Statics Torque

8.5.1 Define torque (moment of force)

A torque is not a force. It is a different type of quantity, the units of torque are or J. We usually do not talk about torque in terms of J to avoid confusion with energy…

If a force is applied to an object and the line of force goes through the center of mass the object will accelerate. If a force is applied to object and the line of force does not go through the center of mass the object will rotate, in this circumstance we say that a torque is applied to the object. A torque will generate angular or rotational acceleration in an analogous way that a force generates linear acceleration.

Torque can be mathematically defined by the following:

(1)
$\tau = Fr\sin\theta$

Where F is the force applied, r is the distance between where the force is applied and the center of gravity and θ is the angle between the F and r. The $\sin\theta$ is really a "fudge factor" for a vector cross product, i.e. the torque can be rewritten as the cross product of r and F without the $\sin\theta$, but you don't need to know that for the IB exam.

8.5.2 State the conditions for translational and rotational equilibrium.

Forces cause linear accelerations and torques cause rotational accelerations, but many objects around us are not accelerating… It is useful to mathematically define conditions for an object to not accelerate (linearly or rotationally), we call this condition equilibrium. Mathematically we can define those conditions as such:

(2)
$\Sigma iFi = 0$

(3)
$\Sigma i\tau i = 0$

In words we would describe this as, the sum of the force and the sum of the torques must equal zero. The first equation is simply a mathematical restatement of Newton's first law. Note: These equations are not in the IB formula book.

8.5.3 Describe the concept of centre of gravity

The center of gravity can be though of as the average of all the mass of an object. We usually have to employ integral calculus to mathematically find the center of mass. Luckily you do not need to calculate the center of mass for the IB exam, you simply need to understand the concept.

The center of mass could be defined as a point in an object where gravity can be seen to only be acting from that point. This is very similar to when we talked about Universal Gravitation and we treated spheres to be point masses. Gravitational forces come from every point in the body, but we treated it as if all the force was coming from the center of mass, i.e. the center of the sphere.

Source: http://ibphysicsstuff.wikidot.com/statics-torque