ENERGY

Energy is defined in physics as a quantitative property that has to be transferred into a specific object in order to heat or perform work to the object. Energy is not created or destroyed, it only changes forms for example from potential energy to kinetic energy. Energy is the capacity to do work. The SI unit of energy is Joule (J). Joule is defined as the amount of energy transferred to an object in order to move the object for a distance of 1 metre against a force of 1 newton.

There are few different kinds of energy:

Kinetic energy

Kinetic energy is the energy an object possesses by virtue of its motion. Newton's second law states that the application of some net force will move an object with some mass at some constant acceleration. Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes.

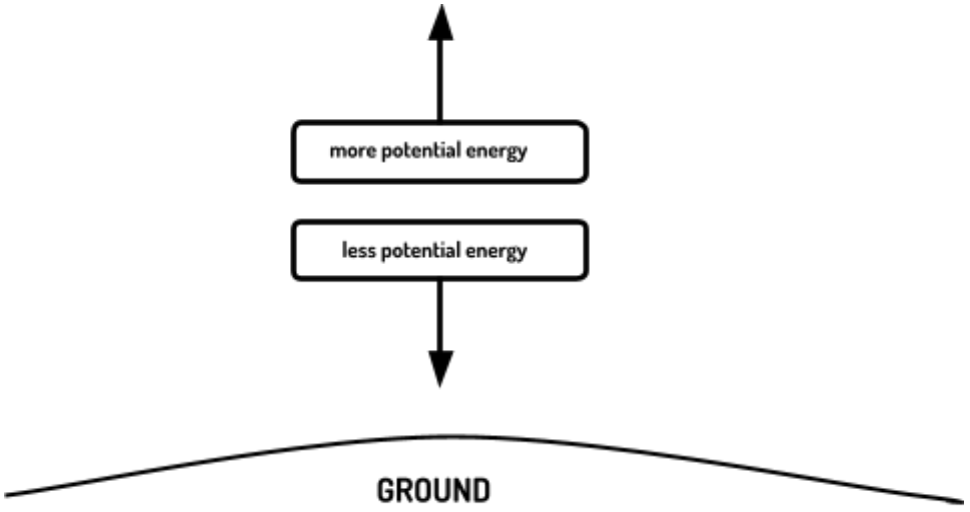
Formula for kinetic energy:

$E = ½ \times m \times v^2$

E = kinetic energy
m = mass
v= velocity

Potential energy

Potential energy is the energy an object possesses by virtue of its position in a field, whether that is a gravitational field or an electromagnetic field, or any other type of field. If you lift an object up into the air, you are increasing its gravitational potential energy as it moves farther away from the ground. If you release for example a ball, that potential energy is converted into the kinetic energy of motion as it falls. The closer an object is to the center of gravity of the earth, the less potential energy it has and as you pull it up and away from the ground it gains potential energy, because it has an increasing potential to fall some distance to the ground. Potential energy is the energy of location.



Formula for gravitational potential energy is:

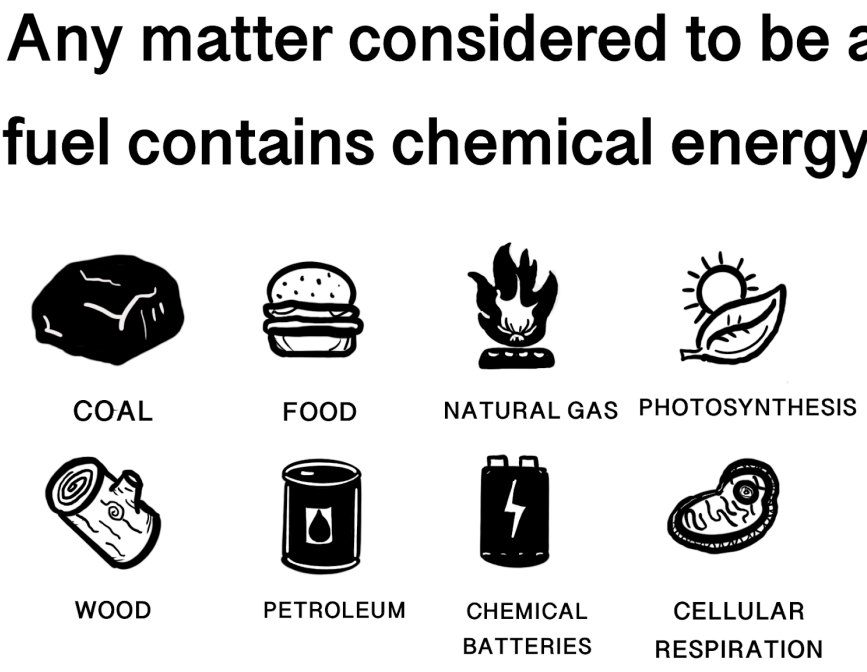
$E = m \times g \times h$

E = potential energy
m= mass
g = gravitational field strength (free fall acceleration 9,8 m/s^2)
h = vertical height

Chemical energy

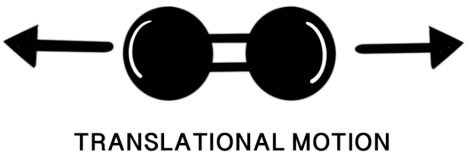
Chemical energy is the potential energy stored in the arrangement of atoms within molecules. It´s a form of potential energy, that you won´t observe until a reaction occurs. Chemical energy can be changed into other forms of energy through chemical reactions or changes. When a chemical reaction takes place, the stored chemical energy is released. Heat is often produced as a by-product of a chemical reaction – this is called an exothermic reaction.

For example the food we eat contains stored chemical energy. The energy produced from this reaction helps us move, allows us to grow and keeps us warm. Different foods store different amounts of energy. Also wood contains stored chemical energy. When you burn that wood, chemical energy is released and converted into thermal energy (heat) and light energy.



TEMPERATURE

Temperature is measuring the amount of heat energy available for work in a system. Heat energy is related to the average kinetic energy of the atoms and molecules within that system. Higher temperature means faster moving particles. This kinetic energy of motion is distributed amongst side-to-side motion, rotational motion and vibrational motion where the covalent bonds in a molecule bend and stretch.



TRANSLATIONAL MOTION

ROTATIONAL MOTION

VIBRATIONAL MOTION

Energy is transferred as heat in a wide variety of processes as collision and friction. In each case the kinetic energy of the particles and the transfer of some of this energy to other particles as the definitions of heat and heat transfer. Heat is energy in transit and will be measured in joules just like any other kind of energy.

Heat will flow from hot objects to cool objects, because as the particles move they will impart some of their kinetic energy onto other particles through collisions. This will continue to occur until the whole system is at the same temperature in a state called thermal equilibrium. Thermometers are in thermal equilibrium with the surroundings.

If you have an object that is at a certain temperature, you may want to prevent that material from becoming the same temperature as neighboring materials. This is usually done by employing a thermal insulation barrier. For example If the air outside is cold, you may want to protect your skin by wearing clothes that keep the cold out and the body warmth in. Insulation is a barrier that minimizes the transfer of heat energy from one material to another.

GOOD HEAT CONDUCTOR

STEEL

IRON

GRANITE

GOOD THERMAL INSULATION

FEATHER

WOOL

PLASTIC

All phases of matter expand with higher temperature whether solid, liquid or gas. This phenomenon is called thermal expansion.

Boiling point is the temperature at which the vapor pressure of a liquid is equal to the pressure of the atmosphere on the liquid, equal to 212°F (100°C) for water at sea level.
The melting point of a substance is the temperature at which it changes state from solid to liquid. At the melting point the solid and liquid phase exist in equilibrium.

temperature scales:

°C = the Celsius Scale (part of the Metric System, used in most countries)
°F = the Fahrenheit Scale (used in the US), and

Celsius (°C)	Fahrenheit (°F)	Kelvin (K)	Description
100	212	373,15	water boils
37	98,6	310,15	body temperature
0	32	273,15	Freezing point of water
-40	-40		Extremely Cold Day
−273.15	−459.67	0	absolute zero

Force

Force is any interaction that if unopposed will alter the motion of an object. A force can cause an object with mass to start moving, stop moving, move faster/slower or in a different direction. A person can exert force by pushing or pulling, an object can exert force by rolling or falling. A planet or star can exert force through it´s gravitational pull. Any force must have both magnitude and direction.

Some forces are called contact forces because they arise when objects touch or collide. Throwing or kicking a ball is an example of a contact force.

Some forces are called non-contact forces. These involve some action at a distance, like objects that fall to the earth because of its gravity. Some of the non-contact forces are called field forces. because they typically involve some kind of field, like an electromagnetic field or gravitational field. Contact forces are really field forces.

The SI unit of force is Newton (N)

$1\,N = 1\,kg \times m/s^2$

Friction

Whenever an object is in motion along a surface the surface exerts a force upon the object. One component of this force is the normal force, which is perpendicular to the surface. There is also a component of this force that is parallel to the surface and this is called the frictional force. Friction is the force that will resist the motion of the object along the surface. Every surface has a different coefficient of friction (μ). The smoother a surface is the less friction it will provide. Every surface will have imperfections on the microscopic level that provide some friction.

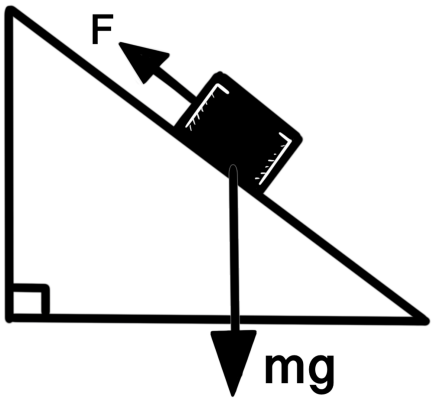
very low friction = low resistance to motion very high friction = high resistance to motion

There are two main types of friction: static and kinetic.

Static friction resists the initiation of motion. If the applied force exceeds the maximum static frictional force the object begins to accelerate. Static friction is proportional to the normal force. Heavier the objects is, the greater the normal force, and the greater the frictional force.

Kinetic friction resists the motion of a moving object. Kinetic friction is always less than static friction, which you will notice if you try to push any object across the surface. It will be more difficult to get the object going than it is to keep it moving once you have started.

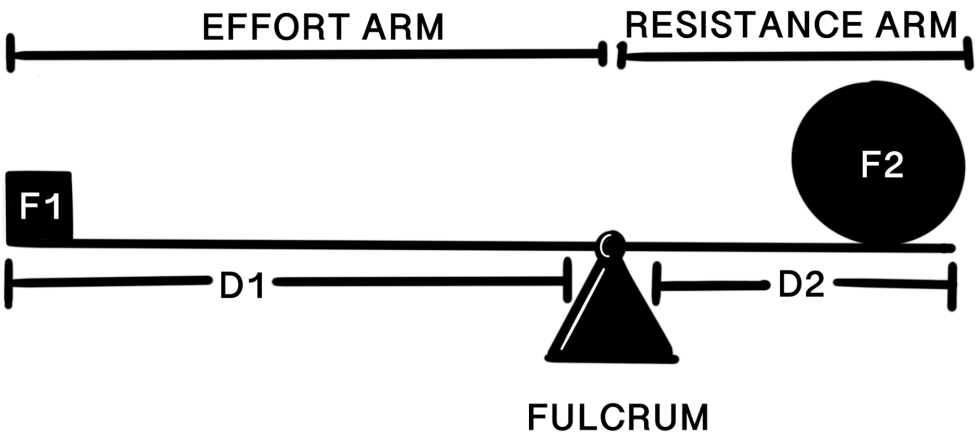
Inclined plain



Inclined planes, also referred to as ramps, are a type of simple machine which manipulate the direction and magnitude of a force. The force required to move an object up the incline is less than the weight being raised. The steeper the incline, the more nearly the required force approaches the actual weight. Gravity (mg) will pull straight down and this vector can be divided into components that are perpendicular and parallel to the incline. The normal force is always perpendicular to the surface. Friction opposes sliding motion. Ramps are used in many scenarios, and are used to make work against gravity easier.

Lever

The lever is one of the most basic forms of a machine. Every lever consists of three main components: Effort arm, the resistance arm and the fulcrum. There is an important relationship between the magnitudes of effort force and resistance force and their distances from the fulcrum. The lever is balanced when the product of the effort force and the length of the effort arm equals the product of the resistance force and the length of the resistance arm. Work measured in joules is equal to force applied over a distance. Increase the distance and you can apply less force



force 1 × distance 1 = force 2 × distance 2 F1 × D1 = F2 × D2