9 Physics: Torque

Curriculum: IB

Material Slides

Slide 1: Torque

- Torque is the rotational equivalent of force.
- It is the tendency of a force to rotate an object about an axis.
- Symbolically represented as τ (tau) and measured in Newton-meters (Nm).
- Calculated by multiplying the force applied by the perpendicular distance from the axis of rotatio

Slide 2: Torque Formula

- Torque (τ) = Force (F) × Perpendicular Distance (r)
- $\tau = F \times r$
- The perpendicular distance is the shortest distance from the axis of rotation to the line of action

Slide 3: Direction of Torque

- Torque can be positive (counterclockwise rotation) or negative (clockwise rotation) depending o
- Positive torque causes counterclockwise rotation, while negative torque causes clockwise rotati

Slide 4: Torque and Moment of Inertia

- The moment of inertia (I) of an object affects how easily it can be rotated.
- Greater moment of inertia requires more torque to achieve the same angular acceleration.
- Torque is directly proportional to angular acceleration and moment of inertia.

Slide 5: Lever Arm

- The lever arm is the perpendicular distance from the axis of rotation to the point of application o
- A longer lever arm results in greater torque for the same force.
- Lever arm influences the mechanical advantage in simple machines.

Slide 6: Calculating Net Torque

- Net torque is the vector sum of all torques acting on an object.
- If the net torque is nonzero, the object will rotate with angular acceleration.
- The principle of moments states that for a body in rotational equilibrium, the sum of clockwise to

Slide 7: Torque and Equilibrium

- For an object to be in rotational equilibrium, the net torque acting on it must be zero.
- This means that the sum of torques causing clockwise rotation equals the sum of torques causi
- Rotational equilibrium is achieved when the object remains at rest or rotates at a constant angu

Slide 8: Applications of Torque

- Torque is fundamental in understanding the motion of rotating objects such as wheels, gears, a
- It plays a crucial role in various engineering applications, including machinery, vehicles, and rob
- Knowledge of torque is essential for designing and optimizing mechanical systems for efficiency

Slide 9: Summary

- Torque is the rotational force that causes objects to rotate about an axis.
- It is calculated as the product of force and lever arm distance.
- Torque influences the rotational motion of objects and is crucial in achieving equilibrium in rotati
- Understanding torque is fundamental in physics and engineering for analyzing and designing ro

Practice Problems

Problem 1:

A force of 20 N is applied to a wrench with a length of 0.3 m. Calculate the torque produced by th

Solution 1:

Torque = Force × Distance

Torque = 20 N × 0.3 m

Torque = 6 N·m

Problem 2:

A lever is 0.5 m long with a 30 N force applied at one end. What is the torque generated at the ax

Solution 2:

Torque = Force × Lever Arm

Torque = 30 N × 0.5 m

Torque = 15 N·m

Problem 3:

A pulley system exerts a force of 50 N on a 0.4 m long lever. Calculate the torque exerted by the

Solution 3:

Torque = Force × Distance

Torque = 50 N × 0.4 m

Torque = 20 N·m

Problem 4:

A person applies a force of 100 N at the end of a 0.2 m wrench. Determine the torque produced b

Solution 4:

Torque = Force × Distance

Torque = 100 N × 0.2 m

Torque = 20 N·m

Problem 5:

A wrench exerts a torque of 80 N·m. If the length of the wrench is 0.4 m, calculate the force appli

Solution 5:

Force = Torque / Distance

Force = 80 N·m / 0.4 m

Force = 200 N

References

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