

11 Physics: Torque

Curriculum: IB

Material Slides

1. Torque is the rotational equivalent of force, defined as the product of force and the perpendicular distance from the pivot point to the line of action of the force.
2. The formula for torque is $\tau = r \times F$, where τ is the torque, r is the distance from the pivot point to the point of application of the force, and F is the magnitude of the force.
3. The SI unit of torque is the Newton-meter (N·m) or Joule (J).
4. Torque can be both positive and negative, depending on the direction of rotation. Clockwise rotation is typically considered positive, and counter-clockwise rotation is considered negative.
5. The principle of moments states that for an object in rotational equilibrium, the sum of the clockwise moments must equal the sum of the counter-clockwise moments.
6. The torque due to a force acting at an angle can be calculated using the equation $\tau = r \times F \times \sin(\theta)$, where θ is the angle between the force vector and the line connecting the pivot point to the point of application of the force.
7. In a simple machine like a lever, torque can be used to magnify the force applied, allowing for the lifting of heavy loads with a smaller input force.
8. The moment of inertia (I) of an object is a measure of its resistance to changes in rotational motion. It depends on the mass of the object and its distribution relative to the axis of rotation.
9. The relationship between torque, angular acceleration, and moment of inertia is given by the equation $\tau = I \times \alpha$, where α is the angular acceleration.
10. Torque can also be calculated using the formula $\tau = I \times \omega \times \alpha$, where ω is the angular velocity.
11. Understanding torque is essential in various physics applications, such as designing machines, analyzing the motion of rotating objects, and understanding the forces involved in everyday activities.

Practice Problems

1. Calculate the force exerted by a 5 kg object accelerating at 2 m/s^2 .
2. What is the potential energy of a 10 kg object at a height of 5 meters?

References

1. Physics for the IB Diploma, K.A. Tsokos
2. Advanced Physics, Steve Adams