AP Objectives: Torque

AP Physics 1

1. The student is able to use representations of the relationship between force and torque.
2. The student is able to compare the torques on an object caused by various forces.
3. The student is able to estimate the torque on an object caused by various forces in comparison to other situations.
4. The student is able to design an experiment and analyze data testing a question about torques in a balanced rigid system.
5. The student is able to calculate torques on a two-dimensional system in static equilibrium, by examining a representation or model (such as a diagram or physical construction).
6. The student is able to make predictions about the change in the angular velocity about an axis for an object when forces exerted on the object cause a torque about that axis.
7. The student is able to plan data collection and analysis strategies designed to test the relationship between a torque exerted on an object and the change in angular velocity of that object about an axis.
8. In an unfamiliar context or using representations beyond equations, the student is able to justify the selection of a mathematical routine to solve for the change in angular momentum of an object caused by torques exerted on the object.
9. The student is able to plan data collection and analysis strategies designed to test the relationship between torques exerted on an object and the change in angular momentum of that object.
10. The student is able to describe a representation and use it to analyze a situation in which several forces exerted on a rotating system of rigidly connected objects change the angular velocity and angular momentum of the system.
11. The student is able to plan data collection strategies designed to establish that torque, angular velocity, angular acceleration, and angular momentum can be predicted accurately when the variables are treated as being clockwise or counterclockwise with respect to a well-defined axis of rotation, and refine the research question based on the examination of data.
12. The student is able to use appropriate mathematical routines to calculate values for initial or final angular momentum, or change in angular momentum of a system, or average torque or time during which the torque is exerted in analyzing a situation involving torque and angular momentum.
13. The student is able to plan a data collection strategy designed to test the relationship between the change in angular momentum of a system and the product of the average torque applied to the system and the time interval during which the torque is exerted.

AP Physics C: Torque

E. Circular motion and rotation

2. Torque and rotational statics

a) Students should understand the concept of torque, so they can:

(1) Calculate the magnitude and direction of the torque associated with a given force.

(2) Calculate the torque on a rigid object due to gravity.

b) Students should be able to analyze problems in statics, so they can:

(1) State the conditions for translational and rotational equilibrium of a rigid object.

(2) Apply these conditions in analyzing the equilibrium of a rigid object under the combined influence of a number of coplanar forces applied at different locations.

c) Students should develop a qualitative understanding of rotational inertia, so they can:

(1) Determine by inspection which of a set of symmetrical objects of equal mass has the greatest rotational inertia.

(2) Determine by what factor an object’s rotational inertia changes if all its dimensions are increased by the same factor.

d) Students should develop skill in computing rotational inertia so they can find the rotational inertia of:

(1) A collection of point masses lying in a plane about an axis perpendicular to the plane.

(2) A thin rod of uniform density, about an arbitrary axis perpendicular to the rod.

(3) A thin cylindrical shell about its axis, or an object that may be viewed as being made up of coaxial shells.