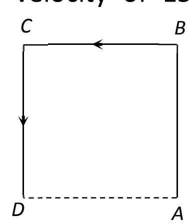
KINEMATICS (Motion in 1D and 2D)

1. A car travels a distance S on a straight road in two hours and then returns to the starting point in the next three hours. Its average velocity is

(a) $S/5$ (b) $2S/5$
(c) $S/2 + S/3$ (d) None of the above

2. A particle moves along the sides AB, BC, CD of a square of side 25 m with a velocity of $15\,ms^{-1}$. Its average velocity is



(a) $15\,ms^{-1}$
(b) $10\,ms^{-1}$
(c) $7.5\,ms^{-1}$
(d) $5\,ms^{-1}$

3. A body has speed V, $2V$ and $3V$ in first 1/3 of distance S, seconds 1/3 of S and third 1/3 of S respectively. Its average speed will be

(a) V (b) $2V$
(c) $\frac{18}{11}V$ (d) $\frac{11}{18}V$

4. If the body covers one-third distance at speed v_1, next one third at speed v_2 and last one third at speed v_3, then average speed will be

(a) $\frac{v_1 v_2 + v_2 v_3 + v_3 v_1}{v_1 + v_2 + v_3}$ (b) $\frac{v_1 + v_2 + v_3}{3}$
(c) $\frac{v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$ (d) $\frac{3 v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$

5. The displacement of the particle varies with time according to the relation $x = \frac{k}{b}[1 - e^{-bt}]$. Then the velocity of the particle is

(a) $k(e^{-bt})$ (b) $\frac{k}{b^2 e^{-bt}}$
(c) $k\,b\,e^{-bt}$ (d) None of these

6. The acceleration of a particle starting from rest, varies with time according to the relation $A = -a\omega^2 \sin\omega t$. The displacement of this particle at a time t will be

(a) $-\frac{1}{2}(a\omega^2 \sin\omega t)t^2$ (b) $a\omega \sin\omega t$
(c) $a\omega \cos\omega t$ (d) $a \sin\omega t$

7. If the velocity of a particle is $(10 + 2t^2)$ m/s, then the average acceleration of the particle between $2s$ and $5s$ is

(a) $2\ m/s^2$ (b) $4\ m/s^2$
(c) $12\ m/s^2$ (d) $14\ m/s^2$

8. A bullet moving with a velocity of 200 cm/s penetrates a wooden block and comes to rest after traversing 4 cm inside it. What velocity is needed for travelling distance of 9 cm in same block

(a) 100 cm/s (b) $136.2\ cm/s$
(c) $300\ cm/s$ (d) 250 cm/s

9. A thief is running away on a straight road in jeep moving with a speed of $9\,ms^{-1}$. A police man chases him on a motor cycle moving at a speed of $10\,ms^{-1}$. If the instantaneous separation of the jeep from the motorcycle is 100 m, how long will it take for the police to catch the thief

(a) 1 s (b) 19 s
(c) 90 s (d) 100 s

10. A car *A* is travelling on a straight level road with a uniform speed of 60 km/h. It is followed by another car *B* which is moving with a speed of 70 km/h. When the distance between them is 2.5 *km*, the car *B* is given a deceleration of 20 km/h^2. After how much time will *B* catch up with *A*

(a) 1 *hr* (b) 1/2 *hr*

(c) 1/4 *hr* (d) 1/8 *hr*

11. The speed of a body moving with uniform acceleration is *u*. This speed is doubled while covering a distance *S.* When it covers an additional distance *S,* its speed would become

(a) $\sqrt{3}\,u$ (b) $\sqrt{5}\,u$

(c) $\sqrt{11}\,u$ (d) $\sqrt{7}\,u$

12. Two trains one of length 100 *m* and another of length 125 *m*, are moving in mutually opposite directions along parallel lines, meet each other, each with speed 10 m/s. If their acceleration are 0.3 m/s^2 and 0.2 m/s^2 respectively, then the time they take to pass each other will be

(a) 5 *s* (b) 10 *s*

(c) 15 *s* (d) 20 *s*

13. A body starts from rest with uniform acceleration. If its velocity after *n* second is υ, then its displacement in the last two seconds is

(a) $\frac{2\upsilon(n+1)}{n}$ (b) $\frac{\upsilon(n+1)}{n}$

(c) $\frac{\upsilon(n-1)}{n}$ (d) $\frac{2\upsilon(n-1)}{n}$

14. A point starts moving in a straight line with a certain acceleration. At a time t after beginning of motion the acceleration suddenly becomes retardation of the same value. The time in which the point returns to the initial point is

(a) $\sqrt{2t}$ (b) $(2+\sqrt{2})\,t$

(c) $\frac{t}{\sqrt{2}}$ (d) Cannot be predicted unless acceleration is given

15. A particle is moving in a straight line and passes through a point O with a velocity of $6\ ms^{-1}$. The particle moves with a constant retardation of $2\ ms^{-2}$ for 4 *s* and there after moves with constant velocity. How long after leaving O does the particle return to O

(a) $3s$ (b) $8s$

(c) Never (d) $4s$

16. A bird flies for 4 s with a velocity of $|t-2|\ m/s$ in a straight line, where *t* is time in seconds. It covers a distance of

(a) $2\ m$ (b) $4\ m$

(c) $6\ m$ (d) $8\ m$

17. A particle is projected with velocity υ_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) $\sqrt{\frac{3\upsilon_0}{2\alpha}}$ (b) $\left(\frac{3v_o}{2\alpha}\right)^{\frac{1}{3}}$

(c) $\sqrt{\frac{3\upsilon_0^2}{2\alpha}}$ (d) $\left(\frac{3\upsilon_0^2}{2\alpha}\right)^{\frac{1}{3}}$

18. A body is projected vertically up with a velocity *v* and after some time it returns to the point from which it was projected. The average velocity and average speed of the body for the total time of flight are

(a) $\vec{v}/2$ and $v/2$ (b) 0 and $v/2$

(c) 0 and 0 (d) $\vec{v}/2$ and 0

19. A stone is dropped from a height *h.* Simultaneously, another stone is thrown up from the ground which reaches a height 4 *h.* The two stones cross each other after time

(a) $\sqrt{\frac{h}{8g}}$ (b) $\sqrt{8gh}$

(c) $\sqrt{2gh}$ (d) $\sqrt{\frac{h}{2g}}$

20. Four marbles are dropped from the top of a tower one after the other with an interval of one second. The first one reaches the ground after 4 *seconds*. When the first one reaches the ground the distances between the first and second, the second and third and the third and forth will be respectively

(a) 35, 25 and 15 *m* (b) 30, 20 and 10 *m*
(c) 20, 10 and 5 *m* (d) 40, 30 and 20 *m*

21. A balloon rises from rest with a constant acceleration $g/8$. A stone is released from it when it has risen to height *h.* The time taken by the stone to reach the ground is

(a) $4\sqrt{\frac{h}{g}}$ (b) $2\sqrt{\frac{h}{g}}$
(c) $\sqrt{\frac{2h}{g}}$ (d) $\sqrt{\frac{g}{h}}$

22. Two bodies are thrown simultaneously from a tower with same initial velocity v_0 : one vertically upwards, the other vertically downwards. The distance between the two bodies after time *t* is

(a) $2v_0 t+\frac{1}{2}g t^2$ (b) $2v_0 t$
(c) $v_0 t+\frac{1}{2}g t^2$ (d) $v_0 t$

23. A body falls freely from the top of a tower. It covers 36% of the total height in the last second before striking the ground level. The height of the tower is

(a) 50 *m* (b) 75 *m*
(c) 100 *m* (d) 125 *m*

24. A particle is projected upwards. The times corresponding to height *h* while ascending and while descending are t_1 and t_2 respectively. The velocity of projection will be

(a) gt_1 (b) gt_2
(c) $g(t_1+t_2)$ (d) $\frac{g(t_1+t_2)}{2}$

25. A projectile is fired vertically upwards with an initial velocity *u*. After an interval of T seconds a second projectile is fired vertically upwards, also with initial velocity *u*.

(a) They meet at time $t=\frac{u}{g}$ and at a height $\frac{u^2}{2g}+\frac{gT^2}{8}$

(b) They meet at time $t=\frac{u}{g}+\frac{T}{2}$ and at a height $\frac{u^2}{2g}+\frac{gT^2}{8}$

(c) They meet at time $t=\frac{u}{g}+\frac{T}{2}$ and at a height $\frac{u^2}{2g}-\frac{gT^2}{8}$

(d) They never meet

26. 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

27. In uniform circular motion

(a) Both velocity and acceleration are constant
(b) Acceleration and speed are constant but velocity changes
(c) Both acceleration and velocity changes
(d) Both acceleration and speed are constant

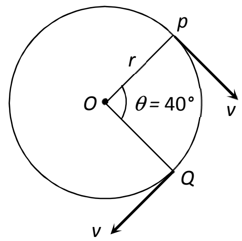
28. For a body moving in a circular path, a condition for no skidding if μ is the coefficient of friction, is

(a) $\frac{mv^2}{r}\le \mu mg$ (b) $\frac{mv^2}{r}\ge \mu mg$
(c) $\frac{v}{r}=\mu g$ (d) $\frac{mv^2}{r}=\mu mg$

29. A car is moving with a uniform speed on a level road. Inside the car there is a balloon filled with helium and attached to a piece of string tied to the floor. The string is observed to be vertical. The car now takes a left turn maintaining the speed on the level road. The balloon in the car will

(a) Continue to remain vertical
(b) Burst while taking the curve
(c) Be thrown to the right side
(d) Be thrown to the left side

30. 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 $(\angle POQ = 40^o)$



(a) $2v\cos 40^o$

(b) $2v\sin 40^o$

(c) $2v\sin 20^o$

(d) $2v\cos 20^o$

31. 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) $\frac{v}{r^2}$

32. 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*

33. 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) $v = \sqrt{2\,\mathrm{lg}}$ (b) $v = \sqrt{3\,\mathrm{lg}}$

(c) $v = \sqrt{4\,\mathrm{lg}}$ (d) $v = \sqrt{5\,\mathrm{lg}}$

34. 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) $F/2$

35. 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

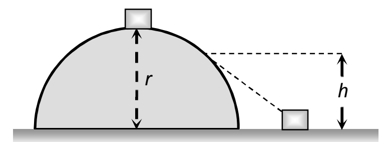
(c) $F/2$ (d) $F/4$

36. 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) $4R$

37. 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) $\frac{v^2}{2g}$

38. 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 the bottom of the circle is

(a) $\frac{mg}{r}$ (b) $\frac{2mg}{r}$

(c) $2mgr$ (d) mgr

39. 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 $'a'\ meter/\sec^2$, 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) $\sqrt{\left\{\frac{v^2}{r^2} + a^2\right\}}$

40. A ball of mass 0.1 *kg* is suspended by a string. It is displaced through an angle of 60^o 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

41. 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*

42. A body is projected horizontally from a height with speed 20 *metres/sec*. What will be its speed after 5 *seconds* ($g = 10\ metres/\sec^2$)

(a) 54 *metres/sec* (b) 20 *metres/sec*

(c) 50 *metres/sec* (d) 70 *metres/sec*

43. 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) $\sqrt{2gh + u^2} : \sqrt{2gh}$

44. A projectile projected at an angle 30^o from the horizontal has a range R. If the angle of projection at the same initial velocity be 60^o, then the range will be

(a) R (b) $2R$

(c) $R/2$ (d) R^2

45. At the highest point of the path of a projectile, its

(a) Kinetic energy is maximum

(b) Potential energy is minimum

(c) Kinetic energy is minimum

(d) Total energy is maximum

46. A cricket ball is hit at 30^o with the horizontal with kinetic energy K. The kinetic energy at the highest point is

(a) Zero (b) $K/4$

(c) $K/2$ (d) $3K/4$

47. 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) $D \tan\theta - \frac{gD^2}{2v_0^2 \sin^2\theta}$

48. A stone is projected from the ground with velocity 50 *m/s* at an angle of 30^o. 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*

49. A body of mass m is projected at an angle of 45^o 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) $mv/\sqrt{2}$

50. 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) $\cos\theta : 1$