Power & Work

1. Power

The word "power" is often used to describe someone in authority like a king or a dictator. It's also used to describe someone or something that is very strong like a baseball player that hits home runs. In physics, power is used to describe the rate at which energy is used. In other words, it is a measurement of how fast you are using energy. The equation that describes power is: **Power = Work ÷ Time** or **P = W/t**

Example
Whether you run up a flight of stairs in 5 seconds or take a slow walk up the same flight in 40 seconds, you are doing the same amount of work. However, you are doing it at a different rate. When you run up the stairs you are working much faster. While running up the stairs you have a higher power than when you walk up the stairs.

If the work it takes you to climb the stairs is 1000 joules, then we can calculate the power in both cases P1 (running) and P2 (walking):

Power = W/t , P1 = 1000 J ÷ 5 s , P1 = 200 W and P2 = 1000 J ÷ 40 s , P2 = 25 W
You can see that the power was much higher while running the stairs than while walking.

How to Measure Power
The standard unit for measuring power is the Watt. From the equation above we can see that power is Work / Time. The unit for work is the joule (J), so a Watt is the same as a joule/second or J/s. Another common unit for power that is used for automobile engines and machines is horsepower. One horsepower is about equivalent to 745.7 Watts.

Power and Force
Power can also be calculated from the force and velocity of an object using the following equation: **power = force * velocity**

Electrical Power
When figuring out the electrical power, we use the current and the voltage. Current is measured in amperes (A) and voltage is measured in volts (V). Note: Current is represented in equations with an "I." **Power = Current * Voltage** **P = I * V**

Facts about Power
⁎Explosions may not always release a lot of energy, but because they release energy over a very short period time, they can still be very powerful.
⁎The "power" bill we get in the mail is usually billed in kilowatt hours. This is power over time which is actually a measurement of energy used and not power.
⁎The power exerted by the Space Shuttle rockets at lift-off is around 12 billion watts.
⁎ One horsepower is equal to the power it takes to lift 550 pounds up one foot in one second.

2.Work

We often use the word "work" in our everyday lives. For example, we would say that getting good grades in school takes a lot of hard "work". In physics, the term "work" has a specific meaning.

Work, in physics, occurs when a force acts on an object to move it some distance from the start point (also called displacement). Work is calculated as the force times the distance. The following equation is used to describe work: **Work = Force * distance** or **W = F*d**

How to Measure Work

The standard unit for work is the joule (J). The joule is the same as a newton-meter where the newton is the force and the meter is the distance.

Force and Displacement

The distance (or displacement) in work is the distance from the start point to the end point. The amount of traveling in between doesn't matter. For example, if you lift a weight off the ground and then place it back on the ground the distance (or displacement) is zero.

Don't be Tricked

Measuring work can sometimes be tricky. In order for the equation W = F*d to work, the force used in the equation must be the force used to cause the displacement or distance. Also, remember for work to have occurred, the object must be displaced by the force. Otherwise, the distance, or "d", in the formula is 0 and the work will be 0.

Some examples:

*If someone is pushing on a wall with all their might, but the wall doesn't move, no work has occurred. This is because the distance is zero.
*If someone is using force to hold a rock over their head while walking eastward across a field, no work has occurred. This is because the force is not in the same direction (the force is up) as the distance moved by the rock (eastward).
*If you do a full push-up, lifting yourself up and then back down, the total work is zero. This is because the total distance from the starting point to the ending point is zero.
*If you drop your pencil, then work has occurred. This is because the displacement of the pencil from your hand to the ground is greater than zero and is in the same direction as the force acting on the pencil, which is gravity.

Facts about Work

*Work is a scalar quantity, not a vector quantity. This means that, unlike force and velocity, it has no direction, only a magnitude.
*Another unit of work is the foot-pound. One foot-pound is equal to 1.35581795 joules.
*The joule is also used as the standard unit of measure for energy.
*Negative work is when force acting on an object hinders the object's displacement.