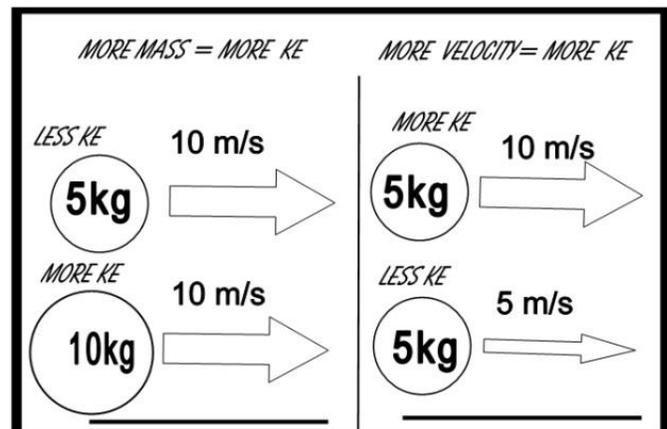
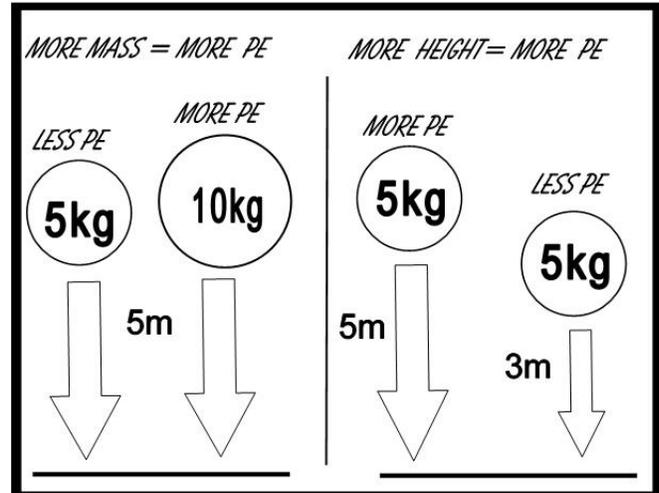


Information A

1. **Energy** is the ability to cause change. There are many different forms of energy. Light, sound, electrical and chemical energy are some everyday examples of energy. All forms of energy can cause changes to occur. Almost everything you see happening around you involves some form of energy.
2. **Potential energy** is the energy an object has as a result of its position. Potential energy is stored energy that has not yet been released.
3. Gravitational potential energy is potential energy that results from an object's position in a gravitational field. An object gets potential energy from height, mass and gravity.
4. An object with potential energy has the potential to do work. This gravitational potential energy is only released if the object falls. The energy is then transformed into energy of motion or transformed into work.
5. For example, a book placed on a shelf possesses gravitational potential energy because of Earth's gravity. If the book were moved to a higher shelf, it would gain potential energy.
6. **Kinetic energy** is energy that an object has as a result of its motion. All moving objects possess kinetic energy, which is determined by the mass and speed of the object.
7. An object with kinetic energy has energy stored in motion. When the object slows down the energy is released into potential energy (if going up) or some other kind of energy like thermal energy in the brakes of car.
8. **How are Kinetic and potential energy different?** Both have the ability to cause change. Kinetic energy is the energy produced by motion while potential energy is the energy of position that can be transformed into motion. Some objects can have both gravitational potential energy and kinetic energy. For example, a flying bird is both moving (kinetic energy) and it is above the ground and can fall (gravitational potential energy).



Information B

1. **Roller Coasters:** All roller coasters rely on the conservation of energy. The **law of conservation of energy** states that within a closed system, energy can change form, but it cannot be created or destroyed. In other words, the total amount of energy remains constant. On a roller coaster, energy changes from potential to kinetic energy and back again many times during the ride.
2. For most roller coasters, the **gravitational potential energy** of the cars at the peak of the first hill determines the total amount of energy that is available for the rest of the ride.
3. The cars are pulled up the first hill by a chain and as the cars climb, they gain potential energy. At the top of the hill, the cars have a great deal of **gravitational potential energy, equal to the cars' mass multiplied by the gravity constant multiplied by the height of the hill.**
4. When the cars are released from the chain and begin down the hill, **potential energy transforms into kinetic energy** until they reach the bottom of the hill.
5. As the cars climb the next hill, some kinetic energy is transformed back into potential energy. Then, when the cars descend this hill, potential energy is again changed to kinetic energy.
6. This conversion between potential and kinetic energy continues throughout the entire ride.

Potential Energy equals mass times gravity times height.

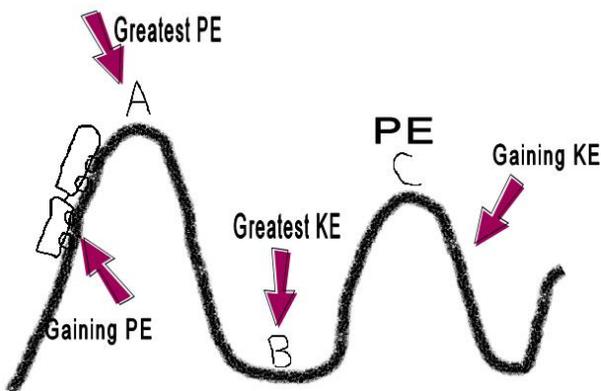
$$\text{Potential Energy (in Joules)} \rightarrow PE = mgh$$

mass (in kg) height (in meters) Acceleration due to gravity (9.8m/s²)

Kinetic Energy equals one-half times mass times velocity squared.

$$\text{Kinetic Energy (in Joules)} \rightarrow KE = (1/2)mv^2$$

mass (in kg) velocity (m/s)



7. The transformation between potential and kinetic energy is not perfect in the real world. The **force of friction** acts on the moving cars. The energy is not lost but transformed into thermal energy. Due to the friction between the coaster cars and the track, the amount of energy available to the ride becomes less throughout the ride. That is why the first hill of a roller coaster must always be the tallest.

Information C

1. In strict scientific terms energy is classified into two main forms: **kinetic and potential energy**.
2. **Kinetic energy** is defined as the energy of a moving object. A thrown football, a speeding automobile, a waterfall, or rocks falling from a cliff are examples of objects that have kinetic energy.
3. **Potential energy** appears in many different forms, and is defined as the energy in matter due to its position or the arrangement of its parts.
4. The various forms of potential energy include gravitational potential energy, elastic potential energy, chemical potential energy, and electrical potential energy.
5. **Gravitational Potential Energy:** When something is lifted or suspended in air, work is done on the object against the pull of gravity. This work is converted to a form of potential energy called gravitational potential energy. When the item falls towards Earth, it converts potential energy into kinetic energy.
6. **Elastic Potential Energy:** A stretched rubber band has the potential to do work or change things. This form of energy is called elastic potential energy. It occurs when an object resists being stretched out of shape. For example, toy airplanes fly when a rubber band untwists and spins a propeller. The elastic potential energy in the rubber band was converted into kinetic energy.
7. **Chemical Potential Energy:** All nonliving and living things are made up of molecules. It takes energy to make these molecules and hold them together. The energy stored in molecules is called chemical potential energy. During combustion, bonds are broken and reformed creating new products.
8. During combustion, chemical bonds are broken and reformed. There are many examples of chemical potential energy being converted to kinetic energy to do work. In a lighted firecracker chemical energy is used to make a loud sound and to scatter pieces of the firecracker all over.
9. **Electrical (Electromagnetic) Potential Energy:** A battery has chemical potential energy along with electrical potential energy. When you turn on a device that is battery-operated, such as a flashlight or a toy, the electrical potential energy stored in the battery is converted into **other forms of energy such as sound, mechanical motion, thermal energy, and light**. For an electrical appliance you plug in, the electrical potential energy is maintained by a spinning generator of a power plant, hydroelectric dam, or a windmill.

Potential energy helps us generate electricity in hydroelectric dams. When the water falls, gravity helps turn energy of height to electrical energy.



Information D

1. **Mechanical energy** is the kinetic energy plus the gravitational potential energy due to position. A moving car possesses mechanical energy due to its motion (kinetic energy). A moving baseball possesses mechanical energy due to both its high speed (kinetic energy) and its vertical position above the ground (gravitational potential energy).
2. **Mechanical energy** is the energy associated with the motion and position of an object. **The law of conservation of mechanical energy** states that in an isolated (closed system) that is only subject to gravity, the mechanical energy remains constant.
3. In a closed system (a system not affected by friction, air resistance, or any other force except gravity), the total mechanical energy will always be equal to the amount of gravitational potential energy plus the amount of kinetic energy.
4. For example, if an object at the top of a ramp is not moving and has a gravitational potential energy of 50J, the mechanical energy of the system is 50J.
5. **The law of conservation of energy** states that energy can neither be created nor destroyed. The energy can be transformed from one type to another.
6. The Mechanical energy of an object always remains the same unless some of it is transformed into another form of energy like thermal energy through the force of **friction**.
7. If no energy is transformed, the mechanical energy of the object remains the same. In order for the mechanical energy to remain the same as an object rolls down the hill, the gravitational potential energy has to transform into kinetic energy and no other forces can be acting on the object.
8. When the object reaches the bottom of the hill, the object will have kinetic energy but no potential energy. As the object travels down the hill, the potential energy will decrease as the kinetic energy increases. If an object then moves up a hill, the potential energy increases as the kinetic energy decreases.
9. **Dissipated energy** is the energy that is transformed into thermal energy by friction or another outside force. In the real world, energy transfers are acted on by outside forces such as friction or air resistance. The total mechanical energy of this type of open system has to take into account the outside forces. So, $M_E = P_E + K_E + D_E$.

$$PE = 50J$$

$$KE = 0J$$

$$PE + KE = ME$$

$$50J + 0J = 50J$$

