Physics

GRADE 11

Key:
Green color indicates a mistake in the naming of the Student Learning

SLOs for Assessment Key:
1.Assessible / Attainable - (Not included in drop down list) cell will be blank and empty **2. Ambiguous (assessable in longer run) - (BOLD White)**
3. Not assessable in Summitive - (Grey)

Domains	Standards	Benchmarks	Topic/Title	NC SLO #	NCP (2022) - SLO	Status of SLOs	SLOs for Assessment	Cognitive Domain
Measurement	1.express and mathematically manipulate basic and derived physical quantities. 2.identify and explain the reasons for common sources of human and systematic error in experiments. 3.identify, explain and describe the utility of measuring instruments in terms of precision. 4. quantify the uncertainty in readings taken and calculations made through those raw readings 5. model and solve contextual problems,	**Benchmark I:** : Describe that physical equations must be dimensionally consistent, and sources of error in measurements can be quantified. These errors can be compounded when measured quantities are used to calculate further derived quantities.	**Physical Quantities**	[SLO: P-11-A-01]	Make reasonable estimates of physical quantities	Modified(rephrased) SLO		Understand
				[SLO: P-11-A-02]	Express derived units as products or quotients of the SI base units	Matched SLO		Understand
				[SLO: P-11-A-03]	Analyze the homogeneity of physical equations	Modified(rephrased) SLO		Analyse
				[SLO: P-11-A-04	Derive formulae in simple cases	Matched SLO		Apply
				[SLO: P-11-A-05]	Analyse and critique the accuracy and precision of data collected by measuring instruments	Modified(rephrased) SLO		Analyse
			Uncertainties in Measurement	[SLO: P-11-A-06]	Assess the uncertainty in a derived quantity	Matched SLO		Evaluate
				[SLO: P-11-A-07]	Justify why all measurements contain some uncertainty.	Modified(rephrased) SLO		Evaluate
	1. Differentiate between and mathematically manipulate scalar and vector quantities 2. Describe and analytically and graphically analyze distance, displacement, speed, velocity, and acceleration 3. Differentiate between different kinds of forces and their effects 4. Use Newton's laws to analyze motion and equilibrium 5. Analyze circular and rotational motion in terms of forces and momentum 6. differentiate between work, energy and power 7. use the law of conservation of energy to analyze the viability and efficiency of systems 8. differentiate between and mathematically analyze kinetic and gravitational potential energy	**Benchmark I**: Describe and analyze translatory and rotational motion in a plane through analytical and graphical manipulation of scalar and vector quantities **BenchmarkII:** Explain events in terms of Newton's laws, including the Law of Gravitation, and the law of conservation of momentum in up to two dimensions **BenchmarkIII:** Describe and analyze the dynamics of rotational and circular motion in terms of forces and momentum in one dimension **BenchmarkIV:** Describe and analyze the deformation of solids, analytically and graphically, in terms of how forces and pressure can cause stretching, compression, stress and strain **BenchmarkV:** Describe and analyze analytically and graphically the effects of energy transfers and energy transformations on a body	**Translatory motion**	[SLO: P-11-B-01]	Represent a vector in 2-D as two perpendicular components	Modified(rephrased) SLO		Understand
				[SLO: P-11-B-02]	Describe the product of two vectors (dot and cross-product) along with their properties	Modified (Split) SLO		Understand
				[SLO: P-11-B-03]	Derive the equations of motion	New SLO		Understand
				[SLO: P-11-B-04]	Solve problems using the equations of motion	Matched SLO		Apply
				[SLO: P-11-B-05]	Evaluate and analyse projectile motion in the absence of air resistance	Matched SLO		Analyse
				[SLO: P-11-B-06]	Predict qualitatively how air resistance affects projectile motion	Matched SLO		Understand
			Rotational motion	[SLO: P-11-B-07]	Express angles in radians	Modified (Split) SLO		Understand
				[SLO: P-11-B-08]	Define and calculate angular displacement, angular velocity and angular acceleration	Modified (Split) SLO		Remember

			Rotational Motion	[SLO: P-11-B-09]	Use equations of angular motion to solve problems involving rotational motions.	Matched SLO		Apply
				[SLO: P-11-B-10]	Analyse qualitatively motion in a curved path due to a perpendicular force.	Matched SLO		Analyse
			Dynamics/Momentum	[SLO: P-11-B-11]	Apply the principle of conservation of momentum to solve simple problems	Modified(rephrased) SLO		Apply
				[SLO: P-11-B-12]	Predict and analyse motion for elastic collisions	Modified(rephrased) SLO		Analyse
				[SLO: P-11-B-13]	Justify why though the momentum of a closed system is always conserved, some change in kinetic energy may take place.	Modified(rephrased) SLO		Evaluate
			Circular Motion & Centripetal Force	[SLO: P-11-B-14]	Define and calculate centripetal force	Modified(rephrased) SLO		Remember
				[SLO: P-11-B-15]	Analyze situations involving circular motion in terms of centripetal force	Modified(rephrased) SLO		Analyse
				[SLO: P-11-B-16]	Explain why the objects in orbiting satellites appear to be weightless.	Matched SLO		Understand
				[SLO: P-11-B-17]	Describe how artificial gravity is created to counter weightlessness.	Matched SLO		Understand
				[SLO: P-11-B-18]	Define and calculate moment of inertia of a body and angular momentum.	Matched SLO		Remember
				[SLO: P-11-B-19]	Derive and apply the relation between torque, moment of inertia and angular acceleration.	Matched SLO		Apply
				[SLO: P-11-B-20]	State and apply the law of conservation of angular momentum. Illustrate the applications of conservation of angular momentum in real life	Matched SLO		Apply
				[SLO: P-11-B-21]	Justify how a centrifuge is used to separate materials using centripetal force	New SLO		Evaluate
				[SLO: P-11-B-22]	Distinguish between the structures of crystalline, glassy, amorphous, and polymeric solids.	Matched SLO		Understand
				[SLO: P-11-B-23]	Describe that deformation of solids in one dimension	Matched SLO		Understand
				[SLO: P-11-B-24]	Define and use the terms stress, strain and the Young modulus	New SLO		Understand

Mechanics			**Deformation of Solids**	[SLO: P-11-B-25]	Describe an experiment to determine the Young modulus of a metal wire.	Modified(rephrased) SLO		Understand
				[SLO: P-11-B-26]	Describe and use the terms elastic deformation, plastic deformation and elastic limit	New SLO		Understand
				[SLO: P-11-B-27]	Justify why and apply the fact that the area under the force–extension graph represents the work done	New SLO		Evaluate
				[SLO: P-11-B-28]	Determine the elastic potential energy of a material	New SLO		Analyse
				[SLO: P-11-B-29]	Derive the formula for kinetic [using the equations of motion]	Modified(rephrased) SLO		Apply
				[SLO: P-11-B-30]	Deduce the work done from force-displacement graph	Modified(rephrased) SLO	**Not assessable in summative**	Analyse
				[SLO: P-11-B-31]	Differentiate between conservative and non conservative forces	Matched SLO		Understand
				[SLO: P-11-B-32]	Utilize the work – energy theorem in a resistive medium to solve problems.	Matched SLO		Apply
				[SLO: P-11-B-33]	Justify and use Archimedes’s principle of flotation	New SLO		Evaluate

				[SLO: P-11-B-34]	Justify how ships are engineered to float in the sea	New SLO		Evaluate
				[SLO: P-11-B-35]	Define and apply the terms: steady (streamline or laminar) flow, incompressible flow and non viscous flow as applied to the motion of an ideal fluid	Modified (Split) SLO		Understand
				[SLO: P-11-B-36]	Use equation of continuity to solve problems	New SLO	**Ambiguous**	Apply
				[SLO: P-11-B-37]	Explain that squeezing the end of a rubber pipe results in increase in flow velocity	New SLO		Understand
				[SLO: P-11-B-38]	Justify that the continuity is a form of the principle of conservation of mass.	Matched SLO		Evaluate
				[SLO: P-11-B-39]	Justify that the pressure difference can arise from different rates of flow of a fluid	Matched SLO		Evaluate
				[SLO: P-11-B-40]	Explain and apply Bernoulli's equation for horizontal and vertical fluid flow.	Modified(rephrased) SLO		Understand
				[SLO: P-11-B-41]	Explain why real fluids are viscous fluids.	Matched SLO		Understand
				[SLO: P-11-B-42]	Describe how viscous forces in a fluid cause a retarding force on an object moving through it.	Matched SLO		Understand
				[SLO: P-11-B-43]	Describe superfluidity	New SLO		Understand
				[SLO: P-11-B-44]	Analyze the real world applications of the Bernoulli effect	Modified(rephrased) SLO		Analyse

Heat and Thermodynamics	1. The effects of heat on the physical properties of matter by making reference to the kinetic theory of matter 2. How heat can be transferred through different modes	**Benchmark I:** Use the kinetic theory of matter to account for the properties of an ideal gas	**Thermodynamics**	[SLO: P-12-C-01]	State that regions of equal temperature are in thermal equilibrium	Modified(rephrased) SLO		Remember
				[SLO: P-11-C-02]	Relate a rise in temperature of an object to an increase in its internal energy	Matched SLO	Repetitive (within same grade)	Understand
				[SLO: P-11-C-03]	Apply the equation of state for an ideal gas	New SLO	**Ambiguous**	Apply
				[SLO: P-11-C-04]	State that the Boltzmann constant k is given by k=R/N_A	New SLO		Remember
				[SLO: P-11-C-05]	Describe the basic assumptions of the kinetic theory of gasses.	New SLO		Understand
				[SLO: P-11-C-06]	Use W = pΔV for the work done when the volume of a gas changes at constant pressure.	Modified(rephrased) SLO		Apply
				[SLO: P-11-C-07]	Describe the difference between the work done by a gas and the work done on a gas.	Modified (Split) SLO		Understand
				[SLO: P-11-C-08]	Define and use the first law of thermodynamics	Modified (Split) SLO		Understand
				[SLO: P-11-C-09]	Explain qualitatively, in terms of particles, the relationship between the pressure, temperature and volume of a gas	New SLO		Understand
				[SLO: P-11-C-10]	Use the equation, including a graphical representation of the relationship between pressure and volume for a gas at constant temperature.	New SLO	**Not assessable in summative**	Apply
				[SLO: P-11-C-11]	Justify how the first law of thermodynamics expresses the conservation of energy.	Modified(rephrased) SLO		Evaluate
				[SLO: P-11-C-12]	Relate a rise in temperature of a body to an increase in its internal energy.	Matched SLO	Repetitive (within same grade)	Understand
				[SLO: P-11-C-13]	State the working principle of a heat engine.	Matched SLO		Remember
				[SLO: P-11-C-14]	Describe the concept of reversible and irreversible processes.	Matched SLO		Understand
				[SLO: P-11-C-15]	State and explain the second law of thermodynamics.	Matched SLO		Understand
				[SLO: P-11-C-16]	State the working principle of Carnot's engine	Modified(rephrased) SLO		Remember
				[SLO: P-11-C-17]	Describe that refrigerator is a heat engine operating in reverse as that of an ideal heat engine.	Matched SLO		Understand

				[SLO: P-11-C-18]	Explain that an increase in temperature increases the disorder of the system.	Matched SLO		Understand
				[SLO: P-11-C-19]	Explain that increase in entropy means degradation of energy.	Matched SLO		Understand
				[SLO: P-11-C-20]	Explain that energy is degraded during all natural processes.	Matched SLO		Understand
				[SLO: P-11-C-21]	Identifying that system tends to become less orderly over time.	Matched SLO		Understand
				[SLO: P-11-C-22]	Explain that Entropy, S, is a thermodynamic quantity that relates to the degree of disorder of the particles in a system.	New SLO		Understand
				[SLO: P-11-C-23]	State that the Carnot cycle sets a limit for the efficiency of a heat engine at the temperatures of its heat reservoirs give by Efficiency=1-T(cold reservoir)/T(hot reservoir)	Modified(rephrased) SLO		Remember
	1. Mathematically describe how waves propagate and the general properties of reflection, refraction and diffraction 2. Explain how the wave theory of light can help explain various optical phenomena	**Benchmark I:** Analytically and graphically explain the nature and effects of simple harmonic motion, the doppler effect, and attenuation of sound wave intensity in media **Benchmark II:** Use wave theory to analyse diffraction patterns, interference and polarization in the context of light and sound and other waves		[SLO: P-11-D-01]	Use intensity = power/area to solve problems Use intensity ∝ (amplitude)2 for a progressive wave to solve problems.	New SLO	**Ambiguous**	Apply
				[SLO: P-11-D-02]	Explain that when a source of sound waves moves relative to a stationary observer, the observed frequency is different from the source frequency	Modified(rephrased) SLO		Understand
				[SLO: P-11-D-03]	Use the expression f0=(fs·v)/(v±vs) for the observed frequency when a source of sound waves moves relative to a stationary observer.	New SLO		Apply
				[SLO: P-11-D-04]	Explain the applications of the Doppler effect	Matched SLO		Understand
				[SLO: P-11-D-05]	Explain that polarization is a phenomenon associated with transverse waves.	Matched SLO		Understand
				[SLO: P-11-D-06]	Define and apply Malus's law	Modified(rephrased) SLO		Understand
				[SLO: P-11-D-07]	Use the principle of superposition of waves to solve problems	New SLO	**Ambiguous**	Apply
				[SLO: P-11-D-08]	Differentiate between constructive and destructive interference.	New SLO		Understand
				[SLO: P-11-D-09]	Apply the principle of superposition to explain the working of noise canceling headphones.	New SLO		Understand
				[SLO: P-11-D-10]	Illustrate experiments that demonstrate stationary waves	Modified(rephrased) SLO		Apply
				[SLO: P-11-D-11]	Explain the formation of a stationary wave using graphical representation	Matched SLO		Understand
				[SLO: P-11-D-12]	Explain the formation of harmonics in stationary waves.	New SLO		Understand

Doamin D: Waves			**Waves**	[SLO: P-11-D-13]	Analyze experiments that demonstrate diffraction	Modified(rephrased) SLO		Understand
				[SLO: P-11-D-14]	Explain the term coherence.	New SLO		Understand
				[SLO: P-11-D-15]	Explain beats	New SLO		Understand
				[SLO: P-11-D-16]	Illustrate examples of how beats are generated in musical instruments	Modified(rephrased) SLO		Understand
				[SLO: P-11-D-17]	Explain the use of polaroids in sky photography and stress analysis of materials	Matched SLO		Understand
				[SLO: P-11-D-18]	Describe qualitatively gravitational waves	New SLO		Understand
				[SLO: P-11-D-19]	State that as a gravitational wave passes a body with mass the distortion in spacetime can cause the body to stretch and compress periodically	New SLO		Remember
				[SLO: P-11-D-20]	State that gravitational waves pass through the Earth due to far off celestial events, but they are very minute amplitude	New SLO		Remember
				[SLO: P-11-D-21]	Describe the use of interferometers in detecting gravitational waves	New SLO		Understand
	1. Describe mathematically the nature of static magnetic and electric fields 2. Analyze and account for the distribution of current, voltage and resistance in simple DC circuits 3. Explain how power can be generated through electromagnetic induction 4. Account for how motors make use of electromagnetism to generate kinetic energy 5. Analyse AC circuits in terms of current, resistance, reactance, voltage, and impedance	**Benchmark I:** Analyze quantitatively the interactions of electric fields in terms of electric force, field strength, potential and potential energy **Benchmark II:** Derive and use Kirchhoff's laws to describe the design and application of simple circuits **Benchmark III:** Apply quantitatively the principles of magnetic flux, electromagnetic forces, induction and radiation to describe: (1) how electricity can be generated (2) how alternating current in circuits can be regulated (3) the applications of electromagnetic radiation in medical technology		[SLO: P-11-E-01]	State that an electric field is an example of a field of force	Matched SLO		Remember
				[SLO: P-11-E-02]	Define and calculate electric field strength	Modified (Split) SLO		Remember
				[SLO: P-11-E-03]	Represent an electric field by means of field lines	New SLO	**Not assessable in summative**	Understand
				[SLO: P-11-E-04]	Describe the effect of a uniform electric field on the motion of charged particles	New SLO		Understand

			Electricity	[SLO: P-11-E-05]	State that, for a point outside a spherical conductor, the charge on the sphere may be considered to be a point charge at its center	New SLO		Remember
				[SLO: P-11-E-06]	Explain how a Faraday cage works	New SLO		Understand
				SLO: P-11-E-07]	State and apply Coulomb's law	Matched SLO		Apply
				[SLO: P-11-E-08]	Use E = k q/r^2 for the electric field strength due to a point charge in free space.	Matched SLO		Apply
				[SLO: P-09-E-09]	Describe how ferrofluids work	New SLO		Understand
				[SLO: P-09-E-10]	Use, for a current-carrying conductor, the expression I=Anvq	New SLO	**Ambiguous**	Apply
				[SLO: P-09-E-11]	State and use V=W/Q	Modified (Split) SLO		Apply
				[SLO: P-09-E-12]	State and use P=IV, P=I^2 R and P=V^2/R	New SLO		Apply
				[SLO: P-09-E-13]	State and use R=ρL/A	Modified(rephrased) SLO		Apply
				[SLO: P-09-E-14]	State that the resistance of a light-dependent resistor (LDR) decreases as the light intensity increases	New SLO		Remember
				[SLO: P-09-E-15]	Define and use the electromotive force (e.m.f.)	Modified(rephrased) SLO		Apply
				[SLO: P-09-E-16]	Distinguish between e.m.f. and potential difference (p.d.) in terms of energy considerations	Matched SLO		Understand
				[SLO: P-09-E-17]	Explain the effects of the internal resistance of a source of e.m.f. on the terminal potential difference	New SLO		Understand
				[SLO: P-09-E-18]	State Kirchhoff's first law and describe that it is a consequence of conservation of charge	New SLO		Remember
				[SLO: P-09-E-19]	State Kirchhoff's second law and describe that it is a consequence of conservation of energy	New SLO		Remember
				[SLO: P-09-E-20]	Derive, using Kirchhoff's laws, a formula for the combined resistance of two or more resistors in series	New SLO		Apply

Domain E: Electricity and Magnetism				[SLO: P-09-E-21]	Derive and apply a formula for the combined resistance of two or more resistors in parallel	New SLO		Apply
				[SLO: P-09-E-22]	Use Kirchhoff's laws to solve simple circuit problems	Modified (Split) SLO		Apply
				[SLO: P-09-E-23]	State and use the principle of the potentiometer as a means of comparing potential differences	New SLO		Understand
				[SLO: P-09-E-24]	Explain the use of a galvanometer in null methods	New SLO	**Ambiguous**	Understand
				[SLO: P-09-E-25]	Explain the use of thermistors and light-dependent resistors in potential dividers	New SLO		Understand
				[SLO: P-09-E-26]	Explain the internal resistance of sources and its consequences for external circuits	Matched SLO		Understand
				[SLO: P-09-E-27]	Explain how inspectors can easily check the reliability of a concrete bridge with carbon fibers as the fibers conduct electricity	Matched SLO		Understand
				[SLO: P-09-E-28]	Define and explain magnetic fields	Modified(rephrased) SLO		Remember
				[SLO: P-09-E-29]	State that a force might act on a current-carrying conductor placed in a magnetic field	Matched SLO		Remember
				[SLO: P-09-E-30]	Use the equation F=BIL sin(θ)	Matched SLO		Apply
				[SLO: P-09-E-31]	Define magnetic flux density	Matched SLO		Remember
				[SLO: P-09-E-32]	Use F=BqV sin(θ) to solve problems	New SLO	**Ambiguous**	Apply
				[SLO: P-09-E-33]	Describe the motion of a charged particle moving in a uniform magnetic field perpendicular to the direction of motion of the particle	Modified (Split) SLO		Understand
				[SLO: P-09-E-34]	Explain how electric and magnetic fields can be used in velocity selection	Modified (Split) SLO		Understand
				[SLO: P-09-E-35]	Sketch magnetic field patterns due to the currents in a long straight wire, a flat circular coil and a long solenoid	Modified(rephrased) SLO	**Not assessable in summative**	Apply

			Electromagnetism	[SLO: P-09-E-36]	State that the magnetic field due to the current in a solenoid is increased by a ferrous core.	New SLO		Remember
				[SLO: P-09-E-37]	Explain the origin of the forces between current-carrying conductors and determine the direction of the forces.	New SLO		Understand
				[SLO: P-09-E-38]	Define magnetic flux	Matched SLO		Remember
				[SLO: P-09-E-39]	Use Φ=BA to solve problems	New SLO		Apply
				[SLO: P-09-E-40]	Use the concept of magnetic flux linkage	New SLO		Understand
				[SLO: P-09-E-41]	Explain experiments that demonstrate Faraday's and Lenz's laws	Modified (Split) SLO		Understand
				[SLO: P-09-E-42]	Use Faraday's and Lenz's laws of electromagnetic induction to solve problems	Matched SLO		Apply
				[SLO: P-09-E-43]	Explain how seismometers make use of electromagnetic induction to the earthquake detection	Modified(rephrased) SLO		Understand
	1. Analyze radioactive decay processes 2.Explain the processes of nuclear fusion and fission 3.Explain the postulates and implications of special relativity 4.Use the quantum mechanical model of photons to explain phenomena	**Benchmark I:** Explain and apply knowledge of the basic inter-related postulates of and discoveries from: (1) the special theory of relativity (2) the standard model of particle physics (3) quantum theory **Benchmark II:** 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.	**Relativity**	[SLO: P-11-F-01]	Distinguish between inertial and non-inertial frames of reference.	Matched SLO		Understand
				[SLO: P-11-F-02]	Describe the significance of Einstein's assumption of the constancy of the speed of light.	Modified(rephrased) SLO		Understand
				SLO: P-11-F-03]	Describe that if c is constant then space and time become relative.	Matched SLO		Understand
				[SLO: P-11-F-04]	State the postulates of Special relativity	Matched SLO		Remember
				[SLO: P-11-F-05]	Explain qualitatively and quantitatively the consequences of special relativity	Matched SLO		Understand

Domain F:Modern Physics				[SLO: P-11-F-06]	State that spacetime is a mathematical model in relativity that treats time as a fourth dimension of the traditional three dimensions of space	New SLO		Remember
				[SLO: P-11-F-07]	State that nucleon number and charge are conserved in nuclear processes	New SLO		Remember
				[SLO: P-11-F-08]	Describe the composition, mass and charge of α, β and γ radiations	New SLO		Understand
				[SLO: P-11-F-09]	Explain that an antiparticle has the same mass but opposite charge to the corresponding particle	New SLO		Understand
				[SLO: P-11-F-10]	State that (electron) antineutrinos are produced during β–decay and (electron) neutrinos are produced during β+ decay	New SLO		Remember
				[SLO: P-11-F-11]	Explain that α-particles have discrete energies but that β-particles have a continuous range of energies because (anti)neutrinos are emitted in β-decay	New SLO		Understand
				[SLO: P-11-F-12]	Describe quarks and anitquarks (as a fundamental	New SLO		Understand
				[SLO: P-11-F-13]	Describe protons and neutrons in terms of their quark composition	New SLO		Understand
				[SLO: P-11-F-14]	State that a hadron may be either a baryon (consisting of three quarks) or a meson (consisting of one quark and an antiquark)	New SLO		Remember
				[SLO: P-11-F-15]	Describe the changes to quark composition that take place during β– and β+ decay	New SLO		Remember
				[SLO: P-11-F-16]	State that electrons and neutrinos are fundamental particles called leptons	New SLO		Understand
				[SLO: P-11-F-17]	State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	New SLO		Remember

			Particle Physics	[SLO: P-11-F-18]	State the Higgs Boson as a fundamental particle which is responsible for the particle's mass.	New SLO		Remember
				[SLO: P-11-F-19]	Explain that every subatomic particle has a corresponding antiparticle	New SLO		Understand
				[SLO: P-11-F-20]	Describe protons and neutrons in terms of their quark composition	New SLO		Understand
				[SLO: P-11-F-21]	State that a hadron may be either a baryon (consisting of three quarks) or a meson (consisting of one quark and an antiquark)	New SLO		Remember
				[SLO: P-11-F-22]	Explain that there are various contending theories about what 'mass' and 'force' are generated from	New SLO		Understand
				[SLO: P-11-F-23]	Explain the working principle of particle accelerators and also their uses.	New SLO		Understand
				[SLO: P-11-F-24]	Explain that antimatter is the counterpart of matter	New SLO		Understand
				[SLO: P-11-F-25]	Illustrate that antiparticles usually have the same weight, but opposite charge, compared to their matter counterparts	New SLO		Understand
				[SLO: P-11-F-26]	State that most of the matter in the observable universe is matter	New SLO		Remember
				[SLO: P-11-F-27]	Describe the asymmetry of matter and antimatter in the universe as an unsolved mystery	New SLO		Understand
				[SLO: P-11-F-28]	Describe annihilation reactions	New SLO		Understand
	Students should be able to make and record observations, measurements and estimates	**Benchmark I:** Students should be able to identify and take the safety measures required to conduct experiments		[SLO: P-11-N-06]	Set up apparatus correctly without assistance from a supervisor	New SLO	Not assesible in Summative	Apply
				[SLO: P-11-N-07]	Follow instructions given in the form of written instructions and diagrams (including circuit diagrams)	New SLO	Not assesible in Summative	Apply

Experimentation Skills				[SLO: P-11-N-08]	Use apparatus to collect an appropriate quantity of data	New SLO	Not assesible in Summative	Apply
				[SLO: P-11-N-09]	Repeat readings where appropriate	New SLO	Not assesible in Summative	Apply
				[SLO: P-11-N-10]	Make measurements that span the largest possible range of values within the limits either of the equipment provided or of the instructions given.	New SLO	Not assesible in Summative	Apply
		Benchmark II: Tabulate and graph data appropriately, including use of false origins		[SLO: P-11-N-11]	Use a false origin where appropriate while plotting graphs	New SLO	Not assesible in Summative	Apply
		Benchmark III: Estimate data collected to an appropriate number of significant figures and with the uncertainty quoted		[SLO: P-11-N-12]	Estimate the absolute uncertainty in measurements	New SLO		Apply
				[SLO: P-11-N-13]	Express the uncertainty in a measurement as an absolute or percentage uncertainty, and translate between these forms	New SLO		Understand
				[SLO: P-11-N-14]	Express the absolute uncertainty in a repeated measurement as half the range of the repeated readings, where this is appropriate.	New SLO		Understand
	Students should be able to interpret and evaluate experimental observations and data	**Benchmark I:** Analyze tabular data, plotted linear and polynomial graphs for how well they fit with the hypothesized theoretical relationship the studied variables by considering the calculated values obtained and their corresponding percentage uncertainty		[SLO: P-11-N-15]	Draw straight lines of best fit or curves to show the trend of a graph	New SLO	Not assesible in Summative	Apply
				[SLO: P-11-N-16]	Draw tangents to curved trend lines and determine the gradient of a straight-line graph or of a tangent to a curve	New SLO	Not assesible in Summative	Apply
				[SLO: P-11-N-17]	Relate straight-line graphs to equations of the form y = mx + c, and derive expressions that equate to the gradient and/or the y-intercept of their graphs	New SLO		Understand
				[SLO: P-110-N-18]	Read the coordinates of points on the trend line of a graph	New SLO		Understand
				[SLO: P-11-N-19]		New SLO		
				[SLO: P-11-N-20]	determine the y-intercept of a straight-line graph or of a tangent to a curve, including where these are on graphs with a false origin.	New SLO		Understand
				[SLO: P-11-N-21]	draw conclusions from an experiment, including determining the values of constants	New SLO	Not assesible in Summative	Analyse
				[SLO: P-11-N-22]	Explain whether experimental data supports a given hypothesis and make predictions based on the data	New SLO		Understand
				[SLO: P-11-N-23]	Determine whether a relationship containing a constant is supported by experimental data	New SLO		Understand
				[SLO: P-11-N-24]	For results of an experiment: (i) Calculate the percentage difference between values of the constant (ii) Compare this percentage difference with a pre-given percentage uncertainty (iii) Give a conclusion based on this comparison.	New SLO		Understand

	Students should be able to evaluate methods and suggest possible improvements	**Benchmark I:** Evaluate and suggest improvements regarding whether an experimental design could improve on the uncertainty in its conclusions		[SLO: P-11-N-25]	Identify and describe the limitations in an experimental procedure	New SLO		Understand
				[SLO: P-11-N-26]	Identify the most significant sources of uncertainty in an experiment.	New SLO		Understand
				[SLO: P-11-N-27]	An experimental arrangement that will improve the accuracy of the experiment or to extend the investigation to answer a new question	New SLO		Understand
				[SLO: P-11-N-28]	Describe these modifications clearly in words or diagrams.	New SLO		Understand