CLASS XI : ASSIGNMENT : CH-5 : WORK, ENERGY AND POWER : PHYSICS

WORK

1. State the factors on which work done by a force depends.

2. What is work done by the force of tension in the string of a simple pendulum?

3. What is represented by area under the forced displacement curve?

4. Does the work done in raising a body through a certain height depends upon how fast it is raised?

5. In a tug of war, one team is giving way to other. What work is being done and by whom?

6. 'Work done in moving a body over a closed loop is 0'. Is this statement true for all forces?

7. Is work done by a non-conservative force always negative? Comment.

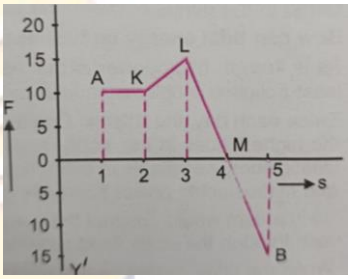
8. A man rowing a boat upstream is at rest with respect to shore.
- **a)** Is he doing any work?
- **b)** If he stops rolling and moving down with a stream. Is any work being done on him?

9. Identify the work done as positive, negative or zero work done:
- **a)** A man pushes the wall and fails to displace it. **b)** A man pushes the wall and displaces it.
- **c)** An elastic ball is thrown towards the rigid wall. Work done by the normal reaction.
- **d)** Work done by the normal reaction when a person climbs up the stairs.
- **e)** Work done by the static frictional force when a person starts running.

10. A body is in accelerated motion. Is it possible that no work is done? Give some example.

11. A box is pushed through 4 m across the floor offering 10 N resistance. How much work is done by the **a)** applied force **b)** resisting force?

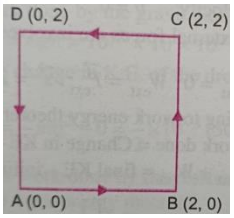
12. A body of moves from point A to B under the action of a force varying in magnitude as shown in figure. Obtain the work done. Force is expressed in Newton and displacement is in meter.



13. The displacement x of a particle of mass 5g moving in one dimension under the action of a constant force is related to the time by the equation $t = \sqrt{x} + 3$, where x is in meter and t is in second.
- **a)** Find the displacement of the particle when its velocity is zero, and
- **b)** Work done by the force in first six seconds.

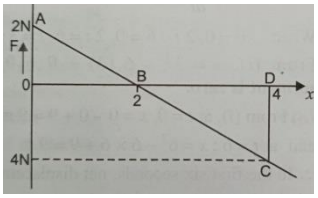
14. A cyclist comes do a skidding stop in 10m. During this process, the force on the cycle due to the road is 200 N and is directly opposed to the motion.
- **a)** How much work does the road do on the cycle? **b)** How much work does the cycle do on the road?

15. A Force **F** = 2x **j** N acts in a region where a particle moves anticlockwise in a square loop of 2 m in x-y plane as shown in figure. Calculate the total amount of work done. is this force a conservative force or a non-conservative force?



16. The variation of force acting on a body with a displacement of a body is shown in figure. calculate work done by this force in the interval

- **a)** $0 \le x \le 2m$ **b)** $2m \le x \le 4m$



17. A force **F** = (**i** + 2 **j** – **k**) N moves a particle along a vector **s** = (4i + j + 7 k) m. What is the work done?

18. A particle is projected from a point A (1, 2) to B (3, 4) by applying force **F** = 2i + 3j. Find the work done by **F** to move the particle from A to B.

19. A force **F** = 0.5 x + 10 acts on a particle. Here F is in Newton and x is in meter. Calculate the work done by the force during the displacement of the particle from x = 0 to x = 2 meter.

20. An object is displaced from point A (1, 2) to point B (0, 1) by applying force **F** = xi + 2yj. Find out the work done by **F** to move the object from A to B.

21. Calculate the work done to displace the particle from (1, 2) to (4, 5) if **F** = 4i + 3j.

22. A force acts on a 3g particle such that its position $x = 3t - 4t^2 + t^3$, where x is in meter and t is in second. Find the work done during first 4 seconds.

23. An object is displaced from position vector $\mathbf{r_1} = (2i + 3j)$ m to $\mathbf{r_2} = (4i + 6j)$ m under a force $\mathbf{F} = (3x^2i + 2yj)$ N. Find the work done by this force.

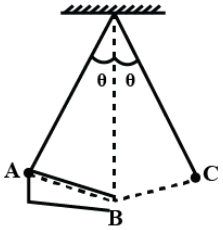
24. If **F =** yi + xj then find out the work done in moving the particle from position (2, 3) to (5, 6).

25. A position dependent force F = (7-2x + $3x^2$) N acts on a small object of mass 2 kg to displace it from x = 0 to x = 5m. Find the work done in joule.

26. A block of mass 5 Kg is being raised vertically upwards by the help of a string attached to it. It rises with an acceleration of 2 m/s^2. The block rises by 2.5 m. find the

a) Work done by gravity **b)** Work done by tension **c)** Net work done on the block.

27. A bob of pendulum is released at rest from extreme position as shown in figure. Find work done by tension from A to B, B to C and C to A.



28. Calculate work done in raising a stone of mass 5 kg and specific gravity 3 lying at the bed of a lake through a height of 4m.

29. A block of mass m is released from the top of a smooth fixed inclined plane of inclination θ. Find the work done by normal reaction and by gravity during the time the block comes to bottom.

30. Find the work done in pulling up a block of wood weighing 200N for length of 10m on a smooth plane inclined at an angle of 30° with the horizontal.

31. A block of mass 4 kg slides down a plane inclined at 37° with the horizontal. The length of plane is 3m. The coefficient of sliding friction between the block and the plane is 0.2. Find the work done by gravity, the frictional force and normal reaction between the block and the plane.

32. A uniform chain of length 2m is kept on a table such that a length of 60cm hangs freely from the edge of the table. The total mass of the chain is 4kg. What is the work done in pulling the entire chain on the table? Take g = 10m/s^2.

ENERGY

33. Name the largest and smallest practical unit of energy.

34. Out of kWh and electron Volt which is bigger unit of energy and by what factor?

35. What is the source of kinetic energy of falling raindrops?

36. Give an example of a situation in which

a) Momentum changes but kinetic energy does not. **b)** Kinetic energy changes but momentum does not.

37. A rocket explodes in midair. What happens to its total momentum and total kinetic energy?

38. Can you associate potential energy with a non-conservative force?

39. When an air bubble rises in water, what happens to its potential energy?

40. Can potential energy of an object be negative?

41. In case of a moving body, as force of friction is µmg. Can we regard µmgx as potential energy similar to mgh?

42. Explain with reason whether the potential energy in the following cases increases or decreases:

a) A spring is compressed. **b)** A spring is stretched.

c) Two dissimilar charges are brought near each other.

d) A body is taken away against the gravitational force.

43. Show graphically the variation of potential energy of an object thrown vertically upwards w.r.t its height.

44. Is it practically possible to have a situation where (E – V) < 0?

45. Does kinetic energy depend upon the direction of motion involved? Can it be negative? Does its value depend on frame of reference?

46. A light body and a heavy body have the same kinetic energy. Which one has greater linear momentum?

47. A truck and a car moving with the same kinetic energy are stopped by applying same retarding force by means of breaks. Which one will stop at a smaller distance?

48. A truck and a car are moving with same kinetic energy on a straight road. Their engines are simultaneously switched off. Which one will stop at a lesser distance?

49. A body of mass 5kg initially addressed is subjected to a force of 20 N. What is the kinetic energy acquired by the body at the end of half minute?

50. Find the average frictional force that would stop a car weighing 500 kg in a distance of 25 meter, if the initial speed is 72 km/h.

51. How high must a body be lifted so that it gains potential energy equal to its kinetic energy while moving with the velocity of 30m/s? Take g = 10 m/s^2.

52. Two bodies of masses 1g and 9g are moving with equal kinetic energies. Find the ratio of the magnitudes of their respective linear momenta.

53. Two bodies of masses 3m and 6m have the same linear momentum. Find the ratio of their kinetic energies.

54. Two bodies of masses 3m and m have their K.E. in the ratio 27:1, and then find the ratio of their momentum.

55. Momentum of a body is doubled. By what percent does its kinetic energy change?

56. If the kinetic energy of a body is increased by 300% then find the percentage increase in momentum.

57. The linear momentum of a body is increased by 10%. What is the percentage change in its kinetic energy?

58. If the momentum of a body is increased by 100% then find the percentage increase in kinetic energy.

59. Two identical 5kg blocks are moving with the same speed of 2m/s towards each other along a frictionless horizontal surface. The two blocks collide, stick together and come to rest. calculate work done by:

a) external forces and **b)** internal forces

60. A particle of mass 0.5 kg travels in a straight line with a velocity $v = (5x^{5/2})$m/s. How much work is done by net force during the displacement from x = 0 to x = 2m?

61. The energy required accelerating the car from rest to 10m/s is E. Find the energy required to accelerate the car from 10m/s to 20m/s.

62. An automobile moving with the speed of 36 km/h reaches an upward inclined road of angle 30°, its engine is switched off. If the coefficient of friction is 0.1, how much distance will the automobile move before coming to rest? Take $g = 10\ m/s^2$.

63. When a long spring is stretched by 2cm, its potential energy is U. If the spring is stretched by 10 cm, find the potential energy stored in it.

64. The potential energy of a spring when stretched through a distance X is 50 Joule. What would be the work done in stretching it further through the same distance?

65. The potential energy of the spring becomes 4J when it is stretched by 2mm. Find the potential energy of the spring when it is stretched by 6mm.

66. 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.

67. Two springs have force constants K_1 and K_2 where $K_1 > K_2$. On which spring, more work is done if

a) They are stretched by the same force. **b)** They are stretched by the same amount.

68. If stretch in a spring of force constant K is doubled. calculate

a) Ratio of final two initial force in the spring. **b)** Ratio of elastic energies stored in the two cases.

c) Work done in changing to the state of double stretch.

69. The potential energy of two atoms separated by a distance X is given by $U = -A/x^6$, where A is a positive constant. What is the force exerted by one atom on another atom?

70. If force is acting on a body moving along X axis in the direction of motion of the body. If this force produces a potential energy $U = Ax^4$ where $A = 1.2\ J/m^4$. Then, what is the force acting on the body when the body is at x= -0.8m?

71. A block of mass m = 1kg moving on a horizontal surface with a speed v_i = 2m/s enters a rough patch ranging from x = 0.10m to x = 2.01m. The retarding force F_r on the block in this range is inversely proportional to x over this range:

$F_r = -k/r$ for $0.1 < x < 2.01$ m

$=0$ for $x < 0.1$.m and $x > 2.01$ m

Where k = 0.5 J. What is the final K.E. and speed v_f of the block as it crosses the patch?

POWER

72. An elevator weighing 500kg is to be lifted up at a constant velocity of 0.4m/s. What should be the minimum horse power of the motor to be used?

73. A person weighing 70 kg runs up a flight of 30 steps in 35 seconds. What is the power of the person if each step is 20cm high?

74. A 1KW motor pumps out water from a well 1 m deep. Calculate the quantity of water pumped out per second.

75. How much water a pump of 2KW can raise in 1 minute to a height of 10m? Take $g = 10m/s^2$.

76. On coolie takes 1 minute to raise a box through a height of 2m. Another one takes 30 seconds for the same job and does the same amount of work. Which one of the two has greater power and which one has greater

energy?

77. An electric motor is used to lift an elevator and its load (total mass 1500 kg) to a height of 20m. The time taken for the job is 20 s. What is the work done? What is the rate at which work is done. if efficiency of the motor is 75%, at which rate is the energy supplied to the motor?

78. An elevator which can carry a maximum load of 1800 kg (elevator +passengers) is moving up with a constant speed of 2m/s. The frictional force opposing the motion is 4000 N. Determine the minimum power delivered by the motor to the elevator in watt and in horsepower.

79. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of energy. How much power is generated by the turbine? Take g = 10m/s^2.

COLLISION

80. Is it possible to have a collision in which the whole of kinetic energy is lost?

81. If two objects collide and one is initially at rest. a) Is it possible for both to be at rest after collision? b) Is it possible for any one to be at rest after collision?

82. Which physical quantities are conserved in an elastic collision?

83. If two bodies stick together after collision. Will the collision be elastic or inelastic?

84. A bullet gets embedded in a wooden block. Where does its kinetic energy go?

85. Throwing mud on a wall is an example of perfectly inelastic collision. Comment.

86. A ball is dropped from a height h. it rebounds from the ground a number of times. if coefficient of restitution is e. to what height does it go after n_{th} rebounding?

87. The plastic ball is dropped from a height of 1m and rebound several times from the floor. If 1.3 s elapses from the moment it is dropped to the second impact with the floor, what is the coefficient of restitution?

88. A body of mass m moving with speed V collides elastically head on with another body of mass m, initially at rest. Show that the moving body will come to a stop after collision.

89. Two equal masses m_1 and m_2, moving along the same straight line with velocities +3m/s and -5m/s respectively, collide elastically. Find the velocities of the two masses after collision.

90. A neutron having a mass of 1.67 x 10^{-27} Kg and moving at 10^8 m/s collides with a deuteron at rest and sticks to it. If the mass of deuteron is 3.34 X 10^{-27}Kg, find the speed of the combination.

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

92. A body of mass 40kg having velocity 4m/s collides with another body of mass 60kg having velocity 2m/s. If the collision is inelastic, find the loss in kinetic energy.

93. Two particles of masses 0.5kg and 0.25kg moving with velocities 4m/s and -3 m/s collide head on in a perfectly inelastic collision. Find the velocity of the composite particle after collision and K.E. lost in the collision.

94. A ball moving with a speed of 9 m/s strikes an identical ball at rest, such that after the collision the direction of each ball makes an angle of 30° with the horizontal line of motion. Find the speeds of the two balls after collision.

TYPICAL PROBLEMS

95. A particle of mass 0.1 kg has an initial speed of 4m/s at a point A on a rough horizontal road. The coefficient of friction between the object and the road is 0.15. The particle moves to a point B at a distance of 2m from A. What is the speed of particle at B?

96. A particle moves in a straight line with retardation proportional to its displacement. Calculate the loss of kinetic energy for any displacement X.

97. A body falling on the ground from a height of 10 m rebounds to a height of 2.5m. Calculate

a) the percentage loss of kinetic energy of the body during its collision with the ground.
b) ratio of velocities of the body just before and just after the collision.

98. A particle of mass 1g executes an oscillatory motion on the concave surface of a spherical dish of radius 2m placed on a horizontal plane. if the motion of the particle begins from a point on the dish at a height of 1cm, from the horizontal plane and coefficient of friction is 0.01, find the total distance covered by the particle before coming to rest.