CBSE

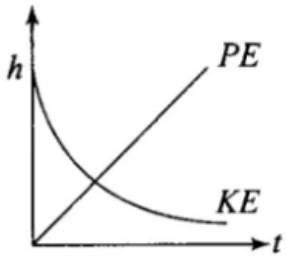
WORK ENERGY AND POWER WS 7

Class 11 - Physics

Section A

1. A raindrop falling from a height h above ground attains a near-terminal velocity when it has fallen through a height (3/4)h. Which of the diagrams shown in Figure correctly shows the change in kinetic and potential energy of the drop during its fall up to the ground? **[1]**

a)



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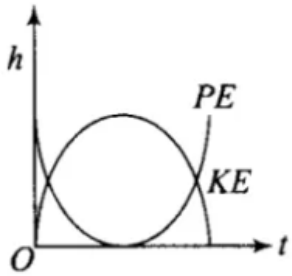

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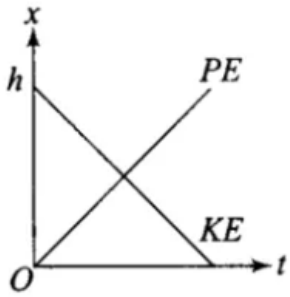

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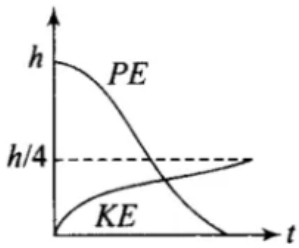


2. A 15 g ball is shot from a spring gun whose spring has a force constant of 600 $\frac{N}{m}$. The spring is compressed by 5 cm. The greatest possible horizontal range of the ball for this compression (g = 10 $\frac{m}{s^2}$) is **[1]**

a) 10.0 m
b) 12.0 m
c) 6.0 m
d) 8.0 m

3. For a ball dropped from a tower of height h, the total mechanical energy is **[1]**

a) the difference of potential and kinetic energies
b) the potential energy
c) the sum of potential and kinetic energies
d) the kinetic energy

4. An iron chain lies on a rough horizontal table. It starts sliding when one-fourth of its length hangs over the edge of the table. The coefficient of static friction between the chain and surface of the table is **[1]**

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

5. A simple pendulum hanging freely and at rest is vertical because in that position **[1]**

a) potential energy is zero
b) potential energy is minimum
c) kinetic energy is zero
d) kinetic energy is minimum

6. A particle is projected making an angle of 45^o with horizontal having kinetic energy K. The kinetic energy at the **[1]**

highest point will be

a) K

b) $\frac{K}{2}$

c) $\frac{K}{\sqrt{2}}$

d) 2K

7. A person trying to lose weight (dieter) lifts a 10 kg mass, one thousand times, to a height of 0.5 m each time. Assume that the potential energy lost each time she lowers the mass is dissipated. Fat supplies 3.8×10^7 J of energy per kilogram which is converted to mechanical energy with a 20% efficiency rate. How much fat will the dieter use up? **[1]**

a) 8.85×10^{-3} kg

b) 8.45×10^{-3} kg

c) 7.45×10^{-3} kg

d) 6.45×10^{-3} kg

8. If pendulum bob on a 2 m string is displaced 60^o from the vertical and then released, what is the speed of the bob as it passes through the lowest point in its path? **[1]**

a) $\sqrt{2 \times 9.8}\,\frac{m}{s}$

b) $\sqrt{2}\,\frac{m}{s}$

c) 4.43 $\frac{m}{s}$

d) $\frac{1}{\sqrt{2}}\,\frac{m}{s}$

9. A body of mass 5 kg is thrown vertically up with a kinetic energy of 490 J. The height at which the kinetic energy of the body becomes half of the original value is **[1]**

a) 5 m

b) 12.5 m

c) 2.5 m

d) 10 m

10. The total mechanical energy of a system is conserved if the forces, doing work on it, are **[1]**

a) not conservative

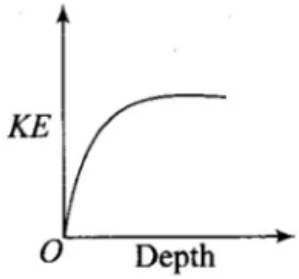
b) damped

c) conservative

d) viscous

11. Which of the graph correctly shows the change in kinetic energy of an iron sphere falling freely in a lake having sufficient depth to impart it a terminal velocity? **[1]**

a)



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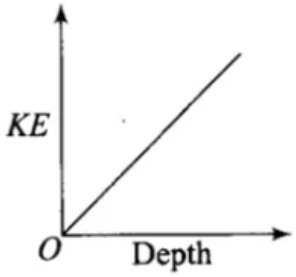

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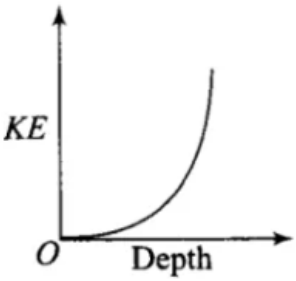

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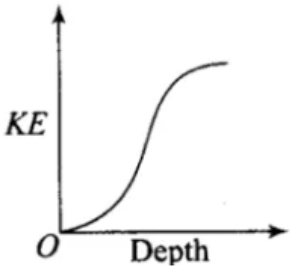


12. A body of mass 5 kg is raised vertically to a height of 10 m by a force of 170 N. The velocity of the body at this height will be **[1]**

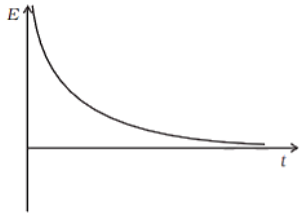
a) 37 ms^{-1}

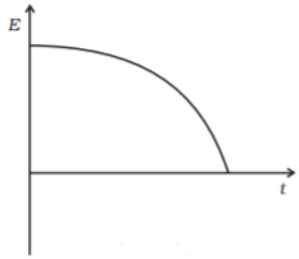
b) 15 ms^{-1}

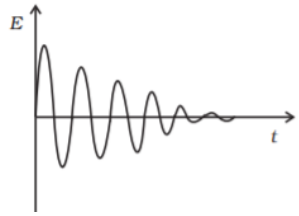
c) 22 ms^{-1}

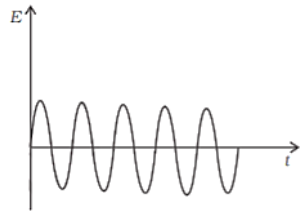
d) 9.8 ms^{-1}

13. Which of the diagrams shown in Fig. represents variation of total mechanical energy of a pendulum oscillating in air as function of time? **[1]**

a) 

b) 

c) 

d) 

14. **Assertion (A):** For springs, plots of potential energy (V) vs. displacement (x) and kinetic energy (K) vs, displacement (x) are parabolic and complementary. **[1]**

Reason (R): The total mechanical energy E = K + V remains constant. As K increases V decreases and vice versa.

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

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion:** If the internal forces are conservative, the work done by the external forces is equal to the change in mechanical energy. **[1]**

Reason: Work done on a system by all the forces is equal to the change in its kinetic energy and the change in potential energy of a system corresponding to conservative internal forces is equal to the negative of the work done by these forces.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

16. **Assertion:** A body cannot have kinetic energy without having linear momentum but it can have momentum without having mechanical energy. **[1]**

Reason: Linear momentum and energy have same dimensions.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

17. **Assertion:** According to the law of conservation of mechanical energy change in potential energy is equal and **[1]**

opposite to the change in kinetic energy.

Reason: Mechanical energy is not a conserved quantity.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

18. **Assertion (A):** According to law of conservation of mechanical energy change in potential energy is equal and opposite to the change in kinetic energy. **[1]**

Reason (R): Mechanical energy is not a conserved quantity.

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

b) Both A and R are true but R is not the correct explanation of A.

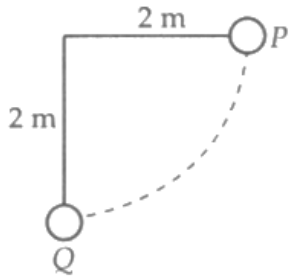
c) A is true but R is false.

d) A is false but R is true.

19. **Fill in the blanks:** **[1]**

(a) The sum of kinetic and potential energies is called as _____ energy. **[1]**

20. The bob of a pendulum of length 2 m lies at P. When it reaches Q, it loses 10% of its total energy due to air resistance. **[1]**



The velocity at Q is

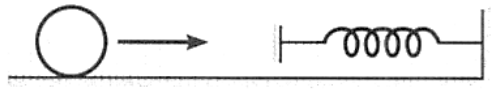
a) 6 m/s

b) 1 m/s

c) 8 m/s

d) 2 m/s

21. A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be **[1]**



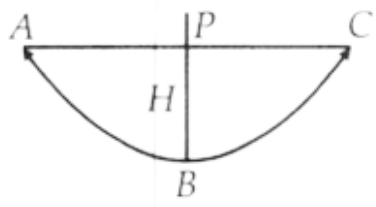
a) 0.5 m

b) 1.5 m

c) 0.15 m

d) 0.12 m

22. A simple pendulum, with a bob of mass m, oscillates from A to C and back to A such that PB is H. If the acceleration due to gravity is g, then the velocity of the bob as it passes through B is **[1]**

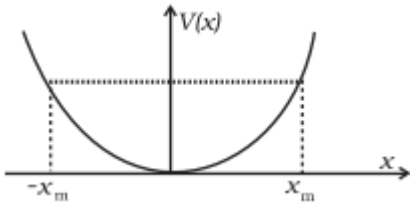


a) zero

b) $\sqrt{2gH}$

c) 2 gH d) mgH

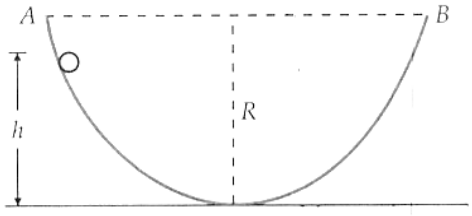
23. The potential energy function for a particle executing linear SHM is given by $V(x) = \frac{1}{2}kx^2$ where k is the force constant of the oscillator (Fig.). For k = 0.5 N/m, the graph of V(x) versus x is shown in the figure. A particle of total energy E turns back when it reaches $x = \pm x_m$. If V and K indicate the P.E. and K.E., respectively of the particle at $x = \pm x_m$, then which of the following is correct? **[1]**



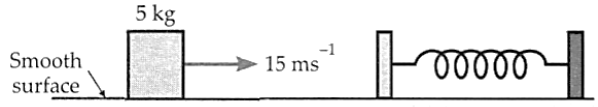
a) V = E, K = O b) V = O, K < E

c) V = O, K = E d) V < E, K = O

24. Fig. shows a frictionless hemispherical bowl of radius R. A ball of mass m is pushed down the wall from point A. It just rises up to the edge of the bowl. Calculate the speed with which the ball is pushed down along the wall. **[1]**



25. The spring constant of the spring shown in the figure is 250 Nm^{-1}. Find the maximum compression of the spring. **[1]**



26. How high must a body be lifted to gain an amount of potential energy equal to the kinetic energy it has when moving at speed 20 ms^{-1}? The value of acceleration due to gravity at a place is g = 9.8 ms^{-2}. **[1]**

27. When an arrow is shot, where from the arrow will acquire its kinetic energy? **[1]**

28. Fill in the blank: A stone projected up with a velocity u reaches a maximum height h. When it is at a height $\frac{3h}{4}$ from the ground, the ratio of its K.E. and P.E. at that point is _____. **[1]**

29. Will water at the foot of the fall be at a different temperature from that at the top? If yes, explain. **[1]**

30. Calculate the velocity of the bob of a simple pendulum at its mean position if it is able to rise to a vertical height of 10 cm. Take g = 9.8 ms^{-2}. **[1]**

31. Is the mechanical energy always conserved? **[1]**

32. If a block attached to a spring (whose other end is rigidly fixed) is pulled up to distance x_0 and released, the amplitude of its motion cannot exceed $\pm x_0$. Why? **[1]**

33. A ball is thrown vertically up with a velocity of 20 ms^{-1}. At what height, will its K.E. be half its original value? **[1]**

34. A block of mass m, initially at rest, is dropped from a height h onto a spring whose force constant is k. Find the maximum distance x through which the spring will be compressed. **[1]**

35. The string of a pendulum is 2.0 m long. The bob is pulled sideways so that the string becomes horizontal and then the bob is released. What is the speed with which the bob arrives at the lowest point? Assume that 10% of the initial energy is dissipated against air resistance, g = 10 ms^{-2}. **[1]**

36. Give three examples of forces that are conservative in nature. **[1]**

37. Can there be a situation in which E - U < 0? **[1]**

38. A bullet gets embedded into a block of wood, how does the loss of energy appear? **[1]**

39. What is the source of the kinetic energy of the falling raindrops? **[1]**

40. A ball is dropped to the ground from a height of 2 m The coefficient of restitution is 0.6. To what height will the ball rebound? **[1]**

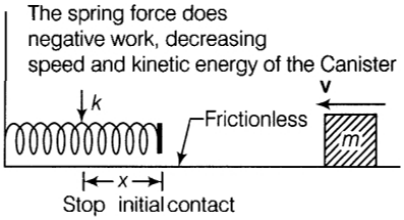
Section B

41. **State True or False:** **[2]**

    (a) It is practically possible to have situation where (E - U) < 0. **[1]**

    (b) In an isolated system, the mechanical energy E_{mec} of the system cannot change. **[1]**

42. As shown in figure, a canister of mass m = 0.40 kg slides across a horizontal frictionless counter with speed v = 0.50 m/s. It then runs into and compresses a spring of spring constant k = 750 N/m. When the canister is momentarily stopped by the spring, by what distance d is the spring compressed ? **[2]**



43. A vehicle of mass 15 quintal climbs up a hill 200 m high. It then moves on a level road with a speed of 30 ms^{-1}. Calculate the potential energy gained by it and its total mechanical energy while running on the top of the hill. **[2]**

44. A ball bounces to 80% of its original height. What fraction of its mechanical energy is lost in each bounce? Where does this energy go? **[2]**

45. A block of mass 2 kg initially at rest is dropped from a height of 1 m into a vertical spring having a force constant of 490 Nm^{-1}. Calculate the maximum distance through which the spring will be compressed. **[2]**

46. A stone of mass 0.4 kg is thrown vertically up with a speed of 9.8 ms^{-1}. Find the potential and kinetic energies after half a second. **[2]**

47. Distinguish between power and energy. Illustrate by giving an example. **[2]**

48. Draw a graph showing the variation potential energy and kinetic energy with respect to height of a free fall under gravitational force. **[2]**

49. A ball at rest is dropped from a height of 12 m. It loses 25% of its kinetic energy in striking the ground, find the height to which it bounces. How do you account for the loss in kinetic energy? **[2]**

50. State the law of conservation of angular momentum. Give an example for it. **[2]**

51. State and prove the principle of conservation of mechanical energy. **[2]**

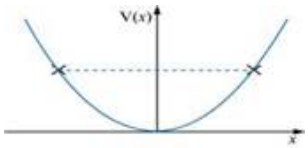
52. A simple pendulum of length 1 m has a wooden bob of mass 1 kg. It is struck by a bullet of mass 10^{-2} kg moving with a speed of 2×10^2 ms^{-1}. The bullet gets embedded into the bob. Obtain the height to which the bob rises before swinging back. **[2]**

53. Draw the variation of potential energy and kinetic energy of a block attached to a spring which obeys Hooke's law. **[2]**

54. A ball falls under gravity from a height of 10 m with an initial downward velocity u. It collides with the ground, loses 50% of its energy in the collision and then rises back to the same height. Find the initial velocity u. **[2]**

55. The potential energy function for a particle executing linear simple harmonic motion is given by $V(x) = \frac{kx^2}{2}$, where k is the force constant of the oscillator. For, k = 0.5 Nm^{-1}, the graph of V(x) versus x is shown in figure. **[2]**

Show that a particle of total energy 1 J moving under this potential must 'turn back' when it reaches x = ± 2 m.



56. A shot travelling at the rate of 100 ms^{-1} is just able to pierce a plank 4 cm thick. What velocity is required to just pierce a plank 9 cm thick? **[2]**

57. A ball, whose kinetic energy is E, is projected at an angle of 45^o to the horizontal. What will be the kinetic energy of the ball at the highest point of its flight? **[2]**

Section C

58. A body falls towards earth in the air. Will its total mechanical energy be conserved during the fall? Justify. **[3]**

59. A curved surface is shown in figure. The portion BCD is free of friction. There are three spherical balls of identical radii and masses. Balls are released from rest one by one from A which is at a slightly greater height than C. With the surface AB, ball 1 has large enough friction to cause rolling down without slipping; ball 2 has a small friction and ball 3 has a negligible friction. **[3]**

i. For which ball is total mechanical energy conserved?

ii. Which ball (s) can reach D?

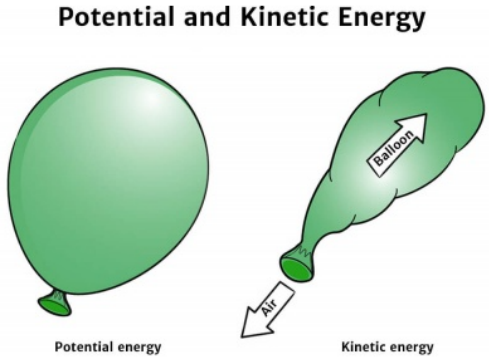
iii. For balls which do not reach D, which of the balls can reach back A?

60. Show that total mechanical energy of a freely falling body remains constant throughout the fall. **[3]**

Section D

Question No. 61 to 65 are based on the given text. Read the text carefully and answer the questions: **[5]**

Potential energy is the energy stored within an object, due to the object's position, arrangement or state. Potential energy is one of the two main forms of energy, along with kinetic energy. Potential energy depends on the force acting on the two objects.



61. A body is falling freely under the action of gravity alone in a vacuum. Which of the following quantities remain constant during the fall?

a) mechanical energy
b) Electrical energy
c) potential energy
d) kinetic energy

62. Work done by a conservative force is positive, if

a) potential energy decreases
b) kinetic energy increases
c) potential energy increases
d) kinetic energy decreases

63. When does the potential energy of a spring increase?

a) only when spring is compressed
b) only when spring is moved
c) both only when spring is stretched and compressed
d) only when spring is stretched

64. Dimension of k/m is, here k is the force constant

a) T^2
b) T^{-2}
c) T^{-1}
d) T^1

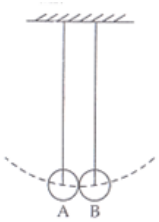
65. A vehicle of mass 5000 kg climbs up a hill of 10 m. The potential energy gained by it

a) 5×10^4
b) 5×10^5 J
c) 500 J
d) 5 J

66. Show that the total mechanical energy of a body falling freely under gravity is conserved. Discuss it graphically also. **[5]**

67. What is a conservative force? Explain its various properties. **[5]**

68. Two pendulums with identical bobs and lengths are suspended from a common support such that in rest position the two bobs are in contact (figure). One of the bobs is released after being displaced by 10^o so that it collides elastically head-on with the other bob. **[5]**



i. Describe the motion of two bobs.
ii. Draw a graph showing variation in energy of either pendulum with time, for $0 \leq T \leq 2T$, where T is the period of each pendulum.