ d) $2\hat{\mathbf{j}}\ \text{ms}^{-2}$

601. The range of particle when launched at an angle $15°$ with the horizontal is 1.5 km. What is the range of projectile when launched at an angle of $45°$ to the horizontal?

a) 3.0 km b) 1.5 km c) 6.0 km d) 0.75 km

602. What vector must be added to the sum of two vectors $2\hat{\imath} - \hat{\jmath} + 3\hat{k}$ and $3\hat{\imath} - 2\hat{\jmath} - 2\hat{k}$ so that the resultant is a unit vector along Z-axis.

a) $5\hat{\imath} + \hat{k}$ b) $-5\hat{\imath} + 3\hat{\jmath}$ c) $3\hat{\jmath} + 5\hat{k}$ d) $-3\hat{\jmath} + 2\hat{k}$

603. A mass of 100 g is tied to one end of string 2 m long. The body is revolving in a horizontal circle making a maximum of 200 revolutions/min. The other end of the string is fixed at the centre of the circle of revolution. The maximum tension that the string can bear is approximately

a) 8.76 N b) 8.94 N c) 89.42 N d) 87.64 N

604. A bucket tied at the end of 11.6 m long string is whirled in a vertical circle with a constant speed. The minimum speed at which water from the bucket does not spill when it is a the highest position is

a) $4\ \text{ms}^{-1}$ b) $6.25\ \text{ms}^{-1}$ c) $2\ \text{ms}^{-1}$ d) $16\ \text{ms}^{-1}$

605. A block of mass m at the end of a string is whirled round in a vertical circle of radius R. The critical speed of the block at the top of its swing below which the string would slacken before the block reaches the top is

a) Rg b) $(Rg)^2$ c) R/g d) $\sqrt{Rg}$

606. A body of mass m is projected with a speed u making an angle α with the horizontal. The change in momentum suffered by the body along he y-axis between the starting point and the highest point of its

path will be

a) $mu\cos\alpha$ b) $mu\sin\alpha$ c) $3\,mu\sin\alpha$ d) mu

607. A bob of mass 10 kg is attached to wire 0.3 m long. Its breaking stress is $4.8\times10^{7}N/m^{2}$. The area of cross section of the wire is $10^{-6}m^{2}$. The maximum angular velocity with which it can be rotated in a horizontal circle

a) 8 rad/sec b) 4 rad/sec c) 2 rad/sec d) 1 rad/sec

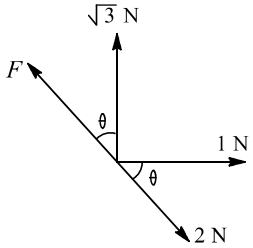
608. A ball is projected upwards from the top of tower with a velocity 50 ms^{-1} making an angle 30° with the horizontal. The height of tower is 70 m. After how many seconds from the instant of throwing will the ball reach the ground

a) 2 s b) 5 s c) 7 s d) 9 s

609. A railway carriage has its centre of gravity at a height of 1 m above the rails, which are 1.5 m apart. The maximum safe speed at which it could travel round an unbanked curve of radius 100 m is

a) 12 ms^{-1} b) 18 ms^{-1} c) 22 ms^{-1} d) 27 ms^{-1}

610. Four concurrent coplanar forces in newton are acting at a point and keep it in equilibrium figure. Then values of F and θ are



a) 1 N, 60° b) 2 N, 60° c) $\sqrt{2}$ N,90° d) 2 N, 90°

611. Two bodies are projected from ground with equal speeds 20 m/sec from the same position in same vertical plane to have equal range but at different angle above the horizontal. If one of the angle is 30° the sum of their maximum heights is (assume $g=10m/s^{2}$)

a) 400 m b) 20 m c) 30 m d) 40 m

612. The length of second's hand in a watch is 1 cm. The change in velocity of its tip in 15 seconds is

a) Zero b) $\frac{\pi}{30\sqrt{2}}\ cm/sec$ c) $\frac{\pi}{30}\ cm/sec$ d) $\frac{\pi\sqrt{2}}{30}\ cm/sec$

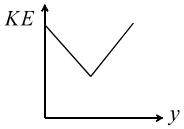
613. A particle A is projected from the ground with an initial velocity of 10 ms^{-1} at an angle 60° with horizontal. From what height should an another particle B be projected horizontally with velocity 5 ms^{-1} so that both the particles collide in ground at point C if both are projected simultaneously $g=10ms^{-2}$

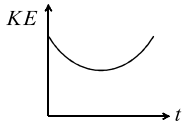
a) 10 m b) 15 m c) 20 m d) 30 m

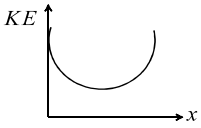
614. The X and Y components of vector $\vec{A}$ have numerical values 6 and 6 respectively and that of $(\vec{A}+\vec{B})$ have numerical values 10 and 9. What is the numerical value of $\vec{B}$?

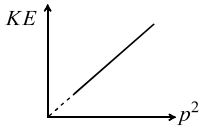
a) 2 b) 3 c) 4 d) 5

615. A particle is projected up from a point at an angle θ with the horizontal direction. At any time t'. If p is the linear momentum, y is the vertical displacement, x is horizontal displacement, the graph among the following which does not represent the variation of kinetic energy KE of the particle

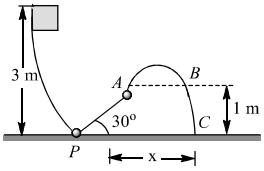
a) 

b) 

c) 

d) 

616. A 0.098 kg block slides down a frictionless track as shown. The vertical component of the velocity of block at A is

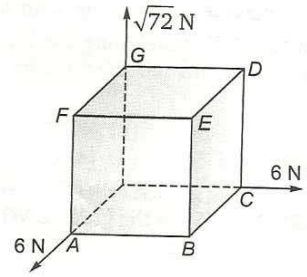


a) $\sqrt{g}$ b) $2\sqrt{g}$ c) $3\sqrt{g}$ d) $4\sqrt{g}$

617. What is the smallest radius of a circle at which a cyclist can travel if its speed is 36 kmh^{-1}, angle of inclination 45° and $g = 10ms^{-2}$?

a) 20 m b) 10 m c) 30 m d) 40 m

618. Three forces of magnitudes 6N, 6N and $\sqrt{72}$ N at a corner of a cube along three sides as shown in figure. Resultant of these forces is



a) 12 N along OB b) 18 N along OA c) 18 N along OC d) 12 N along OE

619. A mass m is attached to the end of a rod of length l. The mass goes along a vertical circular path with the other end hinged at its centre. What should be the minimum velocity of the mass at the bottom of the circle so that the mass completes the circle?

a) $\sqrt{5gl}$ b) $\sqrt{2gl}$ c) $\sqrt{3gl}$ d) $\sqrt{4gl}$

620. The equation of motion of a projectile is $y = 12x - \frac{3}{4}x^2$. The horizontal component of velocity is $3ms^{-1}$. What is the range of the projectile?

a) 18 m b) 16 m c) 12 m d) 21.6 m

621. A cannon of a level plane is aimed at an angle θ above the horizontal and a shell is fired muzzle velocity v_0 towards a cliff D distance away. The height at which the canon strikes the cliff is given by

a) $D\sin\theta - \frac{1}{2}\frac{gD^2}{v_0^2\sin^2\theta}$ b) $D\cos\theta - \frac{1}{2}\frac{gD^2}{v_0^2\sin^2\theta}$

c) $D\tan\theta - \frac{1}{2}\frac{gD^2}{v_0^2\cos^2\theta}$ d) $D\tan\theta - \frac{1}{2}\frac{gD^2}{v_0^2\sin^2\theta}$

622. At the top of the trajectory of a projectile, the direction of its velocity and acceleration are

a) perpendicular to each other b) parallel to each other

c) inclined to each other at angle of 45° d) antiparallel to each other

623. An aeroplane is flying horizontally with a velocity of 600 km/h and at a height of 1960 m. When it is vertically 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) 1200 m b) 0.33 km c) 333.3 km d) 3.33 km

624. If the resultant of two forces $(A + B)$ and $(A - B)$ is $\sqrt{A^2 + B^2}$, then the angle between these forces is

a) $\cos^{-1}\left[-\frac{(A^2 - B^2)}{A^2 + B^2}\right]$ b) $\cos^{-1}\left[-\frac{(A^2 + B^2)}{(A^2 - B^2)}\right]$

c) $\cos^{-1}\left[-\frac{A^2 + B^2}{2(A^2 - B^2)}\right]$ d) $\cos^{-1}\left[-\frac{2(A^2 + B^2)}{A^2 - B^2}\right]$

625. A body of mass 1 kg tied to one end of string is revolved in a horizontal circle of radius 0.1 m with a speed of 3 $revolution/sec$, assuming the effect of gravity is negligible, then linear velocity, acceleration and tension in the string will be

a) $1.88\ m/s, 35.5 m/s^2, 35.5\ N$ b) $2.88\ m/s, 45.5 m/s^2, 45.5\ N$
c) $3.88\ m/s, 55.5 m/s^2, 55.5\ N$ d) None of these

626. A body is projected vertically upwards at time $t = 0$ and it is seen at a height H at instants t_1 and t_2 seconds during its flight. The maximum height attained is (g is acceleration due to gravity)
a) $\frac{g(t_2 - t_1)^2}{8}$ b) $\frac{g(t_1 + t_2)^2}{4}$ c) $\frac{g(t_1 + t_2)^2}{8}$ d) $\frac{g(t_2 - t_1)^2}{4}$

627. A particle describes a horizontal circle in a conical funnel whose inner surface is smooth with speed of 0.5 ms^{-1}. What is the height of the plane of circle from vertex of the funnel?
a) 0.25 cm b) 2 cm c) 4 cm d) 2.5 cm

628. A 100 kg car is moving with a maximum velocity of 9 m/s across a circular track of radius 30 m. The maximum force of friction between the road and the car is
a) 1000 N b) 706 N c) 270 N d) 200 N

629. If the radius of curvature of the path of two particles of same masses are in the ratio $1 : 2$, then in order to have constant centripetal force, their velocity, should be in the ratio of
a) $1 : 4$ b) $4 : 1$ c) $\sqrt{2} : 1$ d) $1 : \sqrt{2}$

630. A bomber plane moves horizontally with a speed of 500ms^{-1} and a bomb released from it, strikes the ground in 10 s. Angel at which it strikes the ground will be (g = 10ms^{-2})
a) $\tan^{-1}\left(\frac{1}{5}\right)$ b) $\tan\left(\frac{1}{5}\right)$ c) $\tan^{-1}(1)$ d) $\tan^{-1}(5)$

631. A particle moves along a circle of radius $\left[\frac{20}{\pi}\right]$ m with constant tangential acceleration. If the velocity of the particle is 80 m/s at the end of the second revolution after motion has begun, the tangential acceleration is
a) 40 ms^{-2} b) 640 πms^{-2} c) 160 πms^{-2} d) 40 πms^{-2}

632. A bullet is to be fired with a speed of 2000 ms^{-1} to hit a target 200 m away on a level ground. If $g = 10\ ms^{-2}$, the gun should be aimed
a) Directly at the target b) 5 cm below the target
c) 5 cm above the target d) 2 cm above the target

633. A wheel making 20 revolution per second is in a horizontal circle with a uniform angular velocity. Let T be the tension in the string. If the length of the string is halved and its angular velocity is doubled, tension in the string will be
a) π rad s^{-2} b) 2 π rad s^{-2} c) 4 π rad s^{-2} d) 8 π rad s^{-2}

634. When a body is thrown with a velocity u making an angle θ with the horizontal plane, the maximum distance covered by it in horizontal direction is
a) $\frac{u^2 \sin\theta}{g}$ b) $\frac{u^2 \sin 2\theta}{2g}$ c) $\frac{u^2 \sin 2\theta}{g}$ d) $\frac{u^2 \cos 2\theta}{g}$

635. A body moving with constant speed in a circular path has
a) angular momentum b) constant acceleration c) constant velocity d) no work done

636. A body is tied to one end of the string and whirled in a vertical circle, the physical quantity which remains constant is
a) Momentum b) Speed c) Kinetic energy d) Total energy

637. The speed limit of a car over a roadways bridge in the form of a vertical arc is 9.8 ms^{-1}. The diameter of the are is
a) 19.6 m b) 9.8 m c) 39.2 m d) 4.9 m

638. Toy cart tied to the end of an unstretched string of length a, when revolved moves in a horizontal circle of radius $2a$ with a time period T. Now the toy cart is speeded up until it moves in a horizontal circle of radius $3a$ with a period T'. If Hook's law holds then
a) $T' = \sqrt{\frac{3}{2}}\,T$ b) $T' = \left(\frac{\sqrt{3}}{2}\right)T$ c) $T' = \left(\frac{3}{2}\right)T$ d) $T' = T$

639. A coastguard ship locates a pirate ship at a distance 560 m. It fires a cannon ball with an initial speed

82 m/s. At what angle from horizontal the ball must be fired so that it hits the pirate ship

a) 54° b) 125° c) 27° d) 18°

640. A body of mass 5 kg is moving in a circle of radius 1 m with an angular velocity of 2 rad s^{-1}. The centripetal force, is

a) 10 N b) 20 N c) 30 N d) 40 N

641. In hydrogen atom, the electron is moving round the nucleus with velocity 2.18×10^6 ms^{-1} in an orbit of radius 0.528 Å. The acceleration of the electron is

a) 9×10^{18} ms^{-2} b) 9×10^{22} ms^{-2} c) 9×10^{-22} ms^{-2} d) 9×10^{12} ms^{-2}

642. The force required to keep a body in uniform circular motion is

a) Centripetal force b) Centrifugal force c) Resistance d) None of the above

643. Given θ is the angle between $\vec{A}$ and $\vec{B}$. Then $|\hat{A} \times \hat{B}|$ is equal to

a) Sin θ b) Cos θ c) Tan θ d) Cot θ

644. A particle of mass m is projected with a velocity v making an angle of 45° with the horizontal. The magnitude of the angular momentum of the particle about the point of projection when the particle is at its maximum height, is

a) $m\sqrt{2gh^3}$ b) $\frac{mv^3}{\sqrt{2}g}$ c) $\frac{mv^3}{4\sqrt{2}g}$ d) Zero

645. If $\vec{A}_1$ and $\vec{A}_2$ are two non-collinear unit vectors and if $|\vec{A}_1 + \vec{A}_2| = \sqrt{3}$, then the value of $(\vec{A}_1 - \vec{A}_2) \cdot (2\vec{A}_1 + \vec{A}_2)$ is

a) 1 b) 1/2 c) 3/2 d) 2

646. A ball is projected with velocity u at an angle α with horizontal plane. Its speed when it makes an angle β with the horizontal is

a) $u \cos \alpha$ b) $\frac{u}{\cos \beta}$ c) $u \cos \alpha \cos \beta$ d) $\frac{u \cos \alpha}{\cos \beta}$

647. Find the maximum velocity for skidding for a car moved on a circular track of radius 100 m. The coefficient of friction between the road and tyre is 0.2

a) 0.14 m/s b) 140 m/s c) 1.4 km/s d) 14 m/s

648. A stone of mass 1 kg tied to a light inextensible string of length $L = \frac{10}{3}$ is whirling in a circular path of radius L in vertical plane. If the ratio of the maximum tension to the minimum tension in the string is 4. What is the speed of stone at the highest point of the circle? (Taking $g = 10 ms^{-2}$)

a) 10 ms^{-1} b) $5\sqrt{2}$ ms^{-1} c) $10\sqrt{3}$ ms^{-1} d) 20 ms^{-1}

649. A man is supported on a frictionless horizontal surface. It is attached to a string and rotates about a fixed centre at an angular velocity ω. The tension in the string if F. If the length of string and angular velocity are doubled, the tension is string is now

a) F b) $F/2$ c) $4F$ d) $8F$

650. A very broad elevator is going up vertically with a constant acceleration of 2 ms^{-2}. At the instant when its velocity is 4 ms^{-1} a ball is projected from the floor of the list with a speed of 4 ms^{-1} relative to the floor at an elevation of 30°. The time taken by the ball to return the floor is ($g = 10$ ms^{-2})

a) 1/2 s b) 1/3 s c) 1/4 s d) 1 s

651. A particle is moving in a circular path with a constant speed v. If θ is the angular displacement, then starting from $\theta = 0°$, the maximum and maximum changes in the momentum will occur, when value of θ is respectively

a) 45° and 90° b) 90° and 180° c) 180° and 360° d) 90° and 270°

652. The angle between $\vec{A}$ and $\vec{B}$ is θ, the value of the triple product $\vec{A} \cdot \vec{B} \times \vec{A}$ is

a) A^2B b) Zero c) $A^2B \sin \theta$ d) $A^2B \cos \theta$

653. A particle is projected with velocity $\sqrt{2gh}$, such that it just crosses two walls of height h and separated by h Find the angle of projection.

a) 15° b) 75° c) 60° d) 30°

654. A weightless thread can support tension upto 30 N. A stone of mass 0.5 kg is tied to it and is revolved in a circular path of radius 2 m in a vertical plane. If $g = 10\ m/s^2$, then the maximum angular velocity of the stone will be

a) $5\ rad/s$ b) $\sqrt{30}\ rad/s$ c) $\sqrt{60}\ rad/s$ d) $10\ rad/s$

655. A body is tided with a string and is given a circular motion with velocity v in radius r. The magnitude of the acceleration

a) $\frac{v}{r}$ b) $\frac{v^2}{r}$ c) $\frac{v}{r^2}$ d) $\frac{v^2}{r^2}$

656. A body starts from rest from the origin with an acceleration of 6 m/s^2 along the x-axis and 8 m/s^2 along the y-axis. Its distance from the origin after 4 seconds will be

a) 56 m b) 64 m c) 80 m d) 128 m

657. The angle between the z-axis and the vector $\hat{\imath} + \hat{\jmath} + \sqrt{2}\hat{k}$ is

a) 30° b) 45° c) 60° d) 90°

658. A proton of mass $1.6 \times 10^{-27} kg$ goes round in a circular orbit of radius 0.10 m under a centripetal force of $4 \times 10^{-13}\ N$. then the frequency of revolution of the proton is about

a) $0.08 \times 10^8\ cycles\ per\ sec$ b) $4 \times 10^8\ cycles\ per\ sec$

c) $8 \times 10^8\ cycles\ per\ sec$ d) $12 \times 10^8\ cycles\ per\ sec$

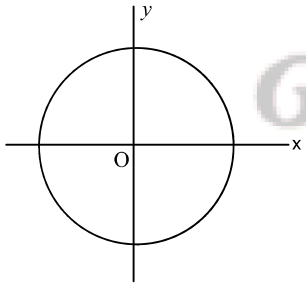
659. For an object thrown at 45° to horizontal, the maximum height (H) and horizontal range (R) are related as

a) $R = 16H$ b) $R = 8H$ c) $R = 4H$ d) $R = 2H$

660. The torque of a force $\vec{F} = -3\hat{\imath} + \hat{\jmath} + 5\hat{k}$ acting at a point is $\vec{\tau}$. If the position vector of the point is $7\hat{\imath} + \hat{\jmath} + \hat{k}$, then $\vec{\tau}$ is

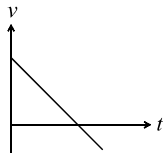
a) $7\hat{\imath} - 8\hat{\jmath} + 9\hat{k}$ b) $14\hat{\imath} - \hat{\jmath} + 3\hat{k}$ c) $2\hat{\imath} - 3\hat{\jmath} + 8\hat{k}$ d) $14\hat{\imath} - 38\hat{\jmath} + 16\hat{k}$

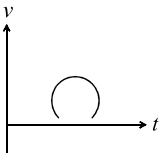
661. The figure shows a circular path of a moving particle. If the velocity of the particle at same instant is $\mathbf{v} = -3\hat{\mathbf{i}} - 4\hat{\mathbf{j}}$, through which quadrant is the particle moving when clockwise and anti-clockwise respectively

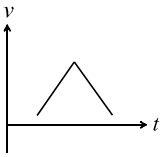


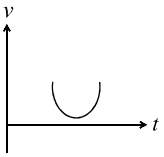
a) 1st and 4 th b) 2nd and 4th c) 2 nd and 3rd d) 3 rd and 4 th

662. A particle is thrown above, the correct $v - t$ graph will be

a) 

b) 

c) 

d) 

663. An aeroplane is flying at a constant horizontal velocity of 600 km/hr at an elevation of 6 km towards a point directly above the target on the earth's surface. At an appropriate time, the pilot releases a ball so that it strikes the target at the earth. The ball will appear to be falling

a) On a parabolic path as seen by pilot in the plane

b) Vertically along a straight path as seen by an observer on the ground near the target

c) On a parabolic path as seen by an observer on the ground near the target

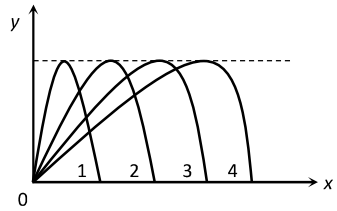
d) On a zig-zag path as seen by pilot in the plane

664. A wheel completes 2000 revolutions to cover the 9.5 km. distance. Then the diameter of the wheel is

a) 1.5 m b) 1.5 cm c) 7.5 cm d) 7.5 m

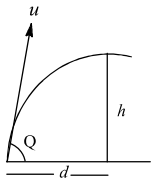
665. Figure shows four paths for a kicked football. Ignoring the effects of air on the flight, rank the paths

according to initial horizontal velocity component, highest first



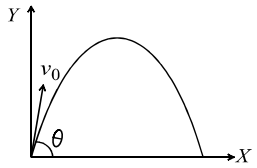
a) 1, 2, 3, 4 b) 2, 3, 4, 1 c) 3, 4, 1, 2 d) 4, 3, 2, 1

666. If a stone s to hit at a point which is at a distance d away and at a height h above the point from where the stone starts, then what is the value of initial sped u, if the stone is launched at an angle Q?



a) $\frac{g}{\cos\theta}\sqrt{\frac{d}{2(d\tan\theta-h)}}$ b) $\frac{d}{\cos\theta}\sqrt{\frac{g}{2(d\tan\theta-h)}}$ c) $\sqrt{\frac{gd^2}{h\cos^2\theta}}$ d) $\sqrt{\frac{gd^2}{(d-h)}}$

667. A small particle of mass m is projected at an angle θ with the x-axis with an initial velocity v_0 in the x-y plane as shown in the figure. At a time $t < \frac{v_0 \sin\theta}{g}$, the angular momentum of the particle is



Where $\hat{\imath}, \hat{\jmath}$ and $\hat{k}$ are unit vectors along x, y and z-axis respectively.

a) $\frac{1}{2}mgv_0t^2\cos\theta\,\hat{\imath}$ b) $-mgv_0t^2\cos\theta\,\hat{\jmath}$ c) $mgv_0t\cos\quad\hat{k}$ d) $-\frac{1}{2}mgv_0t^2\cos\theta\,\hat{k}$

668. If the magnitude of the sum of the two vectors is equal to the difference of their magnitudes, then the angle between vectors is

a) 0° b) 45° c) 90° d) 180°

669. A particle of a mass m is projected with velocity v making an angle of 45° with the horizontal. The magnitude of the angular momentum of the particle about the point of projection when the particle is at its maximum height is (where g = acceleration due to gravity)

a) Zero b) $mv^3/(4\sqrt{2}g)$ c) $mv^3/(\sqrt{2}g)$ d) $mv^2/2g$

670. A toy cyclist completes one round of a square track of side 2 m in 40 s. What will be the displacement at the end of 3 min?

a) 52 m b) Zero c) 16 m d) $2\sqrt{2}$ m

671. The angular velocity of a particle rotating in a circular orbit 100 times per minute is

a) 1.66 rad s^{-1} b) 10.47 rad s^{-1} c) 10.47 deg s^{-1} d) 60 rad s^{-1}

672. Two forces $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ are acting at right angles to each other. Then their resultant is

a) $F_1 + F_2$ b) $\sqrt{F_1^2 + F_2^2}$ c) $\sqrt{F_1^2 - F_2^2}$ d) $\frac{F_1 + F_2}{2}$

673. Two bodies are projected with the same velocity. If one is projected at an angle of 30° and the other at an angle of 60° to the horizontal, the ratio of the maximum heights reached is

a) 3 : 1 b) 1 : 3 c) 1 : 2 d) 2 : 1

674. If a_r and a_t represent radial and tangential accelerations, the motion of a particle will be uniformly circular if

a) $a_r = 0, a_t = 0$ b) $a_r \neq 0, a_t \neq 0$ c) $a_r \neq 0, a_t = 0$ d) $a_r = 0, a_t \neq 0$

675. The kinetic energy of a projectile at the highest point is half of the initial kinetic energy. What is the angle of projection with the horizontal?
a) 30° b) 45° c) 60° d) 90°

676. The distance r from the origin of a particle moving in $x-y$ plane varies with time as $r = 2t$ and the angle made by the radius vector with positive x-axis is $\theta = 4t$. Here, t is in second, r in metre and θ in radian. The speed of the particle at $t = 1$ s is
a) 10 ms^{-1} b) 16 ms^{-1} c) 10 ms^{-1} d) 12 ms^{-1}

677. In uniform circular motion
a) Both the angular velocity and the angular momentum vary
b) The angular velocity varies but the angular momentum remains constant
c) Both the angular velocity and the angular momentum stay constant
d) The angular momentum varies but the angular velocity remains constant

678. A cyclist is travelling with velocity v on a banked curved road of radius R. The angle θ through which the cyclist leans inwards is given by
a) $\tan\theta = \frac{Rg}{v^2}$ b) $\tan\theta = v^2\,Rg$ c) $\tan\theta = \frac{v^2 g}{R}$ d) $\tan\theta = \frac{v^2}{Rg}$

679. A small cone filled with water is revolved in a vertical circle of radius 4 m and the water does not fall down. What must be the maximum period of revolution?
a) 4 s b) 2 s c) 1 s d) 6 s

680. In uniform circular motion, the velocity vector and acceleration vector are
a) Perpendicular to each other b) Same direction
c) Opposite direction d) Not related to each other

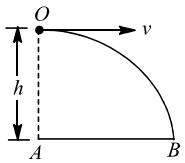
681. In a bicycle the radius of rear wheel is twice the radius of front wheel. If r_f and r_r are the radius, v_f and v_r are the speed of top most points of wheel, then
a) $v_r = 2v_f$ b) $v_f = 2v_r$ c) $v_f = v_r$ d) $v_f > v_r$

682. An object of mass 10 kg is whirled round a horizontal circle of radius 4 m by a revolving string inclined 30° to the vertical. If the uniform speed of the object is 5 ms^{-1}, the tension in the string (approximately) is
a) 720 N b) 960 N c) 114 N d) 125 N

683. A bullet is fired horizontally with a velocity of 80 ms^{-1}. During the first second,
a) It falls 9.8 m b) It falls $\frac{80}{9.8}$ m c) It does not fall at all d) It falls 4.9 m

684. A mass is supported on a frictionless horizontal surface. It is attached to a string and rotates about a fixed centre at an angular velocity ω_0. If the length of the string and angular velocity both are doubled, the tension in the string which was initially T_0 is now
a) T_0 b) $T_0/2$ c) $4T_0$ d) $8T_0$

685. An aeroplane is flying in a horizontal direction with a velocity 600kmh^{-1} at a height of 1960 m. when it is vertically above the point A on the ground, a body is dropped from it. The body strikes the ground at point B. Calculate the distance AB.

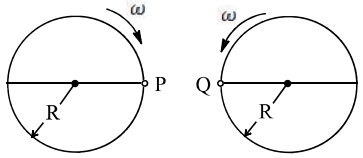


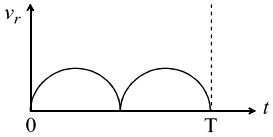
a) 3.33 km b) 333 km c) 33.3 km d) 3330 km

686. A cylinder full. Of water, is rotating about its own axis with uniform angular velocity ω. The shape of free surface of water will be
a) Parabola b) Elliptical c) Circular d) Spherical

687. A cricketer hits a ball with a velocity 25 m/s at 60° above the horizontal. How far above the ground it passes over a fielder 50 m from the bat (assume the ball is struck very close th the ground)
a) 8.2 m b) 9.0 m c) 11.6 m d) 12.7 m

688. 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 figure. The relative speed between the two points P and Q is V_r as function of times best represented by



a)


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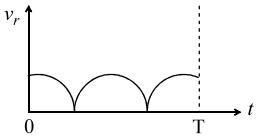

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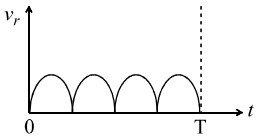
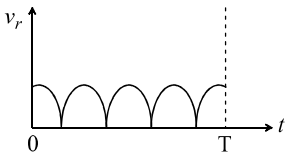


d)


689. A car is moving rectilinearly on a horizontal path with acceleration a_0. A person sitting inside the car observes that an insect S is crawling up the screen with an acceleration a. If θ is the inclination of the screen with the horizontal the acceleration of the insect
   a) Parallel to screen is $a + a_0 \cos\theta$
   b) Along the horizontal is $a_0 - a\cos\theta$
   c) Perpendicular to screen is $a_0 \sin\theta$
   d) Perpendicular to screen is $a_0 \tan\theta$

690. A particle of mass M is moving in a horizontal circle of radius R with uniform speed V. When it moves from one point to a diametrically opposite point, its
   a) Kinetic energy changes by $MV^2/4$
   b) Momentum does not change
   c) Momentum changes by $2MV$
   d) Kinetic energy changes by MV^2

691. A ball is projected from the ground at a speed of $10ms^{-1}$ making an angle of $30°$ with the horizontal. Another ball is simultaneously released from a point on the vertical line along the maximum height of the projectile. Both the balls collide at the maximum height of first ball. The initial height of the second ball is $(g = 10ms^{-2})$
   a) $6.25m$ b) $2.5m$ c) $3.75m$ d) $5m$

692. A ball is thrown up at an angle with the horizontal. Then the total change of momentum by the instant it returns to ground is
   a) Acceleration due to gravity × total time of flight
   b) Weight of the ball × half the time of flight
   c) Weight of the ball × total time of flight
   d) Weight of the ball × horizontal range

693. A man, using a 70 kg garden roller on a level surface exerts a force of 200 N at 45° to the ground. What is the vertical force of the roller on the ground, if he pushed the roller? $(g = 10ms^{-2})$
   a) 70 N b) 200 N c) 560 N d) 840 N

694. An aeroplane moving horizontally at a speed of 200 m/s and at a height of 8.0×10^3 m is to drop a bomb

on a target. At what horizontal distance from the target should the bomb be released

a) 7.234 km b) 8.081 km c) 8.714 km d) 9.124 km

695. A particle is projected with certain velocity at two different angels of projections with respect to horizontal plane so as to have same range R on a horizontal plane. If t_1 and t_2 are the time taken for the two paths, the which one of the following relations is correct?

a) $t_1 t_2 = \frac{2R}{g}$ b) $t_1 t_2 = \frac{R}{g}$ c) $t_1 t_2 = \frac{R}{2g}$ d) $t_1 t_2 = \frac{4R}{g}$

696. A particle moves in a circle of radius 25 cm at two revolutions per second. The acceleration of the particle in m/s^2 is

a) π^2 b) $8\pi^2$ c) $4\pi^2$ d) $2\pi^2$

697. The vector which can give unit vector along x-axis with $\vec{A} = 2\hat{i} - 4\hat{j} + 7\hat{k}$, $\vec{B} = 7\hat{i} + 2\hat{j} - 5\hat{k}$ and $\vec{C} = -4\hat{i} + 7\hat{j} + 3\hat{k}$ is

a) $4\hat{i} + 5\hat{j} + 5\hat{k}$ b) $-5\hat{i} - 5\hat{j} + 5\hat{k}$ c) $-4\hat{i} - 5\hat{j} - 5\hat{k}$ d) $4\hat{i} - 5\hat{j} + 5\hat{k}$

698. The acceleration of a train travelling with speed of 400 m/s as it goes round a curve of radius 160 m, is

a) 1 km/s^2 b) 100 m/s^2 c) 10 m/s^2 d) 1 m/s^2

699. A man standing on the roof of a house of height h throws one particle vertically downwards and another particle horizontally with the same velocity u. The ratio of their velocities when they reach the earth's surface will be

a) $\sqrt{2gh + u^2} : u$ b) 1: 2 c) 1: 1 d) $\sqrt{2gh + u^2} : \sqrt{2gh}$

700. An artillery piece which consistently shoots its shells with the same muzzle speed has a maximum range R. To hit a target which is $\frac{R}{2}$ from the gun and on the same level, the elevation angle of the gun should be

a) 15° b) 45° c) 30° d) 60°

701. A body is projected with initial velocity of $(8\hat{i} + 6\hat{j})\text{ms}^{-1}$. The horizontal range is

a) 9.6 m b) 14 m c) 50 m d) None of these

702. A stone is tied at one end of a 5m long string and whirled in a vertical circle. The minimum speed required to just cross the topmost position is

a) 5 ms^{-1} b) 7 ms^{-1} c) 57 ms^{-1} d) 75 ms^{-1}

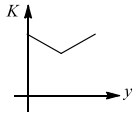
703. A particle of mass m moves with constant speed along a circular path of radius r under the action of force F. Its speed is

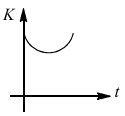
a) $\sqrt{Fr/m}$ b) $\sqrt{F/r}$ c) $\sqrt{F\,m\,r}$ d) $\sqrt{F/mr}$

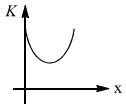
704. For a projection, $(\text{range})^2$ is 48 times of $(\text{maximum height})^2$ obtained. Find angle projection.

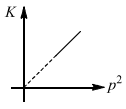
a) 60° b) 30° c) 45° d) 75°

705. A particle is projected up from a point at an angle with the horizontal. At any time t if p =linear momentum, y =vertical displacement, x =horizontal displacement, then the kinetic energy (K) of the particle plotted against these parameters can be

a) 

b) 

c) 

d) 

706. The equation of a projectile is $y = \sqrt{3}x - \frac{gx^2}{2}$. The angle of projection is given by

a) $\tan\theta = \frac{1}{\sqrt{3}}$ b) $\tan\theta = \sqrt{3}$ c) $\frac{\pi}{2}$ d) Zero

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

a) its velocity is always perpendicular to its acceleration

b) its velocity becomes zero as its maximum height

c) its velocity makes zero angle with the horizontal at its maximum height

d) the body just before hitting the ground, the direction of velocity coincides with the acceleration

708. The speed of revolution of a particle going around a circle is doubled and its angular speed is halved. What

happens to the centripetal acceleration?

a) Becomes four times b) Double c) Halved d) Remains unchanged

709. Given $\vec{R} = \vec{A} + \vec{B}$ and R = A = B. The angle between $\vec{A}$ and $\vec{B}$ is

a) 60° b) 90° c) 120° d) 180°

710. A stone is projected with a velocity $20\sqrt{2}\text{ms}^{-1}$ at an angle of 45° to the horizontal. The average velocity of stone during its motion from starting point to its maximum height is ($g = 10\text{ms}^{-2}$)

a) $5\sqrt{5}\text{ ms}^{-1}$ b) $10\sqrt{5}\text{ ms}^{-1}$ c) 20 ms^{-1} d) $20\sqrt{5}\text{ ms}^{-1}$

711. A body moving along a circular path of radius R with velocity v, has centripetal acceleration$a$. If its velocity is made equal to $2v$, then its centripetal acceleration is

a) $4a$ b) $2a$ c) $\frac{a}{4}$ d) $\frac{a}{2}$

712. The speed of a projectile at its maximum height is half of its initial speed. The angle of projection is

a) 60° b) 15° c) 30° d) 45°

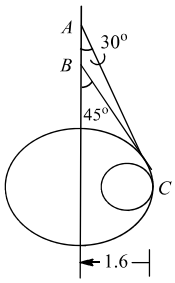
713. If a_r and a_t represent radial and tangential accelerations, the motion of a particle will be uniformly circular if

a) $a_r = 0$ and $a_t = 0$ b) $a_r = 0$ but $a_t \neq 0$ c) $a_r \neq 0$ but $a_t = 0$ d) $a_r \neq 0$ and $a_t \neq 0$

714. In above question, if the centripetal force F is kept constant but the angular velocity is doubled, the new radius of the path (original radius R) will be

a) $2R$ b) $R/2$ c) $R/4$ d) $4R$

715. Two wires AC and BC are tied at C of small sphere of mass 5 kg, which revolves at a constant speed v in the horizontal circle of radius 1.6 m. The minimum value of v is



a) 3.01 ms^{-1} b) 4.01 ms^{-1} c) 8.2 ms^{-1} d) 3.96 ms^{-1}

716. If the resultant of the vectors $(\hat{i} + 2\hat{j} - \hat{k})$, $(\hat{i} - \hat{j} + 2\hat{k})$ and $\vec{C}$ is a unit vector along the y-direction, then $\vec{C}$ is

a) $-2\hat{i} - \hat{k}$ b) $-2\hat{i} + \hat{k}$ c) $2\hat{i} - \hat{k}$ d) $2\hat{i} + \hat{k}$

717. A small disc is on the top of a hemisphere of radius R. What is the smallest horizontal velocity v that should be given to the disc for it to leave the hemisphere and not slide down it? [There is no friction]

a) $v = \sqrt{2gR}$ b) $v = \sqrt{gR}$ c) $v = \frac{g}{R}$ d) $v = \sqrt{g^2R}$

718. What is the angle between $\vec{P}$ and $\vec{Q}$. The resultant of $(\vec{P} + \vec{Q})$ and $(\vec{P} - \vec{Q})$?

a) Zero b) $\tan^{-1}(P/Q)$

c) $\tan^{-1}(Q/P)$ d) $\tan^{-1}(P-Q)/(P+Q)$

719. A long horizontal rod has a bead, which can slide along its length and initially placed at a distance L from one end A of the rod. The rod is set in angular acceleration α. If the coefficient of friction, between the rod and the bead is μ and gravity is neglected, then the time after which the bead starts slipping is

a) $\sqrt{\mu/\alpha}$ b) $\mu/\sqrt{\alpha}$ c) $1/\sqrt{\mu\alpha}$ d) Infinitesimal

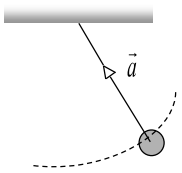
720. The earth moves round the sun in a near circular orbit of radius 1.5×10^{11} m. Its centripetal acceleration is

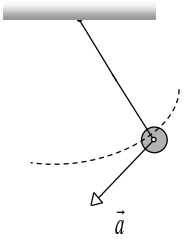
a) $1.5 \times 10^{-3}\ m/s^2$ b) $3 \times 10^{-3}\ m/s^2$ c) $6 \times 10^{-3}\ m/s^2$ d) $12 \times 10^{-3}\ m/s^2$

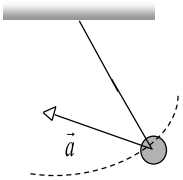
721. A particle is projected with speed v at an angle $\theta\left(0 < \theta < \frac{\pi}{2}\right)$ above the horizontal from a height H above the ground. If v = speed with which particle hits the ground and t =time taken by particle to reach ground, then

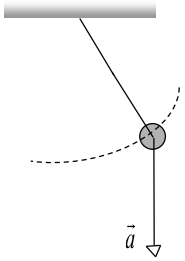
a) As θ increases, v decreases and t increases
b) As θ increases, v increases and t increases
c) As θ increases, v remains same and t increases
d) As θ increases, v remains same and t decreases

722. A simple pendulum is oscillating without damping. When the displacement of the bob is less than maximum, its acceleration vector $\vec{a}$ is correctly shown in

a) 

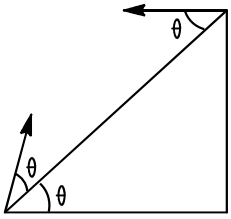
b) 

c) 

d) 

723. For a projectile, the ratio of maximum height reached to the square of flight time is ($g = 10\ ms^{-2}$)
a) 5 : 4 b) 5 : 2 c) 5 : 1 d) 10 : 1

724. From an inclined plane two particles are projected with same speed at same angle θ, one up and other down the plane as shown in figure, which of the following statements is/are correct?



a) The time of flight of each particle is the same
b) The particles will collide the plane with same speed
c) Both the particles strike the plane perpendicularly
d) The particles will collide in mid air if projected simultaneously and time of flight of each particle is less than of collision

725. Two racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same duration of time t. The ratio of the angular speed of the first to the second car is
a) $m_1 : m_2$ b) $r_1 : r_2$ c) 1 : 1 d) $m_1 : r_1 : m_2 r_2$

726. A car moving with the speed of 10 m/s takes a circular turn of radius 20 m. The magnitude of the acceleration of the car is
a) 5.0 ms^{-2} b) 50.0 ms^{-2} c) 0.25 ms^{-2} d) 0.5 ms^{-2}

727. Two vectors $\vec{a}$ and $\vec{b}$ are at an angle of 60° with each other. Their resultant makes an angle of 45° with $\vec{a}$. If $|\vec{b}| = 2$ units, then $|\vec{a}|$ is
a) $\sqrt{3}$ b) $\sqrt{3} - 1$ c) $\sqrt{3} + 1$ d) $\sqrt{3}/2$

728. A body crosses the topmost point of a vertical circle with critical speed. What will be its acceleration when the string is horizontal?
a) g b) 2 g c) 3 g d) 6 g

729. A particle is moving in a horizontal circle with constant speed. It has constant
a) Velocity b) Acceleration c) Kinetic energy d) Displacement

730. A bend in a level road has a radius of 80 m. Find the maximum speed which a car turning the bend may have without skidding, if $\mu = 0.25$
a) 24 ms^{-1} b) 4 ms^{-1} c) 14 ms^{-1} d) 9.8 ms^{-1}

731. An object of mass 2 m is projected with a speed of 100 ms^{-1} at angle $\theta = \sin^{-1}\left(\frac{3}{5}\right)$ to the horizontal. At the highest point, the object breaks into pieces of same mass m and the first one comes to rest. The distance

between the point of projection and the point of landing of the bigger piece (in metre) is (given, $g = 10\ \text{ms}^{-2}$)

a) 3840 b) 1280 c) 1440 d) 960

732. Given $\vec{P} = 3\hat{j} + 4\hat{k}$ and $\vec{Q} = 2\hat{i} + 5\hat{k}$. The magnitude of the scalar product of these vectors is

a) 20 b) 23 c) 26 d) $5\sqrt{33}$

733. A cricketer can throw a ball to a maximum horizontal distance of 100 m. With the same effort, he throws the ball vertically upwards. The maximum height attained by the ball is

a) 100 m b) 80 m c) 60 m d) 50 m

734. Neglecting the air resistance, the time of flight of a projectile is determined by

a) U_{vertical} b) $U_{\text{horizontal}}$

c) $U = U_{\text{vertical}}^2 + U_{\text{horizontal}}^2$ d) $U = \left(U_{\text{vertical}}^2 + U_{\text{horizontal}}^2\right)^{1/2}$

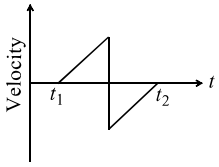
735. The height y and the distance x along the horizontal plane of a projectile on a certain planet (with no surrounding atmosphere) are given by $y = 8t - 5t^2$ metre and $x = 6t$ metre, where t is in second. The velocity with which the projectile is projected, is

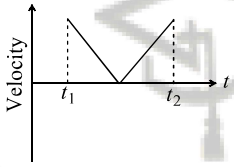
a) $14\ \text{ms}^{-1}$ b) $10\ \text{ms}^{-1}$ c) $8\ \text{ms}^{-1}$ d) $6\ \text{ms}^{-1}$

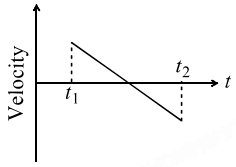
736. A car when passes through a convex bridge exerts a force on it which is equal to

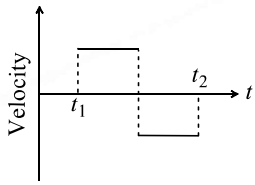
a) $Mg + \frac{Mv^2}{r}$ b) $\frac{Mv^2}{r}$ c) Mg d) None of these

737. A batsman hits a sixer and the ball touches the ground outside the cricket ground. Which of the following graph describes the variation of the cricket ball's vertical velocity v with time between the time t_1 as it hits the bat and time t_2 when it touches the ground

a) 

b) 

c) 

d) 

738. The time period of the second's hand of a watch is

a) 1 h b) 1 s c) 12 h d) 1 min

739. A particle is tied to 20cm long string. It performs circular motion in vertical plane. What is the angular velocity of the string when the tension in the string at the top is zero

a) 5 rad/sec b) 2 rad/sec c) 7.5 rad/sec d) 7 rad/sec

740. A particle moves in the $x - y$ plane with velocity $v_x = 8t - 2$ and $v_y = 2$. If it passes through the pointy $x = 14$ and $y = 4$ at $t = 2s$, find the equation ($x - y$ relation) of the path

a) $x = y^2 - y + 2$ b) $x = 2y^2 + 2y - 3$

c) $x = 3y^2 + 5$ d) Can not be found from above data

741. A body just being revolved in a vertical circle of radius R with a uniform speed. The string breaks when the body is at the highest point. The horizontal distance covered by the body after the string breaks is

a) 2 R b) R c) $R\sqrt{2}$ d) 4 R

742. If $\vec{A}$ and $\vec{B}$ denote the sides of a parallelogram and its area is $\frac{1}{2}AB$(A and B are the magnitude of $\vec{A}$ and $\vec{B}$ respectively), the angle between $\vec{A}$ and $\vec{B}$ is

a) 30° b) 60° c) 45° d) 120°

743. Given $\vec{r} = 4\hat{j}$ and $\vec{p} = 2\hat{i} + 3\hat{j} + \hat{k}$. The angular momentum is

a) $4\hat{i} - 8\hat{k}$ b) $8\hat{i} - 4\hat{k}$ c) $8\hat{j}$ d) $9\hat{k}$

744. A car is moving along a straight horizontal road with a speedv_0. If the coefficient of friction between tyres and the road is μ, the shortest distance in which the car can be stopped is

a) $\frac{v_0^2}{2\mu g}$ b) $\frac{v_0}{\mu g}$ c) $\left(\frac{v_0}{\mu g}\right)^2$ d) $\frac{v_0}{\mu}$

745. Work done when a force, $\vec{F} = (\hat{i} + 2\hat{j} + 3\hat{k})$N acting on a particle takes it from the point $\vec{r}_1 = (\hat{i} + \hat{j} + \hat{k})$m

to the point $\vec{r}_2 = (\hat{i} + \hat{j} + 2\hat{k})$

a) -3 J b) -1 J c) zero d) 2 J

746. An aeroplane is flying with a uniform speed of 100 m/s along a circular path of radius 100 m. the angular speed of the aeroplane will be

a) 1 rad/sec b) 2 rad/sec c) 3 rad/sec d) 4 rad/sec

747. A particle comes round a circle of radius 1 m once. The time taken by it is 10 sec. The average velocity of motion is

a) 0.2 $\pi m/s$ b) 2 $\pi m/s$ c) 2 m/s d) Zero

748. A chain of 125 links is 1.25 m long and has mass of 2 kg with the ends fastened together. It is set for rotating at 50 revs^{-1}, centripetal force on each links is

a) 3.14 N b) 0.314 N c) 314 N d) None of these

749. A particle of mass m is fixed to one end of a light spring of force constant k and unstretched length l. The system is rotated about the other end of the spring with an angular velocity ω, in gravity free space. As shown in figure the increase in length of the spring will be

a) $\frac{m\,\omega^2 l}{k}$ b) $\frac{m\,\omega^2 l}{k - m\,\omega^2}$ c) $\frac{m\,\omega^2 l}{k + m\,\omega^2}$ d) None of these

750. The position of a particle moving in the xy- plane at any time t is given by $x = (3t^2 - 6t)\ metres$, $y = (t^2 - 2t)\ metres$. Select the correct statement about the moving particle from the following

a) The acceleration of the particle is zero at $t = 0$ second

b) The velocity of the particle is zero at $t = 0$ second

c) The velocity of the particle is zero at $t = 1$ second

d) The velocity and acceleration of the particle are never zero

751. A car is moving on a circular path and takes a turn. If R_1 and R_2 be the reactions on the inner and outer wheels respectively, then

a) $R_1 = R_2$ b) $R_1 < R_2$ c) $R_1 > R_2$ d) $R_1 \geq R_2$

752. Which one is Angular resolution fundamental quantity

a) Length b) Time c) Radian d) Angle

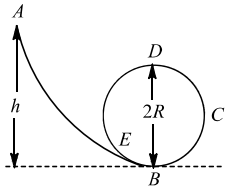
753. A particle is projected from horizontal making an angle 60° with initial velocity 40ms^{-1}. The time taken by the particle to make angel 45° from horizontal, is

a) 15 s b) 2.0 s c) 20 s d) 1.5 s

754. If a car is to travel with a speed v along the frictionless, banked circular track of radius r, the required angle of banking so that the car does skid is

a) $\theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$ b) $\theta = \tan^{-1}\left(\frac{v}{rg}\right)$ c) $\theta = \tan^{-1}\left(\frac{r^2}{vg}\right)$ d) $\theta < \tan^{-1}\left(\frac{v^2}{rg}\right)$

755. A frictionless track $ABCDE$ ends in a circular loop of radius R, figure. A body slides down the track from point A which is at a height $h = 5$ cm. Maximum value of R for the body to successfully complete the loop is



a) 5 cm b) 15/4 cm c) 10/3 cm d) 2 cm

756. A stone of mass 16 kg is attached to a string 144 m long and is whirled in a horizontal circle. The maximum tension the string can withstand is 16 $Newton$. The maximum velocity of revolution that can be given to the stone without breaking it, will be

a) 20 ms^{-1} b) 16 ms^{-1} c) 14 ms^{-1} d) 12 ms^{-1}

757. When a projectile is projected at a certain angle with the horizontal, its horizontal range is R and time of

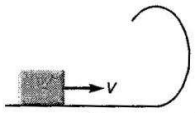
flight is T_1. When the same projectile is throwing with the same speed at some other angle with the horizontal, its horizontal range is R and time of flight is T_2. The product of T_1 and T_2 is

a) $\frac{R}{g}$ b) $\frac{2R}{g}$ c) $\frac{3R}{g}$ d) $\frac{4R}{g}$

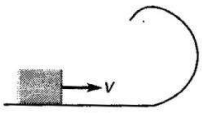
758. If $\vec{P} = 4\hat{i} - 2\hat{j} + 6\hat{k}$ and $\vec{Q} = \hat{i} - 2\hat{j} - 3\hat{k}$, then the angle which $\vec{P} + \vec{Q}$ makes with x-axis is

a) $\cos^{-1}\left(\frac{3}{\sqrt{50}}\right)$ b) $\cos^{-1}\left(\frac{4}{\sqrt{50}}\right)$ c) $\cos^{-1}\left(\frac{5}{\sqrt{50}}\right)$ d) $\cos^{-1}\left(\frac{12}{\sqrt{50}}\right)$

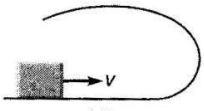
759. A small block is shot into each of the four tracks as shown below. Each of the frictionless track rises to the same height. The speed, which the block enters the tracks, is same in all cases. At the highest point of the track, normal reaction is maximum in

a) 

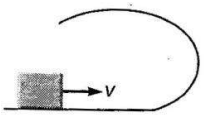
(a)

b) 

(b)

c) 

(c)

d) 

(d)

760. A particle moves in a circle with a uniform speed. When it goes from a point A to a diametrically opposite point B, the momentum of the particle changes by $\vec{\mathbf{p}}_A - \vec{\mathbf{p}}_B = 2\ \text{kg ms}^{-1}(\hat{\mathbf{j}})$ and the centripetal fore acting on it changes by $\vec{\mathbf{F}}_A - \vec{\mathbf{F}}_B = 8\ \text{N}(\hat{\mathbf{i}})$ where $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$ are unit vectors along X and Y axes respectively. The angular velocity of the particle is

a) Dependent of its mass b) 4 rad s^{-1} c) $\frac{2}{\pi}$ rad s^{-1} d) 16 μ rad s^{-1}

761. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is 20 m. The speed of the car at the top of the hill is between

a) 16 m/s and 17 m/s b) 13 m/s and 14 m/s c) 14 m/s and 15 m/s d) 15 m/s and 16 m/s

762. If a particle of mass m is moving in a horizontal circle of radius r with a centripetal force $(-k/r^2)$, the total energy is

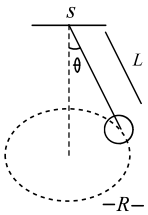
a) $-\frac{k}{2r}$ b) $-\frac{k}{r}$ c) $-\frac{2k}{r}$ d) $-\frac{4k}{r}$

763. Two vectors $\vec{A}$ and $\vec{B}$ are inclined at an angle θ. Now if the vectors are interchanged then the resultant turns through an angle β. Which of the following relation is true

a) $\tan\frac{\alpha}{2} = \left(\frac{A-B}{A+B}\right)^2 \tan\frac{\theta}{2}$ b) $\tan\frac{\alpha}{2} = \left(\frac{A-B}{A+B}\right) \tan\frac{\theta}{2}$

c) $\tan\frac{\alpha}{2} = \left(\frac{A-B}{A+B}\right)^2 \cot\frac{\theta}{2}$ d) $\tan\frac{\alpha}{2} = \left(\frac{A-B}{A+B}\right) \cot\frac{\theta}{2}$

764. A string of length L is fixed at one end and the string makes $\frac{2}{\pi}$ rev/s around the vertical axis through, the fixed and as shown in the figure, then tension in the string is



a) ML b) 2 ML c) 4 ML d) 16 ML

765. An electric fan has blades of length 30 cm measured from the axis of rotation. If the fan is rotating at 120 rpm, the acceleration of a point on the tip of the blade is

a) 1600 ms^{-2} b) 47.4 ms^{-2} c) 23.7 ms^{-2} d) 50.55 ms^{-2}