

MECHANICS – Some definitions

The intuitive concepts which arise concerning such basic quantities of dynamics as force, mass, and time must be put into a precise form before they can serve as a foundation for the development of the subject. The following definitions prescribe the sense in which these words will be used in mechanics.

Force and Mass. The primary objective of the science of mechanics is the study of the interactions which occur between material bodies. These interactions are of various types and might be, for example, impacts, electrical or gravitational attractions, mechanical linkages, etc. Experience shows that during these interactions, the velocities of the interacting bodies are changed.

We define force, by Newton's first law, as an action which tends to change the motion of a body. The fact that forces arise from mutual interactions and thus occur in equal and opposite pairs forms the empirical content of Newton's third law. The concept of force is made quantitatively precise by the definition that a unit force produces a unit acceleration of a specified standard body.

The mass of a body may now be defined by Newton's second law as the ratio of the force acting on the body to the resulting acceleration. By international agreement, the unit of mass is defined as the mass of a particular platinum-iridium cylinder, called the international prototype kilogram, which is in the possession of the International Committee of Weights and Measures at Sevres, France.

The force exerted upon a body by the earth's gravitational field is called the weight of the body. The weight of a body is thus variable, depending upon the location of the body with respect to the earth. The magnitude of the earth's gravitational field is specified by the acceleration of gravity (g) which is the acceleration of an otherwise unrestrained body attracted to the earth. The gravitational acceleration has been determined experimentally.

The mass of any body can be determined by comparing the body with the standard kilogram. In practice the mass of a body is usually determined by means of the ordinary balance. A number of different standards of mass have been defined in terms of the prototype kilogram.

The unit of time is the second, which is defined as the $1/86,400$ part of a mean solar day. The mean solar day is the yearly average of the time intervals between successive transits of the sun past a meridian of the earth.

Length. The international standard of length is the standard meter, which is defined as the distance, at zero degrees centigrade, between two lines on a platinum-iridium bar in the possession of the International Committee of Weights and Measures.