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The GED Science Test

Physics

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#26 Passing the GED Science Test

The airplane stays up, because it doesn't have the time to fall.
Orville Wright (1871-1948), US aviator
(explaining the principles of powered flight)

Video 26 Focus: exploring the forces that move things as well as sound, electricity, heat, light and the relationship between matter and energy

You Will Learn From Video 26:

- About different sources and types of energy.
- The difference between potential and kinetic energy.
- The Law of Conservation of Energy.
- The 3 Laws of Motion and Sir Isaac Newton.
- How 2 types of waves can carry energy by their motion.

Words You Need to Know:

While viewing the video, put the letter of the meaning by the correct vocabulary word. Answers can be found on Page 20.

_____1. energy — a. the use of a force to move something over a distance

_____2. work — b. number of complete waves produced each second

_____3. frequency — c. the increase in velocity or speed of an object

_____4. inertia — d. a property of matter that allows an object in motion to remain in motion

_____5. acceleration — e. the ability to do work

Points to Remember:

- Physics revolves around the study of energy, and how we can use this energy to do work.
- There are different kinds of energy. Some examples are heat, nuclear, water, sound, electrical, solar, and wind.
- Even though physics involves many mathematical equations, you will be tested more on concepts, rather than solving algebraic and geometric equations.

Energy

Energy! Have you ever had trouble finishing your workday? felt too tired to think clearly? had trouble getting out of bed? You were probably suffering from a lack of energy. Every living thing needs and uses energy to complete its life's actions. Energy not only gives us the power to work, it also allows us to hear our favorite music, surf the Pacific Ocean, and warm ourselves on a cold winter night. Physics is the science of energy. Physicists are concerned with how energy is produced, in what forms it can come, and how to make energy creation and consumption more efficient. How important is this science? Well, the world's population is increasing faster than ever. Improvements in medicine and health have not only extended peoples' life spans, but they have also lowered infant mortality, especially compared to just a hundred years ago. Our standard of living across the world has been rising likewise. More and more products consume some type of energy, from electricity, to gasoline, to batteries. Therefore, the need for energy has increased to an all-time high.

Often, it is the physical scientists who have the task of finding the energy we need to continue to grow. Physicists have been responsible for inventions making us more efficient, from the microwave, to incredible feats such as landing on both the Moon and Mars. In general, physicists often become involved in projects that have practical applications.

One of the most pressing challenges for physicists today is the possibility of an energy shortage. Imagine how your life would be affected if you could not buy gasoline. Imagine if you could only use electricity for 2 hours a day, or take a hot shower only once a week. Where can we get the new sources of energy we will soon need to meet the world's demands? More importantly, are there any renewable sources, in other words, energy sources that will never run out?

Test Your Knowledge

Directions: Circle the best answer to each question.
Answers can be found on Page 20.

1. Which of the following was a cause for energy consumption to rise during the last 100 years?
    a. the increase in population
    b. the increase in dependence on batteries
    c. the increase in gasoline prices
    d. the increase in availability of solar power

2. What is one major challenge currently facing physicists today?
    a. exploration of the moon
    b. finding new energy sources
    c. creating new electronic entertainment products
    d. creating pharmaceutical products to extend humans' life spans

3. Which phrase best describes the work of physicists?
    a. often has practical applications
    b. does not often use mathematics
    c. little to do with the other sciences
    d. work centers around schools and universities

Law of Conservation of Energy

First of all, what is energy? **Energy** is defined as the ability to do work. **Work** is the idea of moving something, by using a force, over a distance. An object must have energy to be able to move something, maybe even itself, over a distance. That is why energy is crucial. Nothing would work without it!

When you turn on an electric stove, electricity is used to heat up the burner. This heat can then be used to cook your food. A physicist would view this as a change in forms of energy, from electrical energy to heat energy; it is this change that is the foundation of a law in physics, the Law of Conservation of Energy. A **law** is a statement or observation that always seems to be true and has stood up to scientific observation and testing.

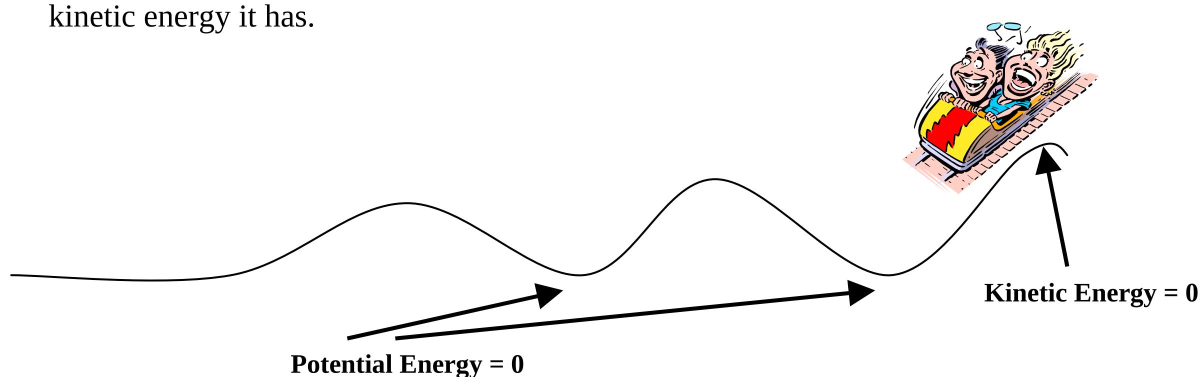
The Law of Conservation of Energy
In a closed system, energy is not lost but can change from one form to another. The total amount of energy remains the same.

This would mean that the amount of electrical energy used is the same amount of heat energy produced.

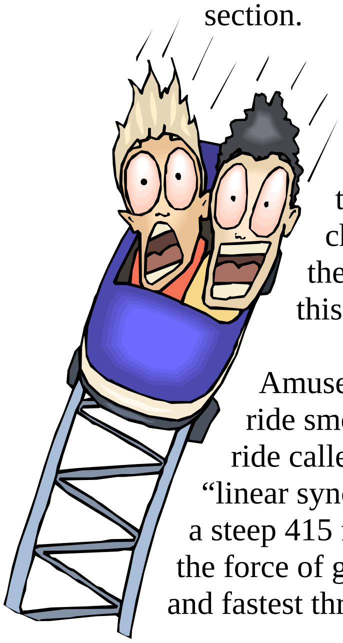
Two Types of Energy

Have you ever been on a roller coaster? A roller coaster is a great example of the laws of physics. When you first climb in and secure yourself, the coaster does not have any energy. Yet, the coaster must climb the first large hill. Traditional coasters use a chain or cable to slowly pull it to the top of the first hill, because coasters are powered by gravity. **Gravity** is the downward force pulling every object toward the Earth. Once at the top of the hill, the coaster is filled with **potential** or stored **energy**. The mechanical energy used to pull the coaster up the hill, now has been transformed into a different type of energy, the energy of position. The higher an object is, the more potential energy it has. This is when gravity causes the coaster to plumm down the hill. All of the coaster's potential energy is then transformed into **kinetic energy**, or the energy of motion.

- **Potential Energy** is the energy of position. A resting object's position determines how much potential energy it holds. As a coaster climbs, it will gather potential energy.
- **Kinetic Energy** is the energy of motion and speed. The more speed it has, the more kinetic energy it has.



At the top of each hill, the coaster's kinetic energy is 0. At the bottom of each dip, the coaster's potential energy is 0. As long as the coaster is moving up and down the hills, the type of energy will keep changing. Notice that each successive hill will be shorter and shorter. This is because of the forces working against it. Some of its energy is lost as heat and sound. Air resistance also slows the coaster down. Gravity also forces the coaster downward, but with all of these forces working against it, what keeps the coaster's momentum going? That will be answered in a later section.



Now, if energy is the ability to do work and work is using a force to move an object over a distance, can you see how a roller coaster can demonstrate these principles? Work, in this example, is moving the coaster along the tracks. The force to do the work consists of the initial mechanical force of the chain pulling it up the hill followed by, the force of gravity pushing it down the hill. The distance is the length the coaster travels, and it takes energy to do this work.

Amusement rides in the future are looking for other ways to propel and to stop a ride smoothly and efficiently. Southern California's Magic Mountain showcases a ride called Superman the Escape. This ride is unique because it uses state of the art "linear synchronous motors," which uses the fundamentals of magnetism to propel it up a steep 415 foot incline at speeds of 100 mph, and it does this in only 7 seconds! Then, the force of gravity causes it to free-fall back down the incline. This makes it the tallest and fastest thrill ride in the US.

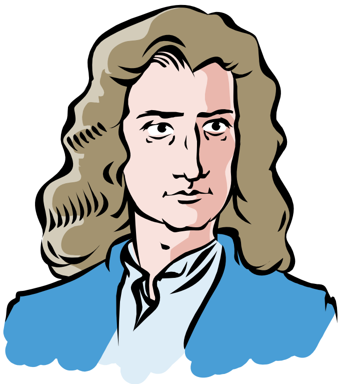
Test Your Knowledge

Directions: Match each word on the left with the best description on the right by writing the corresponding letter to its number.
Answers can be found on Page 20.

1. _______gravity
2. _______energy
3. _______work
4. _______potential energy
5. _______kinetic energy
6. _______law

a. the force which pulls two objects toward one another
b. energy of position
c. energy of motion and speed
d. a statement that always seems to be true and has stood up to scientific observation and testing
e. the ability to do work
f. use of a force to move something over a distance

Earlier, we wondered why, if gravity and other forces are pushing a coaster down toward Earth, is a coaster able to climb up another hill, or even go through a loop. This leads us to an amazing man named Sir Isaac Newton.



Laws of Motion

Sir Isaac Newton was an English physicist and mathematician, who in the 17th and 18th centuries was able to solve several mysteries that have stumped humans for centuries. His remarkable work created modern day physics as we know it.

Newton's First Law of Motion: The Law of Inertia

Newton observed that a ball rolling on a smooth surface will roll farther than a ball rolling on a rough surface such as grass. He realized that unless another force acted upon it, the ball would keep on rolling. This led him to his first law of motion.

The Law of Inertia
An object at rest will remain at rest, and an object in motion will remain moving in a straight line and at a constant speed, unless a force acts upon it.

Inertia is a property of matter that allows an object in motion to remain in motion. So if you push a ball, its inertia will naturally continue it in that motion. So, a roller coaster moving down a hill due to gravity can climb another hill due to inertia. Of course, as it climbs, the force of gravity is still pushing it back to Earth, and friction slows the coaster too. Thus, the coaster will not be able to climb higher than the previous hill. You can also see inertia at work if you have seen children

playing on a "Slip n' Slide." By just throwing themselves onto the slick yellow pad, they a
to travel long distances.

Likewise, inertia describes how an object at rest will remain motionless. A cup sitting on a table will not move unless something causes it to move. Inertia is what allows it to stay at rest. Every object has inertia, whether it is moving or still.

The Force of Friction

Common sense tells us that if you roll a ball along a smooth, flat surface, even with inertia, it will not roll forever. Eventually, the ball will come to a stop. Yet, if Newton's Law of Inertia is true, what force stops it?

Friction is the force that will stop a moving object rolling on a flat surface. Friction is everywhere, since there are very few truly "frictionless" surfaces, even in the air. Have you ever stuck your hand out the window of a moving car? If you have, you would have felt air friction, more commonly known as air resistance. Friction, from the air and from the contact of the coaster and the tracks, slows a coaster down.

What causes friction you may ask. Friction is caused by the electric forces between the atoms and molecules of the two objects in contact. So the atoms and molecules in your hand are actually meeting resistance from the atoms and molecules in the air. Likewise, the molecules of a ball will interact with the molecules on a flat surface, changing the kinetic energy of the ball into heat energy. Friction always produces heat energy, and if you have ever received a "rug burn," you have first-hand experience with friction and heat energy. This change from kinetic energy to heat energy demonstrates the Law of Conservation of Energy.

Without friction, what would our lives be like? Cars would be useless! You would not be able to write with a pen on paper! None of your possession would stay in place! Imagine trying to walk anywhere.

Newton's Second Law of Motion: The Law of Acceleration

The Law of Acceleration describes how, if an unequal force is applied to an object, the object will change speed, either by going faster, accelerate, or slowing down, decelerate. Again, let us use the roller coaster as a model. First, we must apply an upward force stronger than the downward force of gravity. This will allow the roller coaster to climb. Once it reaches the top, it is filled with gravitational potential energy, and as we stop the upward force, gravity will take over. Since there is not an equal force pushing up on the coaster, this unbalanced force causes the coaster to accelerate downward. In other words, as an object falls, its speed will increase.

Newton's Law of Acceleration is often broken into two parts, because it is actually based on two observations made by Newton. The first observation was that an object, such as a stick, could be thrown farther and faster simply by throwing it harder or with more force.

The Law of Acceleration, Part I An object's speed increases in proportion to the amount of force applied.

Part II can also be explained by common experience. Which is easier, throwing a heavy bowling ball or throwing a softball? The heavier an object is, the harder it is to throw it. In other words, if the same amount of force is applied, a lighter object will accelerate faster than a heavy object.

The Law of Acceleration, Part II A heavier object needs a greater force to accelerate it at the same rate as a lighter object.

The Law of Acceleration can also be written as a mathematical equation.

Force= Mass x Acceleration (F=m x a)

Force is any push or pull on an object.

Mass is the amount of matter that makes up the object.

Acceleration is the rate at which the object's speed changes due to the force.

So if any two parts of the equation are known, the third part can be found.

Newton's Third Law of Motion: The Law of Interaction

This law is extremely important, but can be more difficult to envision. Try this example: When a bat hits a baseball, the baseball will fly through the air. Right? The ball will do so because the bat exerts a force onto the baseball, but also because the baseball exerts a force back onto the bat. If it did not do this, the bat would just sail right through the ball.

The Law of Interaction For every action, there is an equal and opposite reaction.

Here's another example: a cup is sitting on a table. If there were not an equal and opposite force pushing against the downward force of gravity, the cup would fall through the table. Thus, the table is actually pushing back, with an equal force, in the opposite direction of gravity.

Test Your Knowledge

Directions: The following actions all demonstrate one of Newton's laws of motion. Beside each action, write the correct letter corresponding with Newton's laws,
Answers can be found on Page 20.

a) The Law Of Inertia
b) The Law Of Acceleration – Part I
c) The Law of Acceleration – Part II
d) The Law Of Interaction

1. ______A hockey puck moving over ice will continue to move, unless a force stops its momentum.

2. ______A professional baseball player has to use more force to throw his fastest "fastball" than one of his slower pitches.

3. ______When a hammer hits a nail, the hammer bounces off, or recoils, off the nail.

4. ______A student finds that she can throw a hard-boiled egg faster than a bowling ball.

5. ______A heavy truck needs a larger engine to move it compared to a smaller, lighter car.

Questions 6-7 apply to the following information.

Force = Mass x Acceleration

Gabriela and Shannon are pushing wheelbarrows full of dirt. Gabriela's wheelbarrow is twice as heavy as Shannon's.

6. For Gabriela to move at the same rate of acceleration as Shannon, which of the following actions must happen?
   a. Gabriela must apply twice the force that Shannon applies.
   b. Shannon must apply twice the force that Gabriela applies.
   c. Gabriela must add more weight to her load.
   d. Both Gabriela and Shannon must use the same amount of force.

7. If Shannon were to reduce her acceleration to match Gabriela's would she
   a. use more force?
   b. use less force?
   c. reduce the weight of her wheelbarrow?
   d. quit working?

Newton's Law of Universal Gravitation

Earlier, we introduced the idea of gravity. Newton discovered the properties of gravity, not by sitting underneath an apple tree and being hit on the head by a falling apple, but rather by using his laws of motion in a quest to answer several mysteries. Before Newton's time, people did not know the answer to the following questions:

- If the Earth is round, why do we not fall off it?
- How and why does the Moon circle the Earth?
- Why do all objects thrown up into the sky always eventually come back down?

Newton eventually described a universal force, called gravity, which applies to all objects. His law states three things:

The Law of Universal Gravitation
Gravity is an attractive force that pulls two objects toward one another.
Gravity is stronger coming from heavy (or more mass) objects when compared to light objects.
The force of gravity weakens as the distance between objects increases.

All objects in the universe feel the effects of gravity; we commonly feel the Earth's gravitational pull towards its center. The Sun, being much larger than the planets, pulls all of them toward itself, and each planet pulls back against the Sun. Since they are much smaller than the Sun, their pull is much weaker.

Even humans have a gravitational pull toward other humans, except that it is relatively weak and not noticeable. So even if you find someone "unattractive," you are each pulling yourselves toward one another. We might not notice it because the only gravitational force we are aware of is from the Earth itself. Therefore, the force of gravity diminishes with the decrease in size. Likewise, the force of gravity diminishes as you draw away from an object. Gravity can lose ¼ of its strength each time the distance between two objects doubles.

Test Your Knowledge

True or False: Please write down "True" next to the statement if you believe it is a true statement. If you believe it is a false statement, please write "False" next to it.
Answers can be found on Page 20.

1. _________Since the planet Mercury is closer to the Sun than Earth, it feels a weaker gravitational pull towards the Sun than the Earth feels.

2. _________If our Moon were twice as far from the Earth as it is now, its gravitational effects would be ¼ less in strength.

3. _________Two humans standing besides each other do exhibit a pull towards each other, but they probably will not be able to feel it.

The Different Forms of Energy

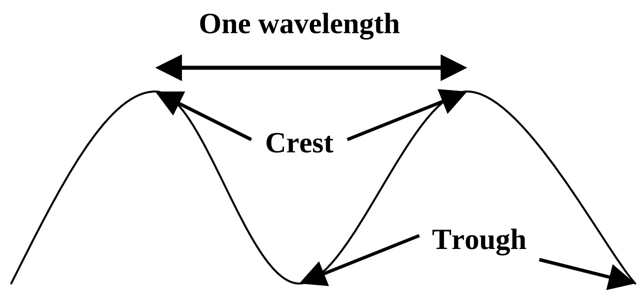
Heat energy might be what one would think of first when asked to name a form of energy. Heat is something everyone is familiar with, whether you are in Minnesota in the winter and wishing for more heat, or in Arizona during the summer and wishing there were less. Much of the heat energy we receive is from the Sun; however, humans have been able to make other sources of heat, primarily fire. Earlier, we said that friction causes heat. The reason why is that the atoms and molecules in each object start to move faster against each other. So **heat** can be described as the energy of moving atoms. The higher an object's temperature, or the measurement of heat, the faster its atoms are moving. That is why water freezes into a solid below zero degrees Celsius, and turns into steam above 100 degrees Celsius.

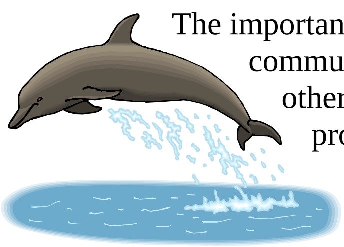
Besides heat, energy comes in other forms. Living in California, you must have seen surfers riding waves of water toward a beach. **Water energy** is found in the form of waves. Water waves can find energy from several sources. Usually, anything from strong winds to the Moon's gravitational pull can cause waves. Sometimes, though, a wave can grow into huge wave called a tsunami that can cause extensive damage and deaths.

Where does the water obtain the extra energy to produce such large, devastating waves? W have you ever dropped a pebble into a bucket of water? What happens? You see circular wav emanating outward from where the pebble broke the surface. The kinetic energy from the pebble causes wave energy in the water. Often, if an earthquake occurs in or near the ocean, the colossal energy produced by an earthquake will be carried throughout water. As, the energy wave gets nearer land, the depth of the water shrinks and forces all that energy into a smaller and smaller area, thus raising the water higher than normally possible. This is a tsunami, and one struck Japan when an earthquake occurred in Chile in 1960. Taking 22 hours to reach Japan from Chile, the tsunami ended up causing the deaths of 138 people in Japan.

Sound energy is also found in the form of wave energy. Sound is produced by any object that vibrates. Music, depending on one's tastes, is when sound from vibrations is produced in a pleasing manner. When music is played through stereo speakers, it is the movement of the speaker's cone that compresses the air molecules next to it, causing sound waves to emanate.

The **frequency** of sound is the number of complete waves produced each second, measured in *hertz*. A wavelength is the distance between two crests or two troughs of a wave. A crest is considered the top-most point of a wave, or peak. A trough then is the lowest point, or the valley, of a wave.





The importance of frequency can be seen when discussing how humans and animals communicate. Certain animals can produce sounds that cannot be heard by us or other animals, but they can hear them just fine. For example, dolphins can produce sounds 6 times higher than what humans can hear. But humans can speak in tones lower than what dolphins can hear. Elephants can make sounds even lower than what humans can hear.

Like other waves, sound will **reflect**, or bounce off, a surface. The smoother the surface, the more reflection back to its source will occur, producing an echo. Higher frequency sounds will tend to reflect off a surface more than lower sounds. This is why all you hear coming from your neighbor's loud stereo is bass. It goes right through their walls and into yours!

Scientists believe that one reason why elephants make such low frequency sounds is to communicate over long distances. Lower sounds, such as from a bass drum, do not reflect as much as higher sounds do. Therefore, elephants use low frequency sounds when communicating over long distances, because the sound waves will not reflect back and lose strength.

Sound tends to travel in a straight line, but, besides reflection, it also demonstrates two other properties that allow it to change directions. **Refraction** is the bending of waves around a boundary. **Diffraction** is the spreading out of waves behind or around a barrier. These two properties allow us to hear someone around a corner or in another room. Architects use these properties of sound waves when designing opera houses, concert halls, and some auditoriums. They must use the proper materials and shape the hall in a way that produces the best quality sound, no matter where you are sitting. Many believe it is impossible to create a perfect hall, but in Los Angeles, there is an auditorium that is supposedly too good! Many of the musicians have complained that from where they sit, they can hear people whispering from many rows away.

Test Your Knowledge:

Directions: Circle the best answer to each question.

Answers can be found on Page 20.

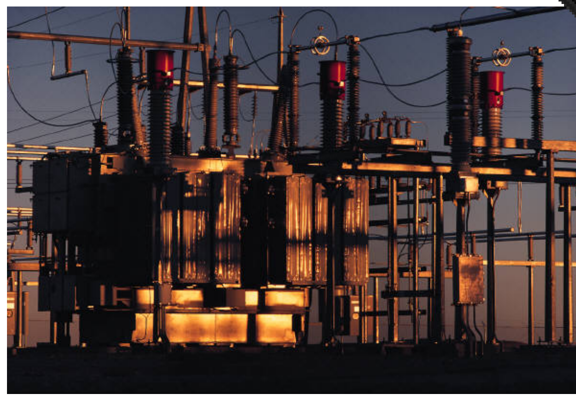
1. Why do scientists believe elephants produce such low frequency sounds?
   a. so humans will not know what they are saying
   b. because they can only produce low sounds
   c. because it is more pleasing to their ears
   d. to communicate over long distances

2. What type of energy does friction produce?
   a. sound
   b. water
   c. heat
   d. kinetic

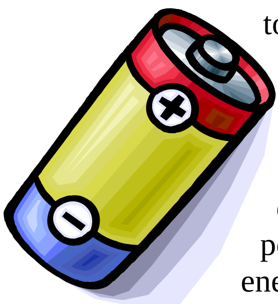
3. What force stops a ball from rolling on a flat surface?
   a. gravity
   b. kinetic energy
   c. friction
   d. heat

4. What commonly gives enough energy to produce a tsunami?
   a. earthquakes
   b. the Moon's gravitational pull
   c. strong winds
   d. tornadoes

Electrical Energy



Ah, electricity! What would we do without it? In 2003, people in the northeastern United States had to find out the hard way as entire states lost their electrical power. **Electrical energy** occurs by the movement of electrons found in the atoms of all things. The negatively charged electrons do not always stay in their original atoms, but often travel to other neighboring atoms. When they travel, they produce energy. For example, when you walk across a carpet and then touch a metal object, electrons are transferred from the carpet to your body, and then when you touch metal you feel a shock as they all jump into the metal. This is called static electricity.



Electric current occurs when a flow of electrons is forced to leave one place for another, usually to be used as energy to do work. They travel through a material that is receptive to the movement of electrons, called a **conductor**. Good conductors are anything made of metal. Batteries are an example of where electrons will flow in one direction from the negative end of the battery to the object, such as a light bulb, then to the positive end of the battery. Lightning is also another form of electrical energy. Electrical energy is one of the most useful forms of energy we have, and, possibly, one day we will be able to use the electrical power of a lightning bolt to energize an entire city.

Magnetism

Magnetism is the phenomenon where a field is produced with the ability to either attract or repel. Magnets are objects that demonstrate these abilities. Magnets are able to do so because they have two regions, or **poles**, where the magnetic force is very strong. When magnets are brought together, opposite poles attract each other, while like poles repel.

Electricity and magnetism always go hand in hand. Whenever you have an electrical current flowing through a wire, a magnetic field surrounds it. By using an electric current, you can magnetize a piece of iron. You can try this experiment at home. You will need one battery, such as a D-cell battery, one compass, and some wire. Set the compass down on a flat surface and lay the wire close to the compass. Now attach the wire between the positive and negative ends of the battery. You should see the needle of the compass swing towards a different direction than previously pointed to, which should have been north. The reason this happens is that the compass needle is a magnet and is sensitive to the magnetic field produced by the electrical current flowing through the wire. For a more obvious effect try wrapping the wire around a nail and then connect to a battery. The tighter you wrap it, the greater the effect on the compass.

Magnets also attract iron, which is not a magnet but it is attracted to both poles. Magnets a around you. You probably have some on your refrigerator right now. The Earth itself produc huge magnetic field encircling the globe, allowing us to use compasses. Without that magnetic field, who knows how long it would have taken European explorers to find America.

Nuclear Power and Other Types of Energy

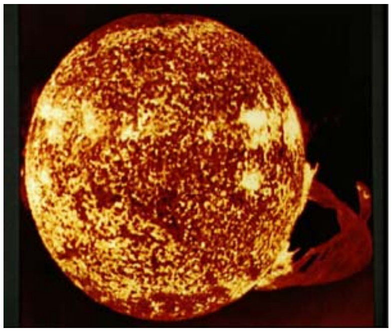
Nuclear energy is generated when the nucleus of an atom is split into two smaller nuclei (plural form of nucleus). This splitting, called **fission**, releases an incredible amount of energy and when controlled in a nuclear chain reaction, it can be a very efficient power source. This controlled reaction was first done by the Italian physicist, Enrico Fermi, in 1942. Sadly, if a chain reaction goes out of control, a terrible explosion can occur. This happened in 1986 at Chernobyl, USSR, now the Ukraine. Even though only 30 people died from the direct results of the explosion, over 2,000 deaths have been blamed on the accident, due to the effects of radiation.

Compared to other types of fuel, nuclear fuel produces a more massive amount of energy. This happens to be one of the main reasons the United States and other countries have developed, or are in the process of developing, nuclear power plants. For example, radioactive uranium can create 3 million times more energy as the same amount of coal. Both coal power plants and nuclear power plants use their fuel to heat up water to produce steam. This steam is then used to turn turbines to create electricity. Are nuclear power plants safe, though? And, should every country be allowed to create nuclear power? Those are questions that the citizens of the world must consider.

Renewable Energy Sources

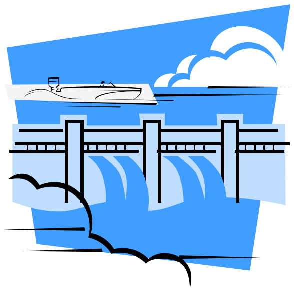
As of 2000, about 75% of the energy the United States consumes comes from **non-renewable sources** such as the fossil fuels, oil, coal, and gas. These are limited sources of energy, where the Earth's supply will eventually run out. Fossil fuels will not only eventually run out, but they are also known to damage the environment, often by pollution. On the other hand, nuclear energy, even though it is more efficient, produces harmful radioactive waste that cannot be destroyed. Storage is the only option, and that, too, has its potential dangers. So physical scientists have been tasked with determining other sources of energy, especially ones that are of unlimited supply and cause as little damage to the environment as possible. Two very potential sources are solar energy and hydroelectric energy.

Solar energy is a **renewable resource**, a virtually unlimited supply. Solar cells gather sunlight to produce electricity, and you probably have seen these on homes before. Often solar cells are packed together to form panels that face the Sun to collect its energy. One advantage of solar cells is that they can be very small; in fact you probably have seen them on solar power calculators. Cover the solar cells up, and the calculator loses power.



The great advantage of **solar energy**, besides being unlimited, is that it does not pollute the environment. Sounds like the perfect solution, so why are we not all using it now? The costs of installing and using solar panels are still too high to be cost effective; however, with advances in technology the costs should decrease enough for a wider use.

Hydroelectric energy comes from the energy created by running rivers. The mass movement of water is used to turn the turbines to produce electricity. This type of resources is being used today all around the world, but some environmentalists will say that it might not be the best thing for the environment, because huge dams must be built to control the river's flow, thus altering many animals' habitats. Also, only large enough rivers can be used, thus many areas of the world would not be able to benefit from hydroelectric energy.



Europe has used this final type of alternative energy source for many centuries. You have probably seen windmills in the Palm Springs area in California, in pictures of Holland, and in the story of Don Quixote. Windmills come in all shapes and sizes, but they all can use **wind energy** to produce power to be used to grind grain or produce electricity. The disadvantage of wind energy is that the energy it produces is quite small, definitely not enough to be a large source for our future.

Geothermal energy would be another great alternative as it would tap into the heat produced by the interior of the Earth to produce electricity; in fact, Iceland uses this type quite effectively. Today, though, we have not solved all of the technological problems associated with drilling down far enough into the Earth to tap into this heat. Again, only time will tell if this will be a viable alternative for power.

Are there other types of energy yet undiscovered? Which one do you believe the United States will most rely upon in the next 50 years? Even though physical scientists will play a large part on those two questions, it will also be up to you and me. Currently, our main sources of energy are proving to be a hazard to our Earth, and to keep our world safe, only tough laws regulating energy production help. So as you can see, our energy future is not just a scientific one, but also a political one.

Review Questions

Directions: Circle the best answer to each question. Answers can be found on Page 20.

1. If a rocket has just left Earth, what is the attractive force between the Earth and the rocket?
   a. magnetic
   b. gravitational
   c. electrical
   d. nuclear

2. A rocket can be used to illustrate Newton's Third Law of Motion. Which of the following causes a rocket to move upward?
   a. the force of gravity pulling the rocket down to Earth
   b. friction from the air slowing the rocket down
   c. the force of the burning fuel pushing the rocket away from the Earth with the Earth pushing back against the rocket
   d. the wind helping lift the rocket off the Earth

3. A wavelength equals the distance between
   a. trough to trough.
   b. crest to crest.
   c. crest to trough.
   d. both a and b.

4. Why are most renewable energy sources not being used as much as fossil fuels?
   a. pollution
   b. limited supplies
   c. general dislike
   d. higher costs

5. Which is not a form of energy?
   a. temperature
   b. electricity
   c. heat
   d. wind

6. The top of a wave is called a ______________.

7. The bottom of a wave is called a ______________.

8. Frequency is often measured in _______________.

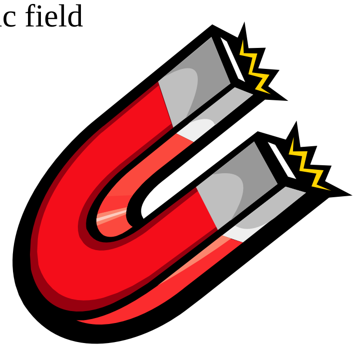
GED Practice Exercises

Directions: Read the following passage, and then answer questions 1-3 to the best of your ability. Answers can be found on Page 20.

Electricity and magnetism always go together. Natural magnets are attracted to iron or metal alloys containing iron. However with electricity you can create a temporary magnet called an electromagnet just by wrapping a coil of wire around a piece of iron and then when an electric current goes through the wire, it will magnetize the iron. However, this is not a natural, permanent magnet for it will only show magnetic properties as long as the electrical current flows through the wire. Reverse the process, and you get electromagnetic induction. This is where you can use a magnet to produce electricity. Here's how: A bar magnet is pushed through a coil of wire producing an electric current, and as long as the magnet keeps moving, it will keep creating this current. Some generators use this principle to create electricity.

Directions: Circle the best answer to each question. Answers can be found on Page 20.

1. Which of the following relates to the principle of electromagnetic induction?
    1) a rotating turbine powered by steam
    2) an electromagnet using an electric current to produce a magnetic field
    3) an engine using gasoline
    4) a generator using a magnetic field to produce electricity
    5) a compass pointing north due to the Earth's magnetic field



2. Which material does a magnet most strongly attract?
    1) tin
    2) iron
    3) bronze
    4) brass
    5) plastic

3. How do you create an electromagnet?
    1) Rub a magnet on a piece of iron
    2) Pass an electrical current through a wire wrapped around a piece of iron
    3) Attach a magnet to a compass
    4) Continually push a magnet through a coil of wire
    5) Rub a piece of iron and a magnet together

Directions: Read the following passage, and then answer questions 4-5 to the best of your a
Answers can be found on Page 20.

A typical battery will be marked with a (+) and a (-) to designate which end is positive and which is negative. Each end is called a terminal, and the negative terminal is the end where all of the electrons within the battery collect. They will stay there until something, like a wire, connects the negative end with the positive end. If this is done, all of the electrons will flow extremely quickly out through the negative end, through the wire and then into the positive end. The circuit must be complete. If there is a break somewhere along the way, the electrons will not flow. To periodically stop the electrons from flowing, one could add a switch that can complete the circuit (fig. B) or cause a break (fig. A). Of course, if completed this would just waste the battery's electrical energy, so to get it to do work, you would also connect something, like a light bulb, to the wire. An incandescent light bulb also contains wire inside. This wire coil is what "lights up" however, it must be whole to work. If the wire coil breaks, the electrons will not be able to flow from one terminal to another. See diagrams below.

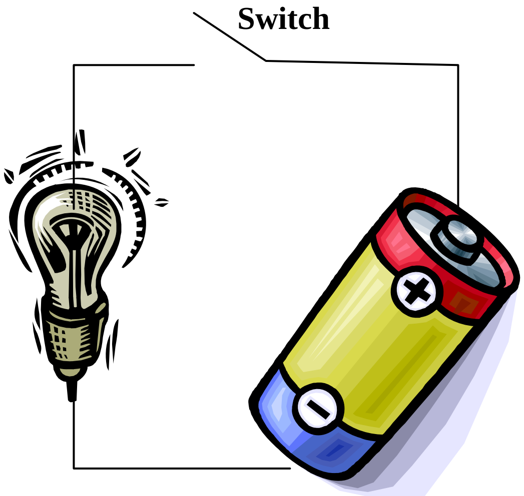


Figure A

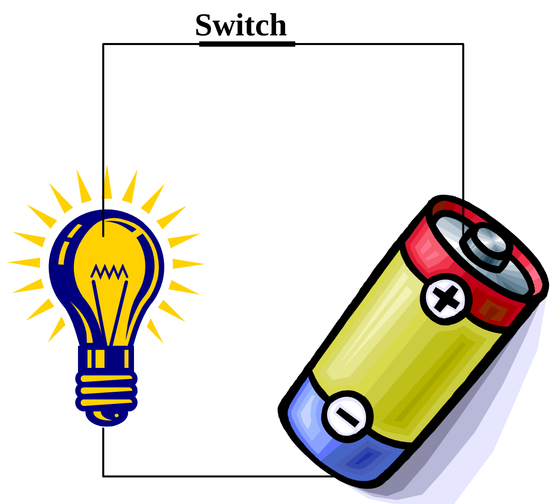


Figure B

Directions: Circle the best answer to each question. Answers can be found on Page 20.

4. Which of the following statements is true concerning lighting up a light bulb?
   1) A wire must be connected from both ends of the battery to the light bulb.
   2) Electrons flow from the positive terminal towards the negative terminal.
   3) The battery does not need to be directly connected to the light bulb.
   4) The battery can be connected to the light bulb by a piece of string.
   5) Electrons will flow from the light bulb towards the negative terminal of the battery.

5. Which of the following statements would cause the light bulb to remain dark?
    1) The switch remains open, thus not completing the circuit for the electrons to flo
    2) The battery is "dead," meaning that there are not enough electrons to power the bulb.
    3) The wire used to connect the battery terminals with the light bulb is not a conductor of electrical current.
    4) The wire coil inside of the light bulb is broken.
    5) All of the above.

Directions: Circle the best answer to each question. Answers can be found on Page 20.

6. Some energy sources do not need to be renewed for they occur naturally in abundance. Which energy type is considered a renewable energy source?
    1) Oil
    2) Coal
    3) Gasoline
    4) Wind
    5) Nuclear

7. A ball rolling across a flat surface will eventually slow to a stop. Which force will stop this ball from permanently rolling?
    1) Friction
    2) Gravity
    3) Heat
    4) Inertia
    5) Acceleration

8. The **frequency** of sound is the number of complete waves produced each second, measured in *hertz*. A 60 Hz sound has how many waves per second?
    1) 6
    2) 10
    3) 60
    4) 600
    5) 6000

Answers & Explanations

Page 1: Words You Need To Know
1. e
2. a
3. b
4. d
5. c

Pages 2-3: Test Your Knowledge
1. a
2. b
3. a

Page 5: Test Your Knowledge
1. a
2. e
3. f
4. b
5. c
6. d

Page 8: Test Your Knowledge
1. a
2. b
3. d
4. c
5. c
6. a
7. b

Page 10: Test Your Knowledge
1. False
2. True
3. True

Pages 12: Test Your Knowledge
1. d
2. c
3. c
4. a

Page 16: Review Questions
1. b
2. c
3. d
4. d
5. a
6. Crest
7. Trough
8. Hertz

Pages 17-19: GED Practice Exercises

1. 4
2. 2
3. 2
4. 1
5. 5
6. 4
7. 1