Forces, Work & Vectors

A force is defined as a unit of mass being accelerated, or by the equation, F = ma.

The unit for measuring force is called the Newton (N), after Isaac Newton. The other units involved in this equation, are kilogram (kg) for mass, and meters per seconds squared (m/s^2) for acceleration.

Forces are defined by Isaac Newton to have three distinct laws, called the . The following table outlines Newton's force laws:

I An object with no force acting on it has constant velocity.
II The acceleration of a body is inversely proportional to its mass and directly proportional to the force acted on it. Demonstrated by the equation a = F / m
III When one object exerts a force on a second object, the second exerts a force on the first that is equal in magnitude but opposite in direction than the first.

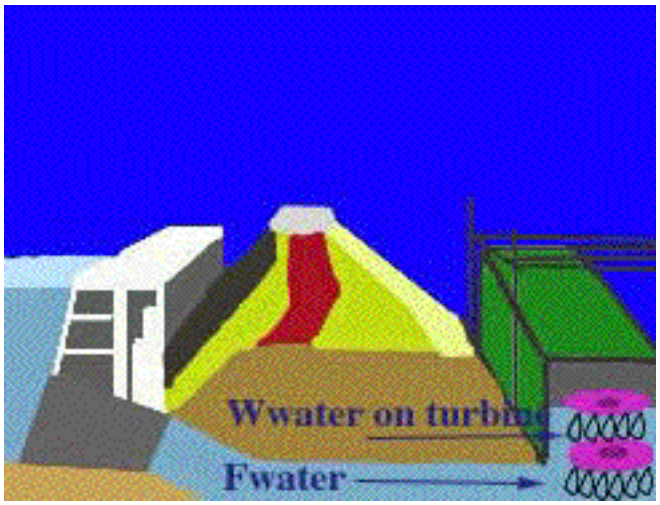
Since force has both a magnitude (a number), and a direction, force can be illustrated with a vector. By definition, a vector has both magnitude and direction. Some example vectors are shown below:

12 N Northwest

0.05 N South

When a force is applied in the direction of motion, it is said to be doing work. Work is equal to Force times distance, or W = Fd. If the weight of a certain object is substituted instead of the Force, because weight is force to the direction downward, the equation evolves to $W = F_w d$. Further extending this equation by substituting the equation given at the top of this page for the definition for force, W = mad, or weight is equal to mass accelerated over a distance. Because work has magnitude, and direction (the direction of motion), it is a vector.

Vectors are extremely valuable in anaylzing the forces that operate within a system, such as a power station. For example, when a propeller is pushed in a water power station, the forces of the water can be summarized by a vector that points into the propellers. As the water spins the propellers, it is doing work on the propellers over the distance of the diameter of the propeller. The next picture illustrates these two vectors, one for force and one for the work being done. Of course these two vectors are in the same direction, because work is done in the direction of motion.



Take a quiz to see how much of forces, work and vectors you grasp.