Mechanics Lexicon

Early science (say, pre-Galileo) was often content with qualitative statements (such as “an object in motion tends to come to rest.”) Before Newton, people used words like power, energy, and force interchangeably or did not agree on their usage. In order to make quantitative predictions about motion, mechanics assigns narrow definitions to words like these, which in everyday speech and literature may have broader and less precise meanings. If you use a force formula when you need power, you won’t just be less precise; you’ll be completely wrong. Here, collected on a single sheet of paper, is a brief dictionary to help you keep these terms straight. You should add your own notes and examples in the margins and back. A later sheet will include angular momentum, torque, and moment of inertia.

Time, position, and mass are considered absolute. You already have a good feeling for them, but they’re actually somewhat tricky to define. Einstein showed that what one observer considers time, another observer will see as a combination of time with a little bit of space thrown in, but this subtlety becomes important only when the observers are moving very rapidly relative to each other (an appreciable fraction of the speed of light). For the most part, we’ll leave Einsteinian relativity to a later course (Modern Physics, PHY 3101).

velocity Change in position $x$ with time $t$; the vector $v = dx/dt$. Measured in meters/second.

acceleration Change in velocity $v$ with time $t$; the vector $a = dv/dt$. Measured in meters/second$^2$.

momentum The product of mass $m$ and velocity $v$; the vector quantity $p = mv$; a vector quantity that stays constant (magnitude and direction conserved) in the absence of external forces; equivalently, the thing that requires a fixed force to change by a fixed amount. Momentum can be transferred from one body to another body. Measured in kg m/sec.

force The vector that can be used to change momentum; a mutual attraction or repulsion between two bodies. Measured in Newtons=kg m/sec$^2$. Weight is a kind of force.

energy A scalar quantity conserved, in addition to momentum, in the absence of external forces. Measured in Joule=kg m$^2$/sec$^2$. Energy may be transferred (as “Work”) from one body to another or between these two forms:

kinetic The product of mass $m$ and the square of velocity $v$ with a factor of one half: $K = \frac{1}{2}mv^2$; to change the kinetic energy of a body requires a force $F$ applied over a distance $x$, thus $\Delta K = F \cdot x$.

potential Energy stored mechanically (as by lifting an object in a uniform gravitational field) or chemically. Heat is a form of energy involving both kinetic and potential energy on a microscopic scale.

power The change in energy $E$ per unit time; i.e., the rate at which energy is delivered, $dE/dt$ (sign depends on who’s delivering and who’s getting it delivered). Measured in Watts=Joules/sec=kg m$^2$/sec$^3$. 