Chapter- 6

Work, Energy, And Power

01. Does the sun do any work on earth, when earth revolves around the sun in a perfectly circular orbit?

02. Does the K.E. depend upon the direction of motion involved? Can it be negative? Does its value depend on the frame of reference?

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

04. Is work done by a nonconservative force always negative? Comment.

05. When P.E of an object be negative?

06. A force $\vec{F} = 6x\hat{i} + 2y\hat{j}$ displaces a body from $\vec{r_1} = 3\hat{i} + 8\hat{j}$ to $\vec{r_2} = 5\hat{i} - 4\hat{j}$, Find the work done by the force.

07. What is restoring force in the spring?

08. A spring is cut into two halves. How is the spring constant of each half affected?

09. Give the conditions for a conservative force with examples.

10. What are elastic and inelastic collisions?

11. What is the common feature of all types of collisions?

12. In which of the two types of collisions elastic or inelastic is the momentum conserved? What about K.E?

13. What is the coefficient of restitution?

14. What is the work done in holding 15 kg suitcase while waiting for a bus for 15 minutes?

15. What should be the angle between the constant force and the displacement for maximum and minimum work?

16. Give one example each of the following (a) zero work (b) negative work.

17. Find the work done in moving a particle through the displacement of $\vec{S} = (4\hat{i} - \hat{j} + 7\hat{k})$ meter if the applied force is $\vec{F} = (\hat{i} + 2\hat{j} - \hat{k})$ newton.

18. Out of joule, calorie, kilowatt, and electron volt, which one is not the unit of energy?

19. What is the relation between energy and momentum?

20. Two bodies having unequal masses possess equal kinetic energies. Which one has more momentum?

21. A force $F = a + bx$ acts on a particle in x-direction where a and b are constant. Find the work from x_1 to x_2.

22. A light and a heavy body have equal kinetic energies of translation. Which one has lesser momentum? justify.

23. State the work-energy theorem for a variable force.

24. Derive an expression for the gravitational potential energy of a body lying at a height h (h<<R, the radius of the earth) above the surface of the earth.

25. Derive an expression for the potential energy stored in a system of a block attached to a massless spring, when the block is pulled from its equilibrium position.

26. Show that the total mechanical energy of a body falling freely under gravity is conserved.

27. What is the total mechanical energy associated with a mass m at rest at height h? If it is dropped to the ground, how does its P.E and K.E change? Explain diagrammatically. (Ignore air resistance and variation of acceleration due to gravity).

28. What is a conservative force? Explain its various properties.

29. In a ballistic demonstration, a police officer fires a bullet of mass 50 gm with a speed 200 m/s on self plywood of thickness 2 cm. The bullet emerges with only 10% of its initial Kinetic Energy. What is the emergent speed of the bullet?

30. A Woman pushes a trunk on a railway platform which has a rough surface. She applies a force of 100N over a distance of 10m. Thereafter, she gets progressively tired and her applied force reduces linearly with distance to 50N. The total distance through which the trunk has been moved is 20m. Plot the force applied by the women and the frictional force, which is 50N versus displacement. Calculate the work done by the two forces over 20m.

31. Prove that when two bodies of equal masses undergo elastic collision in one dimension, their velocities are just interchanged.

32. Two ball bearings of mass m each moving in opposite directions with equal speed collide head-on with each other. Predict the outcome of the collision, assuming it to be perfectly elastic.

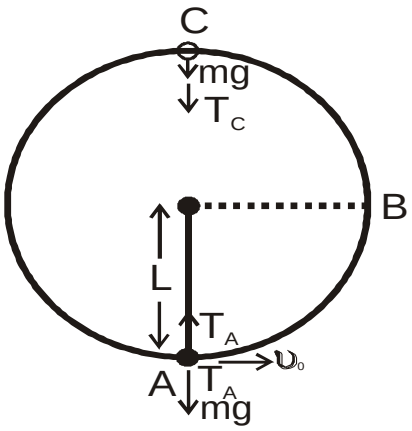
33. Discuss the elastic collision of two bodies in one dimension. Calculate the velocities of the bodies after the collision. Discuss what happens when both the bodies are of equal mass.

34. A block of mass = 1 kg moving on a horizontal surface with speed enters a rough patch ranging from x = 0.1m to x = 2.01 m. The retarding force F_r on the block in the range is $F_r = \frac{-k}{x}$, for $0.1 < r < 2.01m$0 <x<.1m and what is the final KE and x > 2.01 m. Speed of the block at V_f=0.5 j…

35. A bob of mass m is suspended by a light string of L. It is imparted a horizontal velocity v_0 at the lowest point A such that it completes a semicircular trajectory in the vertical plane with the string becoming just slack only on reaching the topmost point, C.

Obtain an expression for.

(i) v_0



(ii) the speeds at points B and C

(iii) the ratio of the kinetic energies (K_B/ K_C) at B and C. Comment on the nature of the trajectory of the bob after it reaches point C.

36. a) Derive potential energy of a spring constant 'K'?
    (b) The draw spring force and distance graph of a spring?
    (c) Draw potential energy, PE, KE, TE Vs position graph of a spring.

37. A 1kg block situated on a rough incline plane is connected to a spring of spring constant 100Nm^{-1} as shown in the figure. The block is released from rest with the spring in the unstretched position. The block moves 10cm down the incline before coming to rest. Find the coefficient of friction between the block and the incline. Assume that the spring has negligible mass and the pulley is frictionless.