Unit - 4
Work Energy And Power

SUMMARY

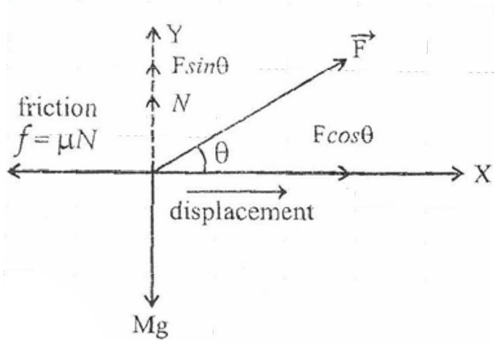
⇒ The product of the magnitude of the displacement during the action of a force and the magnitude of the component of the force in the direction of displacement is known as work. Its unit in joule and its dimensional formula is $M^1L^2T^{-2}$.

⇒ If angle between force and displacement is θ

(i) for $\theta = 0 \therefore W = Fd$ (ii) for $\theta = \frac{\pi}{2} \therefore w = 0$ (iii) for $\theta = \pi \therefore w = -Fd$

⇒ If θ is an acute, work is positive and work is done by the force on the body. If θ is an obtuse angle, work is negative and work is done by the body aganist the force.

⇒ Work on a body lying on rough horizontal surface acted by force. As there is no displacement along Y-axis



$N + F\sin\theta = Mg$

$\therefore N = Mg - F\sin\theta$

Responsible resultant force for displacement along X-direction

$= F\cos\theta - \mu N = F\cos\theta - \mu(Mg - F\sin\theta)$

Work $W = [F\cos\theta - \mu(Mg - F\sin\theta]d = [F(\cos\theta - \mu\sin\theta) - \mu Mg]\, d$

⇒ The work done by a variable force is given by $W = \int_i^f \vec{F} \cdot \vec{dl}$

⇒ If a variable force and displacement due to it are in the same direction the area below the F - x graph gives value of work.

⇒ The ability of a body to do work by virtue of its motion is known as its **Kinetic energy.** If the velocity of a body of mass `m' is `v' its kinetic energy is $K = \frac{1}{2}mv^2 = p^2/2m$. It is scalar quantity.

⇒ **Work Energy Theorem** : Work done by a resultant force on a body is equal to the change in its kinetic energy. $W = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2 = K - K_0 = \Delta K$

⇒ When a body has the ability to do work due to its position in a force field or its configuration. It is known as **potential energy.** It is scalar quantity.

⇒ If the gravitational potential energy, due to the gravitational field of Earth, is randomly taken to be zero on its surface the potential energy of a body of mass m, at height h is mgh, where g is the gravitational acceleration. The value of `h' is negligible compared to the radius of the earth.

⇒ The sum of the potential energy (U) and the kinetic energy (K) of a substance is called the **mechanical energy.** E = K + U.

⇒ Considering potential energy of a spring as zero in its normal state, if its length is changed by x, the potential energy of the spring is $U = \frac{1}{2}kx^2$. Here k is the spring constant. Unit of k is N/m and dimensional formula is $M^1L^0T^{-2}$

⇒ The forces for which work done is independent of the path of motion of the body but depends only on initial and final positions, are called **conservative force.** The force of gravitation or the restoring force developed in a spring due to its compression or extension are conservative forces.

⇒ The relation between the conservative force and the potential energy is $F = -\frac{dU}{dx}$.

⇒ The time-rate of doing work is called **power.** Its unit is watt (J/s). Its dimensional formula is $M^1L^2T^{-3}$.

The power $P = W / t$ or $P = \vec{F} \cdot \vec{v}$

1 horse power $\simeq$ 746 watt

Unit of electric energy for domestic use is 1 unit = 1 kWh = 3.6×10^6 J

⇒ If during collision of two bodies the kinetic energy is conserved the collision said to be **elestic**.

⇒ A body of mass m_1 moving with velocity v_1 undergoes elastic collision with a body of mass m_2 moving with velocity v_2 in the direction of v_1 If after collision their velocities are v_1' and v_2'.

$$v_1' = \frac{m_1 - m_2}{m_1 + m_2} v_1 + \frac{2m_2}{m_1 + m_2} v_2 \quad \text{and} \quad v_2' = \frac{2m_1}{m_1 + m_2} v_1 + \frac{m_2 - m_1}{m_1 + m_2} v_2$$

⇒ In case of complete inelastic collision bodies colliding move together after collision with a common velocity v. In this case

$$v = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

⇒ A body of mass m_1 moving with velocity v_1 collides with a stationary body of mass m_2 elastically. They move with velocities v_1' and v_2' making angles θ_1 and θ_2 with direction of v_1 then $m_1 v_1 = m_1 v_1' \cos\theta_1 + m_2 v_2' \cos\theta_2$

$$0 = m_1 v_1' \sin\theta_1 - m_2 v_1' \sin\theta_2 \quad \text{and} \quad m_1 v_1^2 = m_1 v_1'^2 + m_2 v_2'^2$$

⇒ As Newton's low of impact, the co-efficient of restitution is,

$e = \frac{v_2' - v_1'}{v_1 - v_2}$, '$e$' depends on the types of materials of bodies colliding.

For perfectly elastic collision e = 1 and for perfectly inelastic collision e = 0.

Equations of velocities after collision of two bodies can be written as :

$$v_1' = \frac{(m_1 - m_2 e)}{m_1 + m_2} v_1 + \frac{(1+e)m_2}{m_1 + m_2} v_2 \quad \text{and} \quad v'_2 = \frac{(1+e)m_1}{m_1 + m_2} v_1 - \frac{(m_1 e - m_2)}{m_1 + m_2} v_2$$

MCQ

For the answer of the following questions choose the correct alternative from among the given ones.

1. How much is the work done in pulling up a block of wood weighing 2KN for a length of 10m on a smooth plane inclined at an angle of 30^{o} with the horizontal ?

   (A) 1.732 KJ (B) 17.32 KJ (C) 10 KJ (D) 100 KJ

2. A force of 7N, making an angle θ with the horizantal, acting on an object displaces it by 0.5m along the horizontal direction. If the object gains K.E. of 2J, what is the horizontal component of the force ?

   (A) 2N (B) 4 N (C) 1 N (D) 14 N

3. A 60 kg JATAN with 10 kg load on his head climbs 25 steps of 0.20m height each. what is the work done in climbing ? ($g = 10\ m/s^2$)

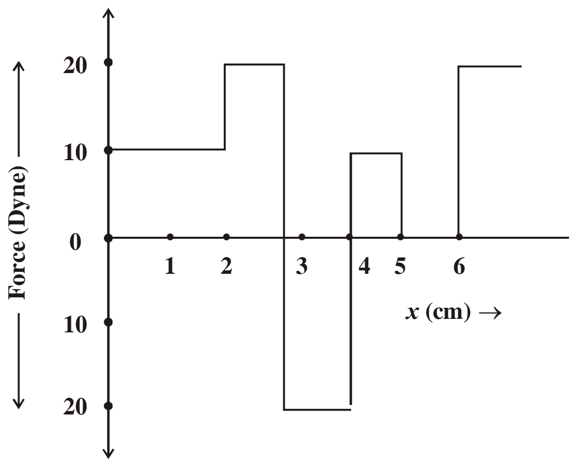
   (A) 5 J (B) 350 J (C) 100J (D) 3500J

4. A ball of mass 5 kg is stiding on a plane with intial velocity of 10 m/s. If co-efficient of friction between surface and ball is $\frac{1}{2}$, then before stopping it will describe...... ($g = 10\ m/s^2$)

   (A) 12.5 m (B) 5 m (C) 7.5 m (D) 10 m

5. The relationship between force and position is shown in the figure given (in one dimensional case) calculate the work done by the force in displacing a body from x = 0 cm to x = 5 cm

   (A) 30 ergs (B) 70 ergs (C) 20 ergs (D) 60 ergs



6. The force constant of a wire is K and that of the another wire is 3k when both the wires are stretched through same distance, if work done are W_1 and W_2, then...

   (A) $w_2 = 3w_1^2$ (B) $W_2 = 0.33W_1$ (C) $W_2 = W_1$ (D) $W_2 = 3W_1$

7. A ball is released from the top of a tower. what is the ratio of work done by force of gravity in first, second and third second of the motion of the ball ? *[h_n α (2n – 1)]*

   (A) 1 : 2 : 3 (B) 1 : 4 : 9 (C) 1 : 3 : 5 (D) 1: 5 : 3

8. A spring of spring constatnt 10^3 N/m is stretched initially 4cm from the unstretched position. How much the work required to stretched it further by another 5 cm ?

(A) 6.5 NM (B) 2.5 NM (C) 3.25 NM (D) 6.75 NM

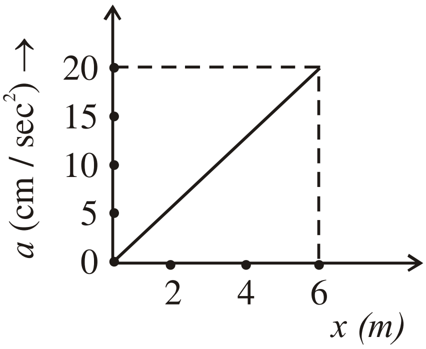
9. The mass of a car is 1000 kg. How much work is required to be done on it to make it move with a speed of 36 km/h ?

(A) 2.5×10^4 J (B) 5×10^3 J (C) 500 J (D) 5×10^4 J

10. A body of mass 6 kg is under a force, which causes a displacement in it given by $S = {}^{2t^3}\!/_3$ (in m). Find the work done by the force in first one seconds.

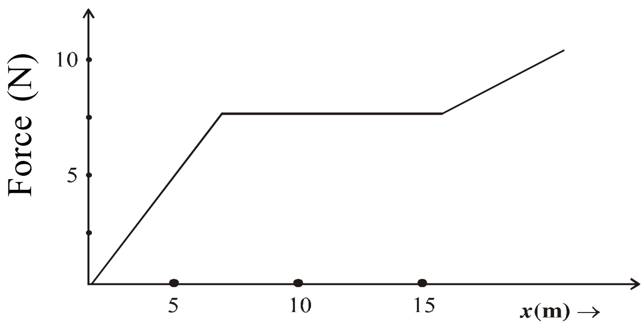
(A) 2 J (B) 3.8 J (C) 5.2 J (D) 24 J

11. A 8 kg mass moves along x - axis. Its accelerations as a function of its position is shown in the figure. What is the total work done on the mass by the force as the mass moves from x = 0 to x = 6cm ?



(A) 48×10^{-3} J (B) 98×10^{-3} J
(C) 4.8×10^{-3} J (D) 9.8×10^{-3} J

12. The work done by a force acting on a body is as shown in the graph. what is the total work done in covering an intial distance of 15m ?



(A) 50 J (B) 75 J
(C) 100 J (D) 25 J

13. A spring gun of spring constant $90\times10^2 N/M$ is compressed 4cm by a ball of mass 16g. If the trigger is pulled, calculate the velocity of the ball.

(A) 60 m/s (B) 3 m/s (C) 90 m/s (D) 30 m/s

14. A uniform chain of length 2m is kept on a table such that a length of 50cm hangs freely from the edge of the table. The total mass of the chain is 5kg. What is the work done in pulling the entire chain on the table. (g = 10 m\s^2)

(A) 7.2 J (B) 3 J (C) 4.6 J (D) 120 J

15. A uniform chain of length L ans mass M is lying on a smooth table and one third of its is hanging vertically down over the edge of the table. If g is acceleration due to gravity, the work required to pull the hanging part on to the table is

(A) MgL (B) MgL / 3 (C) MgL/9 (D) MgL / 18

16. A cord is used to lower vertically a block of mass M by a distance d with constant down-word acceleration $g/2$.work done by the cord on the block is

(A) - Mgd/2 (B) Mgd/4 (C) -3Mgd/4 (D) Mgd

17. A block of mass 5 kg is resting on a smooth surface. At what angle a force of 20N be acted on the body so that it will acquired a kinetic energy of 40J after moving 4m

(A) 30^0 (B) 45^0 (C) 60^0 (D) 120^0

18. Natural length of a spring is 60 cm, and its spring constant is 2000N/m. A mass of 20kg is hung from it. The extension produced in the spring is..... ($g = 9.8\ m/s^2$)

(A) 4.9 cm (B) 0.49 cm (C) 9.8 cm (D) 0.98 cm

19. The potential energy of a body is given by $U = A - Bx^2$ (where x is displacement). The magnitude of force acting on the particle is

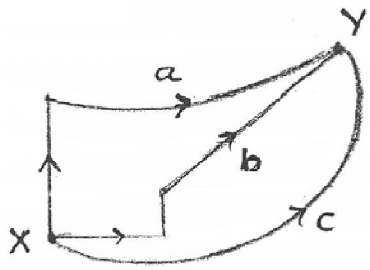
(A) constant (B) proportional to x

(C) proportional to x^2 (D) Inversely proportional to x

20. A uniform chain of length L and mass M is lying on a smooth table and $(1/4)^{th}$ of its length is hanging vertically down over the edge of the table. If g is acceleration due to gravity, the work required to pull the hanging part on to the table is

(A) MgL (B) MgL/9 (C) MgL/18 (D) MgL/ 32

21. If Wa, Wb, and Wc represent the work done in moving a particle from X to Y along three different path a, b, and c respectively (as shown) in the gravitational field of a point mass m, find the correct relation between Wa, Wb and Wc



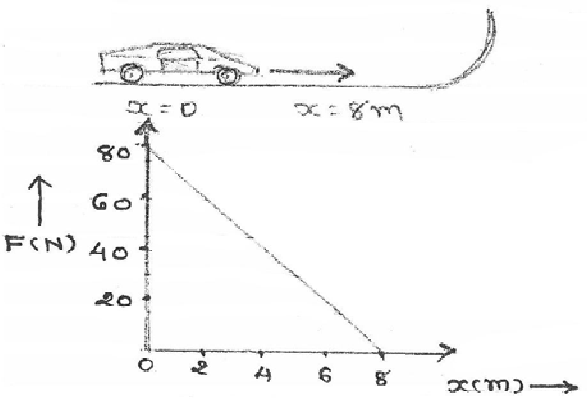
(A) Wb > Wa > Wc (B) Wa< Wb < Wc

(C) Wa > Wb > Wc (D) Wa = Wb = Wc

22. An open knife edge of mass m is dropped from a height h on a wooden floor. If the blade penetrates upto the depth d into the wood, the average resistance offered by the wood to the knife edge is,

(A) mg (B) $mg\ (1+h/d)$ (C) $mg(1+h/d)^2$ (D) $mg\ (1 - h/d)$

23. A toy car of mass 4 kg moves up a ramp under the influence of force F plotted against displacement x. The maximum height attained is given by (Take g = 10 m/s^2)



(A) ymax = 5m

(B) ymax = 10m

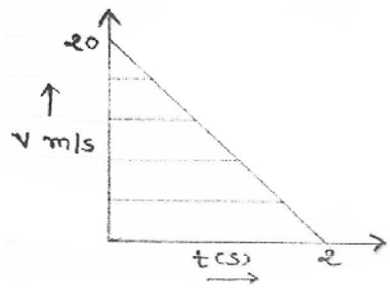
(C) ymax = 15m

(D) ymax = 20m

24. A particle of mass 0.5kg travels in a straight line with velocity v = $ax^{3/2}$, Where a = 5 $m^{-1/2} s^{-1}$. The work done by the net force during its displacement from x = 0 to x = 2m is

(A) 50 J (B) 45 J (C) 25 J (D) None of these

25. Velocity time graph of a particle of mass 2kg moving in a straight line is as shown in figure. Wrok done by all forces on the particle is



(A) 400 J

(B) -400 J

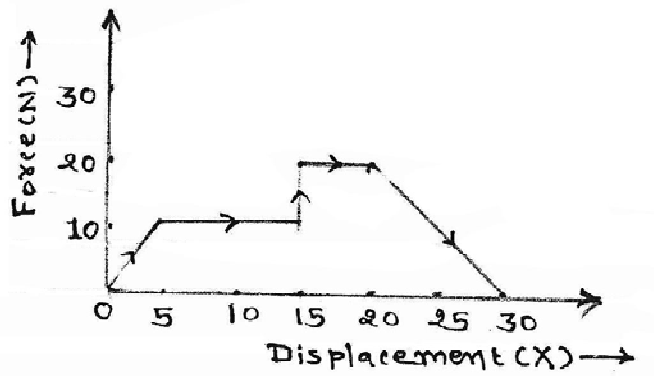
(C) -200 J

(D) 200 J

26. A mass of M kg is suspended by a weight-less string, the horizontal force that is required to displace it until the string makes an angle of 60° with the intial varticale direction is

(A) $Mg/\sqrt{3}$ (B) $Mg.\sqrt{2}$ (C) $Mg/\sqrt{2}$ (D) $Mg.\sqrt{3}$

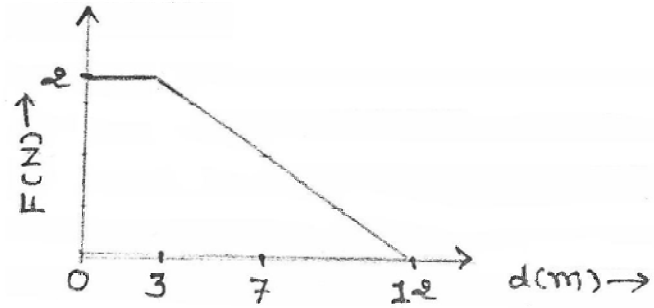
27. Given below is a graph between a variable force (F) (along y-axis) and the displaement (X) (along x-axis) of a particle in one dimension. The work done by the force in the displacement interval between 0m and 30m is



(A) 275 J (B) 325 J

(C) 400 J (D) 300 J

28. Force F on a particle moving in a straight line varies with distance d as shown in the figure. The work done on the particle during its displacement of 12m.



(A) 27 J (B) 24 J
(C) 36 J (D)26 J

29. A force $F = Ay^2 + By + C$ acts on a body in the y-direction. The work done by this force during a displacement from y = -a to y = a is

(A) $\frac{2Aa^3}{3}$ (B) $\frac{2Aa^3}{3}+2ca$

(C) $\frac{2Aa^3}{3}+\frac{Ba^2}{2}+ca$ (D) None of these.

(ENERGY AND CONSERVATVE, NON CONSERVATIVE FORCE)

30. A spring with spring constant K when streched through 2cm the potential energy is U. If it is streched by 6cm. The potential energy will be......

(A) 6U (B) 3U (C) 9U (D) 18U

31. If linear momentum of body is increased by 1.5%, its kinetic energy increases by.......%

(A) 0% (B) 10% (C) 2.25% (D) 3%

32. With what velocity should a student of mass 40 kg run so that his kinetic energy becomes 160 J ?

(A) 4 m/s (B) $\sqrt{8}$ m/s (C) 16 m/s (D) 8 m/s

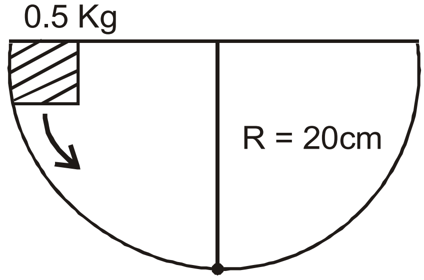
33. A body of mass 1 kg is thrown upwords with a velocity 20 m/s. It momentarily comes to rest after a height 18m. How much energy is lost due to air friction. ($g = 10\ m/s^2$)

(A) 20 J (B) 30 J (C) 40 J (D) 10 J

34. Two bodies of masses m_1 and m_2 have equal kinetic energies. If P_1 and P_2 are their respective momentum, what is ratio of $P_2 : P_1$?

(A) $m_1 : m_2$ (B) $\sqrt{m_2}:\sqrt{m_1}$ (C) $\sqrt{m_1}:\sqrt{m_2}$ (D) $m_1^2 : m_2^2$

35. A body having a mass of 0.5 kg slips along the wall of a semispherical smooth surface of radius 20 cm shown in figure.What is the velocity of body at the bottom of the surface ? (g = 10 m/s^2)



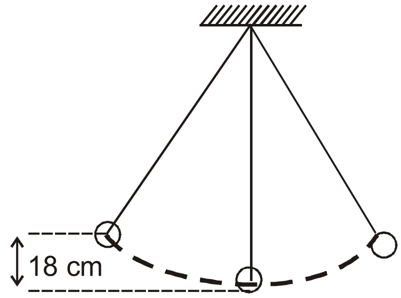
(A) $\sqrt{2}$ m/s (B) 2 m/s

(C) $2\sqrt{2}$ m/s (D) 4 m/s

36. Two bodies of masses m and 3m have same momentum. their respective kinetic energies E_1 and E_2 are in the ratio.....

(A) 1 : 3 (B) 3 : 1 (C) 1 : $\sqrt{3}$ (D) 1 : 6

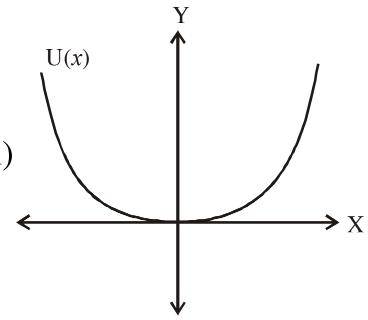
37. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of 18 cm (Take g = 10 m/s^2)

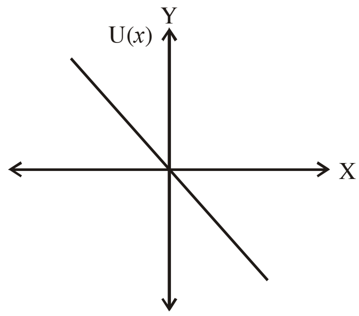


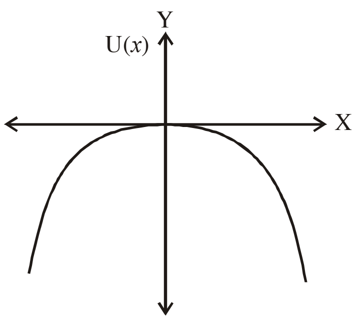
(A) 0.4 m/s (B) 4 m/s

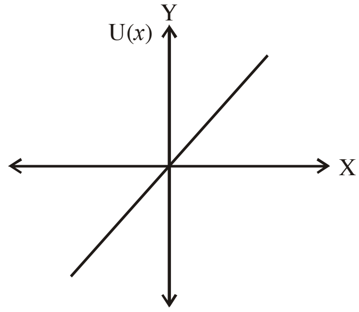
(C) 6 m/s (D) 0.6 m/s

38. A particle is placed at the origin and a force F = kx is acting on it (Where K is positive constant) If Ucos = 0, which one of the following graph of U(x) versus x. (where U is the potential energy function)

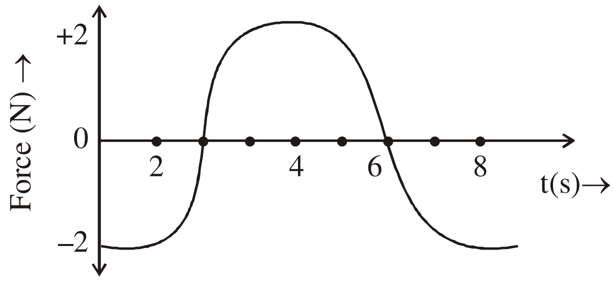
(A)


(B)


(C)


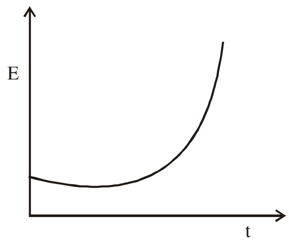
(D)


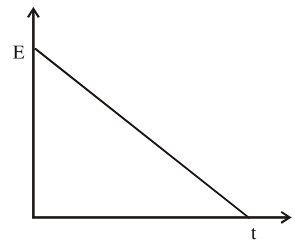
39. A force → time graph for a linear motion is shown in figure where the segments are circular. what is linear momentum gained between zero and 8 second ?

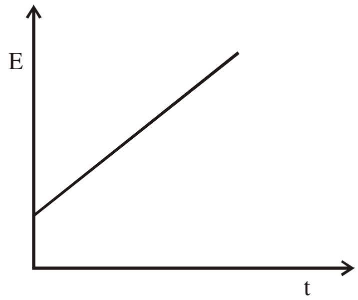


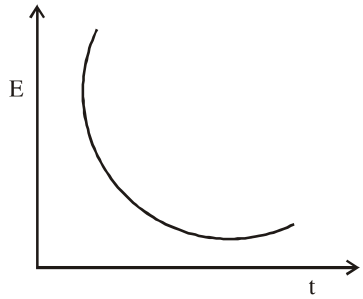
(A) -2 π N S (B) 0 NS
(C) 4 π NS (D) -6 π NS

40. A particle is dropped from a height-h. A constant horizontal velocity is given to the particle. Taking g to be constant everywhere kinetic energy E of the particle with respect to time t is correctly shown in....

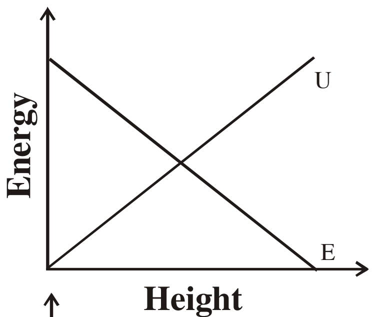
(A)


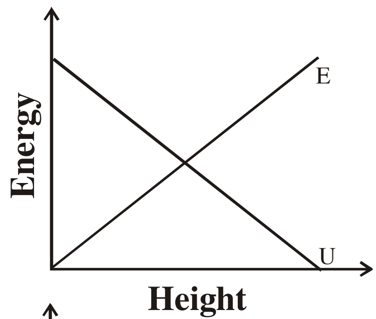
(B)


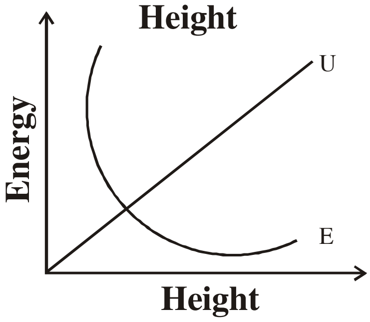
(C)


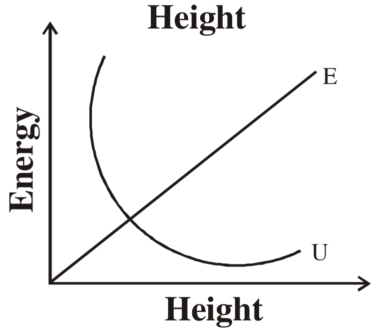
(D)


41. Which of the following graph is correct between kinetic energy (E), potential energy (U) and height (h) from the ground of the particle.

(A)


(B)


(C)


(D)


42. An engine pump is used to pump a liquid of density ρ continuosly through a pipe of cross-sectional area A. If the speed of flow of the liquied in the pipe is v, then the rate at which kinetic energy is being imparted to the liquid is

(A) $\frac{1}{2}$ A ρ V^3 (B) $\frac{1}{2}$ A ρ V^2 (C) $\frac{1}{2}$ A ρ V (D) A ρ V

43. The velocity of a body of mass 400 gm is $\left(-3\hat{i}-4\hat{j}\right)$ m/s. So its kinetic energy is ......

(A) 5 J (B) 10 J (C) 8 J (D) 16 J

44. A particle is moving under the influence of a force given by F = kx, where k is a constant and x is the distance moved. What energy (in joule) gained by the particle in moving from x = 1m to x = 3m ?

(A) 2 k (B) 3 k (C) 4 k (D) 9 k

45. A spring is compressed by 1 cm by a force of 4 N. Find the potential energy of the spring when it is compressed by 10 cm.

(A) 2 J (B) 0.2J (C) 20 J (D) 200 J

46. when 2kg mass hangs to a spring of length 50 cm, the spring stretches by 2 cm. The mass is pulled down until the length of the spring becomes 60 cm. What is the amount of elastic energy stored in the spring in this condition, if g = 10 m/s^2

(A) 10 J (B) 2 J (C) 2.5 J (D) 5 J

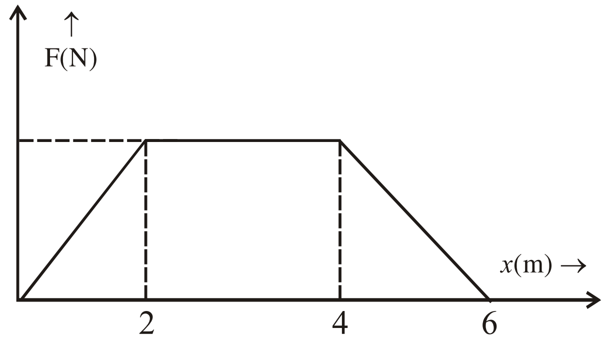
47. The potential energy of a projectile at its highest point is $\left(\frac{1}{2}\right)^{th}$ the value of its initial kinetic energy. Therefore its angle of projection is ......

(A) 30^0 (B) 45^0 (C) 60^0 (D) 75^0

48. Two bodies P and Q have masses 5 kg and 20 kg respectively. Each one is acted upon by a force of 4 N. If they acquire the same kinetic energy in times t_P and t_Q then the ratio t_p/t_q = ...

(A) ½ (B) 2 (C) ⅖ (D) ⅚

49. A particle of mass 0.1kg is subjected to a force which varies with distance as shown in figure. If it starts its jounery from rest at x = 0. What is the particle's velocity squre at x = 6 cm ?



(A) 0 $(m/s)^2$ (B) $240\sqrt{2}$ $(m/s)^2$

(C) $240\sqrt{3}$ $(m/s)^2$ (D) 480 $(m/s)^2$

50. The potential energy of 2kg particle, free to move along x axis is given by $U(X) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right)$ J. If its mechanical energy is 2 J, its maximum speed is.... m/s

(A) $\frac{3}{2}$ (B) $\sqrt{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) 2

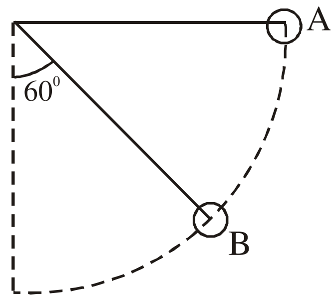
51. If the K.E. of a body is increased by 44%, its momentum will increase by.......

(A) 20 % (B) 22 % (C) 2 % (D) 120 %

52. A bullet of mass 0.10 kg moving with a speed of 100 m/s enters a wooden block and is stopped after a distance of 0.20m. what is the average resistive force exerted by the block on the bullet ?

(A) 2.5×10^2 N (B) 25 N (C) 25×10^2 N (D) 2.5×10^4 N

53. A simple pendulum is released from A as shown in figure. If 10 g and 100 cm represent the mass of the bob and length of the pendulum. what is the gain in K.E. at B ? (g = 10 m/s^2)



(A) 0.5 J (B) 5×10^{-2} J
(C) 5 J (D) 0.5×10^{-3} J

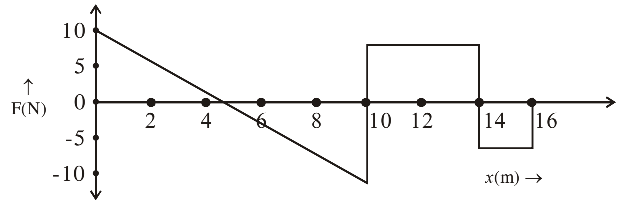
54. A rifle bullet loes $\left(\frac{1}{10}\right)^{th}$ of its velocity in passing through a plank. The least number of such planks required just to stop the bullent is

(A) 5 (B) 10 (C) 11 (D) 20

55. A sphere of mass m moving the velocity v enters a hanging bag of sand and stops. If the mass of the bag is M and it is raised by height h, then the velocity of the sphere was

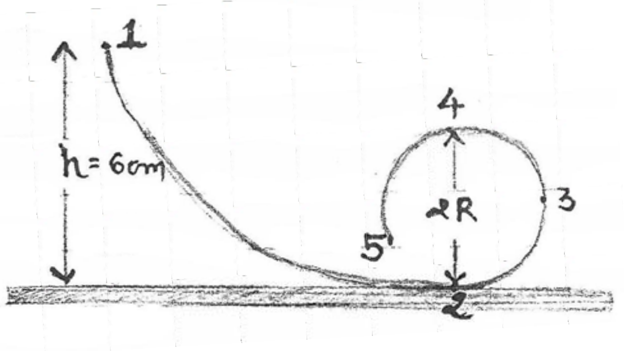
(A) $\frac{m+m}{m}\sqrt{29h}$ (B) $\frac{M}{m}\sqrt{29h}$ (C) $\frac{m}{M+m}\sqrt{29h}$ (D) $\frac{m}{M}\sqrt{29h}$

56. A particle is acted upon by a force F which varies with position x as shown in figure. If the particle at x = 0 has kinetic energy of 20 J. Then the calculate the kinetic energy of the particle at x = 16 cm.



(A) 45 J (B) 30 J
(C) 70 J (D) 135 J

57. A frictionless track 12345 ends in a circular loop of radius R. A body slids down the track from point 1 Which is 6 cm. Maximum value of R for the body to successfully complete the loop is



(A) 6 cm (B) $^{15}/_{4}$ cm

(C) $^{5}/_{12}$ cm (D) $^{12}/_{5}$ cm

58. If the water falls from a dam into a turbine wheel 19.6m below, then the velocity of water at the turbine is ...... (g = 9.8 m/s^2)

(A) 9.8 m/s (B) 19.6 m/s (C) 39.2 m/s (D) 98.0 m/s

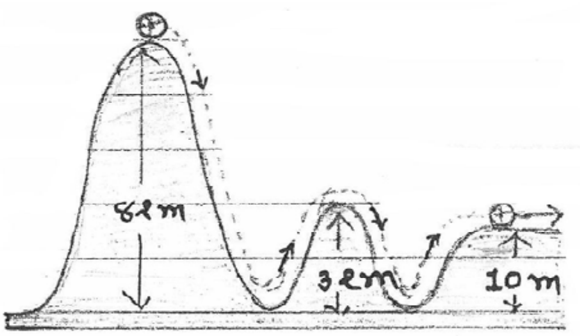
59. A bomb of 12 kg divedes in two parts whose ratio of masses is 1:4. If kinetic energy of smaller part is 288 J, then momentum of bigger part in kgm/sec will be

(A) 48 (B) 72 (C) 108 (D) Data is incomplete

60. An ice-cream has a marked value of 700kcal. How many kilo-watt-hour of energy will it deliver to the body as it is digested (J = 4.2 J/cal)

(A) 0.81 kwh (B) 0.90 kwh (C) 1.11 kwh (D) 0.71 kwh

61. A spherical ball of mass 15 kg stationary at the top of a hill of height 82m. It slides down a smooth surface to the ground, then climbs up another hill of height 32m and finally slides down to horizontal base at a height of 10 m above the ground. The velocity attained by the ball is



(A) $30\sqrt{10}$ m/s (B) $10\sqrt{30}$ m/s (C) $12\sqrt{10}$ m/s (D) $10\sqrt{12}$ m/s

62. A bomb of mass 10 kg explodes into 2 pieces of mass 4 kg and 6 kg. The velocity of mass 4 kg is 1.5 m/s, the K.E. of mass 6 kg is ....

(A) 3.84 J (B) 9.6 J (C) 3.00 J (D) 2.5 J

63. A bomb of mass 3.0 kg explodes in air into two pieces of masses 2.0 kg and 1.0 kg. The smaller mass goes at a speed of 80m/s. The total energy imparted to the two fragments is

(A) 1.07 KJ (B) 2.14 KJ (C) 2.4 KJ (D) 4.8 KJ

64. The bob of simple pendulum (mass m and length *l*) dropped from a horizontal position strike 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) zero

65. A gun fires a bullet of mass 40 g with a velocity of 50 m/s. Because of this the gun is pushed back with a velocity of 1 m/s. The mass of the gun is

(A) 1.5 kg (B) 3 kg (C) 2 kg (D) 2.5 kg

66. The decreases in the potential energy of a ball of mass 25 kg which falls from a height of 40 cm is

(A) 968 J (B) 100 J (C) 1980 J (D) 200 J

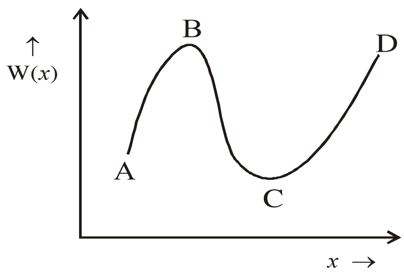
67. If a man increase his speed by 2 m/s, his K.E. is doubled, the original speed of the man is

(A) $(2+2\sqrt{2})$ m/s (B) $(2+\sqrt{2})$ m/s (C) 4 m/s (D) $(1+2\sqrt{2})$ m/s

68. The potential energy of a conservative system is given by U(X) = (x^2-5x) J. Then the equilibrium position is at....... (where x in m)

(A) x = 1.5 m (B) x = 2m (C) x = 2.5 m (D) x = 5 m

69. The potential energy of a particle varies with distance x as shown in the graph. The force acting on the particle is zero at



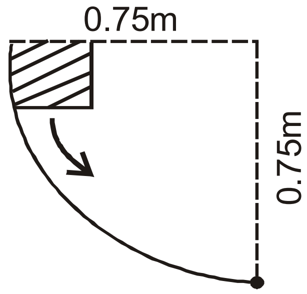
(A) C (B) B

(C) B and C (D) A and D

70. A nucleus at rest splits into two nuclear parts having same density and radii in the ratio 1:2. Their velocites are in the ratio

(A) 2:1 (B) 4:1 (C) 6:1 (D) 8:1

71. A body of mass 1.5 kg slide down a curved track which is quadrant of a circle of radias 0.75 meter. All the surfaces are frictionless. If the body starts from rest, its speed at the bottom of the track is ..... (g = 10 m/s^2)



(A) 3. 87 m/s (B) 2 m/s

(C) 1.5 m/s (D) 0.387 m/s

72. A single conservative force F(x) acts on a 2.5 kg particle that moves along the x-axis. The potential energy U(x) is given by U(x) = $(10 + (x - 4)^2)$ where x is in meter. At x = 6.0m the particle has kinetic energy of 20J. what is the mechanical energy of the system ?

(A) 34 J (B) 45 J (C) 48 J (D) 49 J

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POWER

73. A body initially at rest undergoes one dimensonal motion with constant acceleration. The power delivered to it at time t is proportional to.....

(A) $t^{1/2}$ (B) t (C) $t^{3/2}$ (D) t^2

74. An electric motor develops 5KW of power. How much time will it take to lift a water of mass 100 kg to a height of 20 m ? ($g = 10\ m/s^2$)

(A) 4 sec (B) 5 sec (C) 8 sec (D) 10 sec

75. Bansi does a given amount of work in 30 sec. Jaimeen does the same amount of work... in 15 sec. The ratio of the output power of Bansi to the Jaimeen is....

(A) 1:1 (B) 1:2 (C) 2:1 (D) 5:3

76. A rope-way trolly of mass 1200kg uniformly from rest to a velocity of 72 km/h in 6s. What is the average power of the engine during this period in watt ? (Neglect friction)

(A) 400 W (B) 40,000 W (C) 24000 W (D) 4000 W

77. A body of mass m is accelarated uniformly from rest to a speed v in time T. The instantaneous power delivered to the body in terms of time is given by.....

(A) $\frac{mv^2}{T^2}.t$ (B) $\frac{mv^2}{T^2}.t^2$ (C) $\frac{mv^2}{2T}.t$ (D) $\frac{mv^2}{2T^2}.t^2$

78. 1 kg apple gives 25 KJ energy to a monkey. How much height he can climb by using this energy if his efficiency is 40%. (mass of monkey = 25 kg and $g = 10\ m/s^2$)

(A) 20m (B) 4m (C) 30m (D) 40m

79. A force of $\left(2\hat{i}+3\hat{j}-\hat{k}\right)$ N acts on a body for 5 second, produces a displacement of $\left(3\hat{i}+5\hat{j}+\hat{k}\right)$. What was the power used ?

(A) 4W (B) 20 W (C) 21 W (D) 4.2 W

80. If the force F is applied on a body and it moves with a velocity v, the power will be

(A) Fv (B) F/v (C) F/v^2 (D) Fv^2

81. From an automatic gun a man fires 240 bullet per minute with a speed of 360 km/h. If each weighs 20 g, the power of the gun is

(A) 400 W (B) 300 W (C) 150 W (D) 600 W

82. A body of mass M is moving with a uniform speed of 10 m/s on frictionless surface under the influence of two forces F_1 and F_2. The net power of the system is $F_1 \rightarrow \boxed{M} \leftarrow F_2$

(A) $10F_1F_2M$ (B) $10(F_1 + F_2)M$ (C) $(F_1 + F_2)M$ (D) Zero

83. A coolie 2.0m tall raises a load of 75 kg in 25 from the ground to his head and then walks a distance to 40m in another 25. The power developled by the coolie is ($g = 10$ m/s^2)

(A)0.25 kw (B) 0.50 kw (C) 0.75 kw (D) 1.00 kw

84. A body is moved along a straight line by a machine delivering a constant power. The velocity gained by the body in time t is proportional to.....

(A) $t^{3/4}$ (B) $t^{3/2}$ (C) $t^{1/4}$ (D) $t^{1/2}$

ELASTIC - INELASTIC (COLLISION)

85. The coefficient of restitution e for a perfectly elastic collision is

(A) 1 (B) 0 (C) ∞ (D) -1

86. Two balls at same temperature collide. What is conserved

(A) Temperature (B) velocity (C) kinetic energy (D) momentum

87. A particle of mass m moving with horizontal speed 6 m/s as shown in figure. If m<<M then for one dimensional elastic collision, the speed of lighter particle after collision will be

(A) 1 m/s in original direction.

(B) 2 m/s opposite to the original direction.

(C) 1 m/s opposite to the original direction.

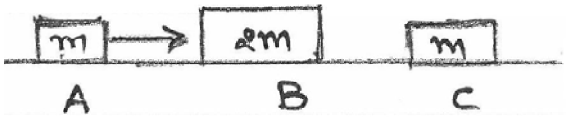
(D) 2 m/s in original direction.

88. A rubber ball is dropped from a height of 5 m on a planet where the acceleration due to gravity is not known. On bouncing, it rises to 1.8 m. The ball losses its velocity on bouncing by a factor of

(A) $16/25$ (B) $9/25$ (C) $3/5$ (D) $2/5$

89. Three objects A, B and C are kept in a straight line on a frictionless horizontal surface. These have masses m, 2m and m respectivelly. The object A moves towards B with a speed 9 m/s and makes an elastic collision with it. Thereafter, B makes compelety inelastic collision with C. All motion occur on the same straight line. Find final speed of the object C

(A) 3 m/s
(B) 4 m/s
(C) 5 m/s (D) 1 m/s



90. Two solid rubber balls P and Q having masses 200 g and 400 g respectively are moving in opposite directions with velocity of P equal to 0.3 m/s. After collision the two balls come to rest, then the velocity of Q is

(A) 0.15 m/s (B) 1.5 m/s (C) -0.15 m/s (D) Zero

91. A sphere collides with another sphere of identical mass. After collision, the two sphere move. The collision is inelastic. Then the angle between the directions of the two spheres is

(A) Different from 90° (B) 90° (C) 0° (D) 45°

92. A ball is allowed to fall from a height 20m . If there is 30% loss of energy due to impact, then after one impact ball will go up to

(A) 18 m (B) 16 m (C) 12 m (D) 14 m

93. If a skater of weight 4 kg has intial speed 40 m/s and 2^{nd} one of weight 6 kg has 6 m/s. After collision, they have speed (couple) 6 m/s. Then the loss in K.E. is.....

(A) 48 J (B) zero (C) 96 J (D) None of these

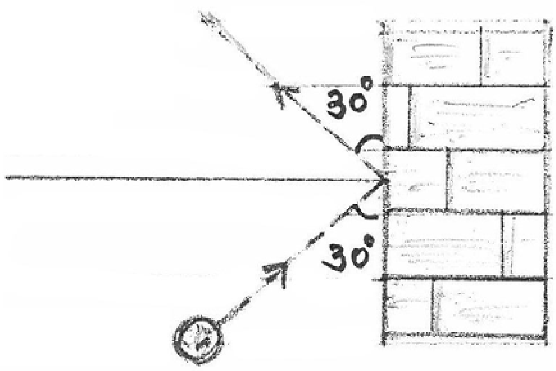
94. A metal ball of mass 2 kg moving with a velocity of 36 km/h has a head on collision with a stationary ball of mass 3 kg. If after the collision, the two balls move togather, the loss in kinetic energy due to collision is

(A) 40 J (B) 60 J (C) 100 J (D) 140 J

95. A neutron having mass of 1.67×10^{-27} kg and moving at 10^8 m/s collides with a deutron at rest and sticks to it. If the mass of the deutron is 3.34×10^{-27} kg then the speed of the combination is

(A) 3.33×10^7 m/s (B) 3×10^5 m/s (C) 33.3×10^7 m/s (D) 2.98×10^5 m/s

96. A mass of 100g strikes the wall speed 5 m/s at an angle as shown in figure and is rebounds with the same speed. If the contact time is 5×10^{-3} sec, what is the force applied on the mass by the wall



(A) $100\sqrt{3}$ N to right
(B) 100 N to right
(C) $100\sqrt{3}$ N to left
(D) 100 N to left

97. Three identical sperical balls A, B and C are placed on a table as shown in the figure along a straight line. B and C are at rest initially. The ball A hits B head on with a speed of 10 m/s. Then after all collision A and B are brought to rest and C takes off with velocity of...... (elastic collision)

(A) 20 m/s (B) 2.5 m/s (C) 10 m/s (D) 7.5 m/s

98. A ball dropped from a height of 4m rebounds to a height of 2.4m after hitting the ground. Then the percentage of energy lost is

(A) 40 (B) 50 (C) 30 (D) 600

99. A billiard ball moving with a speed of 8 m/s collides with an identical ball originally at rest. If the first ball stops after collision, then the second ball will move forward with a speed of..... (elastic collision)

(A) 8 m/s (B) 4 m/s (C) 16 m/s (D) 1.0 m/s

100. A bullet of mass m moving with velocity v strikes a block of mass M at rest and gets embedded into it. The kinetic energy of the composite block will be

(A) $\frac{1}{2}mv^2 \times \frac{M}{(m+m)}$ (B) $\frac{1}{2}mv^2 \times \frac{(m+m)}{M}$

(C) $\frac{1}{2}MV^2 \times \frac{m}{(m+M)}$ (D) $\frac{1}{2}mv^2 \times \frac{m}{(m+M)}$

101. A body of mass m_1 is moving with a velocity v. It collides with another stationary body of mass m_1. They get embeded. At the point of collision, the velocity of the system

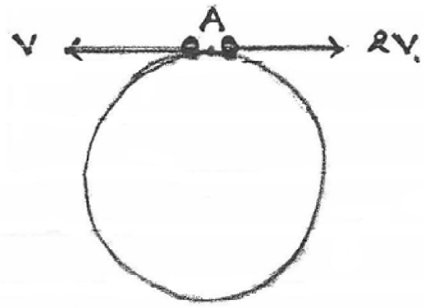
(A) Increases

(B) Decreases but does not become zero

(C) Remains same

(D) Become zero

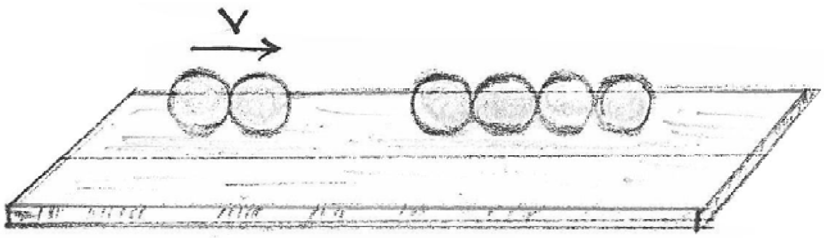
102. Two small particles of equal masses start moving in opposite directions from a point. A in a horizontal circular orbit. Their tangential velocities are v and 2v, repectively, as shown in the figure. Between collisions, the particles move with constant speeds. After making how many elastic collisions, other than that at A, these two particles will again reach the point A



(A) 1 (B) 2

(C) 3 (D) 4

103. Four identical balls are lined in a straight grove made on a horizontal frictionless surface as shown. Two similar balls each moving with a velocity v collide elastically with the row of 4 balls from left. What will happen



(A) One ball from the right rolls out with a speed 2v and the remaining balls will remain at rest.

(B) Two balls from the right roll out speed v each and the remaining balls will remain statinary.

(C) All the four balls in the row will roll out with speed $v/4$ each and the two colliding balls will come to rest.

(D) The colliding balls will come to rest and no ball rolls out from right.

(ASSERTION & REASON)

* Assertion and Reason are given in following questions. Each question have four option. One of them is correct it.

(1) If both assertion and reason and the reason is the correct explanation of the Assertion.

(2) If bothe assertion and reason are true but reason is not the correct explanation of the assertion.

(3) If the assertion is true but reason is false.

(4) If the assertion and reason both are fare.

104. Assertion : In the elastic collision between two bodies, the relative speed of the bodies after collision is equal to the relative speed before the collision.

Reason : In the elastic collision the linear momentum of the system is conserved.

(A)1 (B) 2 (C) 3 (D) 4

105. Assertion : When a gas is allowed to expand, work done by gas is positive.

Reason : Force due to gaseous pressure and displacement (of position) on in the same direction.

(A) 1 (B) 2 (C) 3 (D) 4

106. Assertion : A light body and heavy body have same momemtum. Then they also have same kinetic energy.

Reason : Kinetic energy does not depend on mass of the body.

(A) 1 (B) 2 (C) 3 (D) 4

107. Assertion : Mountain roads rarely go straight up the slope.

Reason : slope of mountains are large, therefore, more chances of vehicle to slip from roads.

(A) 1 (B) 2 (C) 3 (D) 4

108. Assertion : The change in kinetic energy of a particle is equal to the work done on it by the net force.

Reason : Change in kinetic energy of particle is equal to the work done only in case of a system of one particle.

(A) 1 (B) 2 (C) 3 (D) 4

109. Assertion : Work done in moving a body over a closed loop is zero for every force in nature.

Reason : Work done does not depend on nature of force.

(A) 1 (B) 2 (C) 3 (D) 4

110. Assertion : A weight lifter does no work in holding the weight up.

Reason : Work done is zero because distance moved is zero.

(A) 1 (B) 2 (C) 3 (D) 4

111. Assertion : stopping distance = $\frac{\text{Kinetic energy}}{\text{Stopping force}}$

Reason : Work done in stopping a body is equal to K.E. of the body.

(A) 1 (B) 2 (C) 3 (D) 4

112. Assertion : The mass equivalent of 1000 kwh energy is 40 microgram.

Reason : This follows from E = mc^2 where $C = 3\times10^8$ m/s

(A) 1 (B) 2 (C) 3 (D) 4

113. Assertion : Work done by centripetal force is zero.

Reason : This is because entripetal force is always along the tangent.

(A)1 (B) 2 (C) 3 (D) 4

114. Assertion : Two bodies of different masses have same momentum. Their kinetic energy are in the inverse ratio of their masses.

Reason : K.E. = $\frac{1}{2}mv^2$

(A) 1 (B) 2 (C) 3 (D) 4

115. Assertion : Linear momentum is conserved in both, elastic and inelastic collisions.

Reason : Total energy is conserved in all such collisins.

(A) 1 (B) 2 (C) 3 (D) 4

116. Assertion : Both, a stretched spring and a compressed spring have potential energy.

Reason : Work is done against the restoring force in each case.

(A) 1 (B) 2 (C) 3 (D) 4

(COLUMN)

117. A force F = kx (where k is positive constant) is acting on a particle. Match column-I and column-II, regarding work done in displacing the particle.

Column - I	**Column - ii**
(a) From x = -4 to x = -2	(P) Positive
(b) From x = -2 to x = -4	(Q) zero
(c) From x = -2 to x = +2	(R) negative

(A) a - R, b - P, c - Q (B) a - P, b - Q, c - R

(C) a - R, b - Q, c - P (D) a - Q, b - P, c - R

118. A body falls freely under the action of gravity from a height h above the ground.

Column - i	**Column - ii**
(a) P.E. = 2(K.E.)	(P) constant at every point
(b) P.E. = K.E.	(Q) at height $h/3$
(c) P.E. = $\frac{1}{2}$ (K.E.)	(R) at height $2h/3$
(d) P.E.+ K.E.	(S) at height $h/2$

(A) a - P, b - Q, c - R, d - S (B) a - Q, b - P, c - S, d - R

(C) a - S, b - R, c - Q, d - P (D) a - R, b - S, c - Q, d - P

119. Two vehicles moving on a horizontal road are stopped by same retarding force.

Column - I	**Column - ii**
(a) When they have same K.E.	(P) faster body stop in larger distance
(b) When they have different masses but same velocity	(Q) larger body stops in larger distance.
(c) When both have same momentum	(R) heavier body stops in larger distance.
(d) When both have same mass but different velocities	(S) stopped in same distance.

(A) a - P, b - Q, c - R, d - S (B) a - Q, b - P, c - S, d - R

(C) a - S, b - R, c - Q, d - p (D) a - R, b - S, c - Q, d - P

KEY NOTE

1	B	26	A	51	A	76	B	101	B
2	B	27	B	52	C	77	A	102	B
3	D	28	A	53	B	78	D	103	B
4	D	29	B	54	A	79	A	104	D
5	A	30	C	55	A	80	A	105	A
6	D	31	D	56	B	81	A	106	D
7	C	32	B	57	D	82	D	107	A
8	C	33	A	58	B	83	C	108	B
9	D	34	B	59	A	84	D	109	D
10	D	35	B	60	A	85	A	110	A
11	A	36	B	61	C	86	D	111	A
12	B	37	C	62	C	87	A	112	A
13	D	38	C	63	D	88	D	113	C
14	B	39	B	64	C	89	B	114	B
15	D	40	A	65	C	90	C	115	B
16	A	41	A	66	B	91	A	116	A
17	C	42	A	67	A	92	D	117	A
18	C	43	A	68	C	93	D	118	D
19	B	44	C	69	C	94	B	119	C
20	D	45	A	70	D	95	A		
21	D	46	D	71	A	96	C		
22	B	47	A	72	A	97	C		
23	B	48	A	73	B	98	A		
24	A	49	D	74	A	99	A		
25	B	50	A	75	B	100	D		

HINT

1. $W = Fd\cos\theta$
2. $\Delta K = Fd\cos\theta = w$
3. $W = Fd = (Mg)(d)$; where $M = m_1 + m_2$
4. $a = \mu g$ and $v^2 - v_0^2 = -2\mu g d$ $\therefore$ $d = \frac{vo^2}{2\mu g}$ $(\therefore v = 0)$
5. W = Area under curve of $F \rightarrow x$ graph.
6. According $W = \frac{1}{2}kx^2$
7. $h_n \alpha (2n-1)$
8. $W = \frac{1}{2}k\left(x_2^2 - x_1^2\right)$
9. According to work energy theorm $W = \Delta k$
10. $s = \frac{2t^3}{3} \Rightarrow$ acceleration $a = \frac{d^2s}{dt^2} = 4t$, work $W = \int_0^l F\,ds = \int_0^l mads$
11. W = F x = max = (m) (Area covered by curve of $a \rightarrow x$ graph)
12. work W = Area covered by curve of $F \rightarrow x$ graph
13. Loss in P.E. of spring = gain in K.E. of ball
14. $W = \frac{mgl}{2n^2}$, where n is, fraction of length of the chain hanging from the table.
15. $W = \frac{mgl}{2n^2}$ (n = 3 Given)
16. Tension in the cord, $T = M(g - \frac{g}{2}) = \frac{mg}{2}$. Work done by cord = -Td = $-\frac{mgd}{2}$
17. $Fd\cos\theta = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
18. $\therefore x = \frac{F}{K} = \frac{mg}{k}$
19. $F = -\frac{du}{dx}$

20. $w = \frac{mgl}{2n^2}$ (n = 4 given)

21. Gravitational force is a conservative force and work done against it is a point function i.e. does not depends on the path.

22. $v^2 - v_0^2 = 2ad$, $(v = 0)$ and $v_0 = \sqrt{2gh}$

$\therefore o = \left(\sqrt{2gh}\right)^2 + 2(g-a)d \quad \therefore a \Rightarrow$

23. Work done = gain in potential energy Area under curve = mgh

24. Intial velocity at x = 0; $v_1 = 0$

Final velocity at x = 2; $v_2 = 5 \times 2^{3/2}$

Work done = $\frac{1}{2} m (v_2^2 - v_1^2)$

25. Intial velocity of particle v_1= 20 m/s

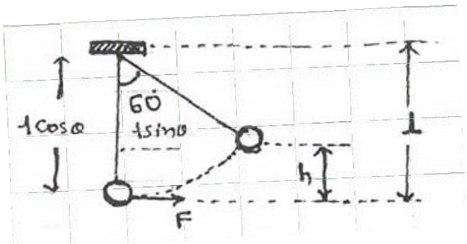
Final velocity of particle v_2= 0

$W = \Delta k = k_2 - k_1 = \frac{1}{2} m (v_2^2 - v_1^2)$

26. $W = Fl \sin\theta$

$U = mgl(1 - \cos\theta)$

$\Rightarrow W = U; (\theta = 60^0)$



27. Work = Area under (F - d) graph

28. Work = Area under (F - d) graph

29. $W = \int F dy$

$= \int_{-a}^{+2} \left(Ay^2 + By + C\right) dy$

$= \left[\frac{Ay^3}{3} + \frac{By^2}{2} + cy\right]_{-a}^{+a}$

$= \frac{2Aa^3}{3} + 2Ca$

30. Energy U α x^2 (k constant)

31. $K = \frac{P^2}{2m}$ $\therefore K \alpha P^2$ (m constant)

$\therefore \frac{dk}{k} = 2\frac{dp}{p}$

32. $k = \frac{1}{2}mv^2$ $\therefore v = \sqrt{\frac{2k}{m}}$

33. Energy lost due to air friction = $\frac{1}{2}$ mv^2 - mgh

34. $P \alpha \sqrt{m}$ $\therefore \frac{p_1}{p_2} = \frac{\sqrt{m_1}}{\sqrt{m_2}}$

35. mgR = $\frac{1}{2}mv^2$

36. $E = \frac{p^2}{2m}$ $\therefore$ $E \alpha \frac{1}{m}$

37. $V = \sqrt{2gh}$

38. $U = -\frac{kx^2}{2}$

39. F. Δt = momentum, The resulatant fore is zero, therefore F. Δt = 0

40. Kinetic Energy (K.E) αv^2 and $v^2 \alpha t^2$....

41. P.E (U) α h and E = K + U = constant

42. $\frac{1}{2}\frac{mv^2}{t} = \frac{1}{2}\frac{Al\ \rho\ V^2}{t}$ = $\frac{1}{2}$ $A\rho v^2$

43. Find the value of $\left|\vec{v}\right|$ and than, K.E = $\frac{1}{2}mv^2$

44. $U = \int_1^3 kx\,dx.$

45. Spring constant $K = \frac{F}{x}, U = \frac{1}{2}kx^2$

46. Spring constant $K = \frac{F}{x}, U = \frac{1}{2}kx^2$

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47. Hmax = $\frac{v_o^2 Sin^2\theta_0}{2g}$, $U = mg\,H\max = \frac{mv_0^2 \sin^2\theta_0}{2} = \frac{1}{2}Ko$

48. According to equation $\frac{1}{2} m_p v_p{}^2 = \frac{1}{2} m_Q v_Q{}^2 \Rightarrow {}^{v_p}\!/\!_{v_Q}$,

Using impulse momentum, $\frac{F\Delta t_P}{F\Delta T_Q} = \frac{m_p v_p}{m_Q v_Q}$

49. $\frac{1}{2}mv^2$ = area covered by curve of $F \to x$, graph

50. K.E. is maximum than P.E. minimum.

so $\frac{du}{dx} = 0 \Rightarrow \times = 0$ OR

For $x = \pm 4$ $U(x) = -\frac{1}{4} = U\min$.

51. $E_1 = E$ and $E_2 = 1.44E$. Than $P\alpha\sqrt{E}$

52. $F\,d = \frac{1}{2}m\left(v_2^2 - v_1^2\right)$.

53. Loss of potential energy = Kinetic energy gained.

54. Let the thickness of one planks be s and n planks are arranged just to stop bullet.

$v^2 - v_0{}^2 = 2as$, put $v = \frac{9}{10}v_0$ $\Rightarrow$ Now $\frac{v_0{}^2}{2as} = -\frac{100}{19}$ $\Rightarrow n = \frac{v_0^2}{2as}$

55. By conservation of linear momentum $\Rightarrow$ mv = (m+M) V_{sys}

By convervation of low of energy. $\frac{1}{2}$(m+M) v^2 sys = (m+M) gh

Find Vsys and put it sin egn.(1)

56. Work done = Area under $F \to X$ graph with proper sign.

57. Condition for up direction loop (Parabola) h = $\frac{5}{2}$R

58. P.E. of water = K.E. at turbine. mgh = $\frac{1}{2}mv^2$

59. The bomb into two masses $m_1 + m_2 = 12kg$ and $\frac{m_1}{m_2} = \frac{1}{4}$, K.E.

energy of smaller part = $\frac{1}{2}m_1 v_1^2$

60. 1 k cal = 10^3 calorie = 4200J = $\frac{4200}{3.6\times10^6}$ kwh

$\therefore 700 \text{ K cal} = \frac{700\times4200}{3.6\times10^6}$ kwh

61. From the conservation of energy,

mg $(h_1 - h_2) = \frac{1}{2}mv^2$

62. $m_1v_1 + m_2v_2 = 0$ and than K.E. = $\frac{1}{2}m_2v_2^2$

63. $m_1v_2, = m_2v_2,$

Total energy of system = $\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

64. The collision between bob and block is elastic $\therefore$ P.E. = K.E.

65. $m_Gv_G = m_Bv_B$

66. $\Delta U = mgh$

67. Initial kinetic energy, E = $\frac{1}{2}mv^2$

Final kinetic energy, 2E = $\frac{1}{2}m(v+2)^2$

68. For a conservation field. Force, $F = -\frac{du}{dx}$,

At equilibrium position, F = 0

69. $F = -\frac{du}{dx}$ it is clear that slope of U - x curve is zero at point B and C.

70. Given $\rho_1 = \rho_2 \therefore \frac{M_1}{M_2} = \left(\frac{R_1}{R_2}\right)^3$

According to low conservation of linear momentum, $\frac{V_1}{V_2} = \left(\frac{2}{1}\right)^3$

71. Conservation of energy, mgh = $\frac{1}{2}mv^2$

72. P.E. at X = 6m is U = 10 + $(6 - 4)^2$ = 14 J

$\therefore$ Mechanical energy = K.E. + P.E. = 20 + 14 = 34 J

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73. Power, $P = Fv = mav$

74. Power, $P = \frac{mgh}{t}$

75. Power, $P \alpha \frac{1}{t}$

76. $E = P^2/_{2m}$

77. $P = \sqrt{2mE}\,; P\alpha\sqrt{E}$

78. $P = \sqrt{2mE}\,; P\alpha\sqrt{E}$

79. $P = W/_t \quad P = \frac{\vec{F}.\vec{d}}{t}$

80. ....

81. Power of gun = $\frac{\text{Total K.E. of fired bullet}}{\text{time}} = n \times \frac{1}{2} mv^2 / t$

82. Work done by forces = 0 ; $W = P/_t$

83. $P = \frac{mgh}{t} = \frac{(75)(10)(2)}{2} = 0.75 KW$

84. $\frac{1}{2} mv^2 = kt\,(K, \text{Constant})$, $v = \sqrt{\frac{2k}{m}}\, t^{1/2}$, $dx = \sqrt{\frac{2k}{m}}\, t^{1/2}$ dt. Take integration.

85. ....

86. ....

87. $v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_1 + \left(\frac{2m_2 u_2}{m_1 + m_2}\right)$ where $m_1 = m$ and $m_2 = M$; $m << M$.

$m_1 = 0$, $v_1 = -u_1 + 2u_2$

88. $\frac{v_2}{v_1} = \sqrt{\frac{h_2}{h_1}}$; i.e. fractional loss in velocity $= 1 - \frac{v_2}{v_1}$

89. $v_2 = \frac{2m_1 u_1}{m_1 + m_2} = 6 m/s$

i.e. After elastic collision B strike to C with velocity of 6 m/s, Now for B and C

[2m] ⟶ (6m/s) [m] → (Rest) [3m] → V_{sys}

$\therefore$ (2m) (6) + 0 = (3m) (V sys)

90. $m_p v_p + m_Q v_Q = 0$

91. Angle will be 90^{o} if collision is perfectly elastic.

92. $mgh' = 70\%$ of mgh

93. Loss in K.E. = (initial K.E. - Final K.E.) of system $=\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2-\frac{1}{2}(m_1+m_2)v^2$

94. By low of conservation of momentum

$2\times 10 = (2+3)\ v \therefore v=4\,m/s$

Loss in K.E. = $\frac{1}{2}(2)(10)^2 - \frac{1}{2}(5)(4)^2$

95. Momentum of neutron = Momentum of combination

96. Force = Rate of change of momentum.

Intial momentum $\overrightarrow{p_1} = mv\sin\theta\hat{j} + mv\cos\theta\hat{j}$

Final momentum $\overrightarrow{p_2} = -mv\sin\theta\hat{j} + mv\cos\theta\hat{j}$

$\vec{F} = \frac{\Delta\vec{P}}{\Delta t}$

97. In elastic head on collision velocity gets interchanged.

98. $U_1 = mgh_1$ and $U_2 = mgh_2$

% energy lost = $\frac{U_1-U_2}{U_1}\times 100$

99. In elastic head on collision velocites gets interchanged.

100. By conservation of momentum, mv + M(o) = (m+M) v

Velocity of composite block V = $\left(\frac{m}{m+M}\right)v$

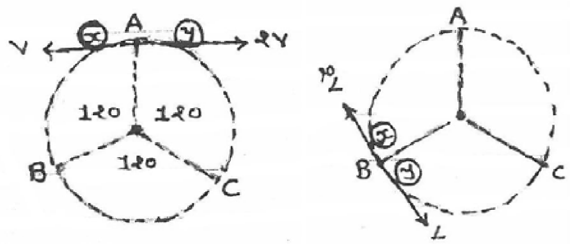
K.E. of composite block = $\frac{1}{2}(M+m)v^2$

101. By conservation of momentum, $m_1V+m_2(0)=(m_1+m_2)v$

102. Let initially particle x is moving in anticlock-wise direction and y in clockwise direction.

As the ratio of velocities of x and y particles are $\frac{Vx}{Vy}=\frac{1}{2}$, therefore ratio of their distance covered will be in the ratio of 2:1. It means they collide at B.

so, after two collision these two particles will again reach the point A.



103. Momentum and kinetic energy is conserved only in this case.