CRCT Science Review

Directions:
Students will popcorn read each question and answer.
Read a paragraph then "popcorn it."

Students are encouraged to take notes and/or write down facts that they feel they need to remember.

All students should LISTEN and PAY ATTENTION!

Physical Science Content Information and Essential Questions/Answers

Structure of Matter Essential Questions and Answers:

What is an atom?
The smallest particle of an element.

What is a molecule?
A particle made of two or more atoms bonded together.

What is a pure substance?
A substance made of one kind of matter and having definite properties.

What is an element?
A substance that contains only one type of atom and cannot be broken down by chemical or physical means.

What is a compound?
A compound is two or more elements bonded together by chemical means.

What is a mixture?
A mixture is two or more substances that can be separated by physical means.

What is the difference between a pure substance (elements and compounds) and mixtures?
Pure substances cannot be separated by physical means while mixtures can.

Describe the movement of particles in a solid.
Particles in a solid have a definite shape and volume and vibrate in place.

Contrast the movement of particles in a liquid and a gas.
Particles in a liquid are close together but are able to slide pass each other, while particles in a gas are spread apart and move at high speeds.

D**escribe the movement of particles in the plasma state.**
Particles in the plasma state do not have a definite shape or volume and have broken apart.

Chemistry of Matter Essential Questions and Answers:

What is matter?
Matter is anything that has mass and volume.

What is a physical property? Give examples.
A physical property is any characteristic of a substance that can be observed without changing its identity. Examples of a physical property include density, boiling point and melting point.

What is a chemical property? Give examples.
A chemical property is a characteristic of a substance that allows it to change its identity when in contact with another substance. Examples of a chemical property include reactivity and combustibility.

Distinguish between a physical change and a chemical change.
A physical change is a that change affects the physical properties of a substance, but does not change its identity. A chemical change produces an entirely new substance.

What are some examples of a physical change?
Examples of a physical change include changing the size or shape of an object, freezing water for ice cubes, crushing an aluminum can, mixing oil and vinegar, or bending a paper clip.

What are some examples of a chemical change?
Examples of a chemical change include burning a match, a nail rusting or milk spoiling.

What are some indicators of a chemical change?
Indicators of a chemical change include the development of a gas, formation of a precipitate, a change in temperature or a change in color.

What is the Law of Conservation of Matter?
The law of conservation of matter states that matter is neither created nor destroyed.

How can the Law of Conservation of Matter be demonstrated?
The Law of Conservation of Matter can be demonstrated by performing an experiment in which the masses of substances are carefully measured and compared before and after the substances are involved in a chemical reaction. The masses of the substances before and after the chemical reaction should be equal provided that the reaction takes place in a closed system.

Periodic Table Essential Questions and Answers:

The 118 **elements** on the modern **periodic table** are arranged by increasing atomic number in rows called **periods**. The **physica**l and **chemical properties** of elements are periodic. Elements with similar properties are located together on the periodic table. Columns of elements have similar physical and chemical properties and are classified as **groups** or **families**.

Metals are found to the left of the staircase on the periodic table. These elements are shiny (have **luster**), are **conductors** of electricity and heat, are **malleable** and **ductile**. **Nonmetals** are found to the right of the staircase on the periodic table. Nonmetals are elements that can be dull, are good **insulators** of electricity and heat, and are not malleable or ductile. Some elements have properties of both metals and **nonmetals**. These elements are called **metalloids**. **Metalloids** are located on the border of the staircase on the periodic table.

What are some characteristics of metals? Give examples.
Metals are shiny, good conductors of electricity and heat. They are also malleable (can be hammered into thin sheets) and ductile (drawn into wire). Examples: copper, gold, iron

What are some characteristics of nonmetals? Give examples.
Nonmetals are very poor conductors of electricity and heat. Solid nonmetals are brittle and neither malleable or ductile. Examples: oxygen, carbon, bromine

What are some characteristics of metalloids? Give examples
Metalloids have both characteristics of metals and nonmetals. They are weak conductors of electricity also called semiconductors. Examples: boron, silicon, germanium

How is the periodic table organized?
Elements are in order of increasing atomic number. The table has 7 horizontal rows called periods and 18 vertical columns called groups (families).

What does the atomic number tell you?
The atomic number tells the number of protons in each atomic nucleus.

Why are groups in the Periodic Table called families?
Elements in the same group are called families because they have properties that are remarkably similar to one another.

How are chemical symbols written?
Chemical symbols can be written as one or two letters. The first letter in always capitalized while the second letter is always lower case.

What are some common chemical formulas?
NaCl (table salt), H_2O (water), H_2SO_4 (sulfuric acid), CO_2 (carbon dioxide)

Law of Conservation of Matter Essential Questions and Answers:

The cornerstone of chemistry is the Law of conservation of mass which states that matter can neither be created nor destroyed, just change forms. In other words, during a chemical reaction, everything you start with, you must end up with, but it might look different. For example, in the simple reaction in which iron and sulfur produce iron sulfide, the amount of the iron and sulfur before the reaction would equal the amount of the iron sulfide after the reaction. The iron sulfide has different physical properties than the iron and sulfur separately, but the masses of the substances before the reaction are the same as the mass of the substance after the reaction.

This idea can be applied to chemical equations. Consider the equation for the iron/sulfur reaction above:

$$Fe + S \rightarrow FeS$$

In this equation there is the same number of atoms in the reactants as in the product. Mass is conserved because no iron or sulfur was lost in producing iron sulfide. The reaction between baking soda and vinegar is written as follows:

$$NaHCO_3 + HOOCCH_3 \rightarrow NaOOCCH_3 + H_2O + CO_2$$

Again, mass is conserved because each side of the equation has the same number of atoms: one sodium atom, five hydrogen atoms, three carbon atoms and five oxygen atoms.

Another common reaction is as follows:

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

The first equation is iron rusting. The coefficients in front of the iron, oxygen, and iron oxide(rust) denote that there are multiple numbers of those atoms needed to balance the equation. In other words there must be the right number of reactants to result in an even number of products. There must be four iron atoms and six oxygen atoms to form two molecules of iron oxide. Balancing the chemical equation in this manner shows that mass is conserved in a chemical reaction.

Here are some other common reactions:

$$2H_2+O_2 \rightarrow 2H_2O$$
$$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$$
$$2Na + Cl_2 \rightarrow 2NaCl$$

Respectively, they are the formation of water, the burning of natural gas, and the formation of salt (sodium chloride).

The law of conservation of mass holds true for all chemical reactions. However in situations where particles are moving at speeds close to the speed or light or in nuclear reactions, mass can be traded for energy or energy can be trade for mass. This conversion is given in Einstein's Theory of Relativity and is expressed as $E=mc^2$.

Energy Essential Questions and Answers:

What is the law of conservation of energy?
The law of conservation of energy states that energy is neither created nor destroyed, but transferred from one form to another. Dropping a ball illustrates the law of conservation of energy. Although the ball doesn't bounce back to its original height, energy is not lost – it is transferred to the ground.

What is potential energy?
Potential energy is stored energy. It is the energy an object has because of its position or shape. For example, the stretched bow of a bow and arrow has potential energy due to its shape. An object lifted high in the air has been given potential energy due to its height or position.

What is kinetic energy?
Kinetic energy is the energy of motion. All moving objects have kinetic energy by virtue of their motion. A bowling ball rolling down the bowling alley has kinetic energy due to its motion. The kinetic energy in the rolling bowling ball was transferred to it from the kinetic energy of the arm motion from the individual who rolled it!

Describe the relationship between kinetic energy and potential energy using an example.
A ball being thrown in the air has kinetic energy because it is moving. The ball is also gaining potential energy (gravitational) as it travels higher and higher into the air. The kinetic energy of motion is being transferred into potential (stored) energy. The ball has the greatest amount of potential energy at its highest point. As it begins to fall, this potential energy begins to transfer into kinetic energy.

Compare and contrast the different forms of energy (heat, chemical, nuclear, light, electrical, mechanical, and sound) **in terms of their characteristics.**
All of the forms of energy can be transformed from one form to another. Some forms of energy such as sound, need a medium in order to be transferred whereas others such as light, do not.

Heat Essential Questions and Answers:

How does temperature relate to kinetic energy?
All matter is made of particles that are in constant motion. Because the particles are in motion, they have kinetic energy. Temperature is the measure of the average kinetic energy of the particles in an object.

What is heat?
Heat is the transfer of energy between objects that are at different temperatures.

What is thermal energy?
Thermal energy is the total energy of the particles that make up a substance. Thermal energy depends on the temperature of the substance and the amount of substance that you have.

What are the three ways that heat can transfer?
Heat can transfer by conduction, convection, and radiation.

What is conduction?
Conduction is the transfer of thermal energy through direct contact.

What is convection?
Convection is the transfer of energy by the movement of a liquid or a gas.

What is radiation?
Radiation is the transfer of energy through matter or space as electromagnetic waves, such as visible light or infrared waves.
expands. When there is a decrease in temperature, particles move slower. As they move slower, they contract and become closer together. This contraction of particles causes the substance to have less volume.

Contrast between heat and temperature.
Heat is the transfer of energy between objects, while temperature is the measure of the kinetic energy of a substance.

How can heat cause matter to expand and contract?
When there is an increase in temperature, particles move faster. The particles do not expand but there is an increase in volume because they spread out so that the entire substance expands. When there is a decrease in temperature, particles move slower. As they move slower, they contract and become closer together. This contraction of particles causes the substance to have less volume.

Contrast between heat and temperature.

Heat is the transfer of energy between objects, while temperature is the measure of the average kinetic energy of a substance.

Heat is the transfer of thermal energy. Heat is always transferred from an area of high thermal energy to an area of low thermal energy. This transfer process can occur by three different methods: conduction, convection, and radiation.

Conduction is the process where thermal energy is transferred through direct contact of particles. Partilces of matter are always in motion due to thermal energy. As the particles move, they bump into each transfering that motion to the next particle. Conduction is most efficient in a solid, but can happen in a fluid (liquid or gas). The primary example of this is a metal pot handle getting hot when put on a stove.

Convection is the process of transfering thermal energy in a fluid due to a current. Typically, as a substance gains thermal energy particles move more and become less dense. As the less dense particles float to the top of the more dense particles, the thermal energy they contain is carried with them. The primary example of this is a pot of water boiling.

Radiation is the process of transfering thermal energy without matter by electromagnetic radiation. The thermal radiation is also refered to as infrared radiation. The primary example of this is the sun heating the surface of the earth.

Light Essential Questions and Answers:

What is reflection?
Reflection is when light bounces off of a surface.

How do we see things that do not emit their own light?
Objects that do not emit their own light must reflect light in order to be seen. Without light there is no sight.

What is refraction?
As light travels through different mediums (such as air and water), it changes speed and direction. This changes the way we see the object. A great example is a spoon in a clear glass of water. The spoon looks bent because of refraction.

How is light diffracted?
It is diffracted when it bends around barriers or through openings.

How can absorption of light be described?
Absorption is the transfer of energy carried by light waves to particles of matter. An example of this is when you shine a flashlight in the air. The air particles absorb the light energy from the light which causes the light to become dimmer the farther it shines.

How do mirrors reflect light?
Mirrors have a very smooth surface which allows light waves to be reflected at the same angle. When your eye detects the reflected beams, you can see a reflection on the mirror's surface.

How do lenses work?
Lenses are a curved transparent object that forms an image by refracting light. There are two types of lenses, convex and concave and are classified by their shape.
Why do objects have different colors? Objects reflect the colors you see and absorb the other colors of light.

How does refraction create the colors of the visible spectrum?
When white light is refracted, the amount that the light bends depends on its wavelength. Light waves with shorter wavelengths bend more than light waves with longer wavelengths. Because of this, white light can be separated into different colors during refraction.

Sound Essential Questions and Answers:

What is a vibration?
A vibration is the complete back-and-forth motion of an object.

What is a wave?
A wave is a disturbance that transmits energy through matter or space.

How does the energy from a vibration produce sound?
The forward movement of the object producing vibrations pushes the air particles in front of it closer together, creating a region of higher density and pressure called a compression. As the object moves backward, air particles close to the object become less crowded, creating a region of lower density and pressure called a rarefaction. As the object continues to produce compressions and rarefactions, they travel away from the object as sound transmitted through the medium.

What is the frequency of a wave?
The frequency of a wave is the number of waves produced in a given amount of time.

What is a wavelength?
A wavelength is the distance between any two adjacent crests or compressions in a series of waves.

What is the amplitude of a wave?
The amplitude of a wave is the maximum distance the wave vibrates from its rest position. The rest position is where the particles of a medium stay when there are not disturbances.

What is the relationship between amplitude and energy?
A wave with larger amplitude carries more energy than a wave with small amplitude.

What is the Doppler effect?
The Doppler effect is the apparent change in the frequency of a sound caused by the motion of either the listener or the source of the sound.

What does the term pitch mean?
The pitch of a sound is how high or low the sound is perceived to be. The pitch of a sound is determined by the frequency of the sound wave.

What does it mean to say a sound is loud or high in volume?
Loudness is how loud or soft a sound is perceived to be.

How does a wave's changing frequency affect its pitch?
When the frequency of a sound wave increases the pitch becomes higher and when the frequency of a sound wave decreases the pitch becomes lower.

Sound and Light Waves Content Information:

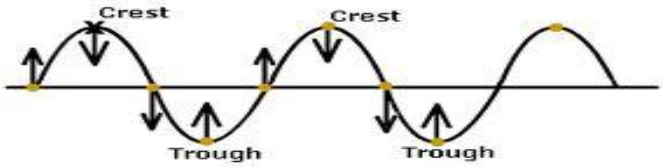
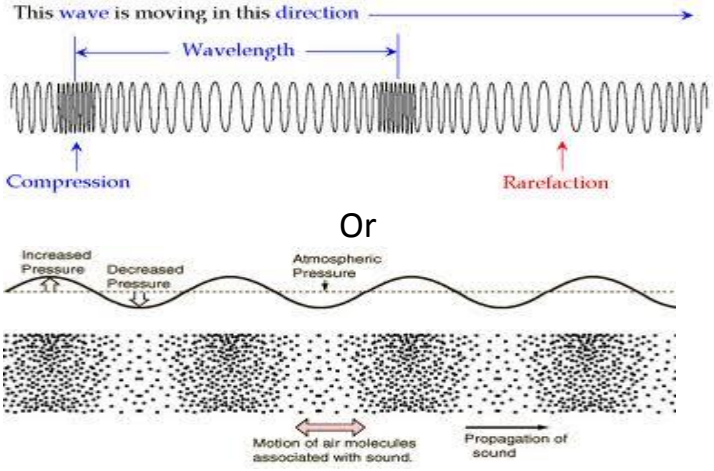
A vibration or a disturbance that transfers energy is called a **wave**. Waves that require a **medium** to travel are **mechanical waves**. A s**ound wave** is a mechanical wave. Waves that do not require a medium to travel are **electromagnetic waves**. Light and radio waves are common types of electromagnetic waves. Electromagnetic waves, like light, can travel through empty space.

If the energy of a wave moves side to side and the wave medium moves up and down perpendicular to the movement of the energy, a **transverse wave** is formed. If the energy and the wave medium move side to side so that the motions are parallel, a **longitudinal wave** is formed. Light is an example of a transverse wave while sound is an example of a longitudinal wave.

Waves have similar characteristics that can be measured. The distance from the **resting position** of a transverse wave to the highest point on the wave is the **amplitude**. It is the

amplitude of sound waves that determines the **loudness**. The loudness of a sound is measured in **decibels**. The highest point of the wave is the **crest** and the lowest point is the **trough**. On a longitudinal wave the corresponding parts are the **compression** and the **rarefaction**. The **wavelength** is the distance between a crest and the very next crest on a transverse wave or from the start of one compression to the start of the very next compression on a longitudinal wave.

The number of waves that pass a given point per second is the wave **frequency**. If you compare two sounds, the sound with the highest frequency has the shortest wavelength. In the same medium, all sound travels at the same speed. The frequency and the wavelength may differ. The frequency, measured in **Hertz**, of a wave is inversely proportional to its wavelength. For example, the high **pitch** sound created by the keys on the extreme right side of the piano keyboard has a shorter wavelength than the low pitch sounds of the keys on the extreme left of the keyboard. Like sound, all colors of visible light travel at the same speed when traveling in the same medium. The violet light and the red light that you see when viewing a rainbow both travel at about 3 x 10^8 m/s. In fact all **electromagnetic waves** travel at the same speed in the same medium. The violet light has a higher frequency and a shorter wavelength than the red light. The two colors are at opposite ends of the visible spectrum. Red light has the longest wavelength and violet light has the shortest wavelength.

Types of Waves	Illustrations
Transverse Wave (tutorvista.com)	
Longitudinal Wave (gcsescience.com) and (hyperphysics.phy-astr.gsu.edu)	

Kinetic and Potential Energy Essential Questions and Answers:

Energy is a part of everything that we do in life. It is all around us. Energy is the ability to do **work**. There are two basic kinds of energy. All energy can be classified into either – kinetic or potential.

Potential Energy is energy of position or stored up energy. A hammer being held high above the ground has the potential to drive a nail into a piece of wood when it hits the nail.

Kinetic Energy is the energy of motion. The word kinetic comes from the Greek word *kinetikos* which means "motion." A baseball bat uses kinetic energy when it swings and possibly hitting the baseball. Because the object is in motion, it has the ability to do work.

Kinetic energy depends on both the mass and velocity. The mathematical relationship between kinetic energy (K.E.), mass, and velocity is:

$$\text{K.E.} = \frac{\text{mass x(velocity)}^2}{2}$$

The **law of conservation of energy** states that energy is neither created nor destroyed, but transferred from one form to another. Some common forms of energy are: **heat, nuclear, light, mechanical, and chemical**.

What is the law of conservation of energy?
The law of conservation of energy states that energy is neither created nor destroyed, but transferred from one form to another. Dropping a ball illustrates the law of conservation of energy. Although the ball doesn't bounce back to its original height, energy is not lost – it is transferred to the ground in the form of heat and to the air in the form of sound.

What is potential energy?
Potential energy is stored energy. It is the energy an object has because of its position or shape. For example, the stretched bow of a bow and arrow has potential energy due to its shape. An object lifted high in the air has been given potential energy due to its height or position.

What is kinetic energy?
Kinetic energy is the energy of motion or position. All moving objects have kinetic energy by virtue of their motion. A bowling ball rolling down the bowling alley has kinetic energy due to

its motion. The kinetic energy in the rolling bowling ball was transferred to it from the kinetic energy of the arm motion from the individual who rolled it!

Describe the relationship between kinetic energy and potential energy using an example.
A ball being thrown in the air has kinetic energy because it is moving. The ball is also gaining potential energy (gravitational) as it travels higher and higher into the air. The kinetic energy of motion is being transferred into potential (stored) energy. The ball has the greatest amount of potential energy at its highest point. As it begins to fall, this potential energy begins to transfer into kinetic energy.

What is gravitational potential energy?
Gravitational Potential energy depends on the height of the object that is above the Earth's surface. For example, a waterfall, suspension bridge, and falling snowflake all have gravitational potential energy. Weight also determines the amount of gravitational potential energy on an object. As a famous saying "The bigger they are the harder they fall," can be one example of how weight can play a major factor in gravitational potential energy. The formula for gravitational potential energy (G.P.E.):

G.P.E. = Weight X Height

What is an energy conversion/transformation?
Energy can be transformed from one form to another form and from one object to another. Changes in the forms of energy are called energy conversions or energy transformations. All forms of energy can convert to other forms of energy. For example, the Sun's nuclear energy can convert into heat energy and or light energy. Solar panels can convert the energy from the Sun into electricity as well.

What is work?
The term work has a special meaning in science. Work is the force acting on an object to move the object from one place to another. To calculate work the force used is multiplied by the distance the object moves. When you push, lift, or throw an object, you are doing work.

What is a joule?
It is a term scientists used to represent a metric unit of work. One joule (1 J) is equal to one Newton-meter (N-m) of work.

What is friction?
Friction is a force that opposes the motion of an object. There are different types of friction that can cause an object to move. The types of friction include: sliding friction, rolling friction, fluid friction, and static friction.

Gravity Essential Questions and Answers:

How does the strength of the force of gravity depend on the mass of the objects and the distance between them? The force of gravity increases as the distance between objects decreases; the opposite is true as the distance increases. The more massive and object is, the more gravitational force it will exert. The less massive an object is the less gravitational force it will exert.

How do the dynamics of the universal law of gravitation relate to the position and mass of the sun and planets? The sun exerts the greatest amount of gravitational force on the planets closest to it. The more massive gas giants exert more gravitational force than the smaller terrestrial planets.

What is the difference between mass and weight? Mass is the amount of that something is made of. Weight, on the other hand, is a measure of the gravitational force exerted on an object, usually by the earth.

Motion and Simple Machines Essential Questions and Answers:

What is speed?
Speed is the distance covered per unit of time. (per means divided by). The formula for speed is distance ÷ speed.

What is the unit for speed used in science?
m/s or meters per second

What is velocity?
Velocity is both the speed and direction of an object.

What is acceleration?
Acceleration is any change in speed and/or velocity. The unit for acceleration is m/s/s

What are distance-time graphs?
Distance-time graphs are a way to visually show a collection of data. The time(s) is shown as the x axis and the distance (m) is shown on the y axis on the graph. These graphs are used to show motion, speed and/or acceleration of one or more objects.

What are the six simple machines?
Lever, pulley, wheel & axle, wedge, inclined plane, screw

What is a lever and what are the three different types of levers?
A level is a bar that pivots at a fixed point called a fulcrum. The three types of levers are called first class, second class and third class levers.

What is a screw?
A screw is an inclined plane that is wrapped in a spiral.

W**hat is a pulley?**
A pulley is made from a wheel and rope used to make lifting easier by changing the direction of the force.

What is an inclined plane?
An incline plane is a straight, slanted surface. A ramp is an example of an inclined plane.

What is a wedge?
A wedge is a double inclined plane that moves.

What is a wheel and axle?
A wheel and axle is a simple machine that consists of two circular objects of different sizes.

Force and Motion Essential Questions and Answers:

What is force?
A force is a push or a pull.

What is mass?
Mass is the amount matter contained in an object or substance.

What is inertia?
Inertia is the tendency to resist changes in motion.

Distinguish between balanced and unbalanced forces.
Balanced forces are forces that act on an object, but do not result in motion. The net force in this case is zero. Unbalanced forces, on the other hand do result in motion and the net force is greater than zero.

How are gravity and inertia related?
Gravity is the force of attraction between two objects of different masses. We are attracted to the Earth due to this force of attraction. The more the gravitational force between two objects, the more inertia they will have and the more force will be required to overcome this inertia and change the motion of the objects.

How are friction and inertia related?
Friction is the opposing force that acts between two objects in direct contact. The greater the force of friction between objects, the more inertia they will have and the more force will be required to change the motion of the objects.

Describe Newton's First Law in terms of forces, mass and inertia.
All objects have inertia due to their mass. Due to their inertia, objects in motion will stay in motion and objects at rest will stay at rest unless acted on by an unbalanced force.

Describe Newton's Second Law in terms of forces, mass and inertia
The greater the force applied to an object, the more the object will accelerate. The more mass an object has, the more inertia it will have and the more force it will require to cause it to accelerate.

Describe Newton's Third Law in terms of forces.
For every action force, there is an equal and opposite reaction force.

Force and Motion Content Information:

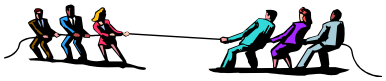
Force is any push or pull on an object. In many of your everyday experiences, you exert a force on an object. Force gives energy to an object to cause it to move, stop and sometimes change direction. Force is related to motion. An example of you applying a force could be when you have to cut the grass. You apply a force (push and pull) to the lawn mower which helps you cut the grass.

Motions of objects are a change of position. Objects are in motion when a force is exerted upon the object to cause it to move. An example could be when the soccer player kicks the soccer ball to score for his team. The ball and the soccer player is in motion.

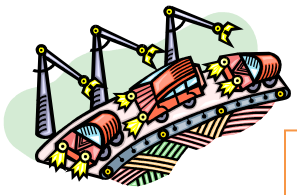
Mass is how much matter is in an object. Mass is measured in grams. You can use a triple beam balancer to determine the mass of an object and or a digital balance.

Balanced Force is a force that is equal in size but opposite in direction. Example: when you have a group of students are playing a game of tug of war and it is even on both sides.

Unbalanced Force is a force that causes a change in the motion of the object. Example: when you have one group that is pulling with more force than the other group, which causes the other group to move forward and cross the line.



Velocity is when an object is moving at a certain speed and in a certain direction.



If the cars are all moving in the same direction and at the same speed, they all have the same velocity.

If the cars are all moving in a different direction and at the same speed, they have a different velocity.

Speed tells how fast an object is moving towards a designated point.

The formula for speed: $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$ or $v = d/t$

Time is how long it will take the object to reach a certain point.

The formula for time: $\text{Time} = \frac{\text{Distance}}{\text{Speed}}$ or $t = d/v$

Distance is the length of the path between two given points. Example: Runner is running a certain distance to stay healthy.

The formula for Distance: $\text{Distance} = \text{Speed} \times \text{Time}$ or $d = vt$

Acceleration is the rate of change in velocity. Acceleration is how fast an object is increasing its speed in a certain direction; also known as positive acceleration. Deceleration is the decrease in speed (slowing down) in a certain direction. This is called negative acceleration. Example: school bus slowing down to stop at the stop sign.

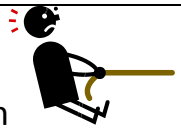
Potential Energy is energy of position or stored up energy. A hammer being held high above the ground has the potential to drive a nail into a piece of wood when it hits the nail.

Kinetic Energy is the energy of motion. The word kinetic comes from the Greek word *kinetikos* which means "motion." A baseball bat uses kinetic energy when it swings and possibly hitting the baseball. Because the object is in motion, it has the ability to do work.

Kinetic energy depends on both the mass and velocity. The mathematical relationship between kinetic energy (K.E.), mass, and velocity is:

$$\text{K.E.} = \frac{\text{mass} \times (\text{velocity})^2}{2}$$

Friction is a force that opposes the motion of an object. There are different types of friction that can cause an object to move. The types of friction include: sliding friction, rolling friction, fluid friction, and static friction.

Types of Friction	Examples
Sliding Friction 	To make the box move, the mover is pushing the solid box over a solid surface. The two solid surfaces are moving over each other which allow the box to move in a certain direction.
Rolling Friction 	Rolling friction occurs as the skaters roll over a surface. The friction acts in a opposite direction which cause the skaters to move.
Fluid Friction 	The surfer shows how the surf board pushes fluid aside to move across the wave (water).
Static Friction 	The friction that acts on objects that is not moving. As the gentleman is trying to pull the object that is attached to the rope.

Gravity is the force of attraction that depends on the mass between any two objects and the distance. The more mass an object has the greater the force of gravity of that particular object. Gravity is a force that keeps us from floating on Earth. In space there is little gravity and this is one reason why astronauts float in space. Gravity also keeps the planets aligned around the sun within their own orbits.

Inertia is a property of matter that tends to resist any change. In other words, an object stays at rest unless acted upon by another force that causes the object to move. The items on the table below will remain on the table unless an outside force causes them to move. A ball rolling will continue to roll unless an outside force caused it to stop.

Newton's Three Laws of Motion

Newton's First Law	An object will stay at rest or in motion unless it is acted upon by a force.	**Inertia** 
Newton's Second Law	Force, mass, and acceleration are related. Unbalanced forces acting on an object is equal to the mass of the object times the acceleration.	**F= m × a** 
Newton's Third Law	For every action, there is an equal or opposite reaction.	**Action/Reaction** 

Work, Power, and Time Essential Questions and Answers:

What is required for work to be done?
In order for work to be done, there must be movement in the direction of the force applied.

What is power?
Power is the amount of work completed in a given amount of time.

What is the relationship between work, power and time?
The more time it takes to complete work the less power is used.

Work, Power, and Time Content Information:

Work is defined as applying a force to an object over a distance. A force is a push or a pull. Work is done when a force causes an object to move in the direction that the force is applied. For example if you push a box across the floor, you are doing work on the box. The force is your pushing. The distance is how far you pushed the box. If you push on the box but it does

not move, no work is being done. Even though you are applying a force, there is no motion in the direction of the force therefore there is no work.

Work can be calculated by the following equation: work = force x distance. Force is measured in Newtons (N), distance is measured in meters (m) and work is measured in Newton meters (Nm) which is equal to a Joule (J). As an extension, students can calculate work and power using this information.

Power is how quickly work can be done. Continuing with the example above, a person who can push the box faster across the room is using more power. Power can be found by the equation: power = work/time. Work is in Joules (J), time is in seconds (s) and power is in joules per second (j/s) or watts (W).

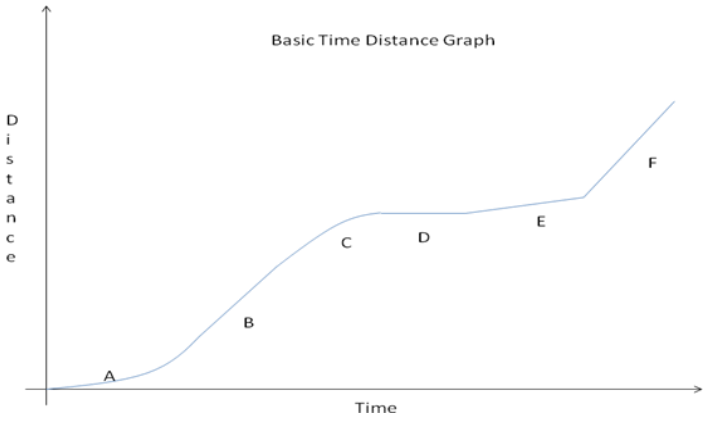
Speed, Acceleration, and Velocity Content Information:

An object's motion can be described by velocity and acceleration. Velocity is comprised of two components, speed and direction. Speed is how fast an object is going. Direction can be any description that offers a common frame of reference. For example, a car's velocity might be going 65 km per hour (speed) north (direction) or a student might be walking 1.4 meters per second (speed) south toward the cafeteria (direction).

The speed of an object can be instantaneous or an average. Instantaneous speed is typically measured through direct observation like a speedometer or a radar gun. For science class, average speed is more often used and is calculated by distance divided by time. Speed = distance/time.

Acceleration is an objects change in velocity. This means that a change in the speed of an object, the direction of the object or both shows acceleration. A car slowing down to a stop sign is a change in speed and therefore shows acceleration. A man riding a bicycle at a constant speed, changing directions from south to southwest also shows acceleration. Acceleration is any change in velocity and can include slowing down, speeding up or turning. An increase in velocity is called positive acceleration and a decrease in velocity is called negative acceleration. In science we do not say an object decelerates, we say it has a negative acceleration.

Both speed and acceleration can easily be seen on a time distance graph. Consider the following graph:



Curved lines represent acceleration. Section A of the graph shows the object speeding up (positive acceleration) while section C of the graph shows the object slowing down (negative acceleration). The steeper the line, the faster an object is going (the greater the acceleration). Section D shows that the objects speed is zero, section E shows the least acceleration and section F shows the greatest acceleration.

Electricity Essential Questions and Answers:

What is electric current/current electricity?
Electrical current is the flow of electrically charged particles through a circuit.
What is static electricity?
Static electricity is the buildup of electrically charged particles on an object or surface.
How do electrical charges move through a circuit?
Electrical charges move through a circuit in one direction. In order for electrical charges to flow through a circuit, the circuit must in closed. A circuit can be opened or closed using a switch. An open switch interrupts the flow of electrical current through a circuit.
What are the major components of a circuit? What are the functions of each component?
The major components of a circuit are a cell, load and switch. The cell is the device in a circuit that provides electrical energy. The cell can be a battery or electrical energy provided by outlets. Once the cell provides the electrical energy it travels through the circuit via wires. Switches can be places along the circuit in order to control the flow of electricity. When a switch is open the flow of electricity is interrupted. Fuses and circuit breakers are devices that are used to prevent circuits from overloading. These devices automatically interrupt the flow of electrical current to prevent the damage caused by overloaded circuits or short circuiting. The load is the component of the cell that uses the electrical energy. A load could be anything from a light bulb to a video game.

What are the advantages and disadvantages of parallel and series circuits?
In a series circuit, all parts of the circuit are connected in a single loop. The charges flowing through the circuit can only flow along one path. If one load of the circuit does not work, the entire circuit stops working. Although this is usually viewed as a disadvantage, there are occasions when it is desirable for a circuit to work in this way. Automatic doors are an example of a simple series circuit. When a person steps on the mat or breaks the switch in some other way, the doors open. Once the circuit is again completed, the doors close.
In a parallel circuit, the loads are located on separate branches of the circuit. Because electricity can flow through more than one path, if one load stops working the rest of the circuit will still work. The wiring in your home is installed in this way. If it were to be in series, you would not be able to run any appliances unless all of your appliances were plugged in and operational.

Electricity and Magetism Essential Questions and Answers:

Contrast between the effect that conductors and insulators have on electric current. Conductors are materials that allow charges to move easily. Most metals are good conductors because some of the electrons in metals are free to move about. Insulators are materials in which charges cannot move easily. Insulators do not conduct electric charges very well because electrons are tightly bound to the atoms of the insulator and cannot flow freely.

What are some advantages of a series circuit?
A series circuit is a circuit in which all parts are connected in a single loop. Some series circuits use a load as a switch. An example would be a automatic door. All loads must be turned on and working for all charges to flow in a series circuit. This is useful in wiring bank alarms and certain computer circuits.

What are some advantages of a parallel circuit?
A parallel circuit is a circuit where different loads are located on separate branches. In this type of circuit, each branch can function on its own. If one load is broken or missing, charges will still run through the other branches, and the loads on those branches will continue to work.

What is a generator?
A generator is a device that uses electromagnetic induction to convert kinetic energy into electrical energy.

How does a generator produce an electric current?
Generators contain a coil of wire attached to a rod that is free to rotate. The coil of wire is in between the pole of a permanent magnet or electromagnet. As the rod is rotated, the coil of wire cuts through the magnetic field lines, and an electric current in induced.

What is a magnetic field?

A magnetic field exists in the region around a magnet in which magnetic forces can act. The shape of a magnetic field can be shown with lines drawn from the north pole of a magnet to the south pole.

How can you illustrate magnetic field lines?

Magnetic field lines show the shape of a magnetic field around a magnet. These lines map the strength of magnetic force. The closer together the field lines are, the stronger the magnetic field is. You can model magnetic field lines by sprinkling iron fillings around a magnet.