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# K-12

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## Question: 1

The measure of energy within a system is called \_\_\_\_\_.

- A. temperature
- B. heat
- C. entropy
- D. thermodynamics

**Answer: B**

Explanation:

The measure of energy within a system is called heat. Temperature is a measurement of the average kinetic energy of molecules in a substance. A higher temperature means greater kinetic energy or faster moving molecules. Entropy is the amount of energy that is no longer available for work, related to the second law of thermodynamics. Thermodynamics is the study of the conversion of energy into heat and work in a system.

## Question: 2

Which of the following is true of an isotope?

- A. It has a different number of protons than its element
- B. It has a different number of electrons than its element.
- C. It has a different charge as compared to its element.
- D. It has a different number of neutrons than its element.

**Answer: D**

Explanation:

It has a different number of neutrons than its element. An isotope is a variation of an element that has a different number of neutrons. The element and its various isotopes continue to have the same numbers of protons and electrons. For example, carbon has three naturally occurring isotopes, carbon-12, carbon-13 and carbon-14, which is radioactive. Isotopes of an element differ in mass number, which is the number of protons and neutrons added together, but have the same atomic number, or number of protons.

## Question: 3

If an atom's outer shell is filled, what must be true?

- A. It reacts with other atoms through chemical reactions.
- B. It exchanges electrons to form bonds with other atoms.
- C. It has 32 electrons in its outer shell.
- D. It is a stable atom.

**Answer: D**

Explanation:

It is a stable atom. If an atom's outer shell is filled, it is a stable atom. The outer shell refers to one of many energy levels, or shells, that electrons occupy around a nucleus. An atom whose outer shell is not filled wants to become stable by filling the outer shell. It fills its outer shell by forming bonds. The atom can do this by gaining electrons or losing electrons in ionic compounds, or if the atom is a part of a molecule, by sharing electrons. If an atom has a full outer shell, such as the noble gases, it does not readily react with other atoms and does not exchange electrons to form bonds. These atoms are known as inert. Therefore, Answers A and B cannot be true. Answer C, having 32 electrons in its outer shell, is not necessarily true because not all elements have the fourth shell that can hold 32 electrons. Some have fewer shells that hold fewer electrons.

### Question: 4

Which type of nuclear process features atomic nuclei splitting apart to form smaller nuclei?

- A. Fission
- B. Fusion
- C. Decay
- D. Ionization

**Answer: A**

Explanation:

Fission is a nuclear process where atomic nuclei split apart to form smaller nuclei. Nuclear fission can release large amounts of energy, emit gamma rays and form daughter products. It is used in nuclear power plants and bombs. Answer B, Fusion, refers to a nuclear process whereby atomic nuclei join to form a heavier nucleus, such as with stars. This can release or absorb energy depending upon the original elements. Answer C, Decay, refers to an atomic nucleus spontaneously losing energy and emitting ionizing particles and radiation. Answer D, Ionization, refers to a process by which atoms obtain a positive or negative charge because the number of electrons does not equal that of protons.

### Question: 5

Electrons with greater amounts of energy are found \_\_\_\_\_ the nucleus than electrons with less energy.

- A. closer to
- B. farther from

- C. more often inside
- D. more randomly around

**Answer: B**

Explanation:

Electrons with greater amounts of energy are found farther from the nucleus than electrons with less energy. The principle quantum number describes the level or shell that an electron is in. The lower the number, the closer the electron is to the nucleus and the lower it is in energy.

### Question: 6

The process whereby a radioactive element releases energy slowly over a long period of time to lower its energy and become more stable is best described as \_\_\_\_\_.

- A. combustion
- B. fission
- C. fusion
- D. decay

**Answer: D**

Explanation:

The process whereby a radioactive element releases energy slowly over a long period of time to lower its energy and become more stable is best described as decay. The nucleus undergoing decay, known as the parent nuclide, spontaneously releases energy' most commonly through the emission of an alpha particle, a beta particle, or a gamma ray. The changed nucleus, called the daughter nuclide, is now more stable than the parent nuclide, although the daughter nuclide may undergo another decay to an even more stable nucleus. A decay chain is a series of decays of a radioactive element into different more stable elements.

### Question: 7

Which of the following is a type of simple machine?

- A. A bicycle
- B. A pair of scissors
- C. A screw
- D. A shovel

**Answer: C**

Explanation:

A screw is a type of simple machine. A screw is an inclined plane wrapped around a

shaft. A wedge is also an inclined plane. A compound machine is a machine that employs two or more simple machines. Answer A, a bicycle, is a compound machine, consisting of a combination of the simple machines: wheels, levers, pulleys and wedges (used as stoppers). Answer B, a pair of scissors, is also a compound machine consisting of two wedges (the blades) that pivot on a lever. Answer D, a shovel, is a compound machine consisting of a lever (the handle) and a wedge (the head of the shovel).

### Question: 8

In which of the following scenarios is work not applied to the object?

- A. Mario moves a book from the floor to the top shelf.
- B. A book drops off the shelf and falls to the floor.
- C. Mario pushes a box of books across the room.
- D. Mario balances a book on his head.

**Answer: D**

Explanation:

Mario balances a book on his head. In this example, work is not applied to the book because the book is not moving. One definition of work is force acting on an object to cause displacement. In this case, the book was not displaced by the force applied to it Mario's head applied a vertical force to the book to keep it in the same position.

### Question: 9

A ball is resting on the front end of a boat. The boat is moving straight forward toward a dock. According to Newton's First law of motion, when the front of the boat hits the dock, how will the ball's motion change with respect to the boat?

- A. The ball will remain at rest.
- B. The ball will move backward.
- C. The ball will move forward.
- D. The ball will move sideways.

**Answer: C**

Explanation:

The ball will move forward with respect to the boat. Newton's First law of motion states that an object in motion tends to stay in motion until a force acts to change it. The ball is initially at rest with respect to the boat, but the boat is moving forward. When the front of the boat hits the dock, the boat quickly decelerates, but the ball does not. It continues to move forward because the force acting to stop the boat does not significantly affect the ball. With the ball now moving forward faster than the boat, the ball's motion relative to the boat is forward motion.

### Question: 10

What two things are required for circular motion to occur?

- A. Acceleration and centripetal force
- B. Acceleration and gravitational force
- C. Constant speed and centripetal force
- D. Constant speed and gravitational force

**Answer: A**

Explanation:

Acceleration and centripetal force. Acceleration and centripetal force are required for circular motion to occur. Acceleration is defined as a change in direction of velocity. Centripetal force is force directed toward the center, or inward force. The force of gravity is not required for circular motion, nor is constant speed.



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