Physics
GRADE 10

SLOs for Assessment Key:
1.Assessible / Attainable - (Not included in drop down list)
2. Ambiguous (assessable in longer run) - (BOLD White)
3. Not assessable in Summitive - (Grey)
4. Repetitive (with in same grade) - (Grey)

Domains	Standards	Benchmarks	Competency Level	NC SLO #	SLO	Status of SLOs	SLOs for Assessment	Cognitive Domain
			Heat Capacity	[SLO: P-10-C-01]	Define and calculate specific heat	Grade 9 SLO		Understand
				SLO: P-10-C-02	Suggest experiments to measure the specific heat capacity [of a solid and of a liquid]	Grade 9 SLO	**Not assessable in summative**	Apply
				SLO: P-10-C-03	Analyse everyday effects due to the large specific heat of water.	Grade 9 SLO		Analyse
			Thermal Expansion and Kinetic Theory of Matter	SLO: P-10-C-04	Use the terms for the changes in state between solids, liquids and gasses [including deposition and sublimation]	Grade 9 SLO		Understand
				SLO: P-10-C-05	Explain thermal expansion in terms of kinetic theory [For solids, liquids and gasses. This includes stating the relative order of magnitudes of the expansion of solids, liquids and gasses.]	Grade 9 SLO		Analyse
				SLO: P-10-C-06	Analyze the applications and consequences of thermal expansion in real life	Grade 9 SLO		Analyse
				SLO: P-10-C-07	Analyze melting, solidification, boiling and condensation in terms of energy transfer without a change in temperature	Grade 9 SLO		Analyse
				SLO: P-10-C-08	State the melting and boiling temperatures for water at standard atmospheric pressure	Grade 9 SLO		Remember
				SLO: P-10-C-09	Describe qualitatively the thermal expansion of solids [linear and volumetric expansion]	Grade 9 SLO		Understand
				SLO: P-10-C-10	Explain the thermal expansion of liquids [real and apparent expansion]. Gases, Pressure, and Thermal Expansion:	Grade 9 SLO		Understand
				SLO: P-10-C-11	Analyse the pressure and the changes in pressure of a gas in terms of particles [the forces exerted by particles colliding with surfaces, creating a force per unit area.]	Grade 9 SLO		Analyse

Domain C: Heat and Thermodynamics	Students should be able to describe and analyze: - the effects of heat on the physical properties of matter by making reference to the kinetic theory of matter - how heat can be transferred through different modes	Use the kinetic theory of matter to explain the physical properties of matter and how these transform upon changes in state Explain how heat can be transferred through convection, conduction and radiation and the effects and applications of these modes of transfer	**Changes in State**	SLO: P-10-C-12	Differentiate between boiling and evaporation	Grade 9 SLO		Understand
				SLO: P-10-C-22	Describe evaporation in terms of particles [in terms of the escape of more energetic particles from the surface of a liquid]	Grade 9 SLO		Understand
				SLO: P-10-C-23	Analyze how temperature, humidity, surface area and air movement over a surface affect evaporation.	Grade 9 SLO		Analyse
				SLO: P-10-C-24	Explain how evaporation causes cooling	Grade 9 SLO		Understand
				SLO: P-10-C-25	Describe the use of cooling caused by evaporation in the refrigeration process without using harmful CFCs.	Grade 9 SLO		Understand
				SLO: P-10-C-26	Explain latent heat [as the energy required to change the state of a substance and explain it in terms of particle behavior and the forces between particles.]	Grade 9 SLO		Remember
				SLO: P-10-C-27	Justify experiments to determine latent heat of fusion and latent heat of vaporization of ice and water [including illustrating the analysis of data by sketching temperature-time graph on heating ice.]	Grade 9 SLO		Understand
				SLO: P-10-C-28	State that certain materials, when cooled to near absolute zero, can exhibit superconductivity	Grade 9 SLO		Understand
				SLO: P-10-C-29	Describe superconductivity [as when atoms are in this state, their kinetic energy is low, so there is little (or no) resistance to the flow of electrons.]	Grade 9 SLO		Understand
				SLO: P-10-C-30	Justify experiments to distinguish between good and bad thermal conductors	Grade 9 SLO		Analyse
				SLO: P-10-C-31	Explain thermal conduction in all solids [in terms of atomic or molecular lattice vibrations and also in terms of the movement of free (delocalised) electrons in metallic conductors]	Grade 9 SLO		Understand
				SLO: P-10-C-32	Explain convection in liquids and gasses [in terms of density changes] Justify experiments to illustrate convection	Grade 9 SLO		Understand
				SLO: P-10-C-33	Explain convection in seawater to support marine life	Grade 9 SLO		Understand
				SLO: P-10-C-34	Describe the role of land breezes and sea breezes in maintaining moderate coastal climates	Grade 9 SLO		Understand
				SLO: P-10-C-35	Explain how birds are able to fly for hours without flapping their wings and gliders are able to rise by riding on thermal currents	Grade 9 SLO		Analyse
				SLO: P-10-C-36	Describe the process of thermal energy transfer by radiation [and know that it does not require a medium]	Grade 9 SLO		Understand

			Modes of Heat Transfe	SLO: P-10-C-37	Describe the effect of surface color and texture on the emission, absorption and reflection of infrared radiation	Grade 9 SLO		Understand
				SLO: P-10-C-38	Justify qualitatively how the rate of emission of radiation depends on the surface temperature and surface area of an object	Grade 9 SLO		Analyse
				SLO: P-10-C-39	Justify Experiments to distinguish between good and bad emitters and absorbers of infrared radiation	Grade 9 SLO		Analyse
				SLO: P-10-C-40	Analyze the consequence of heat radiation in the greenhouse effect and its effect in global warming	Grade 9 SLO		Analyse
				SLO: P-10-C-41	Analyze everyday applications of conduction, convection and radiation [Including: (a) heating objects such as kitchen pans (b) heating a room by convection (c) measuring temperature using an infrared thermometer (d) using thermal insulation to maintain the temperature of a liquid and to reduce thermal energy transfer in buildings (e) the mechanism of a household hot-water system]	Grade 9 SLO		Analyse
				SLO: P-10-D-01	Prove that waves transfer energy without transferring matter	Modified(rephrased) SLO		Understand
				SLO: P-10-D-02	Describe what is meant by wave motion [as illustrated by vibrations in ropes and springs and by experiments using water waves.]	Modified(rephrased) SLO		Understand
				SLO: P-10-D-03	Describe the features of a wave [in terms of wavefront, wavelength, frequency, time period, crest (peak), trough, compression, rarefaction, amplitude and wave speed]	Modified(rephrased) SLO		Understand

			Wave Theory	SLO: P-10-D-04	Define the terms frequency, wavelength, and amplitude.	Modified(rephrased) SLO		Remember
				SLO: P-10-D-05	Recall and apply the equation wave speed = frequency × wavelength($v=f\cdot\lambda$)	Modified(rephrased) SLO		Remember
				SLO: P-10-D-06	Illustrate that for a transverse wave, the direction of vibration is at right angles to the direction of the energy transfer [including giving examples such as electromagnetic radiation, waves on the surface of water, and seismic S-waves (secondary)]	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-07	Illustrate that for a longitudinal wave, the direction of vibration is parallel to the direction of the energy transfer [including give examples such as sound waves and seismic P-waves (primary)]	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-08	Describe how waves can undergo reflection, refraction and diffraction	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-09	Describe how wavelength affects diffraction at an edge	Modified(rephrased) SLO		Understand
				SLO: P-10-D-10	Analyse the phenomenon of tsunamis generated under the surface of water [in terms of underwater earthquakes/volcanic activity generating waves that increase in frequency and amplitude as they encounter increasingly shallow water]	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-11	Describe how wavelength and gap size affects diffraction through a gap	Modified(rephrased) SLO		Analyse

			Sound	SLO: P-10-D-12	Describe the production of sound	Modified(rephrased) SLO		Understand
				SLO: P-10-D-13	Describe the longitudinal nature of sound waves	Modified(rephrased) SLO		Understand
				SLO: P-10-D-14	State the approximate range of frequencies audible to humans as 20Hz to 20000Hz	Modified (Split) SLO		Remember
				SLO: P-10-D-15	Justify why sound waves cannot travel in a vacuum [including describing experiments to demonstrate this]	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-16	Describe how changes in amplitude and frequency affect the loudness and pitch of sound waves	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-17	Describe how different sound sources produce sound waves with different timbres [including making reference to the shape of the traces on an oscilloscope]	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-18	Describe an echo as the reflection of sound waves	Modified(rephrased) SLO		Understand
				SLO: P-10-D-19	Justify simple experiments to show the reflection of sound waves	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-20	Illustrate a method involving a measurement of distance and time for determining the speed of sound in air	Modified(rephrased) SLO		Apply
				SLO: P-10-D-21	State that the speed of sound in air is approximately 330–350m/s	Modified(rephrased) SLO		Remember

Domain D: Waves	Students should be able to ● mathematically describe how waves propagate and the general properties of reflection, refraction and diffraction ● explain how the wave theory of light can help explain various optical phenomena	Explain wave motion in terms of oscillations and energy and apply the basic principles of wave reflection, refraction and diffraction to solve problems Use the principles of reflection and refraction from the wave model of light to create and analyse ray diagrams that help explain images generated by simple mirrors, lenses and total internal reflection		SLO: P-10-D-22	Describe that, in general, sound travels faster in solids than in liquids and faster in liquids than in gasses.	Modified(rephrased) SLO		Understand
				SLO: P-10-D-23	Define ultrasound as sound with a frequency higher than 20kHz	Modified(rephrased) SLO		Remember
				SLO: P-10-D-24	Illustrate and analyze the uses of ultrasound [in cleaning, prenatal and other medical scanning, and in sonar (including calculation of depth or distance from time and wave speed)]	Modified(rephrased) SLO		Apply
				SLO: P-10-D-25	Illustrate the use of infrasound [e.g. by elephants in communication, and in the study of seismic activity]	Modified(rephrased) SLO		Apply
				SLO: P-10-D-26	Analyze the effects of noise pollution on the environment	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-27	Justify the importance of acoustic protection	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-28	Describe how knowledge of the properties of sound waves is applied in the design of buildings with respect to acoustics	Modified(rephrased) SLO		Understand
				SLO: P-10-D-29	Explain the use of soft materials to reduce echo sounding [such as in classroom studies, and other public gathering buildings]	Modified(rephrased) SLO		Understand
				SLO: P-10-D-30	Explain, with examples, how sound can reflect, refract and diffract.	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-31	Explain how sound is converted by the eardrum and nerves into electrical signals that are then interpreted by the brain	Modified(rephrased) SLO		Understand
				SLO: P-10-D-32	Define and use the terms normal, angle of incidence and angle of reflection	Modified(rephrased) SLO		Remember
				SLO: P-10-D-33	Describe an experiment to find the position and characteristics of an optical image formed by a plane mirror.[same size, same distance from mirror as object and virtual]	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-34	Use the law of reflection to solve simple optical problems	Modified(rephrased) SLO		Apply
				SLO: P-10-D-35	Define the terms normal, angle of incidence and angle of refraction	Modified(rephrased) SLO		Remember
				SLO: P-10-D-36	Apply the qualitative principle that a wave refracts towards the normal when it slows down while entering a medium, and that it refracts away from the normal if it speeds up when it enters a new medium [in the case the angle of incidence is zero, then the waves continues parallel to the normal]	Modified(rephrased) SLO		Apply

				SLO: P-10-D-37	Define and use the refractive index from a vacuum to a medium for light as c/v	Modified(rephrased) SLO		Remember
				SLO: P-10-D-38	Define refractive index n as n=(□sin(i))/(□sin(r)) Apply Snell's law, n_i □sin(i)=n_r □sin(r) to solve simple problems.	Modified(rephrased) SLO		Understand
				SLO: P-10-D-39	Describe an experiment to show refraction of light by transparent blocks of different shapes	Modified(rephrased) SLO		Understand
				SLO: P-10-D-40	Define the terms critical angle and total internal reflection	Modified(rephrased) SLO		Remember
				SLO: P-10-D-41	Derive the equation n=1/□sin©	Modified(rephrased) SLO		Apply
				SLO: P-10-D-42	Apply the equation n=1/□sin(c) to solve simple problems	Modified(rephrased) SLO		Apply
				SLO: P-10-D-43	Describe experiments to show internal reflection and total internal reflection	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-44	Evaluate and illustrate the use of optical fibers [particularly in telecommunications, stating the advantages of their use in each context]	Modified(rephrased) SLO		Understand
				SLO: P-10-D-45	Analyze the action of thin converging and thin diverging lenses on a parallel beam of light	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-46	Define and use the terms focal length, principal axis and principal focus (focal point)	Modified(rephrased) SLO		Remember
				SLO: P-10-D-47	Draw ray diagrams to illustrate the formation of real and virtual images of an object by a converging lens	Modified(rephrased) SLO		Apply
				SLO: P-10-D-48	Differentiate between real and virtual images	Modified(rephrased) SLO		Analyse
				SLO: P-10-D-49	Define and calculate linear magnification [as the ratio of image length to object length; state and use the equation linear magnification = image length/object length]	Modified(rephrased) SLO		Apply
				SLO: P-10-D-50	Describe the use of a single lens as a magnifying glass	Modified(rephrased) SLO		Understand
				SLO: P-10-D-51	Explain the dispersion of light by a prism [including the detection of non-visible spectra by a thermometer]	Modified(rephrased) SLO		Understand
				SLO: P-10-D-52	State the traditional seven colors of the visible spectrum in order of frequency and in order of wavelength	Modified(rephrased) SLO		Remember
				SLO: P-10-D-53	Describe the use of a single lens as in various optical device applications [specifically in the case of a magnifying glass, a camera, projector, and a photographic enlarger. This includes drawing ray diagrams to show how each forms an image.]	Modified(rephrased) SLO		Understand

				SLO: P-10-D-54	Draw ray diagrams to show the formation of images in the normal eye, a short-sighted eye and a long-sighted eye	Modified(rephrased) SLO		Apply
				SLO: P-10-D-55	Describe the use of converging and diverging lenses to correct long-sightedness and short-sightedness	Modified(rephrased) SLO		Understand
				SLO: P-10-D-56	Illustrate with examples how the biological eye processes color in various organisms [a. role of rods and cones in the eye, along with the brain, in detecting light and discerning color in combinations of 3 channels (red, yellow, blue) b. know that different living organisms may see more and less colors e.g. the mantis shrimp has 12 channels of color and view ultraviolet light.]	Modified(rephrased) SLO		Understand
				SLO: P-10-D-57	State that extreme gravity from interstellar objects like blackholes can cause light to bend (from the perspective of the observer) in a way that is analogous to a simple lens [This is called 'gravitational lensing'.]	New SLO	**Ambiguous**	Remember
				SLO: P-10-D-58	State that 'acoustic lenses' are made of materials and shapes that work to focus or diverge sound	New SLO	**Ambiguous**	Remember
				SLO: P-10-E-01	State that there are positive and negative charges [and charge is measured in coulombs]	Modified(rephrased) SLO		Remember
				SLO: P-10-E-02	State that unlike charges attract and like charges repel	Modified(rephrased) SLO		Remember
				SLO: P-10-E-03	Describe experiments to show electrostatic charging by friction	Modified(rephrased) SLO		Understand

				SLO: P-10-E-04	Explain that charging of solids by friction involves only a transfer of negative charge (electrons)	Modified(rephrased) SLO		Understand
				SLO: P-09-E-05	Explain how and why an insulator can be discharged by (a) putting it above a flame, and (b) exposing it to damp conditions	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-06	Explain how a conductor can be charged by electric induction and then "earthing"	Modified(rephrased) SLO		Understand
				SLO: P-10-E-07	Describe examples where charging could be a problem e.g. lightning.	Modified(rephrased) SLO		Understand
				SLO: P-10-E-08	Suggest how charging and discharging is used in the application of various devices [e.g. photocopier and electrostatic precipitator]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-09	Describe an electric field as a region in which an electric charge experiences a force	Modified(rephrased) SLO		Understand
				SLO: P-10-E-10	State that the direction of an electric field line at a point is the direction of the force on a positive charge at that point	Modified(rephrased) SLO		Remember
				SLO: P-10-E-11	Analye and illustrate simple electric field patterns [including the direction of the field: (a) around a point charge (b) around a charged conducting sphere (c) between two oppositely charged parallel conducting plates (end effects will not be examined)]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-12	State examples of electrical conductors and insulators	Modified(rephrased) SLO		Remember
				SLO: P-10-E-13	Describe an experiment to distinguish between electrical conductors and insulators	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-14	state and use a simple electron model to explain the difference between electrical conductors and insulators	Modified(rephrased) SLO		Understand
				SLO: P-10-E-15	Explain how a lightning rod can protect humans	Modified(rephrased) SLO		Understand
				SLO: P-10-E-16	Explain electrical breakdown [it occurs when a strong electric field passes through a gas and causes its atoms to ionize]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-17	State that Corona discharge and Lichtenberg figures are visible examples of electrical breakdown.	Modified(rephrased) SLO		Remember

			ic Current and Ohm'	SLO: P-10-E-18	Explain how lightning is generated (including the below steps of formation: - through friction between the water molecules suspended in clouds in the case of thunderstorms, and from between smoke particles in the case of volcanic lightning - lightning streamers are created through the process of electrical breakdown and this provided a path for the electric current from one charged object to the other - in the case of cloud-ground lightning a strong electric field from the clouds induces an opposite net charge in the conducting material present in the ground, and when this field becomes strong enough it generates lightning streams that provide the path for cloud-to-ground and ground-to-cloud discharge)	Modified(rephrased) SLO		Understand
				SLO: P-10-E-19	State that there are many kinds of atmospheric lightning [e.g. sprites, jets, elves, trolls, pixies, ghosts, ball lightning) that are still being researched]	Modified(rephrased) SLO		Remember
				SLO: P-10-E-20	Define and calculate electric current [Use the equation electric current = charge/time I = Q/t to solve simple problems]	Modified(rephrased) SLO		Apply
				SLO: P-10-E-21	Explain electrical conduction [in metals in terms of the movement of free electrons]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-22	state that current is measured in amps (amperes) and that the amp is given by coulomb per second (C/s)	Modified(rephrased) SLO		Remember
				SLO: P-10-E-23	Differentiate between direct current (d.c.) and alternating current (a.c.)	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-24	Differentiate between conventional and actual current	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-25	Justify and illustrate the use of ammeters [(analogue and digital) with different ranges]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-26	Define e.m.f. [as the electrical work done by a source in moving a unit charge around a complete circuit. Use the equation e.m.f. = work done (by a source) per unit charge E = W/Q]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-27	Define p.d. (potential difference) [As the work done by a unit charge passes through a component. Use the equation p.d. = work done (on a component) charge V = W/Q to solve simple problems]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-28	State that e.m.f. and p.d. are measured in volts and that the volt is given by joule per coulomb (J/C)	Modified(rephrased) SLO		Remember
				SLO: P-10-E-29	Justify and illustrate the use of voltmeters [(analogue and digital) with different ranges]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-30	Calculate the total e.m.f. where several sources are arranged in series	Modified(rephrased) SLO		Apply
				SLO: P-10-E-31	State that the e.m.f of identical sources connected in parallel is equal to the e.m.f. of one of the sources	Modified(rephrased) SLO		Remember

				SLO: P-10-E-32	Describe an experiment to determine resistance [using a voltmeter and an ammeter and do the appropriate calculations]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-33	Define and calculate resistivity [Use for a wire, the direct proportionality between resistance and length, and the inverse proportionality between resistance and cross-sectional area]	Modified(rephrased) SLO		Apply
				SLO: P-10-E-34	Define and apply Ohm's law [Including reference to constant temperature. Use the equation resistance = p.d./current R = V/I to solve simple problems.]	Modified(rephrased) SLO		Apply
				SLO: P-10-E-35	Describe the effect of temperature increase on the resistance of a resistor [such as the filament in a filament lamp]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-36	Interpret current–voltage graphs [including for a resistor of constant resistance, a filament lamp and a diode]	Modified(rephrased) SLO		Evaluate
				SLO: P-10-E-37	Draw circuit diagrams [with cells, batteries, power supplies, generators, potential dividers, switches, resistors (fixed and variable), heaters, thermistors (NTC only), light-dependent resistors (LDRs), lamps, motors, ammeters, voltmeters, transformers, fuses, relays, diodes and light-emitting diodes (LEDs)]	Modified(rephrased) SLO		Apply
				SLO: P-10-E-38	Use common rules regarding current and voltage distribution in circuits to solve problems [specifically:(a) the current at every point in a series circuit is the same (b) the sum of the currents entering a junction in a parallel circuit is equal to the sum of the currents that leave the junction (c) the total p.d. across the components in a series circuit is equal to the sum of the individual p.d.s across each component (d) the p.d. across an arrangement of parallel resistances is the same as the p.d. across one branch in the arrangement of the parallel resistances]	Modified(rephrased) SLO		Apply
				SLO: P-10-E-39	Calculate the combined resistance of two or more resistors in series	Modified(rephrased) SLO		Apply
				SLO: P-10-E-40	Calculate the combined resistance of two resistors in parallel	Modified(rephrased) SLO		Apply
			Circuit Diagrams	SLO: P-10-E-41	Calculate current, voltage and resistance in parts of a circuit or in the whole circuit	Modified(rephrased) SLO		Apply

SLO: P-10-E-42	Describe the action of negative temperature coefficient (NTC) thermistors and light-dependent resistors [including explaining their use as input sensors]	Modified(rephrased) SLO		Analyse
SLO: P-10-E-43	Analyze the function of variable potential dividers in circuits [including using the equation for two resistors used as a potential divider R1/R2= V1/V2]	Modified(rephrased) SLO		Analyse
SLO: P-10-E-44	Justify and illustrate the use of color codes for resistors	Modified(rephrased) SLO		Analyse
SLO: P-10-E-45	Describe the working of a diode	Modified(rephrased) SLO		Understand
SLO: P-10-E-46	Describe the action of a light-emitting diode in passing current in one direction only and emitting light.	Modified(rephrased) SLO		Understand
SLO: P-10-E-47	Describe and explain the action of relays in switching circuits.	Modified(rephrased) SLO		Understand
SLO: P-10-E-48	State common uses of electricity [including heating, lighting, battery charging and powering motors and electronic systems.]	Modified(rephrased) SLO		Understand
SLO: P-10-E-49	Justify the advantages of connecting lamps in parallel in a lighting circuit	Modified(rephrased) SLO		Analyse
SLO: P-10-E-50	Use the equation, power = current × voltage P = IV to solve simple problems	Modified(rephrased) SLO		Apply
SLO: P-10-E-51	Use the equation energy = current × voltage × time E = IVt to solve simple problems	Modified(rephrased) SLO		Apply
SLO: P-10-E-52	Define the kilowatt-hour (kWh)	Modified(rephrased) SLO		Understand

Domain E: Electricity and Magnetism	Students should be able to: - describe mathematically the nature of static magnetic and electric fields - analyze and account for the distribution of current, voltage and resistance in simple DC circuits - explain how power can be generated through electromagnetic induction - account for how motors make use of electromagnetism to generate kinetic energy	Explain qualitatively the origin, properties, phenomena and applications of static magnetic and electric fields in terms of magnetic domain theory and electric charges. Apply knowledge of the relationships between electric current, voltage, resistance and power in simple circuits to describe their applications (in technology and in nature) and the need for safety measures in electric appliances	Appliances and Trans	SLO: P-10-E-53	Explain the need to choose components with suitable power ratings.	Modified(rephrased) SLO		Understand
				SLO: P-10-E-54	Calculate the cost of using electrical appliances where the energy unit is the kWh	Modified(rephrased) SLO		Apply
				SLO: P-10-E-55	State common electric hazards that may be caused from malpractice and lack of maintenance [specifically: (a) damaged insulation (b) overheating cables (c) damp conditions (d) excess current from overloading of plugs, extension leads, single and multiple sockets when using a mains supply]	Modified(rephrased) SLO		Remember
				SLO: P-10-E-56	Explain the use and operation of trip switches and fuses and choose appropriate fuse ratings and trip switch settings	Modified(rephrased) SLO		Remember
				SLO: P-10-E-57	Explain what happens when a live wire touches a metal case that is earthed	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-58	Explain why the outer casing of an electrical appliance must be either non-conducting (double-insulated) or earthed	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-59	State that a mains circuit consists of a live wire (line wire), a neutral wire and an earth wire.	Modified(rephrased) SLO		Remember
				SLO: P-10-E-60	Explain why fuses and circuit breakers are connected into the live wire for the circuit to be switched off safely.	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-61	Explain why domestic supplies are connected in parallel.	Modified(rephrased) SLO		Analyse

				SLO: P-10-E-62	Explain the damage that electric shock could do to a human being [in terms of burns, cardio-respiratory failure and seizures]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-63	Explain that electronic devices are built from digital logic circuits [that can act as switches that can convert incoming voltage into binary electrical pulses of high and low (or 1 and 0)]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-64	Explain that Boolean logic is the basis for converting analogue data to digital data [this includes knowing that 'bit' is the smallest unit of data in computing; either 1 or 0. Eight bits make up a byte.]	Modified(rephrased) SLO		Remember
				SLO: P-10-E-65	State in words and in truth table form, the action of logic gates [specifically of AND, OR, NAND, NOR and NOT]	Modified(rephrased) SLO		Remember
				SLO: P-10-E-66	Identify the use of logic gates for security purposes [e.g; burglar alarm, fire extinguisher etc.]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-67	Use circuit symbols for the logic gates	Modified(rephrased) SLO	**Not assessable in summative**	Apply
				SLO: P-10-E-68	Identify in given problems how Boolean switches can be put into combinations that then allow them to achieve logical operations	Modified(rephrased) SLO		Understand
				SLO: P-10-E-69	Describe the action of a bipolar npn transistor as a switch.	Modified(rephrased) SLO	**Ambiguous**	Analyse
				SLO: P-10-E-70	Explain that transistors are commonly used in digital devices because they are both economical and act as rapid-response switches [To enrich this concept students should be given an overview of how with advances in engineering, the number of transistors that can be fit per unit area onto a circuit board has continued to increase dramatically; this has rapidly enhanced computing power. They also be given an overview of how - breakthroughs in quantum physics are causing a new revolution in computing that are enabling computers to make exponentially more logical operations per unit time than with traditional computers]	Modified(rephrased) SLO	**Ambiguous**	Analyse
				SLO: P-10-E-71	State that circuits that maintain their 'state' after receiving an input can be said to exhibit 'memory' [since they retain the effect of the last action upon them (this should be taught to them with the context provided that circuit systems that allow for logical processing and memory functions form the basis of programmable electronics)]	Modified(rephrased) SLO		Remember
				SLO: P-10-E-72	State that quantum computers are still in early stages of development, and have to overcome manufacturing challenges such core components only functioning at very cold temperatures that are at almost absolute zero	Modified(rephrased) SLO	**Ambiguous**	Remember

				SLO: P-10-E-73	Compare analogue and digital electronics.	Modified(rephrased) SLO		Understand
				SLO: P-10-E-74	Describe an experiment to demonstrate electromagnetic induction	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-75	Use the fact that the magnitude of an induced e.m.f. is affected by (a) the rate of change of the magnetic field or the rate of cutting of magnetic field lines, and (b) the number of turns in a coil, to solve simple electromagnetic problems	Modified(rephrased) SLO	**Not assessable in summative**	Apply
				SLO: P-10-E-76	Use the fact that the effect of the current produced by an induced e.m.f. is to oppose the change producing it (Lenz's law)	Modified(rephrased) SLO	**Not assessable in summative**	Apply
				SLO: P-10-E-77	Describe how a.c. generators work [(rotating coil or rotating magnet setup) and the use of slip rings and brushes where needed]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-78	Sketch and interpret graphs of e.m.f. against time for simple a.c. generators [including relating the position of the generator coil to the peaks, troughs and zeros of the e.m.f.]	Modified(rephrased) SLO	**Not assessable in summative**	Analyse
				SLO: P-10-E-79	Describe the pattern and direction of the magnetic field due to currents in straight wires and in solenoids.	Modified(rephrased) SLO		Understand
				SLO: P-10-E-80	State the effect on the magnetic field of changing the magnitude and direction of the current	Modified(rephrased) SLO		Remember
				SLO: P-10-E-81	Describe how the magnetic effect of a current is used in relays and loudspeakers [including giving examples of their application]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-82	Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field [including the effect of reversing: (a) the current (b) the direction of the field]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-83	state and use the relative directions of force, magnetic field and current	Modified(rephrased) SLO		Apply
				SLO: P-10-E-84	Describe the magnetic field patterns between currents in parallel conductors and relate these to the forces on the conductors [excluding the Earth's field]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-85	state that a current-carrying coil in a magnetic field may experience a turning effect and that the turning effect is increased by increasing: (a) the number of turns on the coil (b) the current (c) the strength of the magnetic field	Modified(rephrased) SLO		Remember

				SLO: P-10-E-86	Describe the operation of an electric motor, including the action of a split-ring commutator and brushes	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-87	State that it is theorized that the Earth's magnetic field is generated by the rotation of the Earth and its molten iron core that contains charged particles in motion	Modified(rephrased) SLO		Remember
				SLO: P-10-E-88	Explain the principle of operation of a simple iron-cored transformer	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-89	Use the terms primary, secondary coils and step-up and step-down transformer	Modified(rephrased) SLO		Remember
				SLO: P-10-E-90	Use the equation V_p/ V_s=N_p/N_s [where P and S refer to primary and secondary, to solve problems]	Modified(rephrased) SLO		Apply
				SLO: P-10-E-91	Justify the advantages of high-voltage transmission [including explaining why power losses in cables are smaller when the voltage is greater]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-92	Describe the deflection of an electron beam by electric fields and magnetic fields.	Modified(rephrased) SLO		Understand
				SLO: P-10-E-93	Interpret waveforms on oscilloscopes Electromagnetic Waves:	Modified(rephrased) SLO		Evaluate
				SLO: P-10-E-94	state the main regions of the electromagnetic spectrum in order of frequency and in order of wavelength	Modified(rephrased) SLO		Remember
				SLO: P-10-E-95	state that the speed of all electromagnetic waves in: (a) a vacuum is 3.0 × 10^8 m/s (b) air is approximately the same as in a vacuum	Modified(rephrased) SLO		Remember
				SLO: P-10-E-96	Describe the applications of electromagnetic waves in society [specifically: (a) radio waves – radio and television communications, astronomy (b) microwaves – satellite television, mobile (cell) phone, Bluetooth, microwave ovens (c) infrared – household electrical appliances, remote controllers, intruder alarms, thermal imaging, optical fibers (d) visible light – photography, vision (e) ultraviolet – security marking, detecting counterfeit bank notes, sterilizing water (f) X-rays – hospital use in medical imaging, security scanners, killing cancerous cells, engineering applications such as detecting cracks in metal (g) gamma rays – medical treatment in detecting and killing cancerous cells, sterilizing food and medical equipment, engineering applications such as detecting cracks in metal]	Modified(rephrased) SLO		Apply

				SLO: P-10-E-97	Describe the damage caused by electromagnetic radiation [including (a) excessive exposure causing heating of soft tissues and burns and (b) ionizing effects caused by ultraviolet (skin cancer and cataracts), X-rays and gamma rays (cell mutation and cancer)]	Modified(rephrased) SLO		Understand
				SLO: P-10-E-98	Explain qualitatively, how scattering of light by molecules in the air give the sky its blue color during the day and its shades of red during sunset [use of the terms Rayleigh and Mei scattering are not required]	Modified(rephrased) SLO		Analyse
				SLO: P-10-E-99	State that theoretically light can also be considered to be made of massless particles that carry energy and momentum called 'photons'. [Students should know as an example of this particle nature, light exerts pressure on objects (very slight) and this has been used by satellites that have 'solar sails' that accelerate with the help of force from light rays.]	Modified(rephrased) SLO	**Ambiguous**	Remember
			Electronics	SLO: P-10-F-01	Describe the structure of the atom [in terms of a positively charged nucleus and negatively charged electrons that go around the nucleus. This should include an understanding of the below big ideas: - These electrons do not go around in predictable circular paths in the way that planets go around the sun. The electrons behave as 'quantum particles' and their location and momentum at any point in time is governed by probability; one cannot predict the motion of an electron. - The 'shells' in which electrons 'orbit' refer to the level of kinetic energy the electrons possess; the further the shell is from the nucleus, the more energy the electron has. - If one were to 'look' at an atom, one would see a fuzzy 'cloud' of electrons with a very small nucleus in the center (akin to a football with flies around it in a boundary of several football fields).]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-02	Justify the findings of the alpha-particle scattering experiments [Specifically that it provides evidence for: (a) a very small nucleus surrounded by mostly empty space (b) a nucleus containing most of the mass of the atom (c) a nucleus that is positively charged]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-03	Define the terms proton number (atomic number) Z and nucleon number (mass number) A and be able to calculate the number of neutrons in a nucleus	Modified(rephrased) SLO		Remember
				SLO: P-10-F-04	Recall the term nuclide and use the nuclide notation ⟦⟦^A⟧⟧_Z X	Modified(rephrased) SLO		Remember
				SLO: P-10-F-05	Explain what is meant by an isotope and state that an element may have more than one isotope	Modified(rephrased) SLO		Remember
				SLO: P-10-F-06	Explain what is meant by background radiation	Modified(rephrased) SLO		Remember

DomainF: Modern Physics	Students should be able to: - describe mathematically the nature of static magnetic and electric fields - analyze and account for the distribution of current, voltage and resistance in simple DC circuits - explain how power can be generated through electromagnetic induction - account for how motors make use of electromagnetism to generate kinetic energy - analyse AC circuits in terms of current, resistance, reactance, voltage, and impedance	Explain qualitatively the origin, properties, phenomena and applications of static magnetic and electric fields in terms of magnetic domain theory and electric charges. Apply knowledge of the relationships between electric current, voltage, resistance and power in simple circuits to describe their applications (in technology and in nature) and the need for safety measures in electric appliances		SLO: P-10-F-07	state the sources that make a significant contribution to background radiation[including: (a) radon gas (in the air) (b) rocks and buildings (c) food and drink (d) cosmic rays]	Modified(rephrased) SLO		Remember
				SLO: P-10-F-08	Describe the emission of radiation from a nucleus as spontaneous and random	Modified(rephrased) SLO		Remember
				SLO: P-10-F-09	Describe α-particles, β-particles and γ-radiation	Modified(rephrased) SLO		Understand
				SLO: P-10-F-10	Justify qualitatively the order of strength for α-particles, β-particles and γ-radiation in terms of their (a) their relative ionizing effects (b) their relative penetrating powers	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-11	Describe the deflection of α-particles, β-particles and γ-radiation in electric fields and magnetic fields	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-12	Explain that radioactive decay is a change in an unstable nucleus that can result, most commonly [there are other kinds of decay as well but students are not required to study those at this level), in the emission of α-particles or β-particles and/or γ-radiation]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-13	Use decay equations, using nuclide notation, to show the emission of α-particles, β-particles and γ-radiation	Modified(rephrased) SLO		Apply
				SLO: P-10-F-14	Describe nuclear reactions (fission & fusion) with examples [fusion as the formation of a larger nucleus by combining two smaller nuclei with the release of energy, and recognise fusion as the energy source for stars]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-14	Recognise that matter can be converted to energy and vice versa (in this way the law of conservation of energy still holds).	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-15	Apply the equationE=mc^2 to calculate the energy released in the process of nuclear reactions	Modified(rephrased) SLO		Apply
				SLO: P-10-F-16	Describe the activity of a radioactive material in terms of counts per unit time	Modified(rephrased) SLO		Understand
				SLO: P-10-F-17	Define and infer the half-life of materials [Half-life as the time taken for half the nuclei of an isotope in any sample to decay. Use this definition of half-life in calculations, which may involve information in tables or decay curves]	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-18	Explain and apply the concept of Carbon dating to solve problems	Modified(rephrased) SLO		Apply
				SLO: P-10-F-19	Explain how the type of radiation emitted and the half-life of the isotope determine which isotope is used for applications [including: (a) household fire (smoke) alarms (b) irradiating food to kill bacteria (c) sterilization of equipment using gamma rays (d) measuring and controlling thicknesses of materials with the choice of radiations used linked to penetration and absorption (e) diagnosis and treatment of cancer using gamma rays]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-20	State the effects of ionizing nuclear radiations on living things, including cell death, mutations and cancer	Modified(rephrased) SLO		Analyse

				SLO: P-10-F-21	Explain how radioactive materials are moved, used and stored in a safe way [(with reference to: (a) reducing exposure time (b) increasing distance between source and living tissue (c) use of shielding to absorb radiation]	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-22	Explain the nature of the Sun [as a star of medium size it consists mostly of hydrogen and helium, and that it radiates most of its energy in the infrared, visible and ultraviolet regions of the electromagnetic spectrum]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-23	Describe that it is hypothesized that most of the matter in the universe is made up of dark matter	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-23	Use ideas of convection to explain how cyclones are formed	Modified(rephrased) SLO		Analyse
				SLO: P-10-F-24	Explain how global warming contributes to extreme weather events [Specifically in the case of hurricanes, heat waves, flooding, rainfall, wildfires, droughts, winter storms]	Modified(rephrased) SLO		Understand
				SLO: P-10-F-25	Explain the phenomena of geothermal activity on the basis of conduction, convection and radiation [How magma flows beneath the Earth, why it causes tectonic plate movement, volcanic eruptions and how the center of the Earth remains hot since being formed over 4 billion years ago]	Modified(rephrased) SLO		Understand
Domain G:Nature of Science	Students will be able to: - Describe the standard model of particle physics - Analyze radioactive decay processes - Explain the processes of nuclear fusion and fission - Explain the postulates and implications of special relativity - Use the quantum mechanical model of photons to explain phenomena	Describe and explain, with reference to broad qualitative ideas from relativity, quantum mechanics and particle physics: (1) the structure of atoms and atomic nuclei (2) the origin of radioactivity and its uses and hazards.	Theory of Knowledge	: SLO: P-10-G-01	Explain, with examples in Physics, falsifiability as the idea that a theory is scientific only if it makes assertions that can be disproven	New SLO		Analyse