JEE Main 2024 – 2019 Chapter-wise PYQs (Physics)

Q1. A body of mass M thrown horizontally with velocity v from the top of the tower of height H touches the ground at a distance of 100 m from the foot of the tower. A body of mass 2M thrown at a velocity $\frac{v}{2}$ from the top of the tower of height 4H will touch the ground at a distance of _____m. ***08 Apr 2024 (E)***

Q2. The angle of projection for a projectile to have same horizontal range and maximum height is : ***08 Apr 2024 (E)***

(1) $\tan^{-1}(4)$ (2) $\tan^{-1}\left(\frac{1}{4}\right)$

(3) $\tan^{-1}\left(\frac{1}{2}\right)$ (4) $\tan^{-1}(2)$

Q3. The maximum height reached by a projectile is 64 m. If the initial velocity is halved, the new maximum height of the projectile is _____ m. ***05 Apr 2024 (E)***

Q4. A man carrying a monkey on his shoulder does cycling smoothly on a circular track of radius 9 m and completes 120 resolutions in 3 minutes. The magnitude of centripetal acceleration of monkey is (in $\mathrm{m/s^2}$) : ***05 Apr 2024 (E)***

(1) $57600\pi^2\ \mathrm{ms^{-2}}$ (2) Zero

(3) $4\pi^2\ \mathrm{ms^{-2}}$ (4) $16\pi^2\ \mathrm{ms^{-2}}$

Q5. The co-ordinates of a particle moving in $x-y$ plane are given by : $x = 2+4\mathrm{t}, y = 3\mathrm{t}+8\mathrm{t}^2$.
The motion of the particle is : ***04 Apr 2024 (M)***

(1) uniformly accelerated having motion along a parabolic path.

(2) uniform motion along a straight line.

(3) uniformly accelerated having motion along a straight line.

(4) non-uniformly accelerated.

Q6. A particle moving in a circle of radius R with uniform speed takes time T to complete one revolution. If this particle is projected with the same speed at an angle θ to the horizontal, the maximum height attained by it is equal to $4R$. The angle of projection θ is then given by : ***01 Feb 2024 (M)***

(1) $\sin^{-1}\left[\frac{2gT^2}{\pi^2R}\right]^{\frac{1}{2}}$ (2) $\sin^{-1}\left[\frac{\pi^2R}{2gT^2}\right]^{\frac{1}{2}}$

(3) $\cos^{-1}\left[\frac{2gT^2}{\pi^2R}\right]^{\frac{1}{2}}$ (4) $\cos^{-1}\left[\frac{\pi R}{2gT^2}\right]^{\frac{1}{2}}$

Q7. A body starts falling freely from height H hits an inclined plane in its path at height h. As a result of this perfectly elastic impact, the direction of the velocity of the body becomes horizontal. The value of $\frac{H}{h}$ for which the body will take the maximum time to reach the ground is _____. ***31 Jan 2024 (M)***

Q8. A particle of mass m projected with a velocity u 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 : ***30 Jan 2024 (M)***

(1) $\frac{\sqrt{3}}{16}\frac{mu^3}{g}$ (2) $\frac{\sqrt{3}}{2}\frac{mu^2}{g}$

(3) $\frac{mu^3}{\sqrt{2}g}$ (4) zero

Q9. Projectiles A and B are thrown at angles of 45° and 60° with vertical respectively from top of a 400 m high tower. If their times of flight are same, the ratio of their speeds of projection $v_A : v_B$ is: ***30 Jan 2024 (E)***

(1) $1 : \sqrt{3}$ (2) $\sqrt{2} : 1$
(3) $1 : 2$ (4) $1 : \sqrt{2}$

Q10. If the radius of curvature of the path of two particles of same mass are in the ratio $3 : 4$, then in order to have constant centripetal force, their velocities will be in the ratio of: ***29 Jan 2024 (M)***

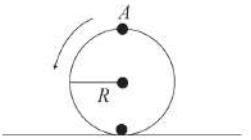
(1) $\sqrt{3} : 2$ (2) $1 : \sqrt{3}$
(3) $\sqrt{3} : 1$ (4) $2 : \sqrt{3}$

Q11. A ball rolls off the top of a stairway with horizontal velocity u. The steps are 0.1 m high and 0.1 m wide. The minimum velocity u with which that ball just hits the step 5 of the stairway will be $\sqrt{x}$ m s^{-1}, where $x =$ _____ [use $g = 10$ m s^{-2}]. ***29 Jan 2024 (M)***

Q12. A vehicle of mass 200 kg is moving along a levelled curved road of radius 70 m with angular velocity of 0.2 rad s^{-1}. The centripetal force acting on the vehicle is: ***13 Apr 2023 (E)***

(1) 560 N (2) 2800 N
(3) 2240 N (4) 14 N

Q13. A disc is rolling without slipping on a surface. The radius of the disc is R. At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is



13 Apr 2023 (M)

(1) $2R$ (2) $R\sqrt{(\pi^2 + 4)}$
(3) $\mathrm{R}\sqrt{(\pi^2 + 1)}$ (4) $2R\sqrt{(1 + 4\pi^2)}$

Q14. A projectile fired at 30° to the ground is observed to be at same height at time 3 s and 5 s after projection, during its flight. The speed of projection of the projectile is m s^{-1}.
(Given $g = 10$ m s^{-2}) ***11 Apr 2023 (M)***

Q15. A projectile is projected at 30° from horizontal with initial velocity 40 m s^{-1}. The velocity of the projectile at t = 2 s from the start will be: ***11 Apr 2023 (E)***

(1) $40\sqrt{3}$ m s^{-1} (2) Zero
(3) 20 m s^{-1} (4) $20\sqrt{3}$ m s^{-1}

Q16. The range of the projectile projected at an angle of 15° with horizontal is 50 m. If the projectile is projected with same velocity at an angle of 45° with horizontal, then its range will be ***10 Apr 2023 (M)***

(1) 100 m (2) $100\sqrt{2}$ m
(3) $50\sqrt{2}$ m (4) 50 m

Q17. Two projectiles are projected at 30° and 60° with the horizontal with the same speed. The ratio of the maximum height attained by the two projectiles respectively is: ***10 Apr 2023 (E)***

(1) $\sqrt{3} : 1$ (2) $1 : \sqrt{3}$
(3) $2 : \sqrt{3}$ (4) $1 : 3$

Q18. Two projectiles A and B are thrown with initial velocities of 40 m s^{-1} and 60 m s^{-1} at angles 30° and 60° with the horizontal respectively. The ratio of their ranges respectively is $(g = 10$ m s$^{-2})$ ***08 Apr 2023 (M)***

(1) $4 : 9$ (2) $2 : \sqrt{3}$
(3) $\sqrt{3} : 2$ (4) $1 : 1$

Q19. The trajectory of projectile, projected from the ground is given by $y = x - \frac{x^2}{20}$. Where x and y are measured in meter. The maximum height attained by the projectile will be. ***08 Apr 2023 (E)***

(1) 200 m (2) 10 m
(3) 5 m (4) $10\sqrt{2}$ m

Q20. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: When a body is projected at an angle 45°, its range is maximum.
Reason R: For maximum range, the value of sin 2θ should be equal to one.
In the light of the above statements, choose the correct answer from the options given below: ***06 Apr 2023 (M)***

(1) A is false but R is true (2) A is true but R is false
(3) Both A and R are correct and R is the correct explanation of A (4) Both A and R are correct but R is NOT the correct explanation of A

Q21. A particle is moving with constant speed in a circular path. When the particle turns by an angle 90°, the ratio of instantaneous velocity to its average velocity is $\pi : x\sqrt{2}$. The value of x will be ***06 Apr 2023 (M)***

(1) 2 (2) 5
(3) 1 (4) 7

Q22. A child of mass 5 kg is going round a merry-go-round that makes 1 rotation in 3.14 s. The radius of the merry-go-round is 2 m. The centrifugal force on the child will be ***06 Apr 2023 (E)***

(1) 80 N (2) 40 N
(3) 100 N (4) 50 N

Q23. A child stands on the edge of the cliff 10 m above the ground and throws a stone horizontally with an initial speed of 5 m s^{-1} . Neglecting the air resistance, the speed with which the stone hits the ground will be _____ m s^{-1} (given, $g = 10$ m s^{-2}). ***01 Feb 2023 (M)***

(1) 20 (2) 15
(3) 30 (4) 25

Q24. The speed of a swimmer is 4 km h^{-1} in still water. If the swimmer makes his strokes normal to the flow of river of width 1 km, he reaches a point 750 m down the stream on the opposite bank. The speed of the river water is _____ km h^{-1}. ***31 Jan 2023 (M)***

Q25. The initial speed of a projectile fired from ground is u. At the highest point during its motion, the speed of projectile is $\frac{\sqrt{3}}{2}u$. The time of flight of the projectile is: ***31 Jan 2023 (M)***

(1) $\frac{u}{2g}$ (2) $\frac{u}{g}$
(3) $\frac{2u}{g}$ (4) $\frac{\sqrt{3}u}{g}$

Q26. Two bodies are projected from ground with same speeds 40 m s^{-1} at two different angles with respect to horizontal. The bodies were found to have same range. If one of the body was projected at an angle of 60°, with horizontal then sum of the maximum heights, attained by the two projectiles, is _____ m. (Given $g = 10$ m s^{-2}) ***31 Jan 2023 (E)***

Q27. A stone of mass 1 kg is tied to end of a massless string of length 1 m. If the breaking tension of the string is 400 N, then maximum linear velocity, the stone can have without breaking the string, while rotating in horizontal plane, is: ***31 Jan 2023 (E)***

(1) $20\ \text{m s}^{-1}$ (2) $40\ \text{m s}^{-1}$

(3) $400\ \text{m s}^{-1}$ (4) $10\ \text{m s}^{-1}$

Q28. A stone tied to 180 cm long string at its end is making 28 revolutions in horizontal circle in every minute. The magnitude of acceleration of stone is $\frac{1936}{x}\ \text{m s}^{-2}$. The value of x _____. [Take $\pi = \frac{22}{7}$] ***30 Jan 2023 (E)***

Q29. A stone is projected at angle 30° to the horizontal. The ratio of kinetic energy of the stone at point of projection to its kinetic energy at the highest point of flight will be : ***29 Jan 2023 (M)***

(1) 1 : 2 (2) 1 : 4

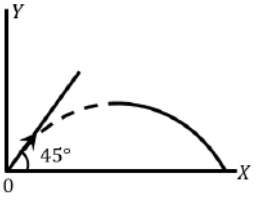
(3) 4 : 1 (4) 4 : 3

Q30. An object moves at a constant speed along a circular path in a horizontal plane with centre at the origin. When the object is at $x = +2$ m, its velocity is $-4\hat{\text{j}}\ \text{m s}^{-1}$. The object's velocity (v) and acceleration (a) at $x = -2$ m will be ***29 Jan 2023 (E)***

(1) $v = 4\hat{\text{i}}\ \text{m s}^{-1},\ a = 8\hat{\text{j}}\ \text{m s}^{-2}$ (2) $v = 4\hat{\text{j}}\ \text{m s}^{-1},\ a = 8\hat{\text{i}}\ \text{m s}^{-2}$

(3) $v = -4\hat{\text{j}}\ \text{m s}^{-1},\ a = 8\hat{\text{i}}\ \text{m s}^{-2}$ (4) $\text{v} = -4\hat{\text{i}}\ \text{m s}^{-1},\ \text{a} = -8\hat{\text{j}}\ \text{m s}^{-2}$

Q31. A particle of mass 100 g is projected at time $t = 0$ with a speed $20\ \text{m s}^{-1}$ at an angle 45° to the horizontal as given in the figure. The magnitude of the angular momentum of the particle about the starting point at time $t = 2$ s is found to be $\sqrt{K}$ kg $\text{m}^2\ \text{s}^{-1}$. The value of K is _____. (Take $g = 10\ \text{m s}^{-2}$)



29 Jan 2023 (E)

Q32. A car is moving on a circular path of radius 600 m such that the magnitudes of the tangential acceleration and centripetal acceleration are equal. The time taken by the car to complete first quarter of revolution, if it is moving with an initial speed of 54 km h^{-1} is $t\left(1-e^{-\frac{\pi}{2}}\right)$ s. The value of t is _____. ***29 Jan 2023 (E)***

Q33. Two objects are projected with same velocity u however at different angles α and β with the horizontal. If $\alpha + \beta = 90^\circ$, the ratio of horizontal range of the first object to the 2nd object will be : ***25 Jan 2023 (E)***

(1) 4 : 1 (2) 2 : 1

(3) 1 : 2 (4) 1 : 1

Q34. The maximum vertical height to which a man can throw a ball is 136 m. The maximum horizontal distance upto which he can throw the same ball is ***24 Jan 2023 (M)***

(1) 192 m (2) 136 m

(3) 272 m (4) 68 m

Q35. A ball is projected with kinetic energy E, at an angle of 60° to the horizontal. The kinetic energy of this ball at the highest point of its flight will become : ***29 Jul 2022 (M)***

(1) Zero (2) $\frac{E}{2}$

(3) $\frac{E}{4}$ (4) E

Q36. An object is projected in the air with initial velocity u at an angle θ. The projectile motion is such that the horizontal range R, is maximum. Another object is projected in the air with a horizontal range half of the range of first object. The initial velocity remains same in both the case. The value of the angle of projection, at which the second object is projected, will be _____ degree. ***29 Jul 2022 (M)***

Q37. At time $t = 0$ a particle starts travelling from a height $7\hat{z}$ cm in a plane keeping z coordinate constant. At any instant of time, it's position along the x and y directions are defined as $3t$ and $5t^3$ respectively. At $t = 1$ s acceleration of the particle will be ***28 Jul 2022 (E)***

(1) $-30y$ (2) $30y$

(3) $3x + 15y$ (4) $3x + 15y + 7\hat{z}$

Q38. A ball of mass m is thrown vertically upward. Another ball of mass 2 m is thrown an angle θ with the vertical. Both the balls stay in air for the same period of time. The ratio of the heights attained by the two balls respectively is $\frac{1}{x}$. The value of x is _____ . ***27 Jul 2022 (M)***

Q39. A body of mass 10 kg is projected at an angle of 45° with the horizontal. The trajectory of the body is observed to pass through a point $(20, 10)$. If T is the time of flight, then its momentum vector, at time $t = \frac{T}{\sqrt{2}}$, is _____. [Take $g = 10\ \text{m s}^{-2}$] ***27 Jul 2022 (E)***

(1) $100\hat{\text{i}} + \left(100\sqrt{2} - 200\right)\hat{\text{j}}$ N s (2) $100\sqrt{2}\hat{\text{i}} + \left(100 - 200\sqrt{2}\right)\hat{\text{j}}$ N s

(3) $100\hat{\text{i}} + \left(100 - 200\sqrt{2}\right)\hat{\text{j}}$ N s (4) $100\sqrt{2}\hat{\text{i}} + \left(100\sqrt{2} - 200\right)\hat{\text{j}}$ N s

Q40. Two projectile thrown at 30° and 45° with the horizontal respectively, reach the maximum height in same time. The ratio of their initial velocities is ***26 Jul 2022 (M)***

(1) $1 : \sqrt{2}$ (2) $2 : 1$

(3) $\sqrt{2} : 1$ (4) $1 : 2$

Q41. Two projectiles are thrown with same initial velocity making an angle of 45° and 30° with the horizontal respectively. The ratio of their respective ranges will be ***26 Jul 2022 (E)***

(1) $1 : \sqrt{2}$ (2) $\sqrt{2} : 1$

(3) $2 : \sqrt{3}$ (4) $\sqrt{3} : 2$

Q42. If the initial velocity in horizontal direction of a projectile is unit vector $\hat{i}$ and the equation of trajectory is $y = 5x(1 - x)$. The y component vector of the initial velocity is _____ $\hat{j}$. (Take $g = 10\ \text{m s}^{-2}$) ***26 Jul 2022 (M)***

Q43. A ball is projected from the ground with a speed 15 m s^{-1} at an angle θ with horizontal so that its range and maximum height are equal, then $\tan\theta$ will be equal to ***25 Jul 2022 (E)***

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$

(3) 2 (4) 4

Q44. A person can throw a ball upto a maximum range of 100 m. How high above the ground he can throw the same ball? ***29 Jun 2022 (E)***

(1) 25 m (2) 50 m

(3) 100 m (4) 200 m

Q45. Motion of a particle in $x-y$ plane is described by a set of following equations $x=4\sin\left(\frac{\pi}{2}-\omega t\right)$ m and $y=4\sin(\omega t)$ m. The path of the particle will be ***28 Jun 2022 (M)***

(1) circular (2) helical

(3) parabolic (4) eliptical

Q46. A ball is spun with angular acceleration $\alpha=6t^2-2t$ where t is in second and α is in rad s^{-2}. At $t=0$, the ball has angular velocity of 10 rad s^{-1} and angular position of 4 rad. The most appropriate expression for the angular position of the ball is ***28 Jun 2022 (E)***

(1) $\frac{3}{2}t^4-t^2+10t$ (2) $\frac{t^4}{2}-\frac{t^3}{3}+10t+4$

(3) $\frac{2t^4}{3}-\frac{t^3}{6}+10t+12$ (4) $2t^4-\frac{t^3}{2}+5t+4$

Q47. A girl standing on road holds her umbrella at 45° with the vertical to keep the rain away. If she starts running without umbrella with a speed of $15\sqrt{2}$ km h^{-1}, the rain drops hit her head vertically. The speed of rain drops with respect to the moving girl is ***27 Jun 2022 (M)***

(1) 30 km h^{-1} (2) $\frac{25}{\sqrt{2}}$ km h^{-1}

(3) $\frac{30}{\sqrt{2}}$ km h^{-1} (4) 25 km h^{-1}

Q48. The distance of the Sun from earth is 1.5×10^{11} m and its angular diameter is 2000″ when observed from the earth. The diameter of the Sun will be ***27 Jun 2022 (E)***

(1) 2.45×10^{10} m (2) 1.45×10^{10} m

(3) 1.45×10^{9} m (4) 0.14×10^{9} m

Q49. A projectile is launched at an angle α with the horizontal with a velocity 20 m s^{-1}. After 10 s, its inclination with horizontal is β. The value of $\tan\beta$ will be : $\left(g=10\text{ m s}^{-2}\right)$. ***27 Jun 2022 (M)***

(1) $\tan\alpha+5\sec\alpha$ (2) $\tan\alpha-5\sec\alpha$

(3) $2\tan\alpha-5\sec\alpha$ (4) $2\tan\alpha+5\sec\alpha$

Q50. A fighter jet is flying horizontally at a certain altitude with a speed of 200 m s^{-1}. When it passes directly overhead an anti-aircraft gun, a bullet is fired from the gun, at an angle θ with the horizontal, to hit the jet. If the bullet speed is 400 m s^{-1}, the value of θ will be _____ $^\circ$. ***26 Jun 2022 (M)***

Q51. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Two identical balls A and B thrown with same velocity 'u' at two different angles with horizontal attained the same range R. If A and B reached the maximum height h_1 and h_2 respectively, then $R=4\sqrt{h_1h_2}$
Reason R: Product of said heights. $h_1h_2=\left(\frac{u^2\sin^2\theta}{2g}\right)\cdot\left(\frac{u^2\cos^2\theta}{2g}\right)$ ***25 Jun 2022 (E)***

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

(2) Both A and R are true but R is NOT the correct explanation of A.

(3) A is true but R is false.

(4) A is false but R is true.

Q52. A projectile is projected with velocity of 25 m s^{-1} at an angle θ with the horizontal. After t seconds its inclination with horizontal becomes zero. If R represents horizontal range of the projectile, the value of θ will be : [use use $g=10\text{ m s}^{-2}$] ***24 Jun 2022 (M)***

(1) $\frac{1}{2}\sin^{-1}\left(\frac{5t^2}{4R}\right)$ (2) $\frac{1}{2}\sin^{-1}\left(\frac{4R}{5t^2}\right)$

(3) $\tan^{-1}\left(\frac{4t^2}{5R}\right)$ (4) $\cot^{-1}\left(\frac{R}{20t^2}\right)$

Q53. A body is projected from the ground at an angle of 45° with the horizontal. Its velocity after 2 s is 20 m s^{-1}. The maximum height reached by the body during its motion is _____ m. (use $g = 10$ m s^{-2}) ***24 Jun 2022 (E)***

Q54. A boy ties a stone of mass 100 g to the end of a 2 m long string and whirls it around in a horizontal plane. The string can withstand the maximum tension of 80 N. If the maximum speed with which the stone can revolve is $\frac{K}{\pi}$ rev min^{-1}. The value of K is :
(Assume the string is massless and un-stretchable) ***24 Jun 2022 (M)***

(1) 400 (2) 300

(3) 600 (4) 800

Q55. The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with the horizontal are $R_1,\ R_2$ and $H_1,\ H_2$ respectively. Choose the correct option: ***01 Sep 2021 (E)***

(1) $R_1 = R_2$ and $H_1 = H_2$ (2) $R_1 = R_2$ and $H_1 < H_2$

(3) $R_1 > R_2$ and $H_1 = H_2$ (4) $R_1 < R_2$ and $H_1 < H_2$

Q56. A helicopter is flying horizontally with a speed v at an altitude h has to drop a food packet for a man on the ground. What is the distance of helicopter from the man when the food packet is dropped ? ***31 Aug 2021 (M)***

(1) $\sqrt{\frac{2ghv^2+1}{h^2}}$ (2) $\sqrt{2ghv^2 + h^2}$

(3) $\sqrt{\frac{2gh}{v^2}} + h^2$ (4) $\sqrt{\frac{2v^2\,h}{g} + h^2}$

Q57. A player kicks a football with an initial speed of 25 m s^{-1} at an angle of 45° from the ground. What are the maximum height and the time taken by the football to reach at the highest point during motion? (Take g = 10 m s^{-2}) ***27 Aug 2021 (E)***

(1) $h_{\max} = 15.625$ m, T = 1.77 s (2) $h_{\max} = 3.54$ m, T = 0.125 s

(3) $h_{\max} = 10$ m, T = 2.5 s (4) $h_{\max} = 15.625$ m, T = 3.54 s

Q58. A bomb is dropped by a fighter plane flying horizontally. To an observer sitting in the plane, the trajectory of the bomb is a : ***26 Aug 2021 (E)***

(1) straight line vertically down the plane (2) parabola in a direction opposite to the motion of plane

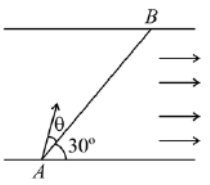
(3) parabola in the direction of motion of plane (4) hyperbola

Q59. A particle of mass m is suspended from a ceiling through a string of length L. The particle moves in a horizontal circle of radius r such that $r = \frac{L}{\sqrt{2}}$. The speed of particle will be : ***26 Aug 2021 (E)***

(1) $\sqrt{rg}$ (2) $\sqrt{2rg}$

(3) $\sqrt{\frac{rg}{2}}$ (4) $2\sqrt{rg}$

Q60. A swimmer wants to cross a river from point A to point B. Line AB makes an angle of 30° with the flow of the river. The magnitude of the velocity of the swimmer is the same as that of the river. The angle θ with the line AB should be _____ $^\circ$, so that the swimmer reaches point B.



27 Jul 2021 (E)

Q61. A butterfly is flying with a velocity $4\sqrt{2}$ m s^{-1} in north-east direction. Wind is slowly blowing at 1 m s^{-1} from north to south. The resultant displacement of the butterfly in 3 seconds is: ***20 Jul 2021 (M)***

(1) 3 m (2) 20 m

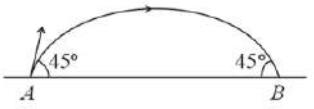
(3) $12\sqrt{2}$ m (4) 15 m

Q62. A boy reaches the airport and finds that the escalator is not working. He walks up the stationary escalator in time t_1. If he remains stationary on a moving escalator then the escalator takes him up in time t_2. The time taken by him to walk up on the moving escalator will be: ***20 Jul 2021 (E)***

(1) $\frac{t_1 t_2}{t_2 - t_1}$ (2) $\frac{t_1 + t_2}{2}$

(3) $\frac{t_1 t_2}{t_2 + t_1}$ (4) $t_2 - t_1$

Q63. The projectile motion of a particle of mass 5 g is shown in the figure. The initial velocity of the particle is $5\sqrt{2}$ ms^{-1} and the air resistance is assumed to be negligible. The magnitude of the change in momentum between the points A and B is $x \times 10^{-2}$ kgms^{-1}. The value of x, to the nearest integer, is ___.



18 Mar 2021 (E)

Q64. A person is swimming with a speed of 10 m s^{-1} at an angle of 120° with the flow and reaches to a point directly opposite on the other side of the river. The speed of the flow is x m s^{-1}. The value of x to the nearest integer is _____. ***18 Mar 2021 (M)***

Q65. If the angular velocity of earth's spin is increased such that the bodies at the equator start floating, the duration of the day would be approximately :

(Take : $g = 10$ ms^{-2}, the radius of earth, $R = 6400 \times 10^3$ m, Take $\pi = 3.14$) ***18 Mar 2021 (E)***

(1) 60 minutes (2) does not change

(3) 1200 minutes (4) 84 minutes

Q66. A block of 200 g mass moves with a uniform speed in a horizontal circular groove, with vertical side walls of radius 20 cm. If the block takes 40 s to complete one round, the normal force by the side walls of the groove is: ***16 Mar 2021 (M)***

(1) 0.0314 N (2) 9.859×10^{-2} N

(3) 6.28×10^{-3} N (4) 9.859×10^{-4} N

Q67. A swimmer can swim with velocity of 12 km/h in still water. Water flowing in a river has velocity 6 km/h. The direction with respect to the direction of flow of river water he should swim in order to reach the point on the other bank just opposite to his starting point is _____ $^\circ$. (Round off to the Nearest Integer) (find the angle in degree) ***16 Mar 2021 (E)***

Q68. The trajectory of a projectile in a vertical plane is $y = \alpha x - \beta x^2$, where α and β are constants and x & y are respectively the horizontal and vertical distances of the projectile from the point of projection. The angle of projection θ and the maximum height attained H are respectively given by ***26 Feb 2021 (E)***

(1) $\tan^{-1}\alpha,\ \frac{4\alpha^2}{\beta}$ (2) $\tan^{-1}\left(\frac{\beta}{\alpha}\right),\ \frac{\alpha^2}{\beta}$

(3) $\tan^{-1}\beta,\ \frac{\alpha^2}{2\beta}$ (4) $\tan^{-1}\alpha,\ \frac{\alpha^2}{4\beta}$

Q69. When a car is at rest, its driver sees rain drops falling on it vertically. When driving the car with speed v, he sees that rain drops coming at an angle 60° from the horizontal. On further increasing the speed of the car to $(1+\beta)$v, this angle changes to 45°. The value of β is close to : ***06 Sep 2020 (E)***

(1) 0.50 (2) 0.41

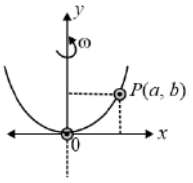
(3) 0.37 (4) 0.73

Q70. A clock has a continuously moving second's hand of 0.1m length. The average acceleration of the tip of the hand (in units of ms^{-2}]) is of the order of : ***06 Sep 2020 (M)***

(1) 10^{-3} (2) 10^{-4}

(3) 10^{-2} (4) 10^{-1}

Q71. A bead of mass m stays at point P(a, b) on a wire bent in the shape of a parabola $y = 4Cx^2$ and rotating with angular speed ω (see figure). The value of ω is (neglect friction)



02 Sep 2020 (M)

(1) $2\sqrt{2gC}$ (2) $\sqrt{2gC}$

(3) $\sqrt{\frac{2gC}{ab}}$ (4) $\frac{\sqrt{2g}}{C}$

Q72. A particle starts from the origin at $t = 0$ with an initial velocity of $3.0\hat{i}\text{m/s}$ and moves in the $x-y$ plane with a constant acceleration $\left(6.0\hat{i}+4.0\hat{j}\right)\text{m/s}^2$. The $x-$ coordinate of the particle at the instant when its $y-$ coordinate is $32m$ is D meters. The value of D is: ***09 Jan 2020 (E)***

(1) 32 (2) 50

(3) 60 (4) 40

Q73. A particle moves such that its position vector $\overrightarrow{r}(t) = \cos\omega t\hat{i} + \sin\omega t\hat{j}$ where ω is a constant and t is time. Then which of the following statements is true for the velocity $\overrightarrow{v}(t)$ and acceleration $\overrightarrow{a}(t)$ of the particle: ***08 Jan 2020 (E)***

(1) $\overrightarrow{v}$ is perpendicular to $\overrightarrow{r}$ and $\overrightarrow{a}$ is directed away from the origin

(2) $\overrightarrow{v}$ and $\overrightarrow{a}$ both are perpendicular to $\overrightarrow{r}$

(3) $\overrightarrow{v}$ and $\overrightarrow{a}$ both are parallel to $\overrightarrow{r}$

(4) $\overrightarrow{v}$ is perpendicular to $\overrightarrow{r}$ and $\overrightarrow{a}$ is directed towards the origin

Q74. A shell is fired from a fixed artillery gun with an initial speed u such that it hits the target on the ground at a distance R from it. If t_1 and t_2 are the values of the time taken by it to hit the target in two possible ways, the product t_1t_2 is: ***12 Apr 2019 (M)***

(1) $R/2g$ (2) R/g
(3) $2R/g$ (4) $R/4g$

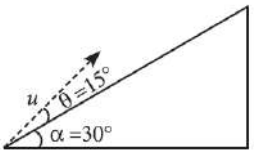
Q75. Two particles are projected from the same point with the same speed u such that they have the same range R, but different maximum heights, h_1 and h_2. Which of the following is correct? ***12 Apr 2019 (E)***

(1) $R^2 = h_1h_2$ (2) $R^2 = 4\ h_1h_2$
(3) $R^2 = 2\ h_1h_2$ (4) $R^2 = 16\ h_1h_2$

Q76. The trajectory of a projectile near the surface of the earth is given as $y = 2x - 9x^2$. If it were launched at an angle θ_0 with speed v_0 then $\left(g = 10\ m\ s^{-2}\right)$: ***12 Apr 2019 (M)***

(1) $\theta_0 = \cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0 = \frac{5}{3}\ ms^{-1}$ (2) $\theta_0 = \cos^{-1}\left(\frac{2}{\sqrt{5}}\right)$ and $v_0 = \frac{3}{5}\ ms^{-1}$
(3) $\theta_0 = \sin^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0 = \frac{5}{3}\ ms^{-1}$ (4) $\theta_0 = \sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$ and $v_0 = \frac{3}{5}\ ms^{-1}$

Q77. A plane is inclined at an angle $\alpha = 30^\circ$ with respect to the horizontal. A particle is projected with a speed $u = 2\ m\ s^{-1}$, from the base of the plane, making an angle $\theta = 15^\circ$ with respect to the plane as shown in the figure. The distance from the base, at which the particle hits the plane is close to: (Take $g = 10\ m\ s^{-2}$)



10 Apr 2019 (E)

(1) 20 cm (2) 18 cm
(3) 14 cm (4) 26 cm

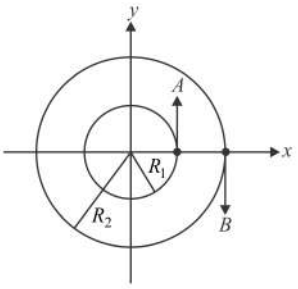
Q78. The stream of a river is flowing with a speed of 2 km h^{-1}. A swimmer can swim at a speed of 4 km h^{-1}. The direction of the swimmer with respect to the flow of the river, to cross the river straight, is ***09 Apr 2019 (M)***

(1) 150° (2) 90°
(3) 120° (4) 60°

Q79. A passenger train of length 60 m travels at a speed of 80 km / hr. Another freight train of length 120 m travels at a speed of 30 km / hr. The ratio of times taken by the passenger train to completely cross the freight train when: (i) they are moving in the same direction, and (ii) in the opposite directions is: ***12 Jan 2019 (M)***

(1) $\frac{5}{2}$ (2) $\frac{3}{2}$
(3) $\frac{11}{5}$ (4) $\frac{25}{11}$

Q80. Two particles A, B are moving on two concentric circles of radii R_1 and R_2 with equal angular speed ω. At $t = 0$, their positions and direction of motion are shown in the figure: The relative velocity $\overrightarrow{V_A} - \overrightarrow{V_B}$ at $t = \frac{\pi}{2\omega}$ is given by:



12 Jan 2019 (E)

(1) $-\omega\,(R_1 + R_2)\hat{i}$ (2) $\omega\,(R_1 + R_2)\hat{i}$
(3) $\omega\,(R_1 - R_2)\hat{i}$ (4) $\omega\,(R_2 - R_1)\hat{i}$

Q81. A particle is moving along a circular path with a constant speed of $10\ \text{ms}^{-1}$. What is the magnitude of the change in velocity of the particle, when it moves through an angle of 60° around the centre of the circle?

11 Jan 2019 (M)

(1) $10\sqrt{3}\ \text{m/s}$ (2) zero

(3) $10\sqrt{2}\ \text{m/s}$ (4) $10\ \text{m/s}$

Q82. A body is projected at $t = 0$ with a velocity $10\ \text{ms}^{-1}$ at an angle of 60° with the horizontal. The radius of curvature of its trajectory at $t = 1$ s is R. Neglecting air resistance and taking acceleration due to gravity $g = 10\ \text{ms}^{-2}$, the value of R is:

11 Jan 2019 (M)

(1) $10.3\ \text{m}$ (2) $2.8\ \text{m}$

(3) $2.5\ \text{m}$ (4) $5.1\ \text{m}$

Q83. Two guns A and B can fire bullets at speeds $1\ km/s$ and $2\ km/s$ respectively. From a point on a horizontal ground, they are fired in all possible directions. The ratio of maximum areas covered by the bullets fired by the two guns, on the ground is:

10 Jan 2019 (M)

(1) $1:16$ (2) $1:2$

(3) $1:4$ (4) $1:8$

Q84. In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed v more than that of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then v is equal to:

09 Jan 2019 (E)

(1) $\frac{2a_1a_2}{a_1+a_2}t$ (2) $\frac{a_1+a_2}{2}t$

(3) $\sqrt{a_1a_2}t$ (4) $\sqrt{2a_1a_2}t$

ANSWER KEYS

1. (100)	**2.** (1)	**3.** (16)	**4.** (4)	**5.** (1)	**6.** (1)	**7.** (2)	**8.** (1)
9. (4)	**10.** (1)	**11.** (2)	**12.** (1)	**13.** (2)	**14.** (80)	**15.** (4)	**16.** (1)
17. (4)	**18.** (1)	**19.** (3)	**20.** (3)	**21.** (1)	**22.** (2)	**23.** (2)	**24.** (3)
25. (2)	**26.** (80)	**27.** (1)	**28.** (125)	**29.** (4)	**30.** (2)	**31.** (800)	**32.** (40)
33. (4)	**34.** (3)	**35.** (3)	**36.** (15)	**37.** (2)	**38.** (1)	**39.** (4)	**40.** (3)
41. (3)	**42.** (5)	**43.** (4)	**44.** (2)	**45.** (1)	**46.** (2)	**47.** (3)	**48.** (3)
49. (2)	**50.** (60)	**51.** (1)	**52.** (4)	**53.** (20)	**54.** (3)	**55.** (2)	**56.** (4)
57. (1)	**58.** (1)	**59.** (1)	**60.** (30)	**61.** (4)	**62.** (3)	**63.** (5)	**64.** (5)
65. (4)	**66.** (4)	**67.** (120)	**68.** (4)	**69.** (4)	**70.** (1)	**71.** (1)	**72.** (3)
73. (4)	**74.** (3)	**75.** (4)	**76.** (1)	**77.** (1)	**78.** (3)	**79.** (3)	**80.** (4)
81. (4)	**82.** (2)	**83.** (1)	**84.** (3)				