UNIT: 4
Work, Energy and Power

Study Guide

Syllabus

- **Work done by a constant force and a variable force**
- **kinetic energy**
- **work-energy theorem**
- **power**
- **Notion of potential energy**
- **potential energy of a spring**
- **conservative forces**
- **conservation of mechanical energy (kinetic and potential energies)**
- **non-conservative forces**
- **motion in a vertical circle**
- **Elastic and inelastic collisions in one and two dimensions**

ACTION PLAN

- Read e-Content
- Watch videos
- Read NCERT book
- Solve problems and answer questions

DISTINGUISH BETWEEN

- Constant and variable force
- Work and energy
- Energy and power
- Kinetic and potential energy
- Energy stored and energy lost
- Conservative and non conservative forces
- Path length and displacement
- Motion in a horizontal circle and motion in a vertical circle

For each concept

- Write the relevant statement.
- Draw diagrams to explain to yourself.
- Write a mathematical statement.
- Draw a graph where ever possible.

WORK ENERGY THEOREM

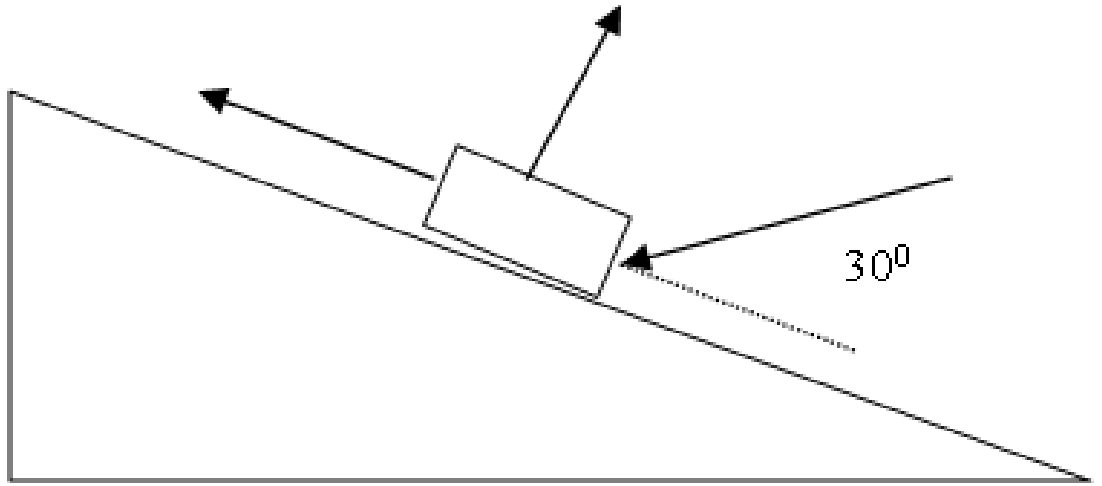
- Take extra care to understand the theorem.
- Study the problems as given in e-content and videos.
- Application of this theorem for problem solving.
- Use it to understand- Motion in a vertical circle and energy used by water to become clouds.

TRY SOLVING PROBLEMS

- Some problems are given
- Work out from NCERT book
- NCERT Exemplar
- Any other source

QUESTIONS FOR PRACTICE

A block of mass M moves up a 30^0 incline under the action of certain forces, Three of which are as per then diagram. What are these forces? Determine their magnitude (take acceleration due to gravity as g, and coefficient of friction as μ Determine the work done by each force as the block moves up 80 cm.



- **How large a force is required to accelerate a 1300 kg car from rest to a speed of 20 ms^{-1} in a distance of 80m?**

- **A bullet having a speed of 153 ms^{-1} crashes through a plank of wood. After passing through the plank, its speed is 130 ms^{-1}. Another bullet of the same mass and size but traveling at 92 ms^{-1}, is fired at the plank. What will be this second bullet's speed after tunneling through? Assume that the resistance of the plank is independent of the speed of the bullet.**

- **A boy throws a 0.15kg stone from the top of a 20 m cliff with a speed of 15 m/s . Find its kinetic energy and speed when it lands in the river below.**

- **After being hit, a golf ball starts out with a velocity of 130 m/s. If it reaches a maximum height of 50m, what is its velocity at that point?**

- **A horizontal force F pulls a 20-kg carton across the floor at constant speed. If the coefficient of sliding friction between the carton and the floor is 0.60, how much work does F do in moving the carton 3.0 m?**

- **Work and energy have the same dimensional formula, Is there a relation between them?**

- **A constant resultant force F = 2i-3j+4k acts on an object to give it a displacement from the origin of s = 2i+6j-2k. Calculate the work done.**

- **A group of clouds at a height of 500m above the earth bursts and rainfall covers an area of 10^6 m^2 with a depth of 2 cm . How much work would have to be done in raising water to the height of the clouds?**

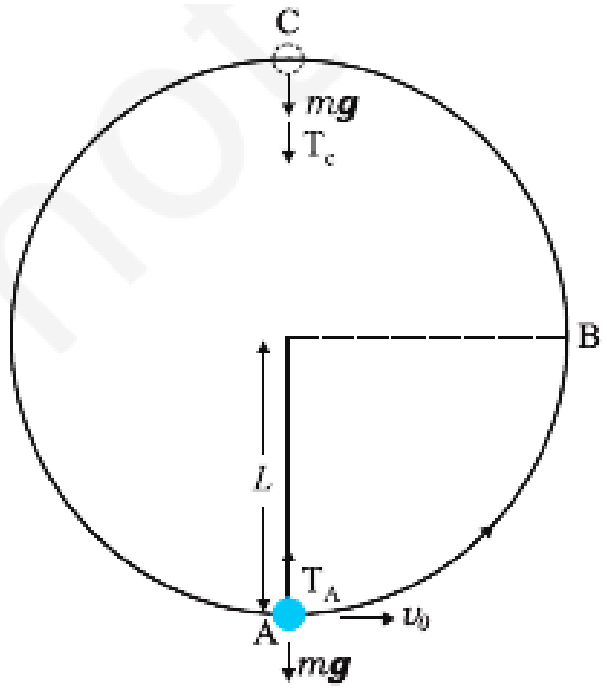
- **A cyclist comes to a skidding stop in 10 m . During this process, the force on the cycle due to the road is 200N. How much work does the road do on the cycle? How much work does the cycle do on the road?**

A light string of length L suspends a bob of mass m. It is imparted a horizontal velocity v_0 at the lowest point A such that it completes a semicircular trajectory in then vertical plane with the string becoming slack only on reaching the topmost point C. This is shown in the figure. Obtain an expression for

i. v_0

ii. the speeds at points B and C

iii. the ratio of the kinetic energies $\left[\frac{K_B}{K_C}\right]$ at B and C. Comment on the nature of the trajectory of the bob after it reaches the point C .



Study Hard

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