

# S1S4 Deep Dive Study Guide

## Short-Answer Quiz

*Instructions: Answer the following ten questions in two to three sentences each, based on the information provided in the source material.*

1. Define kinetic energy and identify the two primary factors that determine its amount.
  2. What is potential energy, and what two factors is it associated with?
  3. Explain how work is calculated and provide its standard unit of measurement.
  4. Using a roller coaster as an example, describe the transformation between potential and kinetic energy.
  5. What is the role of friction in a moving system, and what form does the "lost" energy typically take?
  6. Why is a roller coaster, after its initial drop, unable to climb a hill that is the same height as or taller than the first one?
  7. Explain how a very small domino can initiate a chain reaction capable of knocking over a much larger domino.
  8. What is mechanical energy?
  9. According to the source material, what is the ultimate source of most of Earth's energy?
  10. Describe how energy is transferred and transformed during a collision between two objects, such as pool balls.
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## Quiz Answer Key

1. Kinetic energy is the energy of motion, or the energy that is currently doing work. It is directly related to the mass of an object and the speed at which it is moving. An object with more mass or a greater speed will have more kinetic energy.
2. Potential energy is stored energy that an object has due to its position or arrangement, giving it the ability to do work in the future. It is associated with the object's mass and its position, such as its height.
3. Work is calculated by measuring the force applied to an object and multiplying it by the distance the object moves ( $w = fd$ ). The standard unit of measurement for work is the Joule.
4. At the top of its first hill, a roller coaster possesses a large amount of potential energy due to its elevated position. As the coaster descends, this stored potential energy is transformed into kinetic energy (motion). This continuous conversion from potential to kinetic energy powers the coaster's movement.
5. Friction is a force that causes energy to be transformed and "lost" from a system's primary motion. This lost energy is not destroyed but is typically transformed into thermal energy (heat) and sound energy, which are then released into the environment.
6. A roller coaster constantly loses energy to frictional forces between its wheels and the track, as well as air resistance. This friction transforms kinetic energy into sound and heat. Because the total energy in the system is continuously decreasing, the coaster will not have enough energy to reach a height equal to or greater than its starting point.
7. When a small domino is stood on its end, it is loaded with potential energy. When it is tipped over, this potential energy is converted to kinetic energy, providing enough force to topple the next, slightly larger domino. This process repeats, with the energy transfer amplifying through the series of increasingly larger dominoes.
8. Mechanical energy is the total energy within an object or system. It is calculated by taking the sum of the object's kinetic energy and its potential energy.

9. The Sun is identified as the ultimate or initial source of most of the energy found on Earth. This energy primarily arrives in the forms of light and thermal energy.
10. During a collision, energy is transferred from one object to the other. However, not all of the energy is transferred into motion. Some energy is transformed into sound due to frictional forces, and that sound is further transformed into thermal (heat) energy that dissipates into the environment.
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## Essay Questions

*Instructions: Formulate detailed responses to the following prompts, synthesizing concepts and citing specific examples from the source material.*

1. Discuss the principle that energy cannot be created or destroyed in the context of a pendulum swinging in an environment both with and without friction. Explain where the energy "goes" and what it transforms into when friction is present.
  2. Compare and contrast the energy transformations in a stretched rubber band being released and a roller coaster completing its circuit. How are their energy conversions similar, and what distinct roles does friction play in each example?
  3. The text states, "The ability to do work or cause change is called energy." Using the examples of a bowling ball hitting pins and a wind-up toy, elaborate on this definition. Be sure to discuss the relationships between work, force, distance, mass, and speed.
  4. Explain how an object's mass is fundamental to both its potential and kinetic energy, while speed is unique to kinetic energy and position (height) is unique to potential energy. Provide at least two distinct examples from the source material for each type of energy to support your explanation.
  5. Frictional forces are described as a cause for the continuous loss of energy from a system. Explain why engineers seek to eliminate friction and describe three different examples from the source context where friction transforms motion energy into other forms like heat and sound.
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## Glossary of Key Terms

Term	Definition
<b>Collision</b>	An event where objects strike one another, causing energy to be transferred from one object to the other.
<b>Energy</b>	The ability to do work or cause change. Energy cannot be created or destroyed, only transferred or transformed.
<b>Force</b>	A push or a pull on an object.
<b>Friction</b>	A force present in moving systems that causes kinetic energy to be transformed into other forms, primarily thermal (heat) energy and sound.
<b>Gravitational Potential Energy</b>	An object's potential to do work as a result of its elevated location or height.
<b>Joule</b>	The unit of measurement for work. One Joule is equivalent to the work required to lift a 100-gram apple one meter into the air.
<b>Kinetic Energy (KE)</b>	The energy of motion. It is associated with an object's mass and its speed.
<b>Mechanical Energy</b>	The total energy of an object, calculated as the sum of its kinetic energy and potential energy.
<b>Potential Energy (PE)</b>	Stored energy that an object possesses due to its mass and position (e.g., height) or its arrangement (e.g., being stretched), giving it the ability to do future work.

<b>System</b>	A collection of interacting objects through which energy flows, is transferred, and is transformed.
<b>Thermal Energy</b>	Heat energy. It is often produced as a result of frictional forces transforming kinetic energy.
<b>Transformation (of Energy)</b>	The process of energy changing from one form to another, such as potential energy converting into kinetic energy.
<b>Transfer (of Energy)</b>	The process of energy moving from one object to another, such as occurs during a collision.
<b>Work</b>	The action of a force causing an object to move over a distance, calculated by the formula $w = fd$ (work = force $\times$ distance). It represents a transfer of energy.