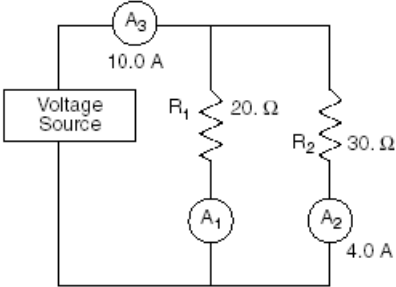
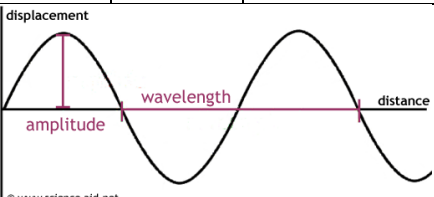
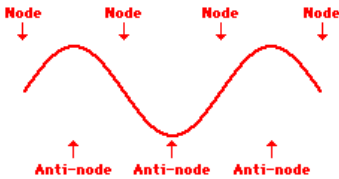
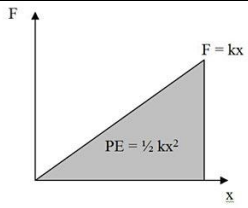
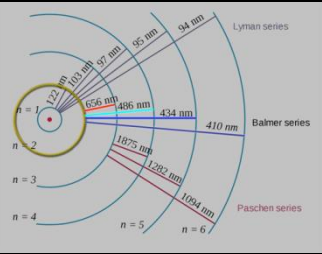
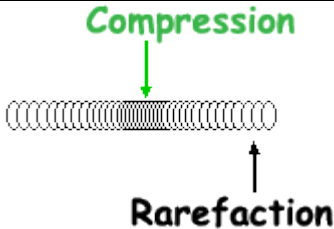
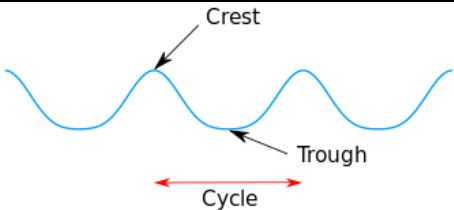
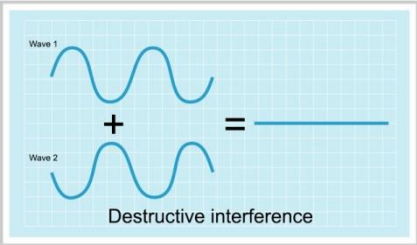
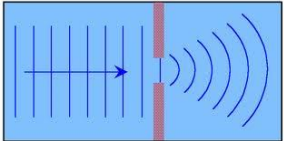
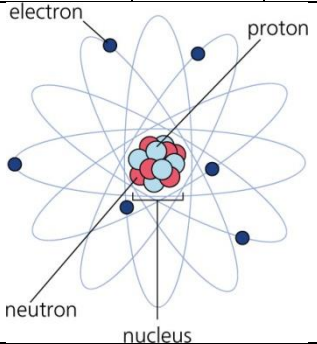


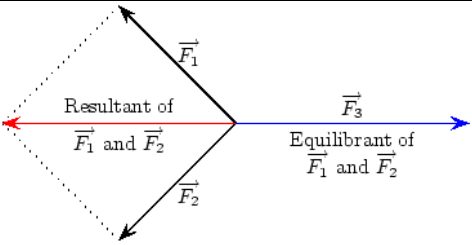
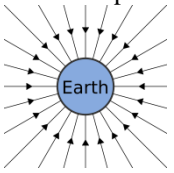
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
(Absolute) index of refraction	n		$n = \frac{c}{v}$	Property of material that determines the speed of light in the material $n=c/v$ “c” is constant, “n” and “v” have an inverse relationship. “n” is also inverse to wavelength and angle of refraction “ $\theta_2$ ”	SKILL 56
Acceleration	a	m/s <sup>2</sup>	$a = \frac{\Delta v}{t}, F = \frac{m}{a}$	The change in velocity in an object (either magnitude or direction). Occurs with a net force. (VECTOR). NET FORCE AND ACCELERATION DO THE SAME THING!	SKILLS 12-23
Ammeter				Device used to measure current. Should be set up in series with components to be measured. A <sub>3</sub> is total current A <sub>2</sub> is current through branch with R <sub>2</sub> A <sub>1</sub> is current through branch with R <sub>1</sub>	SKILL 42
Ampere	I	A, C/s		Unit of current, (the amount of charge that flows through a conductor per second) IF CHARGE IS IN ELECTRONS OR ELEMENTARY CHARGE YOU MUST CONVERT TO COULOMBS	SKILL 38
Amplitude				The maximum displacement of a crest or a trough of a wave	SKILL 48 and 49
Angle of incidence	$\theta_i, \theta_1$	Degrees		The angle between an incoming light ray and <b>the normal line</b>	SKILLS 55 and 56
Angle of reflection	$\theta_r$	Degrees		The angle between a reflected ray and the normal line ( $\theta_i = \theta_r$ )	SKILL 56
Angle of refraction	$\theta_2$	Degrees		The angle between the refracted ray and the normal line. Find angle of refraction by using the equation $n_1 \sin \theta_1 = n_2 \sin \theta_2$	SKILL 57
Annihilation				The conversion of matter into energy when a particle of matter and its antimatter meet. Use $E=mc^2$ to determine energy of photons produced by annihilation. Remember to include the mass of both particles	SKILL 47
Antimatter				Matter composed of antiparticles. Indicated by a line over the symbol Ex: anti-up is symbolized by $\bar{u}$	SKILL 47
Antinode				Antinode are the point of maximum displacement on a standing wave. Results from constructive interference when waves are in phase. (0 or 360 degrees apart)	SKILL 53

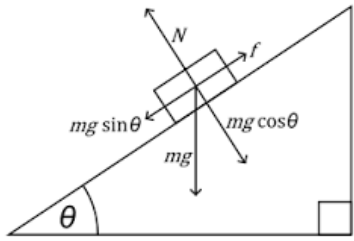
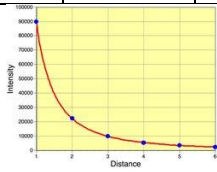
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Area under the curve (line or graph)				<p>The product of the assigned “x” and “y” is the area “bound by the graph”. For a rectangle area use xy, for a triangle area use 1/2xy.</p> <p>Examples: for a velocity vs time graph area equals distance or displacement</p> <p>-for a frequency vs wavelength graph area under any point equals velocity of the wave</p> <p>-for a force vs distance graph the area equals work or energy</p> <p>- for an Fs vs x graph area (always a triangle equals ½ bh)</p>	MULTIPLE SKILL SETS
Atomic Spectra				The absorption or emission lines that result from the movement of electrons between energy levels in an atom.	SKILL 57
Average velocity or Average speed	$\bar{v}$	m/s	$\bar{v} = \frac{d}{t}$ or $\frac{v_f + v_i}{2}$	Velocity of an object at constant velocity. The total distance over total time. Or the mid-point in velocity for an object moving with a constant acceleration.	SKILL 12
Baryon				A particle made up of 3 quarks. A proton is a baryon made up of 3 quarks (uud) and total charge of +1, an neutron is a baryon made up of 3 quarks (udd) with a charge of 0. Baryons experience the strong force.	SKILL 47
Blue shift				Apparent change in frequency resulting from the Doppler effect that occurs when a wave source and an observer are approaching each other.	SKILL 54
Centripetal acceleration	$a_c$	$m/s^2$		Change in the velocity of an object due to change in direction. Always pointed toward the center of the circle (VECTOR)	SKILL 25
Centripetal force	$F_c$	N	$F_c = \frac{mv^2}{r}$ , $F_c = ma_c$	The force that causes something to move in a circular path. Directed toward the center of the circle. $F_c$ and $a_c$ go in the same direction	SKILL 25
Charge	q	C or elementary charge		The property of matter that causes the EM force. All charges have electric fields. Moving charges have magnetic fields. Oscillating (accelerating charges) produce EM waves. $1e = 1.6 \times 10^{-19}C$ multiply into C and divide out. Transfer of charge in static electricity involves only the motion of electrons.	SKILL 33 and 34
Circuit				A conductive path where charge can flow. Requires a source of potential difference and some sort of resistance.	SKILL 42-45
Coefficient of friction	$\mu$	None	$F_f = \mu F_N$	A relationship between two surfaces (an object and the surface over which it moves).	SKILL 23
Collision				Can be elastic, inelastic or separation (explosion). Involve the conservation of momentum	SKILL 27

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Compression				An area on a longitudinal wave where particles are scrunched. Compressions are 1 wavelength apart.	SKILL 50
Conductor				A material that allows electrons to flow easily	SKILL 33
Constructive interference				When a crest meets a crest or a trough meets a trough during wave interference. Maximum interference occurs when the phase difference is zero. (Results in antinodes on a standing wave)	SKILL 53
Coulomb's Law				$F_e = \frac{kq_1q_2}{r^2}$ ; force between 2 charged particles.	SKILL 35
Crest				The high point in a wave	SKILL 48 and 49
Current	I	Amp (A) or C/s	$I = \frac{q}{t}$ or $I = \frac{V}{R}$	The flow of charge through a closed conducting loop	SKILL 38
Derived unit				A unit that is combined of other SI units (ex, N, J, A, V)	
Destructive Interference				When a crest and trough meet during wave interference. Happens when two waves are 180 degrees out of phase. (results in nodes)	SKILL 53
Diffraction				The bending of a wave around a barrier or through an opening. The amount of bending is dependent on the relative size of the wavelength to the size of the opening. (Most diffraction when wavelength is big and opening small). The speed of the wave and the wavelength do not change unless an additional factor such as medium or water depth changes. Evidence of wave nature of light.	SKILL 52


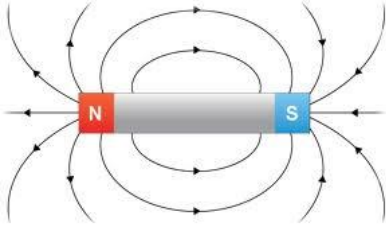
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Diffuse Reflection	<p>Regular Reflection: Incident rays, Reflected Rays. Eg. plane mirror or any other surface that produces a reflected image.</p> <p>Diffuse Reflection: Incident rays, Reflected Rays. This is like any surface that we can see but does not reflect an image</p>			Diffuse reflection occurs when the surface is not smooth. Normal lines are in different directions and the reflected rays will not form a clear image.	SKILL 52
DIRECT RELATIONSHIP	<p>Mass v. Net Force</p> <p>Net Force</p> <p>Mass</p>			A change in one variable causes a corresponding change in the other variable. $y = mx$ Examples: $F_f = \mu F_N$ (If $F_N$ doubles $F_f$ doubles) $F_{net} = ma$ (If $m$ doubles, $F_{net}$ doubles) $F_c = m \frac{v^2}{r}$ If $m$ doubles $F_c$ doubles	SKILL 19
DIRECT SQUARE RELATIONSHIP	<p>Kinetic Energy</p> <p>Velocity</p>			A change in one variable causes a corresponding proportional squared relationship. If “x” doubles the “y” quadruples....I “x” triples the “y” is multiplied by 9 etc.	SKILL 19
Discrete				Quantized, discontinuous or distinct. Usually used in physics to refer to energy levels or spectral lines.	SKILL 57
Displacement	d	m		A <b>VECTOR</b> which measures overall movement (length) from the starting point	MULTIPLE SKILLS
Distance	d	m		The total distance traveled as an object moves on a path (SCALAR)	SKILLS 4-32
Doppler effect				The perceived distortion of a wave when the wave source and the observer are in motion. Coming toward is higher frequency, moving away is lower frequency. If the pitch continually changes the object is accelerating. Red shifted light is toward low frequency (ie away). Blue is toward high frequency (ie toward)	SKILL 54
Elastic potential energy	$PE_s$	J or $\frac{kgm^2}{s^2}$	$PE_s = \frac{1}{2} kx^2$	The energy stored in a stretched spring. Can be converted to gravitational potential, kinetic energy or related to work done.	SKILL 28
Electric Field lines				Electric field lines always point away from positive and toward negative. Field lines never cross. Field lines are vectors.	SKILL 36
Elastic Collision				A collision in which the objects remain separate before and after the collision	SKILL 27
Electric Field strength	E	N/C	$E = \frac{F_e}{q}$ or $F_e = \frac{kq_1q_2}{r^2}$	The strength of the electric field on a charge. The amount of force on each unit of charge due to the electric field. If two like charges the force repulsive, if two opposite charges the force is attractive.	SKILL 35

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Electrical energy	W	J	$W = Pt = VIt$ $= I^2 R t = \frac{V^2 t}{R}$ $= Vq$	Equal to the amount of <b>work</b> done against an electric field. Equal to the total amount of energy in a circuit.	SKILL 37
Electrical power	P	W or J/s	$P = VI = I^2 R = \frac{V^2}{R}$	The rate at which energy is converted into other forms.	SKILL 38
Electromagnetic spectrum				The range of frequencies for photons of light. All EM waves move at $3.0 \times 10^8$ m/s through a vacuum or air. $c = f\lambda$ Created by the oscillation (acceleration) of charged particles.	SKILL 51
Electron				A negatively charged elementary particle that has a charge equal and opposite of a proton but has less mass. The electron is found outside the nucleus in orbits (energy levels). 1 electron has a charge of $-1.6 \times 10^{-19}$ C. It is a type of lepton matter (it does not interact with the strong force..	SKILLS 33-58
Electron volt	eV	eV	$1\text{eV} = 1.6 \times 10^{-19}\text{J}$	The amount of energy equal to the work done in moving an elementary charge (electron or proton) through a potential difference of 1 volt. Can also be the energy from the conversion of mass (1 universal mass unit = $9.31 \times 10^2$ MeV)	SKILL 37 and SKILL 57
Electroscope				Device used to sense charge on an object	SKILL 33
Electrostatic force	$F_e$	N	$F_e = Eq$ $F_e = \frac{kq_1q_2}{r^2}$	The force that acts between two charged objects. Directly proportional to the product of the charges and inversely proportional to the square of the distance between them.	SKILL 35
Elementary Charge	e or q	C	$1e = 1.6 \times 10^{-19}\text{C}$	The smallest possible quantity of charge that can be present on an independent (stable) particle. For example an electron or proton etc. To convert from elementary charges to coulombs, multiply by $1.6 \times 10^{-19}\text{C}$ . To convert to elementary charge divide by $1.6 \times 10^{-19}\text{C}$	SKILL 33, 37
Elongation of a spring	x	M	$F_s = kx$ , $PE_s = \frac{1}{2}kx^2$	The change in spring length from its equilibrium position	SKILL 24 and 28
Energy level		eV	$\Delta E = E_i - E_f$	The energy possessed by an electron based on its distance from the center of an atom (location in an atom). Ground state energy is negative, as an electron absorbs energy it becomes less negative. Electrons can only jump between levels given exact energy unless the energy exceeds amount needed for ionization (extra becomes kinetic). Increasing “n” means energy absorbed. Decreasing “n” means energy emitted.	SKILL 57

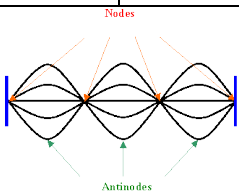
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Equilibrant				The force that is equal in magnitude and opposite in direction (180 degrees) from the <i>resultant</i> . The single force that keeps two other forces in <i>equilibrium</i> .	SKILL 22
Equilibrium			$F_{\text{net}}=0$ so $a=0$	A state when an object is not accelerating or experiencing a net force. ( $a=0$ or $v$ is constant) NOT SPEEDING UP OR SLOWING DOWN (ie rest or constant $v$ )	SKILL 6-22
Equivalent resistance	$R_{\text{eq}}$	$\Omega$	Series: $R_{\text{eq}}=R_1+R_2+\dots$ Parallel: $1/R_{\text{eq}}=1/R_1+1/R_2+1/R_3$	The overall resistance of a circuit or a segment of a circuit. -The overall resistance of a circuit or a segment of a circuit. $R_{\text{eq}}$ increases with every resistor in series ( $R_{\text{eq}}=R_1+R_2+R_3$ ). Adding a resistor decreases total current and reduces current and voltage in existing resistors - $R_{\text{eq}}$ decreases with every resistor in parallel $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ “Inverse of the sum of the inverses” Adding a resistor in parallel decreases the overall resistance and increases the total current (values for pre-existing resistors are unchanged)	SKILL 43-44
Fission				Nuclear reaction involving the splitting of the nuclei	SKILL 58
Force	$F$	$N$		A push or a pull on a mass or charge. Force is vector quantity.	SKILL 20-35
Free Fall				When an object falls due to the force of gravity (without air resistance)	SKILLS 14-18
Frequency	$f$	Hz or cycles/s	$v=f\lambda$ , $f=\frac{1}{T}$	The number of cycles/second of an oscillating particle, a wave or a pendulum.	SKILL 48-57
Frictional Force	$F_f$	$N$	$F_f=\mu F_N$	The force that opposes the motion of an object. For an object in motion use <i>coefficient of kinetic friction</i> . For an object at rest use <i>coefficient of static friction</i> .	SKILL 23
Fundamental Force				4 forces that govern nature – Strong, electromagnetic, weak, gravity	SKILL 47
Fusion				Nuclear Reaction involving the joining of 2 nuclei	SKILL 57
Generator				A device that converts mechanical energy into electrical energy	SKILL 37
Gravitational field strength	$g$	$N/kg$ $m/s^2$	$g = \frac{F_g}{m}$	The force per unit of mass of when an object is in a gravitational field.  Field arrows always point inward	SKILL 26
Gravitational Constant	$G$	$\frac{Nm^2}{s^2}$	$F_g = G \frac{m_1 m_2}{r^2}$	$6.67 \times 10^{-11} \frac{Nm^2}{s^2}$	SKILL 26
Gravitational Force	$F_g$	$N$	$F_g=mg$ $F_g = G \frac{m_1 m_2}{r^2}$	The force between two objects due to their masses. Vector	SKILL 26

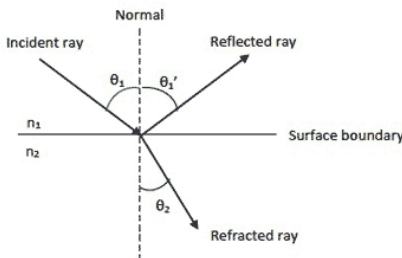
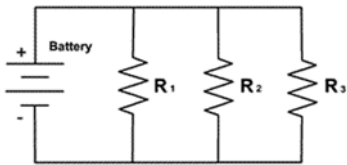
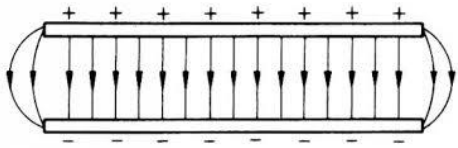
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Gravitational Potential energy	PE	J or $\frac{kgm^2}{s^2}$	PE = mgh	The energy of an object due to its position above the ground. Objects gain potential energy by moving against the gravitational field. Object naturally move from a high place to a low place. Gravitational energy gets converted to kinetic energy when an object falls.	SKILL 28
Gravity				The force of attraction between all masses.	SKILL 22 and 26
Ground State				The lowest or base level of an electron within an atom. Ground state is the most negative.	SKILL 57
Hadron				A particle that interacts through the strong nuclear force, EM force, weak force and gravitational force. Hadrons are made up of quarks. They can be classified as baryons (3quarks) or mesons (a quark and an anti-quark)	SKILL 47
Hertz		Hz		The unit of frequency. Equal to 1 cycle per second $\frac{cycles}{second}$	SKILL 48, 57
Horizontal Component	$A_x$		$A_x = A \cos \theta$	Parallel, horizontal or x-axis component of a resultant vector. Use for objects on a level surface.	SKILL 8, 10 etc
Impulse	J	Ns or $\frac{kgm}{s}$	$J = Ft = mv = \Delta p$	Causes a change in momentum of an object. Equal to the product of the average force acting on an object and the time the force acts.	SKILL 20
Inclined Plane				<p>A surface that is raised from the horizontal axis. Directions of motion are redefined as parallel and perpendicular.</p> <p>Perpendicular axis is at equilibrium <math>F_N = F_{g\text{perpendicular}} = F_g \cos \theta = mg \cos \theta</math></p> <p>The net force (acceleration) can be found using parallel axis</p> <ul style="list-style-type: none"> <li>-Frictionless <math>F_{\text{net}} = F_{g\text{parallel}} = F_g \sin \theta = mg \sin \theta</math> [so <math>ma = mg \sin \theta</math> becomes <math>a = g \sin \theta</math>]</li> <li>- With Friction <math>F_{\text{net}} = F_{g\text{parallel}} + F_f = mg \sin \theta + F_f</math></li> <li>-With Friction and applied force <math>F_{\text{net}} = F_{g\text{parallel}} + F_f + F_A</math></li> </ul>	SKILL 22
(Absolute) index of refraction	n	No Units	$n = \frac{c}{v}$	Property of material that determines the speed of light in the material $n = c/v$	SKILL 51 and 56
Inelastic Collision			$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v'$	A collision in which two objects combine after the crash	SKILL 27
Inertia				Inertia is mass. Inertia is an objects resistance to change in motion. Inertia does not change as you move in a gravitational field.	SKILL 20
Interference				When two or more waves are in the same place at the same time. Constructive Interference occurs when a crest/crest or trough/trough meet and form a supercrest or supertrough. In a standing wave constructive interference leads to antinodes from in phase motion and destructive interference leads to nodes in which points are 180 degrees out of phase.	SKILL 53
Internal Energy	Q	J		Usually refers to heat built up by friction within the object. The difference between the “ideal and the real” or start and final.	SKILL 28-32
INVERSE RELATIONSHIP				A change in one variable causes the opposite change in the other. For example as “X” doubles, “Y” is halved as “X” quadruples, “Y” is quartered. NOT LINEAR – NEVER CROSSES X AXIS	SKILL 19
INVERSE SQUARE RELATIONSHIP				A change in one variable causes the opposite and squared change in the other. For example, as “X” doubles, “Y” is quartered. As “X” triples, “Y” is divided by 9.	SKILL 19

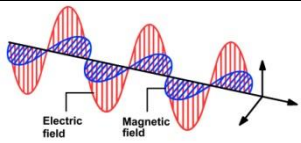

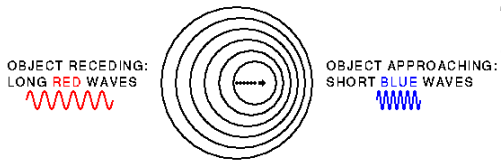



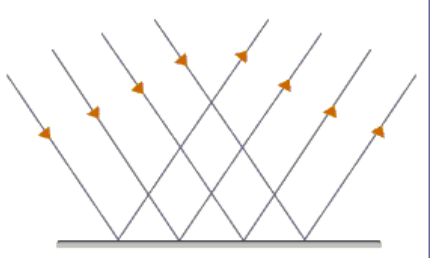
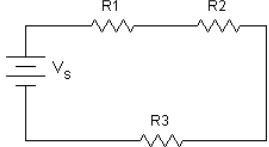
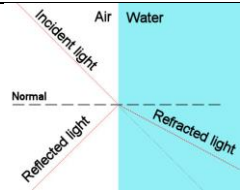
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Joule		J	$1\text{eV}=1.6 \times 10^{-19}\text{J}$	Unit of energy or work. (potential, kinetic, electrical energy, photon energy) or work. To convert from Joules to eV's divide by $1.6 \times 10^{-19}\text{J}$	SKILL 28-58
Kilogram		kg		Unit of mass	MULTIPLE SKILLS
Kinetic Energy	KE	J or $\frac{\text{kgm}^2}{\text{s}^2}$		The energy of an object associated with motion of the object	SKILL 28
Kinetic friction	$F_{fk}$	N		The force that opposes the motion of a moving object.	SKILL 23
Law of conservation of energy			$E_T = KE + PE + Q$	Energy can be transformed from one form to another but it is not lost.	SKILL 31
Law of conservation of charge				In a closed system the total charge (net charge) must remain the same. If one object loses 10 electrons or $1.6 \times 10^{18}\text{C}$ , the other object must gain them.	SKILL 33
Law of conservation of momentum			$p_{\text{before}} = p_{\text{after}}$	In a closed system the total amount of momentum is constant	SKILL 27
Law of reflection			$\theta_i = \theta_r$	When a light wave reflects off of a surface the speed will not change because the medium is the same and the angle relative to the normal will be the same	SKILL 55
Lepton				A particle that does not interact through the strong force. The electron and the neutrino are both examples of a lepton.	SKILL 47
Light				EM Spectrum	SKILLS 51-58
Longitudinal wave				A mechanical wave in which the particles of the wave move parallel to the direction of propagation (travel) of the wave. SOUND IS A MECHANICAL LONGITUDINAL WAVE	SKILL 49 and 50
Magnet				A material which has north and south poles due to electron spin and is influenced by the magnetic field of another object. A magnet is caused by a moving electric charge.	SKILL 46
Magnetic field				A region where one magnet can feel the force of another magnet. Magnetic field lines point in the direction of a north needle of a compass (toward a south magnetic pole)	SKILL 46
Magnitude				The size of a value without consideration of direction. In a problem replace with "how big"	MULTIPLE SKILLS
Mass	m	kg		The amount of matter contained in an object. The reason for gravity. Mass is inertia	MULTIPLE SKILLS
Mechanical energy	$E_T$	J		The sum of the kinetic and potential energy in a system	SKILL 28-32
Mechanical wave				A wave that requires a medium to propagate.	SKILL 49-50
Medium				The matter through which a wave travels (propagates)	SKILL 48-56

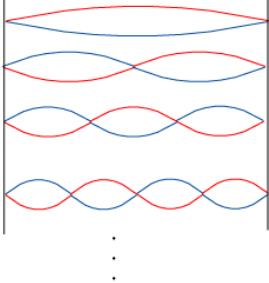
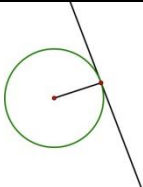
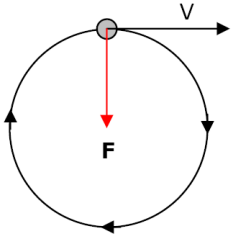


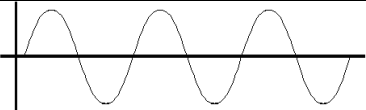
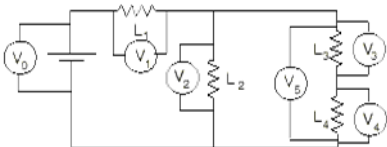
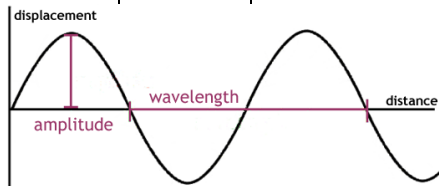
Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Meson				A particle made up of one quark and one anti-quark. A type of hadron	SKILL 47
Meter		m		The unit of length, distance, wavelength, spring stretch	MULTIPLE SKILLS
Momentum	p	kg m/s		The product of an object's mass and velocity. Changed by an impulse. Momentum is vector quantity that is conserved in a collision	SKILL 27
Net force	$F_{\text{net}}$ or $\sum F$	N	$\sum F = ma$	The sum of all the forces that act on an object. $F_{\text{net}} = 0$ for objects that are at constant speed. $F_{\text{net}} = ma$ for objects that are speeding up or slowing down. Sum the forces on each axis and set equal to "0" for constant speed or "ma" for objects speeding up or slowing down. Add perpendicular axes using Pythagorean theorem. <b>WHATEVER NET FORCE DOES, ACCELERATION DOES</b> ie ( $F_{\text{net}}=0$ , $a=0$ ; $F_{\text{net}}$ constant then acceleration is constant)	SKILLS 20-27
Neutrino				A lepton without any charge. Does not interact with the strong force or the electromagnetic force	SKILL 57
Neutron				A particle in the center of a nucleus that does not have charge. A baryon particle made up of 3 quarks (udd)	SKILL 57
Newton		N or $\frac{kg \cdot m}{s^2}$		The unit of force. Remember the 1N is the weight of a mass of about 100g or 0.1kg. 1N is equal to the weight of an apple	SKILL 20-27
Newton's Laws				1 <sup>st</sup> Law – An object at rest will stay at rest, an object in motion will stay in motion unless acted upon by an outside force. (ie a net force is required to make something speed-up, slow down or change direction) 2 <sup>nd</sup> Law – $F_{\text{net}} = ma$ 3 <sup>rd</sup> Law – For every force there exists an equal and opposite force [remember force pairs always work on different objects tire pushes road, road pushes tire]	SKILL 20-27
Node				A location on a standing wave that experiences no displacement due to maximum destructive interference when a reflecting wave is 180 degrees out of phase with initial wave.	SKILL 53
Normal force	$F_N$	N	$F_N = F_{\text{gperp}} = F_g \cos \theta$	The force that "presses" perpendicular to the surface between two objects. $F_N = F_{\text{gperp}} = F_g \cos \theta = mg \cos \theta$ on a level surfaces $\theta=0$ and $\cos \theta=1$ so $F_N = F_g$ or $mg$ Remember $\theta$ is difference in degrees between $F_g$ and $F_N$ .	SKILLS 22-23

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Normal line	 <p>Ray representation of incident, reflected, and refracted rays. The angles of incidence (<math>\theta_i</math>), reflection (<math>\theta_r</math>), and refraction (<math>\theta_t</math>), and indices of refraction (<math>n_1</math> and <math>n_2</math>) are labeled.</p>			Line <b>perpendicular to the surface</b> on a reflective or refractive surface. Angle of reflection and the angle of refraction are measured in relation to the normal line.	SKILL 53 and 54
Nucleon				Name of particles that make up the nucleus. A proton or a neutron	SKILL 47
Ohm		$\Omega$		The unit of electrical resistance	SKILL 39-45
Ohm's Law			$R = \frac{V}{I}$	At constant temperature the resistance of a conductor is equal to the ration of potential difference and current. A resistor that obey's Ohm's Law has a constant resistance. $P = \frac{V^2}{R}$ or $P = I^2 R$	SKILL 40-44
Parallel Circuit				An electrical circuit in which the current has multiple pathways. Equivalent resistance of circuit decreases as resistors are increased. $V_T = V_1 = V_2 = V_3$ $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $I_T = I_1 + I_2 + I_3$	SKILL 44
Parallel component of weight	$F_{g\parallel}$	N	$F_{g\parallel} = F_g \sin\theta$ $= mg \sin\theta$	For an object on an inclined plane the normal force ( $F_N$ ) and the weight force ( $F_g$ ) are not equal. When the surface is frictionless the portion of the weight that is directed parallel to the incline ( $F_{g\parallel}$ ) causes the net force. When friction or an additional applied force is present the net force in the parallel plane ( $\Sigma F_{\parallel}$ ) is equal to the sum of all parallel forces ( $\Sigma F_{\parallel} = F_{g\parallel} + F_f + F_A$ )	SKILL 22
Parallel Plate				Parallel plates have a uniform electric field. Field lines always point away from positive and toward negative. Between plates field lines should be evenly spaced.	SKILL 35-36
Perpendicular component of Weight	$F_{g\text{parallel}}$	$F_{g\perp}$	$F_{g\text{perp}} = F_g \cos\theta$	For an object on an inclined plane (ramp) this is the portion of the weight ( $F_g$ ) which acts perpendicular to the ramp. Equal and opposite to Normal Force ( $F_N$ ) $F_N = F_{g\text{perp}} = F_g \cos\theta = mg \cos\theta$ on a level surfaces $\theta=0$ and $\cos\theta=1$ so $F_N = F_g$ or $mg$ Remember $\theta$ is difference in degrees between $F_g$ and $F_N$ .	SKILL 22
Period	T	s	$T = \frac{1}{f}$	The time required for complete cycle of a wave (seconds/cycle). The inverse of frequency	SKILL 48
Phase				The position of a point on a wave relative to another point on the wave. A complete wave is 360 degrees. Two points are in phase if they are in the same point in the cycle or a multiple of 360 degrees away.	SKILL 49

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Photon				The basic unit of EM energy. The particle that carries the EM force. Described as a wave or light or a quantum of energy. Photons carry both momentum and energy.	SKILL 47, 51, 57
Planck's constant	h	Js	$6.63 \times 10^{-34} \text{ Js}$	The proportion between a photon's energy and frequency. Slope of an E vs f graph	SKILL 57
Potential difference	V	V	$V = \frac{W}{q}, V = IR$	The difference in potential energy per charge in an electric field. Scalar quantity	SKILL 37
Potential energy	PE	J	$PE = mgh$	Stored energy due to height	SKILL 28
Power	P	W	$P = \frac{W}{t} = \frac{Fd}{t} = Fv$ $P = VI = I^2 R = \frac{V^2}{R}$	The <b>rate at which energy</b> is consumed or work is done. Measured in watts	SKILL 30
Proton			$1e = 1.6 \times 10^{-19} \text{ C}$	A positive elementary charge located in the nucleus of an atom. One of the nucleons. Made up of 3 quarks (uud). Protons CANNOT be exchange during build up of static electricity.	SKILL 33 to 58
Pulse				A single vibratory disturbance moving through a medium	SKILL 48
Quantized				A fixed amount of energy that restricts the absorption or emission of photons	SKILL 57
Quark	u,d,c,s,t,b		See Particles of the Standard Model	A basic particle that makes up matter and the elementary particles. All combination of quarks must create particles with zero or whole number charge (+ or -)	SKILL 47
Radio Wave				Low frequency AM wave. Moves through a vacuum at $3 \times 10^8 \text{ m/s}$	SKILL 51
Rarefaction				The region of a longitudinal wave that is stretched	SKILL 49 and 50
Red Shift				The apparent decrease in frequency and increase in wavelength that occurs when a wave source and observer are moving AWAY from each other.	SKILL 54
Reflected ray				The ray that bounce off of a surface around a normal line	SKILL 52 and 55
Refracted ray			$n_1 \sin \theta_1 = n_2 \sin \theta_2$	The ray that passes into a new medium and bends toward or away from the normal line relative to the index of refraction	SKILL 56

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Refraction				The change in speed and direction of a wave when it passes between mediums	SKILL 56
Regular Reflection				Reflection off of a smooth surface in which all normal lines are aligned to form a clear image.	SKILL 52 and 55
Resistance	R	$\Omega$	$R = \frac{\rho L}{A}$ $R = \frac{V}{I}$	The difficulty a charge experiences as it moves through a conductor Resistance in a conducting wire is directly related to resistivity and length and inversely proportion to area. Note the relationship to radius of the wire is inverse square. Resistance increases with temperature (not in equation) REMEMBER – SHORT, FAT, COLD, GOLD is low resistance	SKILL 39
Resistivity	$\rho$	$\Omega m$	$R = \frac{\rho L}{A}$	A measure of the difficulty of charge through dependent on the nature of the material. Values are listed on the reference table	SKILL 39
Resonance				The vibration of an object at its natural frequency due to the presence of a wave or source with the same frequency	SKILL 53
Resultant	R or A		$R^2 = R_x^2 + R_y^2$	The single vector that can replace a combination of vectors “The net vector”	SKILL 7, 21
Scalar				A quantity that has magnitude only. Direction is not important	SKILL 3-58
Series circuit				A circuit in which the current follows a single path. The equivalent resistance of a series circuit is the sum of all the resistances ( $R_{eq} = R_1 + R_2 + R_3$ ). The current is the same throughout a series circuit ( $I_T = I_1 = I_2 = I_3 \dots$ ). The total potential difference is equal the sum of the potential differences in each component ( $V_T = V_1 + V_2 + V_3$ )	SKILL 43
SI System				The System International which agrees upon common standards of measurement among scientists throughout the world In most cases it is the metric system.	SKILL 1
Slope	<p>for all graphs <math>m = \frac{y}{x}</math></p> <p>for motion graphs “as goes the slope goes the velocity”</p>			“rise over run” or $\frac{y}{x}$ . The slope is significant when the quotient of two values is equal to a third variable in the equation. For example the slope of a V vs I graph is equal to R since $R = \frac{V}{I}$ . Or the slope of d vs t equals v. You can observe what is happening to slope of d vs t to determine if an object is moving at constant speed (+ or -) or speeding up or slowing down.	SKILL 1-58
Snell's law			$n_1 \sin \theta_1 = n_2 \sin \theta_2$	The law that governs refraction of light relative to index of refraction (n). As a wave enters a new medium its frequency remains the same but speed and wavelength change. If the index of refraction has an inverse relationship to both speed (v) and wavelength ( $\lambda$ ): ( $n = \frac{c}{v} = \frac{c}{f\lambda}$ ). For waves aligned with the normal they will slow down and decrease $\lambda$ upon entering a higher n and speed up and spread out ( $\lambda$ ) when entering a lower n. When not aligned with normal an increase in “n” means a decrease in $\theta$ and a decrease in n means an increase in $\theta$	SKILLS 52. 55 and 56

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Speed	v	m/s	$v = \frac{d}{t}$	Distance traveled in time. Scalar quantity. (Same equation as velocity but without consideration of direction)	SKILLS 1-58
Speed of a wave	v	m/s	$v = f\lambda$	The product of frequency and wavelength of a wave	SKILL 49-58
Spring constant	k	N/m	$F_s = kx$ , $PE_s = \frac{1}{2}kx^2$	Ratio of applied force and stretch of a spring.	SKILL 24 and 28
Spring Force	$F_s$	N	$F_s = kx$	The force that causes a spring to stretch or compress. For a vertical spring with an attached mass $F_s = mg = kx$	SKILL 24 and 28
Standard Model				Theory which explains the particles that make up matter and the force that control their interaction	SKILL 47
Standing wave	Fundamental 1st Harmonic  First Overtone 2nd Harmonic  Second Overtone 3rd Harmonic  Third Overtone 4th Harmonic  And so on...			A pattern of wave crests and troughs that result from the reflection and interference of a wave. Nodes form when from destructive interference when phase difference is 180degrees. Antinodes from from constructive interference when phase difference is zero.	SKILL 53
Static friction	$F_s$	N	$F_s = \mu_s F_N$	The frictional force that opposes the start of motion of an object $\mu_s > \mu_k$	SKILL 23
Strong Force				The force that governs the attraction between quark particles in the nucleus. Present in all "Hadron matter" not present in "lepton matter"	SKILL 47
Superposition				When two or more waves are in the same place at the same time.	SKILL 53
Tangent				A line on a graph or curve surface that passes through one point which is equal to the slope of the curve at that point	SKILL 25, 56
Tangential Velocity				The velocity of an object moving in a circular path. At any given point it is directed tangent to the circle.	SKILL 25

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Transverse wave				A wave in which the vibration of the particle is perpendicular to the travel of the wave.	SKILL 49
Trough				The maximum displacement of a wave below the equilibrium line	SKILL 49
Uniform circular motion				The motion of an object in a circle at a constant speed	SKILL 35
Universal mass unit	u	MeV	$1u=9.31 \times 10^{-31} \text{kg}$	The mass of a proton or a neutron. The mass of an atomic unit is $1.67 \times 10^{-27} \text{kg}$ . Using $E=mc^2$ you can find energy to be $1.503 \times 10^{-10} \text{J}$ . Converted to eV $=931,000,000 \text{eV}=9.31 \times 10^2 \text{MeV}$ aka "atomic mass unit"	SKILL 58
Vacuum				Empty space. Contains no matter. All forms of EM waves move through a vacuum at $3 \times 10^8 \text{m/s}$	SKILL 51-57
Variable resistor				A conductor whose resistance can be changed (usually by adjusting length)	SKILL 39 and 40
Vector	<p>A = Any vector quantity</p> <p><math>A^2 = A_x^2 + A_y^2</math></p> <p><math>A_y = A \sin \theta</math></p> <p><math>A_x = A \cos \theta</math></p> <p><math>\theta = \tan^{-1} \frac{A_y}{A_x}</math></p>			<p>A quantity in which direction is important. If the direction of the value impacts the outcome of the problem then the value is a vector (displacement, velocity, force, momentum and impulse are all vectors).</p> <p>Parallel vectors are added using signs to account for direction</p> <p>Perpendicular vectors use the equations provided at left.</p>	MULTIPLE SKILLS
Velocity	v	m/s		The speed and direction of an object (Vector)	MULTIPLE SKILLS
Vertical component	$A_y$		$A_y = A \sin \theta$	The component of a vector that is perpendicular to the horizon, in line with the y-axis or oriented vertically.	MULTIPLE SKILLS
Volt	V	V	$V = \frac{W}{q}$ $V = IR$	The unit of potential difference	SKILL 41
Voltmeter				A device used to measure voltage or potential difference in a circuit. Should be set up in parallel with components to be measured.	SKILL 42
Watt		W or J/s		The unit of power or <b>rate of energy</b>	SKILL 30 and 41
Wavelength	$\lambda$	m	$v = f\lambda$	The distance between any two successive points in phase with one another on a periodic wave. $\lambda = \frac{\text{meters}}{\text{cycle}}$	SKILL 48-57
					SKILL 48-49

Term	Variable	UNIT OF MEASUREMENT	Equation (s)	NOTES/Definitions	Unit #
Wave Particle Duality				Particles behave like waves and waves behave like particles. Usually evident at the atomic scale. Evidence for wave behavior (of light or particles) is diffraction, interference, double slit experiment. Evidence of particle behavior is momentum, photoelectric effect, blackbody radiation	SKILL 57
Weak Force				The force that governs beta decay.	SKILL 47
Weight	$F_g$	N	$F_g = mg$	The force due to gravity which pulls on an object. Always downward.	SKILL 22
Work	W	J	W = Fd (only use the component of F that agrees with d) Work equals $\Delta E$	The transfer of energy to an object due to a force To calculate work only use the component of force that agrees with displacement. Or set work equal to gain in energy. For energy of small particles eV's are sometimes used. $1\text{eV} = 1.6 \times 10^{-19}\text{J}$	SKILL 28-32, 37
Work against friction	Q	J	$E_T = KE + PE + Q$	The difference between the total energy ( $E_T$ ) at the start of the objects motion and at the end.	SKILL 32
Work against gravity	PE	J or $\text{J} \frac{\text{kgm}^2}{\text{s}^2}$	$PE = mgh$	The energy used to lift a weight to a height $W = F_g d = mgh$	SKILL 28