MASS AND WEIGHT

Definitions of Mass and Weight

There is generally a good deal of confusion over the difference between mass and weight. This problem can generally be associated to two common issues. The bathroom scale measures your weight and reports it to you in kilograms or pounds even though these are units of mass. Secondly, we tend to use the bathroom scale in an environment in which our point of view is not experiencing any acceleration in any direction.

Generally, we are taught that mass is the amount of “stuff” contained in an object, and that the object’s weight is the mass times the gravity. This concept, however, can be refined that would lead to a greater understanding of motion.

It is better to think of mass as a measure of inertia where inertia is a measure of resistance to change in motion. If an astronaut has a mass of 80 kg (176 lbs) on earth, how would we measure their mass on the International Space Station (ISS)? If that astronaut lost weight weight during the stay on the ISS, how could that be measured? The answer lies in measuring the resistance to motion as a result of a known force.

Mass is a measure of inertia or a measure of its resistance to a change in motion.

Weight, on the other hand, is the force that gravity exerts on a mass. The SI units for weight are Newtons and not kilograms.

Weight is the force that gravity exerts on a mass.

Nevertheless, weight is directly proportional to mass, and it proportional by the acceleration due to gravity “g”.

Let us consider an object under the influence of gravity in which the acceleration due to gravity is straight down. The vector equation for weight would be written as follows:

$$\vec{W} = m\vec{g}$$

If we were only to examine the magnitude of the equation, because we know the direction of gravity, the equation could be written as follows:

$$W = mg$$

We know that weight is a force, but we also know from Newton’s second law that

$$F = ma$$

As a result, it follows that

$$mg = ma$$

Since the mass on each side of the equation is the same, dividing both side of the equation by “m” does not change the equality of the equation and yields the result:

g=a

This derivation indicates that all falling bodies fall at the same rate regardless of their mass. A bowling ball falling from the leaning tower of pizza would fall at the same rate as a tennis ball. If both objects were dropped at the same time, they would both hit the ground together. Furthermore, the acceleration experienced by both objects would be “g” which represents $9.81 m/s^2$.