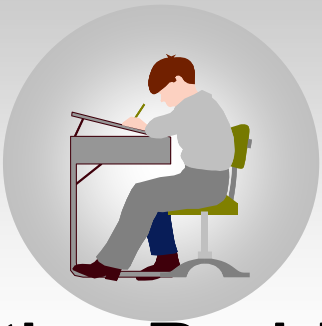


Practice Problems

Problems based on work done by constant force

▶ Basic level

1. A body moves a distance of 10 *m* along a straight line under the action of a force of 5 *N*. If the work done is 25 *joules*, the angle which the force makes with the direction of motion of the body is

[NCERT 1980; JIMPER 1997; CBSE PMT 1999; BHU 2000; RPMT 2000; Orissa JEE 2002]

(a) 0^o (b) 30^o (c) 60^o (d) 90^o

2. A particle moves from position $\vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$ under the action of force $4\hat{i} + \hat{j} + 3\hat{k}\ N$. The work done will be [Pb. PMT 2002]

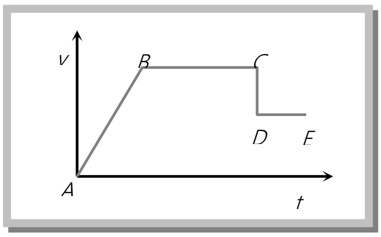
(a) 100 *J* (b) 50 *J* (c) 200 *J* (d) 75 *J*

3. The work done on a body does not depend upon

(a) Force applied (b) Displacement

(c) Initial velocity of the body (d) Angle at which force is inclined to the displacement.

4. The adjoining diagram shows the velocity versus time plot for, a particle. The work done by the force on the particle is positive from



(a) *A* to *B*

(b) *B* to *C*

(c) *C* to *D*

(d) *D* to *E*

5. The length of the sides of a rectangular hexahedron are in the ratio $1:2:3$. It is placed on a horizontal surface. The body is in the position of maximum stability when the length of the sides placed on the surface are in ratio

(a) 1 : 2 (b) 1 : 3

(c) 2 : 3 (d) In all positions stability is same

6. In which of the following is no work done by the force

(a) A man carrying a bucket of water, walking on a level road with a uniform velocity

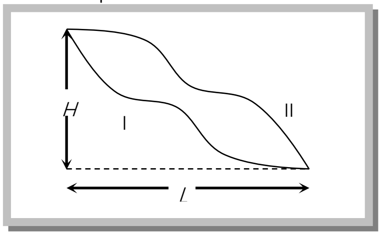
(b) A drop of rain falling vertically with a constant velocity

(c) A man whirling a stone tied to a string in a circle with a constant speed

(d) A man walking up on a staircase

▶▶ *Advance level*

7. A body is lifted over route I and route II such that force is always tangent to the path. Coefficient of friction is same for both the paths. Work done



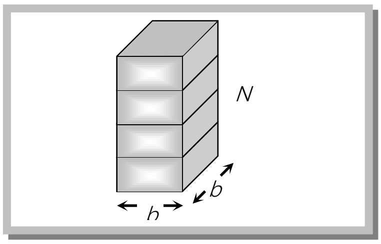
(a) On both routes is same

(b) On route I is more

(c) On route II is more

(d) On both routes is zero

8. *N* similar slabs of cubical shape of edge *b* are lying on ground. Density of material of slab is *D*. Work done to arrange them one over the other is



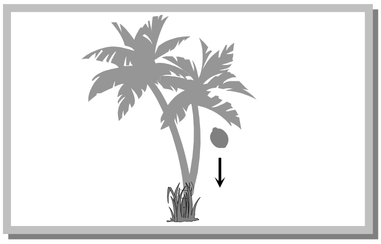
(a) $(N^2-1)b^3Dg$

(b) $(N-1)b^4Dg$

(c) $\frac{1}{2}(N^2-N)b^4Dg$

(d) $(N^2-N)b^4Dg$

9. A coconut of mass *m kg* falls its tree through a vertical distance *m* and could reach ground with a velocity of $v\ ms^{-1}$ due to air resistance. Work done by air resistance is



(a) $-\frac{m}{2}(2gs-v^2)$

(b) $-\frac{1}{2}mv^2$

(c) $-mgs$

(d) mv^2+2mgs

Problems based on work done by variable force

▶ *Basic level*

10. A body of mass 3 *kg* is under a force which causes a displacement in it given by $S=\frac{t^2}{3}$ (in *m*) find the work done by the force in first 2 seconds [BHU 1998]

(a) 2 *J* (b) 3.8 *J* (c) 5.2 *J* (d) 2.6 *J*

11. A particle moves along the *x*-axis from $x = x_1$ to $x = x_2$ under the influence of a force given by $F = 2x$. Then work done in the process is [CPMT 1993]

(a) Zero (b) $x_2^2 - x_1^2$ (c) $2x_2(x_2 - x_1)$ (d) $2x_1(x_1 - x_2)$

12. The force on a particle varies as $F = \frac{9}{x^2}$. The work done in displacing the particle from $x = 1$ to $x = 3$ is

(a) 4 *J* (b) 3 *J* (c) 5 *J* (d) 6 *J*

▶▶ *Advance level*

13. A force acts on a 3.0 *g* particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where *x* is in *metres* and *t* is in seconds. The work done during the first $4s$ is

(a) 576 *mJ* (b) 450 *mJ* (c) 490 *mJ* (d) 530 *mJ*

14. A force $\vec{F} = -K(y\hat{i} + x\hat{j})$ (where *K* is a positive constant) acts on a particle moving in the *xy*-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 point (*a*, *a*). The total work done by the force $\vec{F}$ on the particles is

(a) $-2Ka^2$ (b) $2Ka^2$ (c) $-Ka^2$ (d) Ka^2

15. The displacement *x* of a particle of mass *m kg* moving in one dimension, under the action of a force, is related to the time *t* by the equation $t = \sqrt{x} + 3$ where *x* is in *metres* and *t* is in seconds. The work done by the force in the first six second in joules is

[IIT-JEE 1979]

(a) 0 (b) 3*m* (c) 6*m* (d) 9*m*

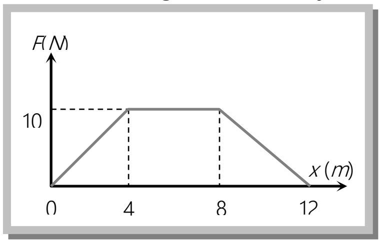
16. The velocity of a particle moving along a line varies with distance as $v = a\sqrt{x}$ where *a* is a constant. The work done by all forces when the particle moves from $x = 0$ to $x = l$ is (mass of the particle is *m*)

(a) 0 (b) ma^2l (c) $\frac{1}{2}ma^2l$ (d) $\frac{1}{3}mal$

Problems based on force displacement graph

▶ *Basic level*

17. A particle of mass 0.1 *kg* is subjected to a force which varies with distance as shown in fig. If it starts its journey from rest at $x = 0$, its velocity at $x = 12\,m$ is [AIIMS 1995]



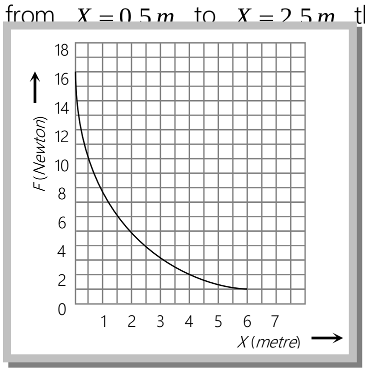
(a) 0 *m/s*

(b) $20\sqrt{2}\ m/s$

(c) $20\sqrt{3}\ m/s$

(d) $40\ m/s$

18. The relation between the displacement X of an object produced by the application of the variable force F is represented by a graph shown in the figure. If the object undergoes a displacement from $X = 0.5\,m$ to $X = 2.5\,m$ the work done will be approximately equal to



(a) 16 J

(b) 32 J

(c) 1.6 J

(d) 8 J

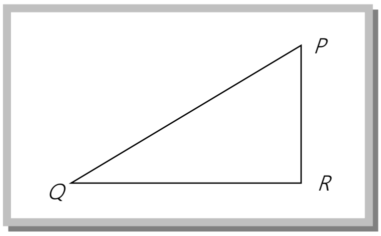
Problems based on work done in conservative and non-conservative field

▶ Basic level

19. If the amount of work done by a force depends only on the initial and final, positions of the object which has been moved, then such a force is called

(a) Gravitational (b) Dissipative (c) Conservative (d) Retarding

20. For the path PQR in a conservative force field. The amounts work done in carrying a body from P to Q and from Q to R are 5 *Joule* and 2 *Joule* respectively. The work done in carrying the body from P to R will be



(a) 7 J

(b) 3 J

(c) $\sqrt{21}$ J

(d) Zero

21. There will be an increase in potential energy of the system, if work is done upon the system by

(a) Any conservative or non-conservative force (b) A non-conservative force

(c) A conservative force (d) None of the above

Problems based on energy

▶ Basic level

22. The energy which an electron acquires when accelerated, through a potential difference of 1 *volt* is called

(a) 1 *Joule* (b) 1 *eV* (c) 1 *erg* (d) 1 *watt*

23. If a 5 *kg* body falls to the ground from a height of 30 *metres* and if all its mechanical energy is converted into heat, the heat produced will be [CPMT 1995]

(a) 350 *cal* (b) 150 *cal* (c) 60 *cal* (d) 6 *cal*

24. A wound watch spring

(a) Has no energy stored in it (b) Has kinetic energy stored in it

(c) Has mechanical potential energy stored in it (d) Has electrical energy stored in it

Problems based on kinetic energy

▶ *Basic level*

25. If the linear momentum is increased by 50%, the kinetic energy will increase by

[CPMT 1983, 95; MP PMT 1994; RPET 1994; MP PET 1996, 99; UPSEAT 2001]

(a) 50% (b) 100 % (c) 125% (d) 25%

26. Two masses of 1 *gm* and 4 *gm* are moving with equal kinetic energies. The ratio of the magnitudes of their linear momenta is

[IIT-JEE 1980; NCERT 1983; AIIMS 1987; MP PMT 1993; RPET 1996; CBSE PMT 1997; RPMT 1999; KCET (Engg./Med.)1999; Orissa JEE 2003]

(a) $4:1$ (b) $\sqrt{2}:1$ (c) $1:2$ (d) $1:16$

27. If the kinetic energy of a body becomes four times of its initial value, then new momentum will [KCET (Engg./Med.) 2000; AIIMS 1998, 2002]

(a) Becomes twice its initial value (b) Become three times its initial value

(c) Become four times its initial value (d) Remains constant

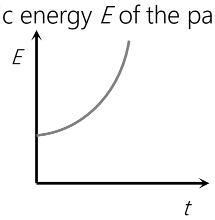
28. A bomb of 12 *kg* explodes into two pieces of masses 4 *kg* and 8 *kg*. The velocity of 8*kg* mass is 6 *m/sec*. The kinetic energy of the other mass is [MNR 1985; CPMT 1991; Manipal MEE 1995; EAMCET 1997]

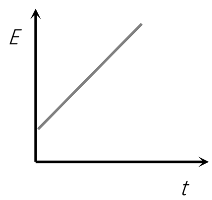
(a) 48 *J* (b) 32 *J* (c) 24 *J* (d) 288 *J*

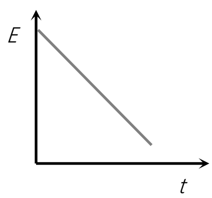
29. The kinetic energy of a body is numerically equal to thrice the momentum of the body. The velocity of the body is

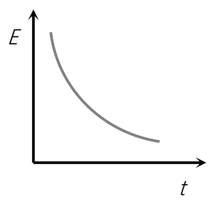
(a) 2 units (b) 3 units (c) 6 units (d) 9 units

30. A particle is dropped from a height *h*. A constant horizontal velocity is given to the particle. Taking *g* to be constant every where, kinetic energy *E* of the particle w. r. t. time *t* is correctly shown in

(a) 

(b) 

(c) 

(d) 

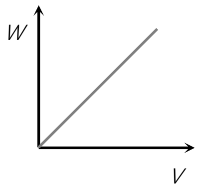
31. A neutron moving with a constant speed passes two points 3.6 *m* apart in 1.8×10^{-4} *s*. The kinetic energy of the neutron is

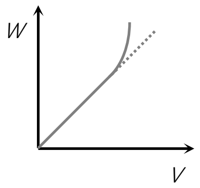
(a) 2.1×10^{3} *eV* (b) 2.1 *eV* (c) 21 *eV* (d) 2.1×10^{-3} *eV*

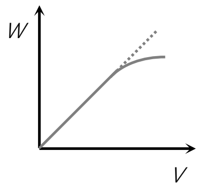
32. A body initially at rest explodes suddenly into three equal parts. The momenta of two parts are $p\hat{i}$ and $2p\hat{j}$ and their kinetic energies are E_1 and E_2 respectively. If the momentum and kinetic energy of the third part are p_3 and E_3 respectively, then the ratio $\frac{E_2}{E_3}$ is

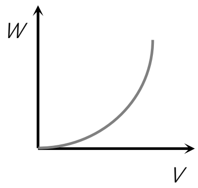
(a) $\frac{4}{5}$ (b) $\frac{3}{5}$ (c) $\frac{2}{5}$ (d) $\frac{1}{5}$

33. A particle, initially at rest on a frictionless horizontal surface, is acted upon by a horizontal force which is constant in size and direction. A graph is plotted of the work done on the particle *W*, against the speed of the particle, *v*. If there are no other horizontal forces acting on the particle the graph would look like

(a) 

(b) 

(c) 

(d) 

34. Two stationary nuclei *A* and *B* are emitting α particles of same kinetic energy. The mass of *A* is greater then that of *B*, then the ratio of kinetic energies of nucleus *A* and nucleus *B* is

(a) Unity (b) More than unity (c) Less then unity (d) Answer is not possible

▶▶ *Advance level*

35. If the kinetic energy of a body is directly proportional to time *t*, the magnitude of the force acting on the body is

(a) Directly proportional to $\sqrt{t}$ (b) Inversely proportional to $\sqrt{t}$

(c) Directly proportional to the speed of the body (d) Inversely proportional to the speed of the body

36. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement *x* is proportional to

(a) x (b) x^2 (c) ln x (d) e^x

37. An engine pumps a liquid of density *d* continuously through a pipe of area of cross-section *A*. If the speed with which the liquid passes the pipe is *V*, then the rate at which kinetic energy is being imparted to the liquid, is

(a) $\frac{1}{2}AdV^3$ (b) $\frac{1}{2}AdV^2$ (c) $\frac{1}{2}AdV$ (d) AdV^2

38. A man of mass *m* is standing on a stationary flat car of mass *M*. The car can move without friction along horizontal rails. The man starts walking with velocity *v* relative to the car. Work done by him

(a) Is greater then $\frac{1}{2}mv^2$ if he walks along rails
(b) Is less then $\frac{1}{2}mv^2$ if he walks along rails
(c) Is equal to $\frac{1}{2}mv^2$ if he walks normal to rails
(d) Can never be less than $\frac{1}{2}mv^2$

Problems based on stopping of vehicle

▶ Basic level

39. A car is moving along a straight horizontal road with a speed V_0. If the coefficient of friction between the types and the road is μ, the shortest distance in which the car can be stopped is [MP PMT 1985]

(a) $\frac{V_0^2}{2\mu g}$ (b) $\frac{V_0}{\mu g}$ (c) $\left(\frac{V_0}{\mu g}\right)^2$ (d) $\frac{V_0^2}{\mu}$

40. A car travelling at a speed of 30 *km/hour* is brought to a halt in 8 *m* by applying brakes. If the same car is travelling at 60 *km/hour*. It can be brought to a halt with the same braking force in [NCERT 1976]

(a) 8 *m* (b) 16 *m* (c) 24 *m* (d) 32 *m*

41. The distance covered by a body to come to rest when it is moving with a speed of $4\ ms^{-1}$ is *s* when a retarding force *F* is applied. If the *K.E.* is doubled, the distance covered by it to come to rest for the same retarding force *F* is

(a) 4 *s* (b) 6 *s* (c) 2 *s* (d) 8 *s*

42. A body is gently dropped on a conveyor belt moving at $3\ ms^{-1}$. If $\mu = 0.5$, how far will the body move relative to the belt before coming to rest ($g = 10\ ms^{-2}$)

(a) 0.3 *m* (b) 0.6 *m* (c) 0.9 *m* (d) 1.8 *m*

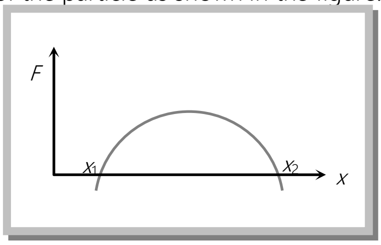
Problems based on potential energy

▶ Basic level

43. In which case does the potential energy decrease [MP PET 1996]

(a) On compressing a spring
(b) On stretching a spring
(c) On moving a body against gravitational force
(d) On the rising of an air bubble in water

44. The force acting on a body moving along *x*-axis varies with the position of the particle as shown in the figure. The body is in stable equilibrium at



(a) $x = x_1$
(b) $x = x_2$
(c) Both x_1 and x_2
(d) Neither x_1 nor x_2

45. If a particle under the action of a force *F* has potential energy *U* then in equilibrium

(a) $F = 0$ and $U = 0$ (b) $F \neq 0$ and $U = 0$ (c) $F = 0$ and $U \neq 0$ (d) $F \neq 0$ and $U \neq 0$

▶▶ *Advance level*

46. A particle free to move along the *x*-axis has potential energy given by $U(x) = k[1 - \exp(-x^2)]$ for $-\infty \le x \le +\infty$, where *k* is a positive constant of appropriate dimensions. Then [IIT-JEE 1999; UPSEAT 2003]

(a) At point away from the origin, the particle is in unstable equilibrium

(b) For any finite non-zero value of *x*, there is a force directed away from the origin

(c) If its total mechanical energy is $k/2$, it has its minimum kinetic energy at the origin

(d) For small displacements from $x = 0$, the motion is simple harmonic

Problems based on elastic potential energy

▶ *Basic level*

47. The potential energy of a certain spring when stretched through a distance '*S*' is 10 *Joule*. The amount of work (in *joule*) that must be done on this spring to stretch it through an additional distance '*S*' will be [MNR 1991; UPSEAT 2000; CPMT 2002]

(a) 30 (b) 40 (c) 10 (d) 20

48. A spring of force constant 800 *N/m* has an extension of 5 *cm*. The work done in extending it from 5 *cm* to 15 *cm* is [AIEEE 2002]

(a) 16 *J* (b) 8 *J* (c) 32 *J* (d) 24 *J*

49. If a spring extends by *x* on loading, then energy stored by the spring is (if *T* is the tension in the spring and *k* is the spring constant)

[AIIMS 1997]

(a) $\frac{T^2}{2x}$ (b) $\frac{T^2}{2k}$ (c) $\frac{2k}{T^2}$ (d) $\frac{2T^2}{k}$

50. Two springs have their force constants K_1 and K_2. Both are stretched till their elastic energies are equal. If the stretching forces are F_1 and F_2 then $F_1 : F_2$ is equal to

(a) $K_1 : K_2$ (b) $K_2 : K_1$ (c) $\sqrt{K_1} : \sqrt{K_2}$ (d) $K_1^2 = K_2^2$

51. A wound watch spring

(a) Has no energy stored in it (b) Has mechanical kinetic energy stored in it

(c) Has mechanical potential energy stored in it (d) Has electrical energy stored in it

52. A force $F = Kx^2$ acts on a particle at an angle of 60^o with the *x*-axis. The work done in displacing the particle from x_1 to x_2 will be

(a) $\frac{kx^2}{2}$ (b) $\frac{k}{2}(x_2^2 - x_1^2)$ (c) $\frac{k}{6}(x_2^3 - x_1^3)$ (d) $\frac{k}{3}(x_2^3 - x_1^3)$

▶▶ *Advance level*

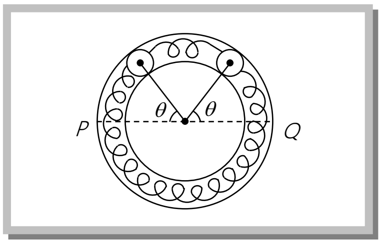
53. Two identical balls A and B of mass m kg are attached to two identical massless springs. The spring mass system is constrained to move inside a rigid smooth pipe bent in the form of a circle as shown in figure. The pipe is fixed in a horizontal plane. The centres of the balls can move in a circle of radius r *metre*. Each spring has a natural length of $r\pi$ *metre* and spring constant K. Initially, both the balls are displaced by an angle θ radian *w.r.t.* diameter PQ of the circles and released from rest. The speed of ball A when A and B are at the two ends of dia PQ is

(a) $R\theta\sqrt{\frac{m}{K}}$

(b) $2R\theta\sqrt{\frac{K}{m}}$

(c) $2R\theta\sqrt{\frac{m}{K}}$

(d) $2R\theta\sqrt{\frac{K}{m}}$



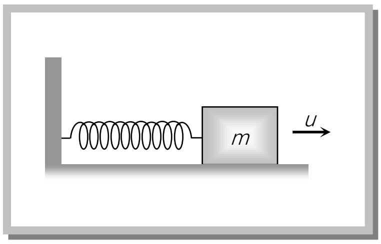
54. A block of mass m has initial velocity u having direction towards $+x$ axis. The block stops after covering distance S causing similar extension in the spring of constant K holding it. If μ is the kinetic friction between the block and the surface on which it was moving, the distance S is given by

(a) $\frac{1}{K}\mu^2m^2g^2$

(b) $\frac{1}{K}(mKu^2 - \mu^2m^2g^2)^{\frac{1}{2}}$

(c) $\frac{1}{K}(\mu^2m^2g^2 + mKu^2 + \mu mg)^{\frac{1}{2}}$

(d) $\frac{1}{K}(\mu^2m^2g^2 - mKu^2 + \mu mg)^{\frac{1}{2}}$



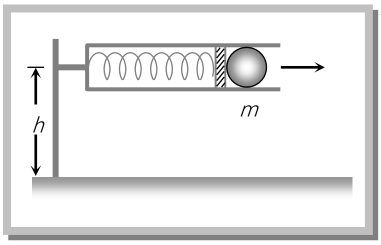
55. A compressed spring of spring constant k releases a ball of mass m. If the height of spring is h and the spring is compressed through a distance x, the horizontal distance covered by ball to reach ground is

(a) $x\sqrt{\frac{kh}{mg}}$

(b) $\frac{xkh}{mg}$

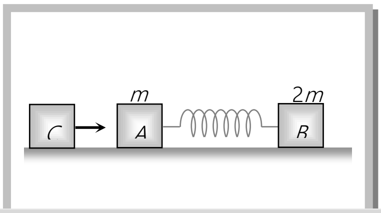
(c) $x\sqrt{\frac{2kh}{mg}}$

(d) $\frac{mg}{x\sqrt{kh}}$



56. Two bodies A and B of masses m and $2m$ respectively are placed on a smooth floor. They are connected by a spring. A third body C of mass m moves with velocity V_0 along the line joining A and B and collides elastically with A as shown in fig. At a certain instant of time t_0 after collision, it is found that instantaneous velocities of A and B are the same. Further at this instant the compression of the spring is found to be x_0. Determine the spring constant

(a) $\frac{2mV_0^2}{3x_0^2}$

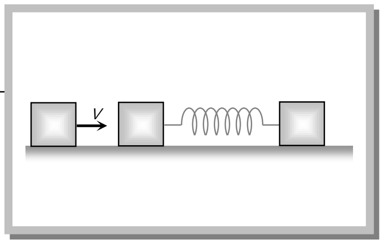


(b) $\frac{1}{3}\frac{mV_0^2}{x_0^2}$

(c) $\frac{1}{4}\frac{mV_0^2}{x^2}$

(d) $\frac{4}{5}\frac{mV_0^2}{x_0^2}$

57. Two blocks *A* and *B* each of mass *m* are connected by a massless spring of natural length *L* and spring constant *k*. The blocks are initially resting on a smooth horizontal floor with the spring at its natural length, as shown in figure. A third identical block *C*, also of mass *m*, moves on the floor with a speed *v* along the line joining *A* to *B* and collides with *A*. Then



(a) The kinetic energy of the *A*-*B* system, at maximum compression of the spring is zero

(b) The kinetic energy of the *A*-*B* system, at maximum compression of the spring is $\frac{mv^2}{4}$

(c) The maximum compression of the spring is $v\sqrt{\frac{m}{k}}$

(d) The maximum compression of the spring is $v\sqrt{\frac{m}{2k}}$

58. A light elastic string of natural length *l* is extended by an amount Fl/λ when subjected to a tension *F*. A small body of mass *m* is attached to a point *O* on a smooth horizontal table by, means of this elastic string. The body moves in a horizontal orbit of constant radius $(5l/4)$ and centre *O* with a tangential velocity. Find the value of *v* and calculate the ratio of kinetic energy to the elastic stored energy

(a) $\left(\frac{5\lambda l}{16m}\right)^{1/2}$, 5 : 1 (b) $\left(\frac{16m}{5\lambda l}\right)^{1/2}$, 5 : 1 (c) $\left(\frac{16\lambda l}{5m}\right)^{1/2}$, 1 : 5 (d) $\left(\frac{16m}{5\lambda l}\right)^{1/2}$, 1 : 5

Problems based on gravitational potential energy

Basic level

59. A ladder 2.5 *m* long and 150 *N* weight has its center of gravity 1*m* from the bottom. A weight 40 *N* is attached to the top end. The work required to raise the ladder from the horizontal position to the vertical position is [EAMCET (Med.) 1999]

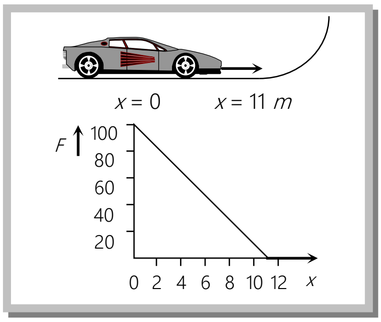
(a) 190 *J* (b) 250 *J* (c) 285 *J* (d) 475 *J*

60. You lift heavy book from the floor of the room and keep it in the book-shelf having height 2*m*. In this process you take 5 seconds. The work done by you will depend upon [MP PET 1993]

(a) Mass of the book and time taken (b) Weight of the book and height of the book-shelf

(c) Height of the book-shelf and time taken (d) Mass of the book, height of the book-shelf and time taken

61. A toy car of mass 5 *kg* moves up a ramp under the influence of force *F* plotted against displacement *x*. The maximum height attained is given by



(a) $y_{max} = 20m$

(b) $y_{max} = 15m$

(c) $y_{max} = 10m$

(d) $y_{max} = 5m$

62. When a body of mass *m* is taken from the surface of the earth to a height *n* times the earth's radius, the change in its potential energy would be

(a) $mgR\left(\frac{n}{n-1}\right)$ (b) $mgnR$ (c) $mgR\left(\frac{n}{n+1}\right)$ (d) $mgR\left(\frac{n^2}{n^2+1}\right)$

▶▶ *Advance level*

63. A chain of length *l* and mass *m* lies on the surface of a smooth sphere of radius $R (R > l)$ with one end tied on the top of the sphere. Then the gravitational potential energy of the chain with reference level at the center of sphere is given by

(a) $\frac{mR^2g}{l}\sin\left(\frac{l}{R}\right)$ (b) $\frac{mR^2g}{l}\cos\left(\frac{l}{R}\right)$ (c) $\frac{mR^2g}{l}\cot\left(\frac{R}{l}\right)$ (d) $\frac{mR^2g}{l}\tan\left(\frac{R}{l}\right)$

64. The attractive force between the two particles is $F = -G\frac{m_1m_2}{x^2}$. The work done in changing the distance between them from *x* to $x + d$ would be

(a) $\frac{Gm_1m_2}{x^2}d$ (b) $\frac{Gm_1m_2}{d}$ (c) $\frac{Gm_1m_2d}{x(x+d)}$ (d) $\frac{Gm_1m_2d}{(x+d)^2}$

65. A rope ladder with a length *l* carrying a man with a mass *m* at its end is attached to the basket of balloon with a mass *M*. The entire system is in equilibrium in the air. As the man climbs up the ladder into the balloon, the balloon descends by a height *h*. Then the potential energy of the man

(a) Increases by *mg*(*l* – *h*) (b) Increases by *mgl*

(c) Increases by *mgh* (d) Increases by *mg*(2*l* – *h*)

66. In above question, the potential energy of the balloon

(a) Decreases by *mgh* (b) Increases by *mgh* (c) Increases by *mg* (1 – *h*) (d) Increases by *mgl*

67. In above question, the work done by the man is

(a) mgl (b) mgh (c) $\frac{1}{2}mgl$ (d) $mg(1-h)$

Problems based on work done in pulling the chain

▶ Basic level

68. A cord is used to lower vertically a block of mass M by a distance d with constant downward acceleration $\frac{g}{4}$. Work done by the cord on the block is [CPMT 1972]

(a) $Mg\frac{d}{4}$ (b) $3Mg\frac{d}{4}$ (c) $-3Mg\frac{d}{4}$ (d) Mgd

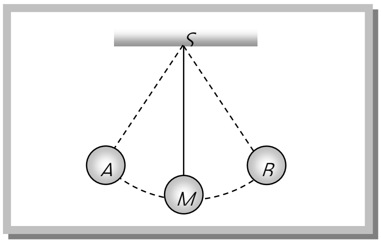
69. A boy pulls a chain of mass M and length L hanging vertically downwards from a roof top. The work done by him is

(a) $\frac{1}{2}MgL$ (b) MgL (c) $\frac{1}{2}MgL^2$ (d) MgL^2

Problems based on conservation of energy

▶ Basic level

70. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of 10*cm* (Take $g = 9.8\, m/s^{-1}$) [BHU 2000]



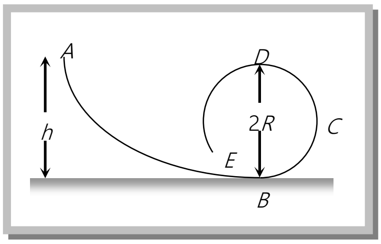
(a) 0.6 *m/s*

(b) 1.4 *m/s*

(c) 1.8 *m/s*

(d) 2.2 *m/s*

71. A frictionless track *ABCDE* ends in a circular loop of radius *R*. 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 [MP PET/PMT 1998]



(a) 5 *cm*

(b) $\frac{15}{4}\,cm$

(c) $\frac{10}{3}\,cm$

(d) 2 *cm*

72. A stone tied to a string of length *L* is whirled in a vertical circle with the other end of string at the centre. At a certain instant of time the stone is at it lowest position and has a speed *u*. The magnitude of change in velocity as it reaches a position where string is horizontal is

(a) $\sqrt{u^2 - 2gL}$ (b) $\sqrt{2gL}$ (c) $\sqrt{u^2 - gL}$ (d) $\sqrt{2(u^2 - gL)}$

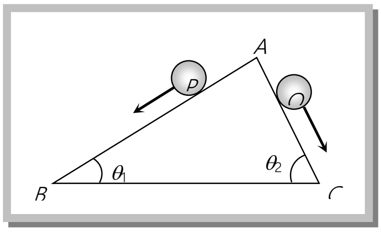
73. A simple pendulum of length 1*m* has a bob of 200 *g*. It is displaced through 60^o and then released. What will be its kinetic energy when it passes through the mean position

(a) 0.5 *J* (b) 1.0 *J* (c) 1.5 *J* (d) 2.0 *J*

74. If *v* be the instantaneous velocity of the body dropped from the top of a tower, when it is located at height *h*, then which of the following remains constant

(a) $gh + v^2$ (b) $gh + \frac{v^2}{2}$ (c) $gh - \frac{v^2}{2}$ (d) $gh - v^2$

75. Two inclined frictionless tracks of different inclinations ($\theta_1 < \theta_2$) meet at A from where two blocks *P* and *Q* of different masses are allowed to slide down from rest at the same time, one on each track as shown in fig.



(a) Both blocks will reach the bottom at the same time

(b) Block *Q* will reach the bottom earlier than block *P*

(c) Both blocks reach the bottom with the same speed

(d) Block *Q* will each the bottom with a higher speed that block *P*

76. A man slides down a snow covered hill along a curved path and falls 20*m* below his initial position. The velocity in *m*/*sec* with which he finally strikes the ground is (g = 10 m/sec^2)

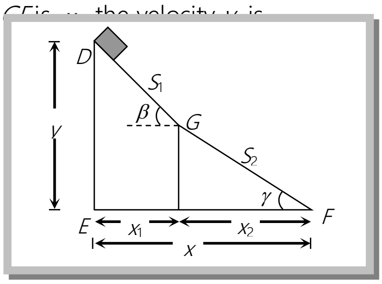
(a) 20 (b) 400 (c) 200 (d) 40

77. In comparison to the temperature of water at the foot of fall, the temperature of the water at the top of the fall is

(a) Same (b) Slightly less (c) Slightly greater (d) Uncertain

▶▶ *Advance level*

78. A small block mass *m* is released from rest from point *D* and slides down *DGF* and reaches the point *F* with speed v_F. The coefficient of kinetic friction between block and both the surface *DG* and *GF* is μ, the velocity v_F is



(a) $\sqrt{2g(y - x)}$

(b) $\sqrt{2g(y - \mu x)}$

(c) $\sqrt{2gy}$

(d) $\sqrt{2g(y^2 + x^2)}$

79. A mass m is thrown vertically upward into air with initial speed u. A constant force F due to air resistance acts on the mass during its travel. Taking into account the work done against air drag the maximum distance covered by the mass to reach the top is

(a) $\frac{u^2}{2g}$ (b) $\frac{u^2}{2g+(2F/m)}$ (c) $\frac{u^2}{2g+F/m}$ (d) $\frac{u^2}{g+F/m}$

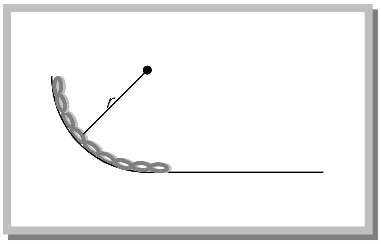
80. A smooth chain PQ of mass M rests against a $\frac{1}{4}th$ circular and smooth surface of radius r. If released, its velocity to come over the horizontal part of the surface is

(a) $\sqrt{2gr}\times\frac{1}{4}$

(b) $\sqrt{2gr\left(1-\frac{1}{\pi}\right)}$

(c) $\sqrt{2gr\left(1-\frac{2}{\pi}\right)}$

(d) $\sqrt{gr\left(1-\frac{2}{\pi}\right)}$



81. A hammer of mass M falls from a height h repeatedly to drive a pile of mass m into the ground. The hammer makes the pile penetrate in the ground to a distance d in single blow. Opposition to penetration is given by

(a) $\frac{m^2gh}{M+md}$ (b) $\frac{M^2gh}{(M+m)d}+(M+m)g$ (c) $\frac{M^2gh}{M+md}$ (d) $\frac{m^2gh}{(m+M)d}-(M+m)g$

82. The height h from which a car of mass m has to fall to gain the kinetic energy equivalent to what it would have gained when moving with a horizontal velocity of $(u+v)$ is given by

(a) $\frac{v}{2g}$ (b) $\frac{v^2}{2g}$ (c) $\frac{(u+v)^2}{2g}$ (d) $\frac{(u+v)^2}{g}$

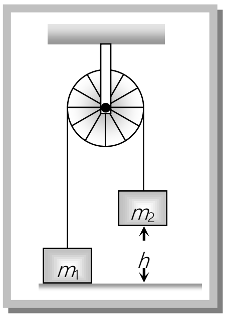
83. Two masses m_1 and m_2 ($m_2 > m_1$) are positioned as, shown in figure, m_1 being on the ground and m_2 at a height h above the ground. When m_2 is released, the speed at which it hits the ground will be

(a) $\sqrt{\frac{2ghm_1}{m_2}}$

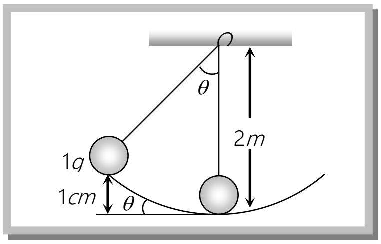
(b) $\sqrt{\frac{2gh(m_1-m_2)}{(m_1+m_2)}}$

(c) $\sqrt{\frac{2gh(m_1+m_2)}{(m_1-m_2)}}$

(d) $\sqrt{\frac{2gh(m_2-m_1)}{(m_1+m_2)}}$



84. A particle of mass 1 *gm* executes an oscillatory motion on a concave surface of radius of curvature 2*m*. If the particle starts its motion from a point at a height of 1 *cm* from the horizontal and the coefficient of friction is 0.01, then the total distance covered by the particle before it comes to rest, will be



(a) 5.001 *m*

(b) 0.015 *m*

(c) 1.005 *m*

(d) None of these

Problems based on power

▶ Basic level

85. A motor pump set lifts 300 *kg* of water per minute from a well of depth 20*m* and delivers to a height of 20*m*. Then its power is [JIPMER 2001, 2002]

(a) 3 *kW* (b) 1.96 *kW* (c) 0.98 *kW* (d) 3.92 *kW*

86. A force of $2\hat{i}+3\hat{j}+4\hat{k}\,N$ acts on a body for 4 sec and produces a displacement of $3\hat{i}+4\hat{j}+5\hat{k}\,m.$ The power used is [CBSE PMT 2001]

(a) 4.5 *W* (b) 6.5 *W* (c) 7.5 *W* (d) 9.5 *W*

87. A truck of mass 30, 000 *kg* moves up an inclined plane of slope 1 in 100 at a speed of 30 *kmph*. The power of the truck is (given g = 10 ms^{-1}) [Kerala (Engg.) 2001]

(a) 25 *kW* (b) 10 *kW* (c) 5 *kW* (d) 2.5 *kW*

88. A car of mass 1250 *kg* is moving at 30*m/s*. Its engine delivers 30 *kW* while resistive force due to surface is 750 *N*. What max acceleration can be given in the car [RPET 2000]

(a) $\frac{1}{3}m/s^2$ (b) $\frac{1}{4}m/s^2$ (c) $\frac{1}{5}m/s^2$ (d) $\frac{1}{6}m/s^2$

89. When friction is present in an otherwise conservative mechanical system, the rate of dissipation of mechanical energy is (where f is the frictional force and v is the speed of the system)

(a) fv (b) $-fv$ (c) fv^2 (d) $-fv^2$

90. An elevator's motor produces 3000 *W* power. The speed with which it can lift a 1000 *kg* load is

(a) $30.6ms^{-1}$ (b) $3.06\,ms^{-1}$ (c) $0.306\,ms^{-1}$ (d) $300.6ms^{-1}$

91. A body of mass *m kg* initially at rest attains a velocity of *v m/sec* in time *t* under the action of a constant force *F*. The power supplied to the mass is

(a) mv/t (b) mv^2/t (c) Fv (d) $Fv/2$

92. A car seller claims that his 1000 *kg* car can accelerate from rest to a speed of 24 ms^{-1} in just 8.0*s*. The engine of the car , on an average, should be of

(a) 60 *hp* (b) 48 *hp* (c) 80 *hp* (d) 24 *hp*

▶ *Advance level*

93. A person decides to use his bath tub water to generate electric power to run a 40 *W* bulb. The bath tub is located at a height of *h m* from ground and it holds *V litres* of water. He installs a water driven wheel generator on ground. The rate at which water should drain from bath tub to light the bulb if efficiency of machine be 90% is

(a) $\frac{11.11}{\rho gh}$ (b) $44.44\ \rho gh$ (c) $\frac{44.44}{\rho gh}$ (d) $\frac{22.22}{\rho gh}$

94. An engine of mass one metric ton is ascending on a inclined plane, at an angle $\tan^{-1}\left(\frac{1}{2}\right)$ with horizontal, with a speed of 36 *km/hour*. If the coefficient of friction of the surface is $1/\sqrt{3}$ then the power (in watts of engine is)

(a) 94400 (b) 9440 (c) 944 (d) 94.4

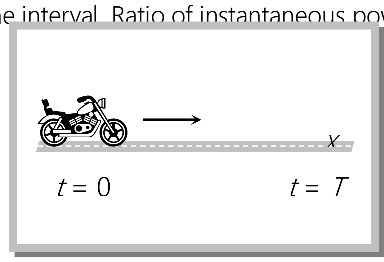
95. The aerodynamic drag on an airplane is given by $D = bv^2$. The power output of an airplane cruising at constant speed *v* in level flight is proportional to

(a) v (b) v^2 (c) v^3 (d) $v^{\frac{3}{2}}$

96. A vehicle of mass *M* is accelerated on a horizontal frictionless road under a force changing its velocity from *u* to *v* in distance *S*. A constant power *P* is given by the engine of the vehicle, then *v* =

(a) $\left(u^3 + \frac{2PS}{M}\right)^{1/3}$ (b) $\left(\frac{PS}{M} + u^3\right)^{1/2}$ (c) $\left(\frac{PS}{M} + u^2\right)^{1/3}$ (d) $\left(\frac{3PS}{M} + u^3\right)^{1/3}$

97. A motorcycle of mass *m* resting on a frictionless road moves under the influence of a constant force *F*. The work done by this force in moving the motorcycle is given by $F^2t^2/2m$, where *t* it the time interval. Ratio of instantaneous power to average power of the motorcycle in *t* = *T* second is



(a) 1 : 1

(b) 2 : 1

(c) 3 : 2

(d) 1 : 2

98. The speed *v* reached by a car of mass *m*, driven with constant power *P*, is given by

(a) $v = \frac{3xP}{m}$ (b) $v = \left(\frac{3xP}{m}\right)^{1/2}$ (c) $v = \left(\frac{3xP}{m}\right)^{1/3}$ (d) $v = \left(\frac{3xP}{m}\right)^{2}$

99. A body of mass *m* accelerates uniformly from rest to a velocity v_0 in time k_0. The instantaneous power delivered to the body at any time *t* is

(a) $\frac{mv_0t}{t_0}$ (b) $\frac{mv_0^2t}{t_0}$ (c) $\frac{mv_0t^2}{t_0}$ (d) $\frac{mv_0^2}{t_0^2}t$

Problems based on head on elastic collision

▶ *Basic level*

100. In the elastic collision of objects [RPET 2003]

(a) Only momentum remains constant (b) Only kinetic energy remains constant

(c) Both remains constant (d) None of these

101. A body of mass 2kg makes an elastic collision with another body at rest and continues to move in the original direction with one fourth of its original speed. The mass of the second body which collides with the first body is [Kerala (Engg.) 2002]

(a) 2 *kg* (b) 1.2 *kg* (c) 3 *kg* (d) 1.5 *kg*

102. In above question if transfer kinetic energy to *B* is maximum then [Orissa JEE 2002; DCE 2001, 2002]

(a) $M_B >> M_A$ (b) $M_B << M_A$

(c) $M_A = M_B$ (d) Can not be predicted as information is incomplete

103. In an elastic collision of two particles the following is conserved [MP PET 1994; DPMT 2001]

(a) Momentum of each particle (b) Speed of each particle

(c) Kinetic energy of each particle (d) Total kinetic energy of both the particles

104. A particle of mass *m* moving with a velocity *V* makes a head on elastic collision with another particle of same mass initially at rest. The velocity of the first particle after the collision will be [MP PMT 1997; MP PET 2001; UPSEAT 2001]

(a) *V* (b) – *V* (c) – 2*V* (d) Zero

105. A particle *P* moving with speed *v* undergoes a head - on elastic collision with another particle *Q* of identical mass but at rest. After the collision [Roorkee 2000]

(a) Both *P* and *Q* move forward with speed $\frac{v}{2}$ (b) Both *P* and *Q* move forward with speed $\frac{v}{\sqrt{2}}$

(c) *P* comes to rest and *Q* moves forward with speed *v* (d) *P* and *Q* move in opposite directions with speed

106. A ball of mass 10 *kg* is moving with a velocity of 10 *m/s*. It strikes another ball of mass 5 *kg* which is moving in the same direction with a velocity of 4 *m/s*. If the collision is elastic, their velocities after the collision will be, respectively

(a) 6 *m/s*, 12 *m/s* (b) 12 *m/s*, 6 *m/s* (c) 12 *m/s*, 10 *m/s* (d) 12 *m/s*, 25 *m/s*

107. A body with velocity 50*m/s* collides with another body at rest. After collision this body moves with a velocity of 30 *m/s*. The velocity of second body after collision in *m/s* is : [Suppose collision is elastic]

(a) 30 (b) 20 (c) 50 (d) 80

108. Two identical spheres move in opposite directions with speeds v_1 and v_2 and pass behind an opaque screen, where they may either cross without touching (Event 1) or make an elastic head - on collision (Event 2)

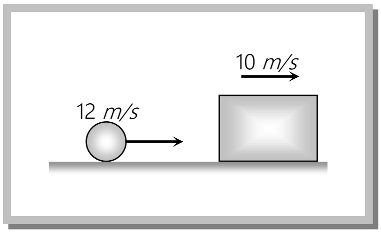
(a) We can never make out which event has occurred

(b) We cannot make out which event has occurred only if $v_1 = v_2$

(c) We can always make out which event has occurred

(d) We can make out which event has occurred only if $v_1 = v_2$

109. A light particle moving horizontally with a speed of 12 *m/s* strikes a very heavy block moving in the same direction at 10 *m/s*. The collision is one-dimensional and elastic. After the collision, the particle will



(a) Move at 2 *m/s* in its original direction

(b) Move at 8 *m/s* in its original direction

(c) Move at 8 *m/s* opposite to its original direction

(d) Move at 12 *m/s* opposite to its original direction

110. A sphere *A* moving with a speed *u* and rotating with an angular velocity ω, makes a head- on elastic collision with an identical stationary sphere *B*. There is no friction between the surfaces of *A* and *B*. Disregard gravity.

(a) *A* will stop moving but continue to rotate with an angular velocity ω

(b) *A* will come to rest and stop rotating

(c) *B* will move with a sped *u* without rotating

(d) *B* will move with a speed *u* and rotate with an angular velocity ω

111. The bob of a simple pendulum (mass *m* and length *l*) dropped from a horizontal position strikes a block of the same mass elastically placed on a horizontal frictionless table. The K.E. of the block will be

(a) 2 *mgl* (b) *mgl*/2 (c) *mgl* (d) 0

112. A neutron moving with a velocity '*V*' and kinetic energy '*E*' collides perfectly elastically head on with the nucleus of an atom of mass number '*A*' at rest. The energy received by the nucleus and the total energy of the system are related by

(a) $\frac{4A}{(A+1)^2}$ (b) $\left(\frac{A-1}{A+1}\right)^2$ (c) $\frac{(A+1)}{4A^2}$ (d) $\left(\frac{A+1}{A-1}\right)^2$

113. A body of mass *m* moving with velocity *V* makes a head - on collision with another body of mass 2*m* which is initially at rest. The ratio of kinetic energies of colliding body before and after collision will be

(a) 9 : 1 (b) 1 : 1 (c) 4 : 1 (d) 2 : 1

114. An object A collides head on elastically with a stationary object *B*. The object *B* will recoil with maximum speed if (*e* = 1)

(a) $M_B >> M_A$ (b) $M_B << M_A$

(c) $M_A = M_B$ (d) Can not be predicted due to incomplete data

115. In above question the transfer momentum to *B* will be maximum if

(a) $M_B >> M_A$ (b) $M_B << M_A$

(c) $M_A = M_B$ (d) Can not be predicted as information is incomplete

Problems based on perfectly elastic oblique collision

▶ Basic level

116. An alpha particle collides with a stationary nucleus and continues moving at an angle of 60° with respect to the original direction of motion. The nucleus recoils at an angle of 30° with respect to this direction. Mass number of the nucleus is

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

117. A sphere has a perfectly elastic oblique collision with another identical sphere which is initially at rest. The angle between their velocities after the collision is

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

118. A ball collides elastically with another ball of the same mass. The collision is oblique and initially one of the body was at rest. After the collision, the two balls move with same speeds. What will be the angle between the initial and final velocities of the colliding ball

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

119. A billiard ball moving at a speed $2m/s$ strikes an identical ball initially at rest, at a glancing blow. After the collision one ball is found to be moving at a speed of $1m/s$ at 60^o with the original line of motion. The velocity of the other ball shall be

(a) $(3)^{1/2}m/s$ at 30^o to the original direction (b) $1m/s$ at 60^o to the original direction

(c) $(3)^{1/2}m/s$ at 60^o to the original direction (d) $1m/s$ at 30^o to the original direction

120. A particle of mass m collides perfectly elastically with another particle of mass $M = 2m$. If the incident particle deflected by 90^o. The heavy mass will make an angle with the initial direction of m equal to

(a) 15^o (b) 30^o (c) 45^o (d) 60^o

▶▶ Advance level

121. Two particles having position vectors $\vec{r_1} = (3\hat{i} + 5\hat{j})$ *metres* $\vec{r_2} = (-5\hat{i} - 3\hat{j})$ *metres* are moving with velocities $\vec{v_1} = (4\hat{i} + 3\hat{j})m/s$ and $\vec{v_2} = (\alpha\hat{i} + 7\hat{j})m/s$. If they collide after 2 *seconds*, the value of 'α' is [EAMCET 2003]

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

122. Two particles of masses m_1 and m_2 in projectile motion have velocities $\vec{v_1}$ and $\vec{v_2}$ respectively at time t = 0. They collide at time t_0. Their velocities become $\vec{v_1'}$ and $\vec{v_2'}$ at time $2t_0$ while still moving in air. The value of $|(m_1\vec{v_1'} + m_2\vec{v_2'}) - (m_1\vec{v_1} + m_2\vec{v_2})|$ is

[IIT-JEE (Screening) 2001]

(a) Zero (b) $[m_1 + m_2]gt_0$ (c) $2(m_1 + m_2)gt_0$ (d) $\frac{1}{2}(m_1 + m_2)gt_0$

123. A moving neutron is deflected by an angle of 45° after colliding with a stationary proton (assuming the masses of both particles equal). Then it again collides with another stationary proton and so on. In this way the particle is deflected through an angle 45° in each collision. When its energy becomes 10^{-6} times the initial energy, the approximate number of collision must have been

(a) 20 (b) 40 (c) 80 (d) 100

Problems based on inelastic collision

▶ Basic level

124. A sphere collides with another sphere of identical mass. After collision, the two spheres move. The collision is inelastic. Then the angle between the directions of the two spheres is [KCET 1994]

(a) 90^o (b) 0^o (c) 45^o (d) Different from 90^o

125. The co-efficient of restitution depends upon

(a) The masses of the colliding bodies (b) The direction of motion of the colliding bodies

(c) The inclination between the colliding bodies (d) The materials of the colliding bodies

126. Which of the following statements is true

(a) Kinetic energy is conserved in all types of collisions

(b) By definition there is no difference between elastic and perfectly elastic collisions

(c) By definition there is no difference between inelastic and perfectly inelastic collisions

(d) After the collision, the relative displacement of the particles can decrease with time

127. During inelastic collision of two particles

(a) $(KE)_{final} = (KE)_{initial}$ (b) $(KE)_{final}$ must be greater than $(KE)_{initial}$

(c) $(KE)_{final}$ must be less than $(KE)_{initial}$ (d) $(KE)_{final}$ may be greater or less than $(KE)_{initial}$

128. Inelastic collision is the

(a) Collision of ideal molecules with the walls of the container

(b) Collision of electron and positron to annihilate each other

(c) Collision of two rigid solid spheres lying on a frictionless table

(d) Scattering of α -particles with the nucleus of gold atom

Problems based on rebounding of ball

▶ Basic level

129. A particle falls from a height h upon a fixed horizontal plane and rebounds. If e is the coefficient of restitution, the total distance travelled before rebounding has stopped is [EAMCET 2001]

(a) $h\left(\frac{1+e^2}{1-e^2}\right)$ (b) $h\left(\frac{1-e^2}{1+e^2}\right)$ (c) $\frac{h}{2}\left(\frac{1-e^2}{1+e^2}\right)$ (d) $\frac{h}{2}\left(\frac{1+e^2}{1-e^2}\right)$

130. A ball is dropped from height $10\,m$. Ball is embedded in sand $1m$ and stops, then [AFMC 1996]

(a) Only momentum remains conserved (b) Only kinetic energy remains conserved

(c) Both momentum and kinetic energy are conserved (d) Neither kinetic energy nor momentum is conserved

131. A ball is dropped from a height *h*. If the coefficient of restitution be *e*, then to what height will it rise after jumping twice from the ground [RPMT 1996]

(a) $eh/2$ (b) $2eh$ (c) eh (d) e^4h

132. A ball hits the floor and rebounds after inelastic collision. In this case

(a) The momentum of the ball just after the collision is the same as that just before the collision

(b) The mechanical energy of the ball remains the same in the collision

(c) The total momentum of the ball and the earth is conserved

(d) The total energy of the ball and the earth is conserved

▶ *Advance level*

133. A ball falls vertically onto a floor, with momentum *P* and then bounces repeatedly. The coefficient of restitution is *e*. The total momentum imparted by the ball to the floor is

(a) $P(1+e)$ (b) $\frac{P}{1-e}$ (c) $P\left(1+\frac{1}{e}\right)$ (d) $P\left(\frac{1+e}{1-e}\right)$

134. A particle strikes a horizontal frictionless floor with a speed *u*, at an angle θ with the vertical and rebounds with a speed *v*, at an angle ϕ with the vertical. The coefficient of restitution between the particle and the floor is *e*. The magnitude of *v* is

(a) eu (b) $(1-e)u$ (c) $u\sqrt{\sin^2\theta + e^2\cos^2\theta}$ (d) $u\sqrt{e^2\sin^2\theta + \cos^2\theta}$

135. In the previous question the angle ϕ is equal to

(a) θ (b) $\tan^{-1}[e\tan\theta]$ (c) $\tan^{-1}[\frac{1}{e}\tan\theta]$ (d) $(1+e)\theta$

Problems based on perfectly inelastic collision

▶ *Basic level*

136. A particle of mass *m* moving with velocity *v* strikes a stationary particle of mass 2*m* and sticks to it. The speed of the system will be [CBSE PMT 1996; MP PMT 1998; AIIMS 1999]

(a) $v/2$ (b) $2v$ (c) $v/3$ (d) $3v$

137. Two putty balls of equal mass moving with equal velocity in mutually perpendicular directions, stick together after collision. If the balls were initially moving with a velocity of $45\sqrt{2}ms^{-1}$ each, the velocity of their combined mass after collision is [KCET 1996]

(a) $45\sqrt{2}ms^{-1}$ (b) $45ms^{-1}$ (c) $90ms^{-1}$ (d) $22.5\sqrt{2}ms^{-1}$

138. A body of 2*kg* mass and velocity 3*m/s* collides with a body of 1*kg* mass and moving oppositely with a velocity of 4*m/sec*. After collision both bodies stik and move with a common velocity. This velocity in *m/s* is [MNR 1995]

(a) $1/4$ (b) $1/3$ (c) $2/3$ (d) 3/4

139. A set of n identical cubical blocks lies at rest parallel to each other along a line on a smooth horizontal surface. The separation between the near surfaces of any two adjacent blocks is L. The block at one end is given a speed v towards the next one at time $t=0$. All collisions are completely inelastic, then [IIT-JEE 1995]

(a) The last block starts moving at $t=\frac{(n-1)L}{v}$
(b) The last block starts moving at $t=\frac{n(n-1)L}{2v}$
(c) The centre of mass of the system will have a final speed v
(d) The centre of mass of the system will have a final speed

140. The coefficient of restitution e for a perfectly elastic collision is [CBSE PMT 1988]

(a) 1 (b) 0 (c) ∞ (d) -1

141. Which of the following statements is true [NCERT 1984]

(a) In elastic collisions, the momentum is conserved but not in inelastic collisions
(b) Both kinetic energy and momentum are conserved in elastic as well as inelastic collisions
(c) Total kinetic energy is not conserved but momentum is conserved in inelastic collisions
(d) Total kinetic energy is conserved in elastic collisions but momentum is not conserved in elastic collisions

142. Two bodies of same mass are moving with same velocity V in mutually opposite directions. They collide and stick together. The resultant velocity of the system will be

(a) Zero (b) $\frac{V}{2}$ (c) V (d) From zero to ∞

143. A $50\,g$ bullet moving with a velocity of $10\,ms^{-1}$ strikes a block of mass $950\,g$ at rest and gets embedded in it. The percentage loss in kinetic energy is

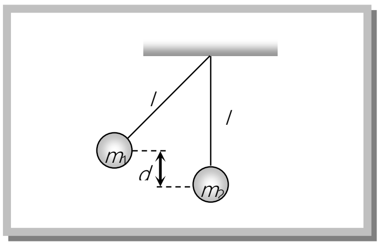
(a) 100% (b) 95% (c) 5% (d) 50%

Problems based on collision between bullet and block

▶ Basic level

144. Two pendulums each of length l are initially situated as shown in figure. The first pendulum is released and strikes the second. Assume that the collision is completely inelastic and neglect the mass of the string and any frictional effects. How high does the centre of mass rise after the collision

(a) $d\left[\frac{m_1}{(m_1+m_2)}\right]^2$
(b) $d\left[\frac{m_1}{(m_1+m_2)}\right]$
(c) $\frac{d(m_1+m_2)^2}{m_2}$
(d) $d\left[\frac{m_2}{(m_1+m_2)}\right]$



145. A body of mass $2.9kg$ is suspended from a string of length $2.5m$ and is at rest. A bullet of mass $100\,g$, moving horizontally with a speed of $150\,ms^{-1}$, strikes and sticks to it. What is the maximum angle made by the string with the vertical after the impact ($g = 10\ ms^{-2}$)

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

146. A bullet of mass $0.01kg$, travelling at a speed of $500\,ms^{-1}$, strikes a block of mass $2kg$, which is suspended by a string of length $5m$ and emerges out. The block rises by a vertical distance of $0.1m$. The speed of the bullet after it emerges from the block is

(a) $55\,ms^{-1}$ (b) $110\,ms^{-1}$ (c) $220\,ms^{-1}$ (d) $440\,ms^{-1}$

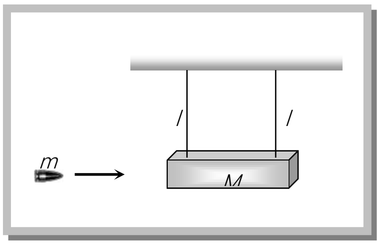
147. A horizontally flying bullet of mass m gets struck in a body of mass M suspended by two identical threads of length l as shown in fig. As a result, the threads swerve through an angle θ. Assuming $m << M$. Then the fraction of the bullet's initial kinetic energy that turned into heat

(a) $1 - \frac{m}{M}$

(b) $\frac{m}{M} - 1$

(c) $1 - \frac{M}{m}$

(d) $\frac{M}{m} - 1$



148. A bullet of mass m moving with velocity v strikes a suspended wooden block of mass M. If the block rises to a height h, the initial velocity of the block will be

(a) $\sqrt{2gh}$ (b) $\frac{M+m}{m}\sqrt{2gh}$ (c) $\frac{m}{M+m}\sqrt{2gh}$ (d) $\frac{M+m}{M}\sqrt{2gh}$

149. A bag of sand of mass M is suspended by a string. A bullet of mass m is fired at it with velocity v and gets embedded into it. The loss of kinetic energy in this process is

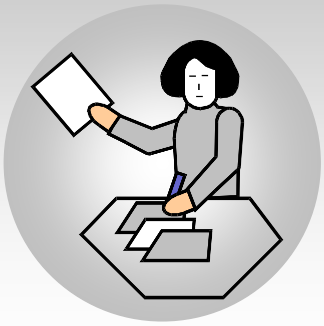
(a) $\frac{1}{2}mv^2$ (b) $\frac{1}{2}mv^2 \times \frac{1}{M+m}$ (c) $\frac{1}{2}mv^2 \times \frac{M}{m}$ (d) $\frac{1}{2}mv^2\left(\frac{M}{M+m}\right)$

150. A bag of sand of mass $2kg$ is suspended by a rope. A bullet of mass $10g$ is fired at it and gets embedded into it. The beg rises up a vertical height of $10\,cm$. The initial velocity of the bullet is nearly

(a) $70\ m/s$ (b) $140\ m/s$ (c) $210\ m/s$ (d) $280\ m/s$

151. A bullet of mass m and velocity v passed through a pendulum bob of mass M and emerges with velocity $v/2$. What is the minimum value of v such that the pendulum bob will swing through a complete cycle

(a) $\frac{M}{m}\sqrt{2l\,g}$ (b) $\frac{2M}{m}\sqrt{2l\,g}$ (c) $\frac{M}{2m}\sqrt{5l\,g}$ (d) $\frac{2M}{m}\sqrt{5l\,g}$



Answer Sheet (Practice problems)

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**
c	a	c	a	c	a, b, c	a	c	a	d
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
b	d	a	c	a	c	d	a	c	a
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
c	b	a	c	c	c	a	d	c	a
31.	**32.**	**33.**	**34.**	**35.**	**36.**	**37.**	**38.**	**39.**	**40.**
b	a	d	c	b, d	b	a	b, c	a	d
41.	**42.**	**43.**	**44.**	**45.**	**46.**	**47.**	**48.**	**49.**	**50.**
c	c	d	b	a, c	d	a	b	b	c
51.	**52.**	**53.**	**54.**	**55.**	**56.**	**57.**	**58.**	**59.**	**60.**
c	c	b	d	c	a	b, d	a	b	b
61.	**62.**	**63.**	**64.**	**65.**	**66.**	**67.**	**68.**	**69.**	**70.**
c	c	a	c	a	b	a	c	a	b
71.	**72.**	**73.**	**74.**	**75.**	**76.**	**77.**	**78.**	**79.**	**80.**
d	a	b	b	b, c	a	b	b	b	c
81.	**82.**	**83.**	**84.**	**85.**	**86.**	**87.**	**88.**	**89.**	**90.**
b	c	d	c	b	d	a	c	b	c
91.	**92.**	**93.**	**94.**	**95.**	**96.**	**97.**	**98.**	**99.**	**100.**
d	b	c	a	c	d	b	c	d	c
101.	**102.**	**103.**	**104.**	**105.**	**106.**	**107.**	**108.**	**109.**	**110.**
b	c	d	d	c	a	d	a	b	c
111.	**112.**	**113.**	**114.**	**115.**	**116.**	**117.**	**118.**	**119.**	**120.**
c	a	a	b	c	b	d	b	a	b
121.	**122.**	**123.**	**124.**	**125.**	**126.**	**127.**	**128.**	**129.**	**130.**
c	c	a	d	d	b	d	b	a	a
131.	**132.**	**133.**	**134.**	**135.**	**136.**	**137.**	**138.**	**139.**	**140.**
d	c	d	c	c	c	b	c	b, d	a
141.	**142.**	**143.**	**144.**	**145.**	**146.**	**147.**	**148.**	**149.**	**150.**
c	a	b	a	c	c	a	a	d	d
151.									
d									