G. Solve the Following Numerical Problems

1. Calculate the work done when a force of 13 N acting on an object displaces it through 5 m in the direction of force.

2. Who has done more work?

   (a) A force of 5 N displacing an object through 3 m in the direction of force, or (b) a force of 8 N displacing an object through 2.5 m in its direction? Show by actual calculations.

3. Calculate the work done when a student weighing 400 N carries a weight of 200 N from the ground to a height of 15 m.

4. Kinetic energy of a ball of mass 50 g is 10 J. Find the speed of the ball.

5. A ball of mass 200 g is thrown upwards with an initial velocity of 30 m s^{-1}. What is its kinetic energy at the highest point of its path? What is the potential energy there?

6. A coconut of mass 1.5 kg falls from a height of 8 m. What was its value of potential energy? Take $g = 10$ m s^{-2}.

7. The motor of a pump lifts 30 kg of water per minute to a height of 6 m. What is the power of motor? Take $g = 10$ m s^{-2}.

8. A tubelight of 40 W power is used daily for 6 hours. How many units of energy are being consumed in 30 days?

Numericals for Practice

1. How much work is done by a force of 10 N in moving an object through a distance of 4 m in the direction of the force.

2. A car is being driven by a force of 2.5×10^{10} N. Travelling at a constant speed of 5 m/s, it takes 2 minutes to reach a certain place. Calculate the work done.

3. How fast should a man of mass 50 kg run so that his kinetic energy is 625 J?

4. A child pulls a toy car through a distance of 10 m on a smooth horizontal floor. The string held in child's hand makes an angle of 60° with the horizontal. If force applied by the child is 16 N, calculate the work done by the child in pulling the toy car.

   16 N
   String
   60°
   ←—— 10 m ——→
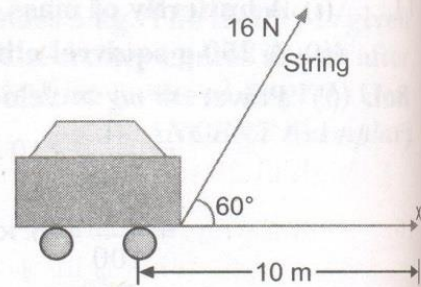
5. Two bodies of equal masses move with uniform velocities v and $3v$ respectively. Find the ratio of their kinetic energies.

6. A rocket of 3×10^6 kg mass takes off from a launching pad and acquires a vertical velocity of 1 km/s at an altitude of 25 km. Calculate (a) the potential energy, and (b) the kinetic energy. (Take the value of g = $10 \, m/s^2$)

7. A cement bag weighs 50 kg. To what height should it be raised so that its potential energy may be 9,800 J? ($g = 9.8$ m/s^2).

8. A man drops a 10 kg rock from the top of a 5 m ladder. What is its speed just before it hits the ground? What is its kinetic energy when it reaches the ground? ($g = 9.8$ m/s^2).

9. A body of mass 4 kg is thrown vertically upwards at a speed of 30 m/s. If $g = 10$ m/s^2, calculate

   (i) maximum kinetic energy of the body

   (ii) potential energy of the body at its maximum height

10. A body of mass 2 kg is thrown vertically upwards with an initial velocity of 20 m/s. (i) What will be its potential energy at the end of 2s? (ii) What is the maximum value of potential energy?
    (Assume $g = 10$ m/s^2).

11. Fig. shows a simple pendulum consisting a bob of mass 100 gram. Initially the bob of pendulum is at rest at O. It is displaced to one side at A. The height of A above O is 5 cm.
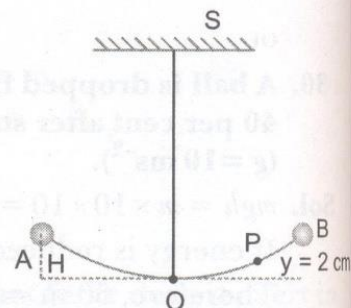
    (i) What is the value of potential energy of bob at A and where does it come from?

    (ii) What is the value of total energy of bob at position A?

    (iii) What is the value of kinetic energy of bob at mean position O?

    (iv) What is the value of kinetic energy and potential energy of bob at position P whose height above O is 2 cm?(Take $g = 10$ ms^{-2}).

    S
    B
    P
    A H
    y = 2 cm
    O

12. On a level road, a scooterist applies brakes to slow down from a speed of 10 m/s to 5 m/s. If the mass of the scooterist and the scooter is 150 kg, calculate the work done by the brakes. (Neglect air resistance and friction).
[**Hint:** Work done = Change in kinetic energy.]

13. A body weighing 1,000 kg accelerates uniformly from 10 m/s to 20 m/s. Find the amount of work done during this period.
[**Hint:** Work done = Change in the kinetic energy of the body]

14. An object of mass 12 kg is at a certain height above the ground. If the potential energy of the object is 480 J, find the height of the object with respect to the ground. Given, $g = 10 \text{ ms}^{-2}$.

15. A boy weighing 40 kg carries a box weighing 20 kg to the top of a building 15 m high in 25 seconds. Calculate the power. ($g = 10 \text{ m/s}^2$)

16. A man weighing 500 N carried a load of 100 N up a flight of stairs 4 m high in 5 seconds. What is his power?

17. An electric bulb of 40 W glows for 10 hours a day. What is the amount to be paid in a month of 30 days, if 1 unit of electricity costs ₹ 2.50?

18. Two masses m and 2m are dropped from a height h and 2h. On reaching the ground, which will have more kinetic energy? Why?

19. 100 joule of work was done to shift a body by 10 m using a force of 20 N. Find the angle of its application with the horizontal.

20. If the velocity of a body is halved, what will be the change in its kinetic energy?

Answers

1. 40 J	2. 1.5×10^{13} J	3. 5 m/s
4. 80 J	5. 1 : 9	6. 1.5×10^9 kJ
7. 20 m	8. 10 m/s, 500 J	9. (i) 1800 J (ii) 1800 J

10. (i) 300 J , (ii) 400 J

11. (i) 5×10^{-2} J; supplied by person causing displacement. (ii) 5×10^{-2} J
   (iii) 5×10^{-2} J   (iv) $K = 3 \times 10^{-2}$ J, $U = 2 \times 10^{-2}$ J

12. 5625 J	13. 150 kJ	14. 4 m
15. 360 W	16. 480 W	17. ₹ 30

18. 2 m will have more kinetic energy;
   The mass 2 m is greater than m and its height is also more.

19. 60°   20. Its kinetic energy will reduce to one-fourth.