CBSE

WORK ENERGY AND POWER WS 3

Class 11 - Physics

Section A

1. A bullet of mass 0.012 kg and horizontal speed 70 m s^{-1} strikes a block of wood of mass 0.4 kg and instantly comes to rest with respect to the block. The block is suspended from the ceiling by means of thin wires. Calculate the height to which the block rises. Also, estimate the amount of heat produced in the bloc?. **[1]**

   a) 72.2 cm, 28.5 J
   b) 21.2 cm, 28.5 J
   c) 29.2 cm, 29.5 J
   d) 23.2 cm, 38.5 J

2. Two bodies with kinetic energies in the ratio of 4 : 1 are moving with equal linear momentum. The ratio of their masses is **[1]**

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

3. A 3.00-kg crate slides down a ramp. The ramp is 1.00 m in length and inclined at an angle of 30.0^{o}. The crate starts from rest at the top, experiences a constant frictional force of magnitude 5.00 N, and continues to move a short distance on the flat floor after it leaves the ramp. Use energy methods to determine the speed of the crate at the bottom of the ramp? **[1]**

   a) 2.78 m/s
   b) 2.54 m/s
   c) 2.25 m/s
   d) 1.76 m/s

4. A bolt of mass 0.3 kg falls from the ceiling of an elevator moving down with a uniform speed of 7 m/s. It hits the floor of the elevator (length of the elevator = 3 m) and does not rebound. What is the heat produced by the impact? **[1]**

   a) 9.22 J
   b) 8.42 J
   c) 8.82 J
   d) 8.11 J

5. In a shotput event an athlete throws the shotput of mass 10 kg with an initial speed of $1ms^{-1}$ at 45° from a height 1.5 m above ground. Assuming air resistance to be negligible and acceleration due to gravity to be 10 ms^{-2}, the kinetic energy of the shotput when it just reaches the ground will be **[1]**

   a) 5.0 J
   b) 2.5 J
   c) 155.0 J
   d) 52.5 J

6. If the kinetic energy of a body is increased by 300%, then the percentage change in momentum will be **[1]**

   a) 265%
   b) 73.2%
   c) 150%
   d) 100%

7. Two bodies of mass m and 4 m have equal kinetic energy. What is the ratio of their momentum? **[1]**

a) 2 : 1

b) 1 : 1

c) 1 : 4

d) 1 : 2

8. Which is odd out? **[1]**

a) Momentum

b) Displacement

c) Potential energy

d) Torque

9. What is the ratio of kinetic energy of a particle at the bottom to the kinetic energy at the top when it just loops a vertical loop of radius r? **[1]**

a) 5 : 2

b) 5 : 1

c) 2 : 3

d) 7 : 2

10. Kinetic energy, with any reference, must be **[1]**

a) positive and negative

b) zero

c) positive

d) negative

11. A body of mass 5 kg has a momentum of 10 kg ms^{-1}. When a force of 0.2 N is applied on it for 10 s, what is the change in kinetic energy? **[1]**

a) 4.4 J

b) 1.1 J

c) 3.3 J

d) 2.2 J

12. If the linear momentum is increased by 50%, then kinetic energy will increase by **[1]**

a) 125%

b) 25%

c) 50%

d) 100%

13. Two bodies of masses m_1 and m_2 have same momentum. The ratio of their KE is **[1]**

a) $\frac{m_1}{m_2}$

b) $\sqrt{\frac{m_2}{m_1}}$

c) $\sqrt{\frac{m_1}{m_2}}$

d) $\frac{m_2}{m_1}$

14. A bomb of mass 9 kg explodes into 2 pieces of mass 3 kg and 6 kg. The velocity of mass 3 kg is 1.6 m/s, the KE of mass 6 kg is **[1]**

a) 9.6 J

b) 1.92 J

c) 3.84 J

d) 2.92 J

15. If the kinetic energy of a body becomes four times of its initial value, then new momentum will **[1]**

a) become thrice its initial value

b) become twice its initial value

c) remain constant

d) become four times its initial value

16. The kinetic energy of body of mass 2 kg and momentum of 2 Ns is **[1]**

a) 4 J

b) 3 J

c) 1 J

d) 2 J

17. The bob of a pendulum is released from a horizontal position. If the length of the pendulum is 1.5 m, what is the speed with which the bob arrives at the lowermost point, given that it dissipated 5% of its initial energy against air resistance? **[1]**

a) 5.5 m/s

b) 4.7 m/s

c) 5.3 m/s

d) 4.9 m/s

18. A gun of mass M fires a bullet of mass m with maximum speed v. Given that m < M. The kinetic energy of the gun will be **[1]**

a) $\frac{1}{2}Mv^2$

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

c) more than $\frac{1}{2}$ mv^2

d) less than $\frac{1}{2}$ mv^2

19. If momentum decreases by 20%, K.E. will decrease by **[1]**

a) 18%

b) 40%

c) 36%

d) 8%

20. A mass of 5 kg is moving along a circular path of radius 1 m. If the mass moves with 300 revolutions per minute, its kinetic energy would be **[1]**

a) 0

b) $250\pi^2$ J

c) $5\pi^2$

d) $100\pi^2$

21. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water? **[1]**

a) $\frac{1}{2}$ m^2v^2

b) $\frac{1}{2}$ mv^3

c) mv^3

d) $\frac{1}{2}$ mv^2

22. A stationary particle explodes into two particles of masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2. The ratio of their kinetic energies $\frac{E_1}{E_2}$ is **[1]**

a) $\frac{m_2}{m_1}$

b) 1

c) $\frac{m_1v_2}{m_2v_1}$

d) $\frac{m_1}{m_2}$

23. A bullet is fired from a rifle. If the rifle recoils freely, then the kinetic energy of the rifle is **[1]**

a) more than that of the bullet

b) same as that of the bullet

c) less than that of the bullet

d) equal or less than that of the bullet

24. **Assertion:** A body may gain kinetic energy and potential energy simultaneously. **[1]**
Reason: Principle of conservation of mechanical energy may not be valid every time.

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.

25. **Assertion (A):** D_2O is used as moderator in nuclear reactors. **[1]**

Reason (R): Colliding with neutron, kinetic energy of neutron and deuterium nucleus both reduce.

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.

26. **Assertion (A):** A kinetic energy of a body is quadrupled when its velocity is doubled. **[1]**

Reason (R): Kinetic energy is proportional to the square of velocity.

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.

27. **Assertion:** When percentage errors in the measurement of mass and velocity are 1% and 2% respectively, the percentage error in KE is 5%. **[1]**

Reason: $\frac{\Delta E}{E} = \frac{\Delta m}{m} + \frac{2\Delta v}{v}$

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.

28. **Assertion:** Internal forces can change the kinetic energy but not the momentum of the system. **[1]**

Reason: The rate of change of momentum of a many particle system is proportional to the sum of the external forces of the system.

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.

29. **Assertion (A):** If momentum of a body increases by 50%, its kinetic energy will increase by 125%. **[1]**

Reason (R): Kinetic energy is proportional to the square of velocity.

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.

30. **State True or False:** **[1]**

(a) The kinetic energy of a body depends upon the frame of reference. **[1]**

31. Two bodies A and B having mass m and M respectively possess same kinetic energy. Given that M > m. If p_A and p_B be their moments, then which of the following statements is true? **[1]**

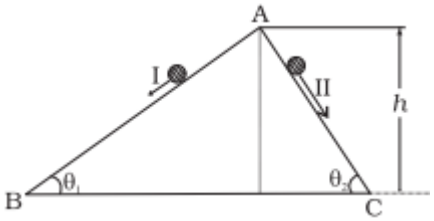
a) $p_A < p_B$

b) $p_A > p_B$

c) $p_A = p_B$

d) It cannot be predicted

32. Two inclined frictionless tracks, one gradual and the other steep meet at A from where two stones are allowed to slide down from rest, one on each track as shown in Fig. **[1]**



Which of the following statement is correct?

a) Both the stones reach the bottom with the same speed and stone I reach the bottom earlier than stone II.

b) Both the stones reach the bottom at different times and at different speeds.

c) Both the stones reach the bottom at the same time but not at the same speed.

d) Both the stones reach the bottom with the same speed and stone II reaches the bottom earlier than stone I.

33. What sort of energy is associated with a bird flying in the air? **[1]**

34. The momentum of a body of mass 5 kg is 500 kg ms^{-1}. Find its K.E. **[1]**

35. A light body and a heavy body have the same momentum. Which one will have greater kinetic energy? **[1]**

36. The kinetic energy of a body decreases by 19%. What is the percentage decrease in its linear momentum? **[1]**

37. Two bodies of masses m_1 and m_2 have equal kinetic energies. What is the ratio of their linear momenta? **[1]**

38. How does the kinetic energy of a body change if its momentum is doubled? **[1]**

39. Two bodies of unequal mass are moving in the same direction with equal kinetic energy. The two bodies are brought to rest by applying retarding force of same magnitude. How would the distance moved by them before coming to rest compare? **[1]**

40. In what type of collision, maximum kinetic energy is transferred? **[1]**

41. Define kinetic energy. Give its units and dimensional formula. **[1]**

42. A light body and a heavy body have the same kinetic energy. Which one will have the greater momentum? **[1]**

43. Can the K.E. of a body be negative? **[1]**

44. How does the kinetic energy of a moving ball change if its speed is reduced to half of the original speed. Take the mass of ball = 4 kg and original speed = $20\frac{m}{s}$. **[1]**

45. Two bodies A and B weighing 5 kg and 6 kg respectively have equal momenta. Which one has more kinetic energy? **[1]**

46. How will the momentum of a body change if its kinetic energy is doubled? **[1]**

47. Is it possible to exert a force which does work on a body without changing its kinetic energy? If so, give example. **[1]**

48. When a planet revolves around the sun, when is its kinetic energy maximum? **[1]**

49. What is the source of the kinetic energy of the bullet coming out of the barrel of a rifle? **[1]**

50. A bullet of mass 20 g is found to pass two point 30 m apart in a time interval of 4 s. Calculate the kinetic energy of the bullet if it moves with constant speed. **[1]**

Section B

51. A ball falls from a height of 20 m. Find out of the velocity with which the ball hits the ground? **[2]**

52. Two identical steel cubes (masses 50 g, side 1cm) collide head-on face to face with a speed of 10 cm/s each. Find the maximum compression of each. Young's modulus for steel $Y = 2 \times 10^{11}$ N/m^2. **[2]**

53. An object of mass 0.4kg moving with a velocity of 4m/s collides with another object of mass 0.6kg moving in same direction with a velocity of 2m/s. If the collision is perfectly inelastic, what is the loss of K.E. due to **[2]**

impact?

54. A rocket explodes in mid-air. How does this affect **[2]**

a. its total momentum and

b. its total kinetic energy?

55. Define the term work and derive its SI unit. Write an expression for the kinetic energy of a body of mass m moving with a uniform speed v. **[2]**

56. The velocity of an aeroplane is doubled. **[2]**

a. What will happen to its momentum? Will the momentum remain conserved?

b. What will happen to its K.E.? Will the energy remain conserved?

Section C

57. The blades of a windmill sweep out a circle of area A. **[3]**

a. If the wind flows at a velocity v perpendicular to the circle, what is the mass of the air passing through it in time t?

b. What is the kinetic energy of the air?

c. Assume that the windmill converts 25% of the wind's energy into electrical energy, and that A = 30 m^2, v = 36 km/h and the density of air is 1.2 kg m^{-3}. What is the electrical power produced?

58. Consider a drop of small pebble of mass 1.00 g falling from a cliff of height 1.00 km. It hits the ground with a speed of 50.0 ms^{-1}. What is the work done by the unknown resistive force? **[3]**

59. An electron and a proton are detected in a cosmic ray experiment, the first with kinetic energy 10 keV, and the second with 100 keV. Which is faster, the electron or the proton? Obtain the ratio of their speeds. (electron mass = 9.11×10^{-31} kg, proton mass = 1.67×10^{-27} kg, 1 eV = 1.60×10^{-19} J). **[3]**

60. A particle of mass m moves in a straight line with retardation proportional to its displacement. Find the expression for loss of kinetic energy for any displacement x. **[3]**

61. The blades of a windmill sweep out a circle of area A. **[3]**

i. If the wind flows at a velocity v perpendicular to the circle, what is the mass of the air passing through it in time t?

ii. What is the kinetic energy of the air?

iii. Assume that the windmill converts 25% of the wind's energy into electrical energy, and that A = 30 m^2, v = 36 km/h and the density of the air is 1.2kgm^{-3}. What is the electrical power produced?

62. A nucleus of radium $\left({}^{222}_{86}\mathrm{Ra}\right)$ decays to ${}^{222}_{86}\mathrm{Rn}$ by the emission of a α-particle $\left({}^{4}_{2}\mathrm{He}\right)$ of energy 4.8 MeV. If mass of ${}^{222}_{86}\mathrm{Rn}$ = 222.0 amu and mass of ${}^{4}_{2}\mathrm{He}$ = 4.003 amu, then calculate the recoil energy of the daughter nucleus ${}^{222}_{86}\mathrm{Rn}$. **[3]**

Section D

63. Define kinetic energy. Derive an expression for the kinetic energy of a body moving with a uniform velocity. **[5]**

64. What percentage of the kinetic energy of a moving particle is transferred to a stationary particle, when a moving particle strikes with a stationary particle of mass **[5]**

i. 9 times in mass

ii. equal in mass and

iii. $\frac{1}{19}$th of its mass?

Section E

65. **Fill in the blanks:** **[6]**

(a) A light body and a heavy body have the same momentum. Then the light body has a _____ kinetic energy than the heavy body. **[1]**

(b) If the kinetic energy of a body decreases by 19%, the percentage decrease in its linear momentum will be _____ %. **[1]**

(c) The energy possessed by a body by virtue of its motion is called _____. **[1]**

(d) If the linear momentum of a body increases by 10%, the percentage increase in its kinetic energy will be _____ %. **[1]**

(e) A light body and a heavy body have the same kinetic energy. Then the light body has a _____ momentum than the heavy body. **[1]**

(f) If the momentum of a body is doubled, then its kinetic energy will become _____ times the initial kinetic energy. **[1]**