ASSESSMENT FRAMEWORK AND MODEL QUESTION PAPER

PHYSICS

Grade XI

NATIONAL CURRICULUM
2022-23

50% MCQs & 50% Descriptive
INCLUSIVE SCHEME OF STUDIES 2024

FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION, ISLAMABAD

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FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION

H-8/4, ISLAMABAD

ASSESSMENT FRAMEWORK

FOR

PHYSICS GRADE-XI

CURRICULUM 2022-23

SCHEME OF STUDIES 2024

ACKNOWLEDGEMENT

It is a great honour that we, at the Federal Board of Intermediate and Secondary Education, have developed the Assessment Framework (AF) for the subject of Physics for Grade-XI. The primary objective of the AF is to optimize the current curriculum 2022-23. This comprehensive framework has been crafted meticulously by subject matter and assessment experts who conducted an in-depth review of all learning outcomes for Grade-XI Physics curriculum. They evaluated these outcomes in terms of their scope, cognitive level, and progression across the grade.

This significant undertaking was the result of a series of extensive meetings and collaborative efforts of the subject and assessment experts. Their dedication and expertise have been instrumental in bringing this framework to fruition.

The Assessment Framework will serve as a guiding document for students, teachers and paper setters. Students will receive clear directions for preparing themselves for the annual examination. Similarly, teachers will use it as a guide to understand what to teach in class and to prepare students for the final examinations accordingly. Similarly paper setters will also seek guidance from this document.

Following subject as well as assessment experts/committee members remained constantly engaged in the development of the AF:

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5. Ms. Saima Waheed Khan, Subject Experts, APSAC Secretariat Rawalpindi

The whole work was successfully accomplished under the able supervision and guidance of Dr. Ikram Ali Malik, Chairman, FBISE and due to the hard work and dedication of the staff of Research Section of FBISE, in particular, Syed Zulfiqar Shah, Deputy Secretary, Research and Academics who played a pivotal and leading role in finalizing the Assessment Framework.

MIRZA ALI
Director
FBISE, Islamabad

ASSESSMENT FRAMEWORK FOR PHYSICS GRADE-XI, CURRICULUM 2022-23

To ensure clarity and precision in assessment, the learning outcomes have been categorized into two distinct groups: formative and summative. This classification helps in effectively measuring student progress and understanding. Each Student learning outcome (SLO) has been carefully marked as either formative or summative within the newly developed Assessment Framework. SLOs of Summative Assessment Format will be part of the Final Examination while SLOs of Formative Assessment will although be part of the teaching-learning activity but they will **NOT** be part of Final Examinations. Estimated cognitive levels i.e Knowledge (K), Understanding (U) and Application (A) of all the SLOs have also been indicated. It may be noted that all the higher cognitive levels have been collectively accumulated in the cognitive level of 'Application'. In subjects involving Practicals (Lab work), it has been mentioned categorically whether an SLO is summative for theory or summative for Practical Based Assessment (PBA). If an SLO is summative for PBA, it means that Laboratory work is required in the teaching-learning activity and it will be part of the Practical Examination/ Practical Based Assessment.

The Assessment Framework will act as a comprehensive guide for students, teachers and paper setters. Students will have clear instructions on how to prepare for the annual examinations. Teachers will use the framework to understand the curriculum and effectively prepare their students for the final examination. Additionally, paper setters will refer to this document for guidance in setting examination papers.

A model question paper has also been developed to provide a clear structure and format for upcoming examinations. The model question paper ensures consistency and fairness, offering students a comprehensive understanding of what to expect in their examinations. By aligning the paper with the Student Learning Outcomes (SLOs) of the curriculum, we ensured that the questions accurately reflect the skills and knowledge that students are expected to acquire.

A detailed Table of Specifications (ToS) has been created to ensure equitable coverage of cognitive levels and content domains in order to generate a balanced question paper. The ToS serves as drawing scale and action plan for the question paper, ensuring that all important areas of the curriculum are adequately and proportionately assessed.

FORMATIVE ASSESSMENT: AN ESSENTIAL COMPONENT OF EFFECTIVE LEARNING

Formative assessment is a pivotal element in the educational process, distinguished by its role in providing ongoing feedback to both students and educators. Unlike summative assessments, which evaluate student learning at the end of an instructional period, formative assessments are integrated into the learning process to monitor student understanding and guide instructional decisions.

The primary objective of formative assessment is to identify learning gaps and misunderstandings as they occur, enabling timely interventions. This dynamic approach allows teachers to adjust their teaching strategies to better meet the needs of their students. For instance, if a teacher notices through a quick quiz or class discussion that a significant portion of the class struggles with a particular concept, they can revisit that topic, providing additional explanations or alternative methods of instruction. This adaptability is crucial for fostering a deeper understanding of the material.

Formative assessments come in various forms, ranging from informal methods like classroom discussions, observations, and questioning, to more structured approaches such as quizzes, peer assessments, and self-reflections. These methods are not limited to paper-and-pencil tasks but can include digital tools that provide instant feedback. The versatility of formative assessments allows educators to cater to diverse learning styles and preferences, ensuring that all students are engaged and supported in their learning journey.

Formative assessment plays a significant role in creating a supportive classroom environment. It shifts the focus from merely achieving grades to understanding the learning process. This approach reduces the pressure on students, as they perceive assessments not as a final judgment of their abilities but as a part of their learning journey. Consequently, formative assessment can lead to increased student motivation and engagement.

In conclusion, formative assessment is a powerful tool that, when effectively implemented, can significantly enhance the learning experience. It provides invaluable insights for both teachers and students, promotes a growth-oriented learning environment, and supports the continuous development of essential skills. As education evolves, the role of formative assessment will undoubtedly continue to be central in fostering successful and meaningful learning experiences.

SUMMATIVE ASSESSMENT: EVALUATING LEARNING OUTCOMES IN THE FORM OF TERMINAL/FINAL EXAMINATION

Summative assessment is a fundamental component of the educational process, designed to evaluate student learning at the conclusion of an instructional period. Unlike formative assessment, which provides ongoing feedback during the learning process, summative assessment serves as a final measure of what students have learned. Typically administered at the end of a unit, course, or academic year. Summative assessment aims to determine the extent to which educational objectives have been achieved.

The primary purpose of summative assessment is to assess the overall effectiveness of instruction and learning. It provides a conclusive evaluation of student performance, often in the form of tests, final projects, or standardized exams. These assessments generate grades or scores that reflect a student's achievement in a given subject area over a specific period or time duration.

Summative assessment is often used to make critical decisions regarding student progression, certification, or placement in subsequent educational levels. Additionally, summative assessments provide valuable data that inform curriculum development and instructional strategies. By analyzing summative assessment results, educators can identify trends, strengths, and weaknesses within their instructional approaches, allowing for improvements in future teaching.

In conclusion, summative assessment plays a critical role in the educational process by providing a final evaluation of student learning. While it differs from formative assessment in its focus and application, it is an essential tool for measuring academic achievement. When balanced with formative assessments, summative assessments contribute to a well-rounded and effective approach to evaluating and supporting student learning.

National Curriculum of Pakistan 2022-2023

Assessment Framework Physics Grade-XI (HSSC-I)

Details of Content Areas/ SLOs

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
Domain: A Measurements				
[**SLO**: P-11-A-01] Make reasonable estimates of physicalquantities [of those quantities that are discussed in the topics of this grade]	Formative	Understanding	Question will not be asked in final examination	07 periods
[SLO: P-11-A-02] Express derived units as products orquotients of the SI base units	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-A-03] Analyze the homogeneity of physical equations [Through dimensional analysis]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-A-04] Derive formulae in simple cases [Through using dimensional analysis]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-A-05] Analyze and critique the accuracy and precision of data collected by measuring instruments	Summative	Application	Question(s) will be asked in final examination.	05 periods
[SLO: P-11-A-06] Assess the uncertainty in a derived quantity [By simple addition of absolute, fractional or percentage uncertainties]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-A-07] Justify why all measurements contain some uncertainty	Summative	Understanding + Application	Question(s) will be asked in final examination.	
Domain: B Mechanics			Question(s) will be asked in final examination.	10 periods
[SLO: P-11-B-01] Represent a vector in 2-D as twoperpendicular	Summative	Understanding + Application	Question(s) will be asked	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
components			in final examination.	
[SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties.	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-03] Derive the equations of motion [For uniform acceleration cases only. Derive from the definitions of velocity and acceleration as well as graphically].	Formative	Understanding	Question will not be asked in final examination	
[SLO: P-11-B-04] Solve problems using the equations of motion [For the cases of uniformly accelerated motion in a straight line, including the motion of bodies falling in a uniform gravitational field without air resistance. This also includes situations where the equations of motion need to be resolved into vertical and horizontal components for 2-D motion]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [This includes solving problems making use of the below facts: (i) Horizontal component (V_H) of velocity is constant. (i) Acceleration is in the vertical direction and is the same as that of a vertically free falling object. (ii) The horizontal motion and vertical motion are independent of each other. Situations may require students to determine for projectiles: - How high does it go? - How far would it go along the level land? - Where would it be after a given time? - How long will it remain in flight? Situations may also require students to calculate for Ja projectile launched from ground height the - launch angle that results in the maximum range. - relation between the launch angles that result in the same range.] [SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion [This includes analysis of both the horizontal component and vertical component of velocity and hence predicting qualitatively the range of the projectile.]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion [This includes analysis of both the horizontal component and vertical component of velocity and hence predicting qualitatively the	Summative	Understanding + Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
range of the projectile.]				
[SLO: P-11-B-07] Express angles in radians	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	05 periods
[SLO: P-11-B-08] Define and calculate angular displacement, angular velocity and angular acceleration [This involves use of S = r θ, v = rω, ω = 2π/T, a == $r\omega^2$ and a = v^2/r to solve problems].	Summative	Knowledge+ Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-09] Use equations of angular motion to solve problems involving rotational motions.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-10] Analyze qualitatively motion in a curved path due to a perpendicular force.	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-11] Apply the principle of conservation of momentum to solve simple problems [Including elastic and inelastic interactions between objects in both one and two dimensions. Knowledge of the concept of coefficient of restitution is not required. Examples of applications include: - karate chops to break a pile of bricks - car crashes - ball & bat - the motion under thrust of a rocket in a straight line considering short thrusts during which the mass remains constant]	Formative	Application	Question will not be asked in final examination.	05 periods
[SLO: P-11-B-12] Predict and analyze motion for elastic collisions [This include making use of the fact that for an elastic collision, total kinetic energy is conserved and the relative speed of approach is equal to the relative speed of separation]	Summative	Application	Question(s) will be asked in final examination.	
[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	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-14] Define and calculate centripetal force *Use F = mrω², F = mv² /r]	Summative	Knowledge+ Application	Question(s) will be asked in final examination.	15 periods
[SLO: P-11-B-15] Analyze situations involving circular motion in terms of centripetal force [e.g. situations in which centripetal acceleration is caused by	Summative	Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
a tension force, a frictional force, a gravitational force, or a normal force.]				
[SLO: P-11-B-16] Explain why the objects in orbiting satellites appear to be weightless.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-17] Describe how artificial gravity is created to counter weightlessness.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-18] Define and calculate moment of inertia of abody and angular momentum.	Summative	Knowledge+ Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-19] Derive and apply the relation between torque, moment of inertia and angular acceleration.	Summative	Application	Question(s) will be asked in final examination.	
[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 [Such as by flywheels to store rotational energy, by gyroscopes in navigation systems, by ice skaters to adjust their angular velocity].	Summative	Knowledge+ Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-21] Justify how a centrifuge is used to separate materials using centripetal force	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-22] Distinguish between the structures of crystalline, glassy, amorphous, and polymeric solids.	Summative	Understanding	Question(s) will be asked in final examination.	32 periods
[SLO: P-11-B-23] Describe that deformation of solids in one dimension [that it is caused by a force and that in one dimension, the deformation can be tensile or compressive].	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-24] Define and use the terms stress, strain and the Young modulus	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-25] Describe an experiment to determine the Young modulus of a metal wire.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-26] Describe and use the terms elastic deformation, plastic deformation and elastic limit	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-27] Justify why and apply the fact that the area under the force–extension graph represents the work done	Summative	Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-11-B-28] Determine the elastic potential energy of amaterial [that is deformed within its limit of proportionality from the area under the force-extension graph. Also state and use $E_P = \frac{1}{2}Fx = \frac{1}{2}kx^2$ for a material deformed within its limit of proportionality].	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-29] Derive the formula for kinetic Energy [using the equations of motion]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-30] Deduce the work done from force-displacement graph	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-31] Differentiate between conservative and non-conservative forces	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-32] Utilize the work – energy theorem in a resistive medium to solve problems.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-33] Justify and use Archimedes' principle offlotation	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-34] Justify how ships are engineered to float in the sea	Summative	Application	Question(s) will be asked in final examination.	
[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	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-36] Use equation of continuity to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-37] Explain that squeezing the end of a rubberpipe results in increase in flow velocity	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-38] Justify that the continuity is a form of theprinciple of conservation of mass.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-39] Justify that the pressure difference can arise from different rates of flow of a fluid [Bernoulli effect].	Formative	Application	Question(s) will not be asked in final examination.	
[SLO: P-11-B-40] Explain and apply Bernoulli's equation for horizontal	Summative	Application	Question(s) will be asked	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
and vertical fluid flow			in final examination.	
[SLO: P-11-B-41] Explain why real fluids are viscous fluids.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-42] Describe how viscous forces in a fluid cause a retarding force on an object moving through it.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-43] Describe super fluidity [As the state in which a liquid will experience zero viscosity. Students should know the implications of this state e.g. this allows for super fluids to creep over the walls of containers to 'empty' themselves. It also implies that if you stir a superfluid, the vortices will keep spinning indefinitely.]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-44] Analyze the real world applications of the Bernoulli effect [For example, atomisers in perfume bottles, the swinging trajectory of a spinning cricket ball and the lift of a spinning golf ball (the magnus effect), the use of Venturi ducts in filter pumps and car engines to adjust the flow of fluid, etc]	Summative	Application	Question(s) will be asked in final examination.	
Domain C: Heat and Thermodynamics				30 periods
[SLO: P-12-C-01] State that regions of equal temperature are in thermal equilibrium	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-C-02] Relate a rise in temperature of an object to an increase in its internal energy	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-03] Apply the equation of state for an ideal gas [expressed as pV = nRT, where n = amount of substance (number of moles) and as pV = NkT, where N = number of molecules]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-04] State that the Boltzmann constant k is given by $k=R/N_A$	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-C-05] Describe the basic assumptions of the kinetic theory of gasses [Including understanding the temperature, pressure and density conditions under which an ideal gas is a good approximation of a real gas.]	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-11-C-06] Use W = pΔV for the work done when the volume of a gas changes at constant pressure.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-07] Describe the difference between the work done by a gas and the work done on a gas.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-08] Define and use the first law ofthermodynamics [Q = ΔU + W expressed in terms of the increase in internal energy, the heating of the system (energy transferred to the system by heating) and the work done on the system]	Summative	Knowledge + Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-09] Explain qualitatively, in terms of particles, the relationship between the pressure, temperature and volume of a gas [Specifically the below case: (a) pressure and temperature at constant volume. (b) volume and temperature at constant pressure (c) pressure and volume at a constant temperature]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-10] Use the equation, including a graphical representation of the relationship betweenpressure and volume for a gas at constant temperature.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-11] Justify how the first law of thermodynamics expresses the conservation of energy.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-12] Relate a rise in temperature of a body to an increase in its internal energy.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-13] State the working principle of a heat engine.	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-C-14] Describe the concept of reversible and irreversible processes.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-15] State and explain the second law of thermodynamics.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-16] State the working principle of Carnot's engine	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-17] Describe that refrigerator is a heat engine operating	Summative	Understanding	Question(s) will be asked	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
in reverse as that of an ideal heatengine.			in final examination.	
[SLO: P-11-C-18] Explain that an increase in temperature increases the disorder of the system.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-19] Explain that increase in entropy means degradation of energy.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-20] Explain that energy is degraded during allnatural processes.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-21] Identifying that system tends to become less orderly over time.	Summative	Understanding	Question(s) will be asked in final examination.	
[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.	Summative	Understanding	Question(s) will be asked in final examination.	
[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 given by Efficiency=1-T(cold reservoir)/T(hot reservoir)	Summative	Knowledge	Question(s) will be asked in final examination.	
Domain D: Waves				
[SLO: P-11-D-01] Use intensity = power/area to solve problems. Use Intensity $\propto$ (amplitude)^2 for a progressive wave to solve problems	Summative	Application	Question(s) will be asked in final examination.	26 periods
[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 [describing of the Doppler effect for a stationary source and a moving observer is not required]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-03] Use the expression $f_o = (f_s \cdot v)/(v \pm v_s)$ for the observed frequency when a source of sound waves moves relative to a stationary observer.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-D-04] Explain the applications of the Doppler effect [such as radar, sonar, astronomy, satellite, radar speed traps and studying	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
cardiac problems in humans]				
[SLO: P-11-D-05] Explain that polarization is a phenomenon associated with transverse waves	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-06] Define and apply Malus's law [$I = I_o \cos^2\theta$ to calculate the intensity of a plane-polarized electromagnetic wave after transmission through a polarizing filter or a series of polarizing filters. (calculation of the effect of a polarizing filter on the intensity of an unpolarized wave is not required).]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-07] Use the principle of superposition of waves to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-D-08] Differentiate between constructive anddestructive interference.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-09] Apply the principle of superposition to explain the working of noise canceling headphones.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-10] Illustrate experiments that demonstratestationary waves [using microwaves, stretched strings and air columns (it will be assumed that end corrections are negligible; knowledge of the concept of end corrections is not required)]	Formative	Application	Question(s) will not be asked in final examination.	
[SLO: P-11-D-11] Explain the formation of a stationary wave using graphical representation	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-12] Explain the formation of harmonics in stationary waves.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-13] Analyze experiments that demonstratediffraction [including the qualitative effect of the gap width relative to the wavelength of the wave; for example diffraction of water waves in a ripple tank]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-14] Explain the term coherence.	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-11-D-15] Explain beats [as the pulsation caused by two waves of slightly different frequencies interfering with each other]	Summative	Knowledge + Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-16] Illustrate examples of how beats aregenerated in musical instruments	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-D-17] Explain the use of polaroids in sky photography and stress analysis of materials	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-18] Describe qualitatively gravitational waves [as waves of the intensity of gravity generated by the accelerated masses of an orbital binary system that propagate as waves outward from their source at the speed of light]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-19] State that as a gravitational wave passes a body with mass the distortion in space-time can cause the body to stretch and compress periodically	Formative	Knowledge	Question(s) will not be asked in final examination.	
[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	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-D-21] Describe the use of interferometers in detecting gravitational waves [Interferometers are very sensitive detection devices that make use of the interference of laser beams (working and set up details are not required) and were used to first detect the existence of gravitational waves]	Formative	Understanding	Question(s) will not be asked in final examination.	
Domain E: Electricity and Magnetism				32 periods
[SLO: P-11-E-01] State that an electric field is an example of a field of force	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-E-02] Define and calculate electric field strength [Use F = qE for the force on a charge in an electric field. Use E= $\frac{\Delta V}{\Delta d}$ to calculate the field strength of the uniform field between charged parallel plates]	Summative	Knowledge+ Understanding + Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-11-E-03] Represent an electric field by means of field lines	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-E-04] Describe the effect of a uniform electric field on the motion of charged particles	Summative	Understanding	Question(s) will be asked in final examination.	
[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	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-E-06] Explain how a Faraday cage works [by inducing internal electric fields that work to shield the inside from the influence of external electric fields]	Summative	Understanding	Question(s) will be asked in final examination.	
SLO: P-11-E-07] State and apply Coulomb's law [F= $k\frac{Q_1Q_2}{r^2}$ for the force between two point charges in free space, where k = $\frac{1}{4\pi\epsilon_o}$]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-E-08] Use E = k $\frac{Q}{r^2}$ for the electric field strength due to a point charge in free space.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-09] Describe how Ferro fluids work [they make use of temporary soft magnetic materials suspended in liquids to develop fluids that react to the poles of a magnet and have many applications in fields such as electronics]	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-09-E-10] Use, for a current-carrying conductor, the expression I=Anvq [where n is the number of charge carriers per unit volume.]	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-11] State and use V=W/Q	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-12] State and use P=IV, $P=I^2R$ and $P=V^2/R$	Summative	Understanding + Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-09-E-13] State and use R=ρL/A	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-14] State that the resistance of a light-dependent resistor (LDR) decreases as the light intensity increases	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-15] Define and use the electromotive force(e.m.f.) [of a source as energy transferred per unit charge in driving charge around a complete circuit]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-16] Distinguish between e.m.f. and potentialdifference (p.d.) in terms of energy considerations	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-17] Explain the effects of the internal resistance of a source of e.m.f. on the terminal potentialdifference	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-18] State Kirchhoff's first law and describe that it is a consequence of conservation of charge	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-09-E-19] State Kirchhoff's second law and describe that it is a consequence of conservation of Energy	Summative	Knowledge + Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-20] Derive, using Kirchhoff's laws, a formula for the combined resistance of two or more resistors in series	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-21] Derive and apply a formula for the combined resistance of two or more resistors in parallel	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-22] Use Kirchhoff's laws to solve simple circuit problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-23] State and use the principle of the potentiometer as a means of comparing potential differences	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-24] Explain the use of a galvanometer in nullmethods	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-25] Explain the use of thermistors and light- dependent resistors in potential dividers [to provide a potential difference that	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
is dependent on temperature and light intensity]				
[SLO: P-09-E-26] Explain the internal resistance of sources and its consequences for external circuits	Summative	Understanding	Question(s) will be asked in final examination.	
[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	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-28] Define and explain magnetic fields	Summative	Knowledge	Question(s) will be asked in final examination.	18 periods
[SLO: P-09-E-29] State that a force might act on a current- carrying conductor placed in a magnetic field	Summative	Knowledge + Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-30] Use the equation F=BIL sin(θ) [with directions as interpreted by Fleming's left-hand rule to solve problems]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-31] Define magnetic flux density [as the force acting per unit current per unit length on a wire placed at right angles to the magnetic field]	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-09-E-32] Use F=BqV sin(θ) to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[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	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-34] Explain how electric and magnetic fields can be used in velocity selection	Summative	Understanding	Question(s) will be asked in final examination.	
[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	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-36] State that the magnetic field due to the current in a solenoid is increased by a ferrous core.	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-09-E-37] Explain the origin of the forces between current-carrying conductors and determine the direction of the forces.	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-09-E-38] Define magnetic flux [as the product of the magnetic flux density and the cross-sectional area perpendicular to the direction of the magnetic flux density]	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-09-E-39] Use Φ=BA to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-40] Use the concept of magnetic flux linkage	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-41] Explain experiments that demonstrate Faraday's and Lenz's laws [(a) that a changing magnetic flux can induce an e.m.f. in a circuit, (b) that the induced e.m.f. is in such a direction as to oppose the change producing it, (c) the factors affecting the magnitude of the induced e.m.f.]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-42] Use Faraday's and Lenz's laws of electromagnetic induction to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-43] Explain how seismometers make use of electromagnetic induction to the earthquake detection [specifically in terms of: (i) any movement or vibration of the rock on which the seismometer rests (buried in a protective case) results in relative motion between the magnet and the coil (suspended by a spring from the frame.) (ii) the emf induced in the coil is directly proportional to the displacement associated]	Summative	Understanding + Application	Question(s) will be asked in final examination.	
Domain F: Modern Physics				08 periods
[SLO: P-11-F-01] Distinguish between inertial and non-inertial frames of reference.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-02] Describe the significance of Einstein's assumption of the constancy of the speed oflight.	Summative	Understanding	Question(s) will be asked in final examination.	
SLO: P-11-F-03] Describe that if c is constant then space and time become relative.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-04] State the postulates of Special relativity	Summative	Knowledge	Question(s) will be asked	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
			in final examination.	
[SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity [Specifically in the case of: a— the relativity of simultaneity. b— the equivalence between mass and energy. c— length contraction. d— time dilation. e— mass increase]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-06] State that space-time is a mathematical model in relativity that treats time as a fourth dimension of the traditional three dimensions of space (It can be thought of as a metaphorical sheet of paper that can bend, and when it bends it can cause effects such as stretching and compression seen when gravitational waves pass through objects.)	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-F-07] State that nucleon number and charge are conserved in nuclear processes	Summative	Knowledge	Question(s) will be asked in final examination.	26 periods
[SLO: P-11-F-08] Describe the composition, mass and charge of α, β and γ radiations [both B— (electrons) and B+ (positrons) are included]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-09] Explain that an antiparticle has the samemass but opposite charge to the corresponding particle [give the example that a positron is the antiparticle of an electron]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-10] State that (electron) antineutrinos are produced during β–decay and (electron) neutrinos are produced during β+ decay	Summative	Knowledge	Question(s) will be asked in final examination.	
[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	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-12] Describe quarks and antiquarks (as afundamental) [including that there are six flavors (types) of quark: up, down, strange, charm, top and bottom]	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
[SLO: P-11-F-13] Describe protons and neutrons in terms of their quark composition	Summative	Understanding	Question(s) will be asked in final examination.	
[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)	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-F-15] Describe the changes to quark composition that take place during β– and β+ decay	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-F-16] State that electrons and neutrinos are fundamental particles called leptons	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-18] State the Higgs Boson as a fundamental particle which is responsible for the particle's mass.	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-19] Explain that every subatomic particle has a corresponding antiparticle [that has the same mass as a given particle but opposite electric or magnetic properties according to the Standard Model of Particle Physics)]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-20] Describe protons and neutrons in terms of their quark composition	Summative	Understanding	Question(s) will be asked in final examination.	
[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)	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-22] Explain that there are various contending theories about what 'mass' and 'force' are generated from [e.g. that these are generated from quantum fields when they are energized, or from multidimensional 'strings' that vibrate in higher dimensions to give rise to particles (no further technical knowledge beyond these simple descriptions is expected at this level)]	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-23] Explain the working principle of particleaccelerators	Formative	Understanding	Question(s) will not be	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
and also their uses.			asked in final examination.	
[SLO: P-11-F-24] Explain that antimatter is the counterpart ofmatter [e.g. a positron is the antimatter counterpart to an electron]	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-25] Illustrate that antiparticles usually have the same weight, but opposite charge, compared to their matter counterparts	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-26] State that most of the matter in the observable universe is matter	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-F-27] Describe the asymmetry of matter and antimatter in the universe as an unsolvedmystery	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-28] Describe annihilation reactions [a particle meets its corresponding antiparticle, they undergo annihilation reactions in which either all the mass is converted to heat and light energy, or some mass is left over in the form of new subatomic particles.]	Summative	Understanding	Question(s) will be asked in final examination.	
Domain N: Experimentation Skills				28 periods
[SLO: P-11-N-01] - test that the lab equipment is functioning properly, without any potential risk of injury, before conducting an experiment	**Formative for PBA**	Application	Question will not be asked in final examination, however, it	
[SLO: P-11-N-02] - ensure that work space for conducting the experiment is not too crowded with apparatus as to be hazardous	**Formative for PBA**	Application	will be part of Lab work.	
[SLO: P-11-N-03] - ensure that safe distance is kept at all times from other investigators who may be handling lab apparatus	**Formative for PBA**	Application	Question will not be asked in final examination, however, it	
[SLO: P-11-N-04] - suggest broadly what potential bodily harm could occur from physical, chemical, biological and safety hazards in the	**Formative for PBA**	Application	will be part of Lab work.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
context of the experiment being conducted				
[SLO: P-11-N-05] - State that it is always better to ask for help from the lab instructor when unsure of how to use new apparatus	**Formative for PBA**	Application	Question will not be asked in final examination, however, it	
[SLO: P-11-N-06] Set up apparatus correctly without assistance from a supervisor	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-07] Follow instructions given in the form of written instructions and diagrams (including circuit diagrams)	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-08] Use apparatus to collect an appropriate quantity of data	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-09] Repeat readings where appropriate	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[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.	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-11] Use a false origin where appropriate whileplotting graphs	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-12] Estimate the absolute uncertainty in Measurements	**Formative for PBA**	Application	Question will not be asked in final	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
			examination, however, it will be part of Lab work.	
[SLO: P-11-N-13] Express the uncertainty in a measurement as an absolute or percentage uncertainty, and translate between these forms	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[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.	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-15] Draw straight lines of best fit or curves to show the trend of a graph	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[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	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[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	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-110-N-18] Read the coordinates of points on the trend line of a graph	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-19]----------				
[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	**Formative for PBA**	Understanding	Question will not be asked in final	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
false origin.			examination, however, it will be part of Lab work.	
[SLO: P-11-N-21] draw conclusions from an experiment, including determining the values of constants	**Formative for PBA**	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-22] Explain whether experimental data supports a given hypothesis and make predictions based on the data	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-23] Determine whether a relationship containing a constant is supported by experimental data	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-24] For results of an experiment: Calculate the percentage difference between values of the constant Compare this percentage difference with a pre-given percentage uncertainty Give a conclusion based on thiscomparison.	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-25] Identify and describe the limitations in an experimental procedure	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-26] Identify the most significant sources ofuncertainty in an experiment.	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-27] An experimental arrangement that will improve the accuracy of the experiment or to extend the investigation to answer	**Formative for PBA**	Understanding	Question will not be asked in final	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of PeriodsRequired (1 period=40 minutes)
a new question			examination, however, it will be part of Lab work.	
[SLO: P-11-N-28] Describe these modifications clearly in wordsor diagrams.	**Formative for PBA**	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	

Note: In the Assessment Framework, summative SLOs for PBA are not identified. Therefore, a separate list of practicals for summative assessment (for PBA) will be shared along with the model question paper of the PBA.

Note: PBA STANDS FOR "PRACTICAL BASED ASSESSMENT"

FINAL CONCEPTUAL PATTERN OF HSSC-I & II

Physics, Chemistry, Biology and Computer Science

Total Marks: 80 Marks (Theory Paper)

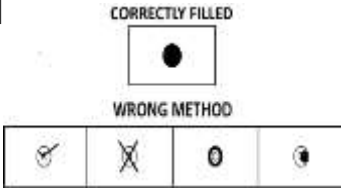
Components	Detail
Marks Allocated to MCQs	40 marks
Total MCQs	80
Marks per MCQ	0.5
Objective Portion – MCQs (40 Marks)	Section-A (MCQs) 56 straight MCQs $(56 \times 0.5 = 28$ marks) 24 MCQs with (6-stimulus/situations/scenario) $(24 \times 0.5 = 12$ marks)
Subjective Portion – SRQs & ERQs Structure (40 Marks)	Section-B (SRQs) Section B having 7 questions. Each question has internal choice. Each question having 4 marks. (7x4= 28 marks) Section –C (ERQs) Section C having 2 questions. Each question has internal choice. Each question having 6 marks. (2x6= 12 marks)
Subjective Portion Structure	7 straight SRQs (with no sub parts) 2 straight ERQs (may having parts but with same concept)

Important Note:

i) Summative SLOs of NCP Physics 2022-23 for grades XI or XII will only be included.

ii) Ensure balanced domain coverage using the Table of Specifications (ToS).

PHY/CHEM/BIO/COMP HSSC-I



To be filled-in by the Candidate

PAPER VERSION	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ

Time Allowed: 1:40 Hours **Total Marks: 40**

Candidate Sign._____ **Invigilator Sign._____**

Question Booklet No. _____ **Roll No. _____**

FILL ONLY ONE BUBBLE FOR EACH CORRECT ANSWER. USE BLACK BALL POINT/MARKER

1	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**21**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**41**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**61**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
2	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**22**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**42**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**62**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
3	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**23**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**43**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**63**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**24**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**44**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**64**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**25**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**45**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**65**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**26**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**46**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**66**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**27**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**47**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**67**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**28**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**48**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**68**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**29**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**49**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**69**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**30**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**50**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**70**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**31**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**51**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**71**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**32**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**52**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**72**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**33**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**53**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**73**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**34**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**54**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**74**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**35**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**55**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**75**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
16	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**36**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**56**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**76**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
17	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**37**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**57**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**77**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
18	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**38**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**58**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**78**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
19	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**39**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**59**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**79**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
20	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**40**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**60**	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**80**	Ⓐ	Ⓑ	Ⓒ	Ⓓ

Federal Board HSSC-I Examination
Physics Model Question Paper

National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)

SECTION - A (Marks 40)

Time Allowed: 1:40 hours

Section – A is compulsory. All parts of this section are to be answered on the OMR Sheet given in the E-Sheet and handed over to the Centre Superintendent. Deleting/ overwriting is not allowed. *Do not use lead pencil.*

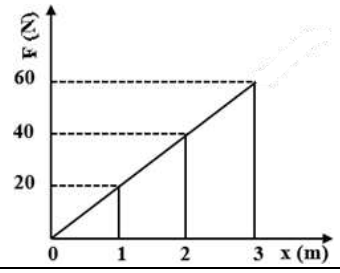
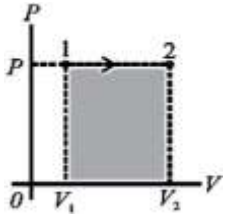
Roll Number							Paper Version
							A

Candidate Sign._____ **Invigilator Sign**. _____

Note: Fill the correct bubble for each question on OMR Sheet given in the E-Sheet. Each question carries 0.5 mark.

Sr #	Question	(A)	(B)	(C)	(D)
1.	Which of the following is the derived unit of density in terms of SI base units?	m^2/kg	m^3/kg	kg/m^3	kg/m^2
2.	Students are dropping a ball from a height close to the ground to calculate the value of g. Students get slightly different values each time under similar conditions. This is because of:	lack of skills	uncertainty in measurements	temperature variation	variation in the value of g
3.	A physical quantity has dimensions $[MLT^{-2}]$. This corresponds to:	energy	force	pressure	power
4.	The direction of the vector $\vec{A} = 3\hat{\imath} + 4\hat{\jmath}$ relative to the x-axis is approximately:	30°	37°	41°	53°
5.	A student calculates the kinetic energy K of a moving body using $K=\frac{1}{2}mv^2$. If both **m** and **v** contain individual percentage uncertainties of 5% respectively, what is the total percentage uncertainty in the calculated kinetic energy K?	5%	10%	15%	20%
6.	The homogeneity of the equation $s = ut + \frac{1}{2}at^2$ is checked by:	comparing numerical values only	comparing dimensions of variables	Analyzing coefficients of variables	plotting s versus t

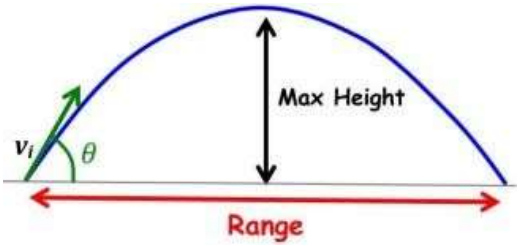
7.	A measurement, which on repetition gives same or nearly same results, is called:	accurate reading	average reading	precise reading	estimated reading
8.	The fractional uncertainty in the given length $L \pm \Delta L = 2.0\ \text{m} \pm 0.1\ \text{m}$ is:	0.05	0.1	0.15	0.5
9.	The equation $\|\mathbf{A} \cdot \mathbf{B}\| = \|\mathbf{A} \times \mathbf{B}\|$ is consistent when angle between vectors **A** and **B** is:	30^o	45^o	60^o	90^o
10.	In the presence of **air resistance**, how does the horizontal component of a projectile's velocity change during its flight?	remains constant	continuously decreases	continuously increases	decreases, then increases
11.	Distance covered by a freely falling body in 2 seconds is:	4.9 m	19.6 m	39.2 m	44.1 m
12.	Rod **A** has a length of (12. 0 $\pm$0.2cm) and rod **B** has a length of (8.0 $\pm$ 0.3cm). Their combined length is given as:	20.0 $\pm$0.5 cm	20.0 $\pm$0.2 cm	20.0 $\pm$0.3 cm	20. 0 $\pm$0.1 cm
13.	Which of the following is the primary reason why friction is a non-conservative force?	It always does negative work	Its work depends on the path taken	It depends on the mass of the object	It acts only on moving objects
14.	An object is dropped from a high cliff and experiences a constant air resistance force **(f)** during its fall. After falling through a vertical distance **(h)**, its kinetic energy increases by **(ΔK).** Which equation represents the correct relationship between these variables?	$\Delta K = mgh$	$\Delta K = (mgh + fh)$	$\Delta K = (mgh – fh)$	$\Delta K = (fh – mgh)$
15.	A cable has a cross-sectional area of **0.025m^2**. Calculate the stress it experiences when supporting a load of $5\times 10^5 N$.	2×10^7 N/m^2	2×10^5 N/m^2	2.5×10^7 N/m^2	2.5×10^5 N/m^2
16.	Two wires are identical having same length and same material. Wire A has twice the cross-sectional area of wire B. If same stretching force is applied to both wires, which statement correctly describes the deformation?	Wire A is stretched more	Wire B is stretched more	Both wires are stretched equally	Neither of the wires is stretched
17.	Calculate the work done from the following force-	30 J	60 J	90 J	180 J

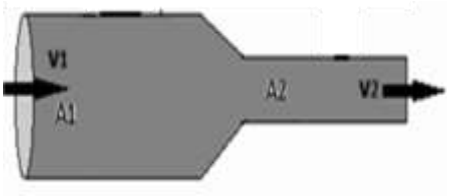
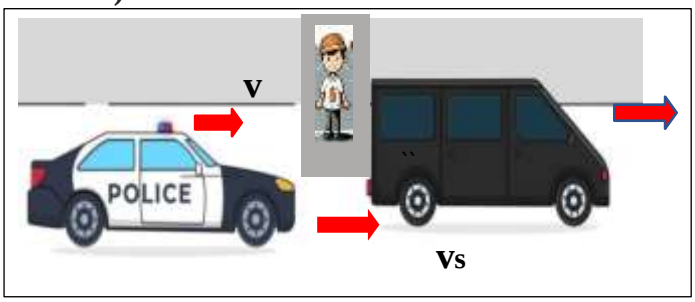
	displacement graph:  				
18.	In angular motion, the angles are expressed in radiansbecause:	Radians are easier to measure	Radians being a ratio are more natural and consistent	Radians are smaller than degrees	Radians were used in ancient maths
19.	Which statement is true about glassy solids?	they have regular geometric shapes	they lack translational symmetry	they are long range ordered materials	they have sharp melting point
20.	The temperature of a solid copper block increases from **20^oC to 30^oC.** What happens to the K.E. and P.E. of its particles?	K.E and P.E both increase	P.E decreases but K.E increases	K.E and P.E both decrease	P.E increases but K.E decreases
21.	Which one is true about the work done by an ideal gas at constant pressure as shown by the graph?  	W< 0	W = ∞	W> 0	W= 0
22.	A string is stretched by applying a force until it breaks. Which of the following statements justifies what the area under force-extension graph represents?	Stiffness of the string	Potential energy stored during deformation	Young's modulus	Extension in the string
23.	A loud speaker emits sound waves with a power of **0.05 W**. The intensity of sound falling at an area **50.24 m^2** will be:	9.95×10^{-3} W/m^2	9.95×10^{-4} W/m^2	9.95×10^{-5} W/m^2	9.95×10^{-6} W/m^2
24.	While passing through a larger slit, diffraction of water waves will be:	less	most	more	negligible
25.	Which of the following correctly pairs **elastic deformation** with **plastic deformation?** (elastic; plastic)	Permanent; Temporary	Irreversible; Reversible	Long range; short range	Reversible; Irreversible
26.	The Boltzmann constant **k** is given by the expression:	$\frac{R}{N_A}$	$\frac{N_A}{N}$	$\frac{N_A}{R}$	$\frac{N}{N_A}$
27.	Which of the following waves lacks the phenomenon	Sound waves	Light waves	Radio waves	Microwaves

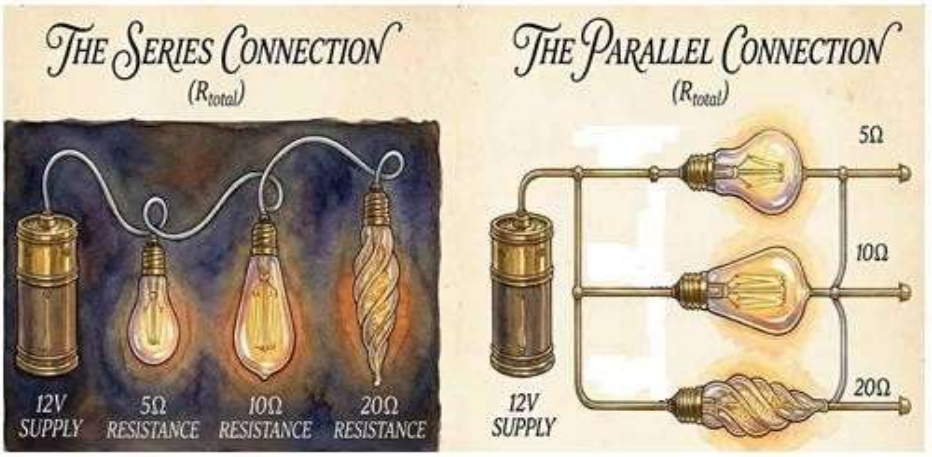
	of polarization?				
28.	Which statement best interprets the second law of thermodynamics?	Total energy of an isolated system remains constant	Total entropy of an isolated system always increases	Heat can flow from colder to hotter body at its own	Entropy of a perfect crystalline substance is zero at 0 Kelvin
29.	Unit for the constant of proportionality **k** in Coulomb's law is:	Nm^2C^2	$Nm^{-2}C^{-2}$	Nm^2C^{-2}	$Nm^{-2}C^2$
30.	The magnitude of electric field intensity **50 cm** away from a **3μC** charge is:	1.08×10^7 N/C	1.08×10^{-7} N/C	1.08×10^{-5} N/C	1.08×10^5 N/C
31.	Which one of the following properties must be kept in mind while drawing electric field lines?	Field lines must always be drawn in circles.	Field lines can cross each other if the charges are large.	Field lines must never cross each other.	Field lines always point toward a positive charge.
32.	A positive charge enters horizontally in a uniform electric field, directed vertically downward, due to oppositely charged parallel plates. In which direction will the charge be deflected?	Upward, towards the positive plate.	Downward, towards the negative plate.	In a straight line with no deflection.	In a circular path
33.	The potential difference between the terminals of a battery is **9V**. How much energy is required to transfer **10 C** of charge across these terminals?	10.9 J	1.9 J	90 J	91 J
34.	The galvanometer is mainly used in null method because:	It is sensitive to very small currents	It allows large currents to flow	It has negligible internal resistance	It measures high voltages directly
35.	If the distance between two charged parallel plates is doubled while keeping the potential difference constant, the electric field strength will become:	Double of its original value	Half of its original value	Four times of its original value	unchanged
36.	The working principle of a seismometer is based on:	electro statics	electro magnetic induction	magnetic attraction	electrical resistance
37.	A square metallic plate of sides **10m** is kept in a magnetic field which is making angle of $\mathbf{30^o}$ with the normal. The magnetic flux associated with it is **200Wb**. What will be the intensity of magnetic field at the plate?	2.2 T	3.21 T	2.31 T	1.32 T
38.	In a velocity selector, if the charged particle's velocity is	be stopped instantly	be deflected in the	be deflected in	move in a straight

	less than E/B, the particle will:		direction of electric field.	the direction of magnetic field.	line.
39.	A rod has a proper length of **10m.** As it moves past a stationary observer at a speed of **0.6c,** its length is measured to be **8m** by the observer. Why there is a change in the observed length?	The proper length is invariant	The atoms of rod physically shrink	Moving objects appear shorter in relative motion	Moving objects appear stretched in relative motion
40.	During β^- decay, a neutron within a nucleus transforms into which of the following sets of particles?	Proton + electron + anti-neutrino	Proton + positron + neutrino	Electron + gamma rays	Neutron + proton
41.	Which statement best compares a quark and an anti-quark of the same flavor?	Both have same electric charge but opposite masses	Both have opposite electric charges but same mass	Both have same charge and mass but different colors	They are identical in every way
42.	Which elementary particle serves as the force carrier for the electromagnetic interactions?	Gluon	Photon	Z-Boson	W-boson
43.	Alpha particles are emitted with discrete energies, whereas beta particles are emitted with a continuous range of energies because:	neutrino shares the energy in alpha decay	neutrino/anti-neutrino shares the energy in beta decay	anti-neutrino shares the energy in alpha decay	alpha particles are bosons
44.	As an object's velocity approaches speed of light **c**, the relativistic mass will:	decrease	remain constant	increase	become zero
45.	In electron- positron annihilation, why are at least two photons produced instead of just one?	To conserve electric charge	To conserve mass	To conserve linear momentum	To conserve lepton number
46.	Both electrons and neutrinos are classified as leptons; because	They experience strong nuclear force	They do not experience strong nuclear force	They are made up of quarks	They are made up of anti-quarks
47.	The speed of light in vacuum is:	Variable with observer's speed	Constant for all inertial frames	Greater for moving observer	Zero in non-inertial frames
48.	Two events occur simultaneously at different locations in a stationary reference frame. According to special relativity, a moving observer will perceive them as:	occurring at the same time and same location	occurring at different times	occurring at the same time but at different locations	merging into a single event

49.	Two systems (placed in contact with each other) are said to be in thermal equilibrium if:	they both have same mass.	no heat transfer between them.	they both have equal volume	they both are isolated from surroundings
50.	An increase in entropy leads to the —Degradation of energy‖; This is because:	Energy is lost permanently	Total energy of universe has decreased	Total energy of system has decreased	Less energy is available for useful work
51.	A wire carries **3A** current having cross- sectional area $\mathbf{10^{-6}m^2}$ and number of electrons per cubic meter $\mathbf{5\times10^{28}\ m^{-3}}$. Given that charge on a single electron is $\mathbf{1.6\times10^{-19}C}$, the drift velocity of electrons will be:	3.75×10^{-4} m/s	2.75×10^{-4} m/s	1.75×10^{-4} m/s	0.75×10^{-4} m/s
52.	A coil of **20** turns experiences a change in magnetic flux from **0.01 Wb** to **0.05 Wb** in **2s**. The induced emf in the coil is:	0.2V	0.4V	0.1V	0.5V
53.	If the speed of light **c** is the only absolute quantity in universe then space and time must;	entirely disappear	also be absolute	be finite	depend on observer's frame of reference
54.	Which real-world phenomenon provides evidence for time dilation?	Expansion of metals when heated	Life spans of cosmic-ray muons reaching the earth's surface	Sound echoes in valleys	Red shift of distant galaxies
55.	A skater is spinning rapidly on ice with angular speed **(ω_1 = 5rad/s)** having her arms tucked. Her initial moment of inertia is **($I_1 = 2kgm^2$)**. If she suddenly extends her arms outward, her moment of inertia becomes **($I_2 = 5kgm^2$).** What will be her new angular speed ω_2?	0.2 rad/s	5 rad/s	2 rad/s	0.5 rad/s
56.	A centripetal force is a force required to change a body's:	Mass	Speed	K.E.	Direction of motion

	STIMULUS/SITUATION/SCENARIO BASED MCQs					
Scenario for MCQs # 57 to 60		**A projectile is launched with an initial speed of 200 m/s at an angle of 30^o with the horizontal.** 				
57.	Determine the time of flight of the projectile.	10.41 s	20.41 s	30.52 s	0.41 s	
58.	Find the peak height of the projectile.	210.2 m	310.2 m	410.2 m	510.2 m	
59.	Calculate the maximum horizontal displacement of the projectile.	2534.7 m	3534.7 m	4534.7 m	5534.7 m	
60.	Find the time for projectile to reach its maximum height.	10.20 s	20.41 s	30.52 s	0.41 s	
Scenario for MCQs # 61 to 64		**A city installs a giant Ferris wheel of 1m radius in a new amusement park. The wheel starts from rest and is uniformly accelerated by an electric motor until it reaches its full operating speed. The time to complete one revolution is 20 seconds.** 				
61.	The angular velocity of the wheel will be expressed as:	$\frac{2\pi}{T}$	$\frac{T}{2\pi}$	$\frac{2\pi}{v}$	$\frac{2\pi}{f}$	
62.	If the wheel turns through an angle **θ= 2rad,** what is the tangential distance covered by it?	2 m	1 m	0.2 m	0.1m	
63.	A boy sitting in the wheel moves at a constant speed along a curved path. What can be concluded about the net force acting on the boy?	it is zero.	it is perpendicular to the direction of motion of boy.	it is parallel to the direction of motion of boy.	it is opposite to direction of motion of boy.	
64.	During first **10 seconds** from rest, the wheel covers an angular displacement of **50 radians.** What will be the angular acceleration of the wheel?	0.1 rad/s^2	1.0 rad/s^2	1.7 rad/s^2	1.5 rad/s^2	

Scenario for MCQs # 65 to 68		**A horizontal ventilation duct points smoothly from a wide inlet (A_1= 0.08m^2) to a narrow nozzle (A_2= 0.02m^2). Air flows continuously through the system, behaving as an ideal, incompressible fluid under steady-state conditions.** 				
65.	The equation of continuity ($A_1v_1 = A_2v_2$) used to analyze this system is a statement of;	Law of conservation of mass	Law of conservation of energy	Law of conservation of momentum	Law of conservation of charge	
66.	How the flow rate of air passing through the wide inlet **(A_1)** can be compared to that passing through the narrow nozzle **(A_2)**?	It is greater at A_1	It is greater at A_2	It is equal in both parts	It is zero at A_1 and non-zero at A_2	
67.	As air moves from the wide pipe into the narrow nozzle, its internal pressure decreases. This is because:	Nozzle exerts extra force on air	The speed of air increases and its P.E decreases	K.E of molecules decreases due to friction	Density of air increases	
68.	If the air moves at **3 m/s** in the wide inlet (A_1), what will be its speed when it will exit the narrow nozzle (A_2)?	1.2 m/s	120 m/s	0.12 m/s	12 m/s	
Scenario for MCQs # 69 to 72		**A police car is chasing 40 m/s a speedy car on a straight highway. The siren of police car is blaring at a constant frequency (f) of 600 Hz. The speedy car ahead is moving at a speed of 50 m/s (Speed of sound in air is v= 340 m/s).** 				
69.	The frequency of the siren heard by the speeding car driver will be:	lower	higher	same	medium	
70.	The frequency of siren heard by the officer in police car is:	Greater than 600 Hz	Lower than 600 Hz	Exactly 600 Hz	Any value from 700 Hz to 1200 Hz	
71.	A person standing stationary by the road side, hears the siren as police car approaches. The frequency **f'** heard by this stationary person will be:	680 Hz	529 Hz	670 Hz	536 Hz	

72.	If the speedy car slows down and matches the police car's speed (both at 40 m/s), the frequency of sound observed by the speedy car's driver will be:	Same as original frequency of sound	Greater than original frequency of sound	Smaller than original frequency of sound	Speed of sound will decrease.	
Scenario for MCQs # 73 to 76		**An electrician designs a lighting circuit using three lamps with resistances 5 Ω, 10 Ω, and 20 Ω connected to a 12 V supply. He compares properties of series and parallel connections.** 				
73.	In the series connection, if the current drawn is **0.34A,** what is the voltage drop across the **10 Ω** lamp?	34 V	29.4 V	3.4 V	2.94 V	
74.	Which lamp will be the brightest in the parallel connection?	The 5 Ω lamp	The 10 Ω lamp	The 20 Ω lamp	All lamps will have the exact same brightness.	
75.	What is the total resistance of the series connection?	30 Ω	15 Ω	20 Ω	35 Ω	
76.	After comparison, he prefers the Parallel connection over Series combination of bulbs. This is because in parallel circuit,	He uses less number of wires.	each lamp operates independently and receives full voltage.	the total current is reduced	the bulbs are safe from ever burning out.	
Scenario for MCQs # 77 to 80		**Inside a "high-velocity" research chamber, physicists observe two different subatomic interactions. They note the following:** <table><tr><th>System</th><th>Interaction Mechanism</th></tr><tr><td>Quarks bound inside a proton</td><td>Exchange of gluons</td></tr><tr><td>Electrons in the beam</td><td>Exchange of photons</td></tr></table>				
77.	Which fundamental force is responsible for the exchange of gluons between quarks?	Electro-magnetic force	Weak nuclear force	Strong force	Gravitational force	
78.	The exchange of photons between electrons mediates which type of interaction?	Strong interaction	Electromagnetic interaction	Gravitational interaction	Beta decay interaction	
79.	In particle physics, gluons and photons both are called force-carrying particles. They are generally categorized as:	Leptons	Hadrons	Gauge-Bosons	Fermions	

80.	Why do quarks exchange gluons whereas electrons do not?	electrons are negatively charged particles and repel gluons	Gluons only interact with particles having color and quarks possess color charge	Gluons decay before reaching electrons	Gluons only interact with leptons	

Federal Board HSSC-I Examination
Physics Model Question Paper

National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)

Time allowed: 1 hour 20 minutes **Total Marks: 40**

Note: Answer all parts from Section 'B' and all questions from Section 'C' on the **E-sheet**. Write your answers on the allotted/given spaces.

SECTION – B (7×4 = 28 Marks)

Note: Give brief answers of the following questions. All questions carry equal marks. (7x4 = 28)

Q #	Question	Marks		Question	Marks
1	Using commutative property, distinguish between scalar product and vector product of two vectors. Give mathematical justifications for both.	2+2	**OR**	Distinguish between inertial and non-inertial frames of reference Providing at least one example for each.	3+1
2	An aero plane while flying horizontally drops a bomb when reaches exactly above the target but misses it. Explain why?	04	**OR**	Explain how inspectors can easily check the reliability of a concrete bridge with carbon fibers?	04
3	Enlist the assumptions made about an ideal fluid.	04	**OR**	What do you mean by conservative and non-conservative forces? Give two examples of each.	2+2
4	A device draws a current of **4A** when connected to a **12V** battery. Calculate the: a) power consumed by the device. b) resistance of the device.	2+2	**OR**	A straight wire of length **0.75m** carries a current of **8A**. It is placed in a uniform magnetic field of **0.2T** such that it makes an angle of **45°** with the magnetic field lines. **(a)** Determine the magnitude of the magnetic force on the wire. **(b)** What would be the force if the wire were placed parallel to the magnetic field?	3+1
5	How beats are produced? Why sometimes beats are not heard as distinct sounds by the human ear?	2 + 2	**OR**	In what ways a refrigerator operates as a heat engine working in reverse? Draw block diagram to show the direction of heat flow and work done.	3+1
6	A metal mesh enclosure blocks external electric charges from affecting a person inside. What physical principle explains this effect and how?	1+3	**OR**	Explain how the path difference between two coherent waves determines whether they produce a bright or dark interference pattern.	2+2
7	Define baryons and mesons. Give two examples of each.	2+2	**OR**	What is drag force? Mention three factors upon which it depends?	1+3

SECTION–C (Marks 2 x 6 = 12)					
1	Draw PV diagram for Carnot cycle. Discuss four processes involved in it using the diagram.	2+ 4	**OR**	Illustrate that frequencies of stationary waves in a stretched string are quantized. Also discuss the physical significance of quantization in this situation.	4+2
2	State why the magnetic field due to a current- carrying solenoid is increased when a ferrous core (iron) is inserted into it? Explain the significance of relative permeability of iron core in this regard?	4+2	**OR**	What is moment of inertia? State and explain law of conservation of angular momentum.	2+1 +3

Federal Board HSSC-I Examination

Physics Model Question Paper

National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)

(50% MCQs & 50% Descriptive)

Alignment of Questions with Student Learning Outcomes

Section: Q. No. (Part no.)	Domain Title/ Content Area	Student Learning Outcomes	Cognitive Domain *	Allocated Marks in Model Paper
A (1)	A: Measurements	[SLO: P-11-A-02] Express derived units as products or quotients of the SI base units	U	0.5
A (2)	A: Measurements	[SLO: P-11-A-07] Justify why all measurements contain some uncertainty	A	0.5
A (3)	A: Measurements	[SLO: P-11-A-04] Derive formulae in simple cases [Through using dimensional analysis]	A	0.5
A (4)	B: Mechanics	[SLO: P-11-B-01] Represent a vector in 2-D as two perpendicular components	A	0.5
A (5)	A: Measurements	[SLO: P-11-A-06] Assess the uncertainty in a derived quantity [By simple addition of absolute, fractional or percentage uncertainties]	A	0.5
A (6)	A: Measurements	[SLO: P-11-A-03] Analyze the homogeneity of physical equations [Through dimensional analysis]	U	0.5
A (7)	A: Measurements	[SLO: P-11-A-05] Analyze and critique the accuracy and precision of data collected by measuring instruments	K	0.5
A (8)	A: Measurements	[SLO: P-11-A-06] Assess the uncertainty in a derived quantity [By simple addition of absolute, fractional or percentage uncertainties]	A	0.5
A (9)	B: Mechanics	[SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties	U	0.5
A (10)	B: Mechanics	[SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion [This includes analysis of both the horizontal component and vertical component of velocity and hence predicting qualitatively the range of the projectile.]	U	0.5
A (11)	B: Mechanics	[SLO: P-11-B-04] Solve problems using the equations of motion [For the cases of uniformly accelerated motion in a straight line, including the motion of bodies falling in a uniform gravitational field without air resistance. This also includes situations where the equations of motion need to be resolved into vertical and horizontal components for 2-D motion]	A	0.5
A (12)	A: Measurements	[SLO: P-11-A-06] Assess the uncertainty in a derived quantity [By simple addition of absolute, fractional or percentage uncertainties]	A	0.5
A (13)	B: Mechanics	[SLO: P-11-B-31] Differentiate between conservative and non-conservative forces.	U	0.5

A (14)	B: Mechanics	[SLO: P-11-B-32] Utilize the work – energy theorem in a resistive medium to solve problems.	U	0.5
A (15)	B: Mechanics	[SLO: P-11-B-24] Define and use the terms stress, strain and the Young modulus	A	0.5
A (16)	B: Mechanics	[SLO: P-11-B-23] Describe that deformation of solids in one dimension [that it is caused by a force and that in one dimension, the deformation can be tensile or compressive].	U	0.5
A (17)	B: Mechanics	[SLO: P-11-B-30] Deduce the work done from force- displacement graph	A	0.5
A (18)	B: Mechanics	[SLO: P-11-B-07] Express angles in radians	U	0.5
A (19)	B: Mechanics	[SLO: P-11-B-22] Distinguish between the structures of crystalline, glassy, amorphous, and polymeric solids.	U	0.5
A (20)	C: Heat and Thermodynamics	[SLO: P-11-C-02] Relate a rise in temperature of an object to an increase in its internal energy	U	0.5
A (21)	C: Heat and Thermodynamics	[SLO: P-11-C-06] Use W = p. ΔV for the work done when the volume of a gas changes at constant pressure.	A	0.5
A (22)	B: Mechanics	[SLO: P-11-B-27] Justify why and apply the fact that the area under the force– extension graph represents the work done	A	0.5
A (23)	D: Waves	[SLO: P-11-D-01] Use intensity = power/area to solve problems. Use Intensity $\propto$ (amplitude)^2 for a progressive wave to solve problems	A	0.5
A (24)	D: Waves	[SLO: P-11-D-13] Analyze experiments that demonstrate diffraction [including the qualitative effect of the gap width relative to the wavelength of the wave; for example diffraction of water waves in a ripple tank]	U	0.5
A (25)	B: Mechanics	[SLO: P-11-B-26] Describe and use the terms elastic deformation, plastic deformation and elastic limit	U	0.5
A (26)	C: Heat and Thermodynamics	[SLO: P-11-C-04] State that the Boltzmann constant k is given by $k=R/N_A$	K	0.5
A (27)	D: Waves	[SLO: P-11-D-05] Explain that polarization is a phenomenon associated with transverse waves	U	0.5
A (28)	C: Heat and Thermodynamics	[SLO: P-11-C-15] State and explain the second law of thermodynamics.	U	0.5
A (29)	E: Electricity & Magnetism	[SLO: P-11-E-07] State and apply Coulomb's law [$F = k\frac{Q_1Q_2}{r^2}$ for the force between two point charges in free space, where $k = \frac{1}{4\pi\epsilon}$]	K	0.5
A (30)	E: Electricity & Magnetism	[SLO: P-11-E-08] use $E = k\frac{Q}{r^2}$ for the electric field strength due to a point charge in free space.	A	0.5
A (31)	E: Electricity & Magnetism	[SLO: P-11-E-03] Represent an electric field by means of field lines.	U	0.5

A (32)	E: Electricity & Magnetism	[SLO: P-11-E-04] Describe the effect of a uniform electric field on the motion of charged particles.	U	0.5
A (33)	E: Electricity & Magnetism	[SLO:P-09-E-11] State and use V=W/Q	A	0.5
A (34)	E: Electricity & Magnetism	[SLO: P-09-E-24] Explain the use of a galvanometer in null methods.	U	0.5
A (35)	E: Electricity & Magnetism	[SLO: P-11-E-02] Define and calculate electric field strength [Use F = qE for the force on a charge in an electric field. Use E=ΔV/Δd to calculate the field strength of the uniform field between charged parallel plates]	A	0.5
A (36)	E: Electricity & Magnetism	[SLO: P-09-E-43] Explain how seismometers make use of electromagnetic induction to the earthquake detection [specifically in terms of: (i) any movement or vibration of the rock on which the seismometer rests (buried in a protective case) results in relative motion between the magnet and the coil (suspended by a spring from the frame.) (ii) the emf induced in the coil is directly proportional to the displacement associated]	K	0.5
A (37)	E: Electricity & Magnetism	[SLO: P-09-E-39] Use Φ=BA to solve problems.	A	0.5
A (38)	E: Electricity & Magnetism	[SLO: P-09-E-34] Explain how electric and magnetic fields can be used in velocity selection.	U	0.5
A (39)	F: Modern Physics	[SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity [Specifically in the case of: a— the relativity of simultaneity. b— the equivalence between mass and energy. c— length contraction. d— time dilation. e— mass increase]	U	0.5
A (40)	F: Modern Physics	[SLO: P-11-F-10] State that (electron) antineutrinos are produced during β–decay and (electron) neutrinos are produced during β+ decay	K	0.5
A (41)	F: Modern Physics	[SLO: P-11-F-12] Describe quarks and antiquarks (as a fundamental) [including that there are six flavors (types) of quark: up, down, strange, charm, top and bottom]	U	0.5
A (42)	F: Modern Physics	[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers.	K	0.5
A (43)	F: Modern Physics	[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	U	0.5
A (44)	F: Modern Physics	[SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity [Specifically in the case of: a— the relativity of simultaneity. b— the equivalence between mass and energy. c— length contraction. d— time dilation. e— mass increase]	K	0.5
A (45)	F: Modern Physics	[SLO: P-11-F-28] Describe annihilation reactions [a particle meets its corresponding antiparticle, they undergo annihilation reactions in which either all the mass is converted to heat and light energy,	U	0.5

		or some mass is left over in the form of new subatomic particles.]		
A (46)	F: Modern Physics	[SLO: P-11-F-16] State that electrons and neutrinos are fundamental particles called leptons	U	0.5
A (47)	F: Modern Physics	[SLO: P-11-F-02] Describe the significance of Einstein's assumption of the constancy of the speed of light.	K	0.5
A (48)	F: Modern Physics	[SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity [Specifically in the case of: a— the relativity of simultaneity. b— the equivalence between mass and energy. c— length contraction. d— time dilation. e— mass increase]	U	0.5
A (49)	C: Heat and Thermodynamics	[SLO: P-12-C-01] State that regions of equal temperature are in thermal equilibrium.	K	0.5
A (50)	C: Heat and Thermodynamics	[SLO: P-11-C-19] Explain that increase in entropy means degradation of energy.	U	0.5
A (51)	E: Electricity & Magnetism	[SLO: P-09-E-10] Use, for a current-carrying conductor, the expression I=Anvq [where n is the number of charge carriers per unit volume.]	A	0.5
A (52)	E: Electricity & Magnetism	[SLO: P-09-E-42] Use Faraday's and Lenz's laws of electromagnetic induction to solve problems	A	0.5
A (53)	F: Modern Physics	SLO: P-11-F-03] Describe that if c is constant then space and time become relative.	U	0.5
A (54)	F: Modern Physics	[SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity [Specifically in the case of: a— the relativity of simultaneity. b— the equivalence between mass and energy. c— length contraction. d— time dilation. e— mass increase]	U	0.5
A (55)	B: Mechanics	[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	A	0.5
A (56)	B: Mechanics	[P-11-B-14] Define and calculate centripetal force.	K	0.5
A (57)	B: Mechanics	[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [This includes solving problems making use of the below facts: (i) Horizontal component (V_H) of velocity is constant. (i) Acceleration is in the vertical direction and is the same as that of a vertically free-falling object. (ii) Horizontal motion and vertical motion are independent of each other. Situations may require students to determine for projectiles: - How high does it go? - How far would it go along the level land? - Where would it be after a given time? - How long will it remain in flight? Situations may also require students to calculate for Ja projectile launched from ground height the - launch angle that results in the maximum range. - relation between the launch angles that result in the same range.]	A	0.5

A (58)	B: Mechanics	[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [This includes solving problems making use of the below facts: (i) Horizontal component (V_H) of velocity is constant. (i) Acceleration is in the vertical direction and is the same as that of a vertically free-falling object. (ii) Horizontal motion and vertical motion are independent of each other. Situations may require students to determine for projectiles: - How high does it go? - How far would it go along the level land? - Where would it be after a given time? - How long will it remain in flight? Situations may also require students to calculate for Ja projectile launched from ground height the - launch angle that results in the maximum range. - relation between the launch angles that result in the same range.]	A	0.5
A (59)	B: Mechanics	[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [This includes solving problems making use of the below facts: (i) Horizontal component (V_H) of velocity is constant. (i) Acceleration is in the vertical direction and is the same as that of a vertically free-falling object. (ii) Horizontal motion and vertical motion are independent of each other. Situations may require students to determine for projectiles: - How high does it go? - How far would it go along the level land? - Where would it be after a given time? - How long will it remain in flight? Situations may also require students to calculate for Ja projectile launched from ground height the - launch angle that results in the maximum range. - relation between the launch angles that result in the same range.]	A	0.5
A (60)	B: Mechanics	[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [This includes solving problems making use of the below facts: (i) Horizontal component (V_H) of velocity is constant. (i) Acceleration is in the vertical direction and is the same as that of a vertically free-falling object. (ii) The horizontal motion and vertical motion are independent of each other. Situations may require students to determine for projectiles: - How high does it go? - How far would it go along the level land? - Where would it be after a given time? - How long will it remain in flight? Situations may also require students to calculate for Ja projectile launched from ground height the - launch angle that results in the maximum range. - relation between the launch angles that result in the same range.]	A	0.5
A (61)	B: Mechanics	[SLO: P-11-B-08] Define and calculate angular displacement, angular velocity and angular acceleration [This involves use of $S = r\theta$, $v = r\omega$, $\omega = 2\pi/T$, $a = r\omega^2$ and $a = v^2/r$ to solve problems].	K	0.5

A (62)	B: Mechanics	[SLO: P-11-B-08] Define and calculate angular displacement, angular velocity and angular acceleration [This involves use of S = $r\ \theta$, v = $r\omega$, $\omega = 2\pi/T$, $a = r\omega^2$ and $a = v^2/r$ to solve problems].	A	0.5
A (63)	B: Mechanics	[SLO:P-11-B-10] Analyze qualitatively motion in a curved path due to a perpendicular force.	U	0.5
A (64)	B: Mechanics	[SLO: P-11-B-09] Use equations of angular motion to solve problems involving rotational motions.	A	0.5
A (65)	B: Mechanics	[SLO: P-11-B-38] Justify that the continuity is a form of the principle of conservation of mass.	K	0.5
A (66)	B: Mechanics	[SLO: P-11-B-37] Explain that squeezing the end of a rubber pipe results in increase in flow velocity	U	0.5
A (67)	B: Mechanics	[SLO: P-11-B-40] Explain and apply Bernoulli's equation for horizontal and vertical fluid flow	U	0.5
A (68)	B Mechanics	[SLO: P-11-B-36] Use equation of continuity to solve problems	A	0.5
A (69)	D: Waves	[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	U	0.5
A (70)	D: Waves	[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	U	0.5
A (71)	D: Waves	[SLO: P-11-D-03] Use the expression fo =(fs·v)/(v±vs) for the observed frequency when a source of sound waves moves relative to a stationary observer.	A	0.5
A (72)	D: Waves	[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 [describing of the Doppler effect for a stationary source and a moving observer is not required]	U	0.5
A (73)	E: Electricity & Magnetism	[SLO: P-09-E-20] Derive, using Kirchhoff's laws, a formula for the combined resistance of two or more resistors in series.	A	0.5
A (74)	E: Electricity & Magnetism	[SLO: P-09-E-12] State and use P=IV, $P=I^2$ R and $P=V^2/R$	U	0.5
A (75)	E: Electricity & Magnetism	[SLO: P-09-E-20] Derive, using Kirchhoff's laws, a formula for the combined resistance of two or more resistors in series.	A	0.5
A (76)	E: Electricity & Magnetism	[SLO: P-09-E-21] Derive and apply a formula for the combined resistance of two or more resistors in parallel.	U	0.5
A (77)	F: Modern Physics	[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	K	0.5
A (78)	F: Modern Physics	[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	K	0.5
A (79)	F: Modern Physics	[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	K	0.5

A (80)	F: Modern Physics	[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	U	0.5
SECTION: B				
B: 1 (f)	B: Mechanics	[SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties	U	2+2
B: 1 (s)	F: Modern Physics	[SLO: P-11-F-01] Distinguish between inertial and non-inertial frames of reference.	U	3+1
B: 2 (f)	B: Mechanics	[SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion [This includes analysis of both the horizontal component and vertical component of velocity and hence predicting qualitatively the range of the projectile.]	U	4
B: 2 (s)	E: Electricity & Magnetism	[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.	U	4
B: 3 (f)	B: Mechanics	[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	K	4
B: 3 (s)	B: Mechanics	[SLO: P-11-B-31] Differentiate between conservative and non-conservative forces	K	2+2
B: 4 (f)	E: Electricity & Magnetism	[SLO: P-09-E-12] State and use $P=IV$, $P=I^2 R$ and $P=V^2/R$.	A	2+2
B: 4(s)	E: Electricity & Magnetism	[SLO: P-09-E-30] Use the equation $F=BIL\sin(\theta)$ [with directions as interpreted by Fleming's left-hand rule to solve problems]	A	3+1
B: 5 (f)	D: Waves	[SLO: P-11-D-15] Explain beats [as the pulsation caused by two waves of slightly different frequencies interfering with each other]	U	2+2
B: 5 (s)	C: Heat and Thermodynamics	[SLO: P-11-C-17] Describe that refrigerator is a heat engine operating in reverse as that of an ideal heat engine.	U	3+1
B: 6 (f)	E: Electricity & Magnetism	[SLO: P-11-E-06] Explain how a Faraday cage works [by inducing internal electric fields that work to shield the inside from the influence of external electric fields].	U	1+3
B: 6(s)	D: Waves	[SLO: P-11-D-08] Differentiate between constructive and destructive interference.	U	2+2
B: 7(f)	F: Modern Physics	[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)	K	2+2
B: 7(s)	B: Mechanics	[SLO: P-11-B-42] Describe how viscous forces in a fluid causes retarding force on an object moving through it.	K	1+3
SECTION: C				
C: 1(f)	C: Heat and Thermodynamics	[SLO: P-11-C-16] State the working principle of Carnot's engine	U	2+4
C: 1(s)	D: Waves	[SLO: P-11-D-12] Explain the formation of harmonics in stationary waves.	U	4+2
C: 2(f)	E: Electricity and Magnetism	[SLO: P-09-E-36] State that the magnetic field due to the current in a solenoid is increased by a ferrous core.	K	4+2

C: 2(s)	B: Mechanics	[SLO: P-11-B-18] Define and calculate moment of inertia of a body and angular momentum. [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 [Such as by flywheels to store rotational energy, by gyroscopes in navigation systems, by ice skaters to adjust their angular velocity].	K	2+1+3

* Cognitive Level

K: Knowledge U: Understanding A: Application

Table of Specifications (ToS) Model Paper Physics (50% MCQs Pattern) Grade XI HSSC- I)

Content/ Domain Areas	Domain A Measurements	Domain B Mechanics						Domain C Heat and Thermodynamics	Domain D Waves	Domain E Electricity And Magnetism			Domain F Modern Physics		Total Marks	Percentages
Assessment Objectives	**Physical Quantities and Measurements (A1-A7)**	**Vectors (B1-B2)**	**Translatory Motion (B3-B6)(B11-B13)**	**Rotational and Circular Motion (B7-B10) (B14-B21)**	**Work and Kinetic Energy (B29-B32)**	**Fluid Mechanics (B33-B44)**	**Physics of Solids (B22-B28)**	**Density and Temperature (C1-C23)**	**Waves (D1-D21)**	**Electrostatics (E01-E09)**	**Electricity (E10- E27)**	**Electromagnetism (E28 – E43)**	**Relativity (F01- F6)**	**Particle Physics (F 7- F28)**		
Unit No	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
K Knowledge	A: 7	-	–	A: 56, 61 C: 2(s)	B: 3(s)	A: 65 B: 7(s) B: 3(f)	–	A: 26, 49		A: 29	–	A: 36 C: 2(f)	A: 44, 47	A: 40, 42, 77, 78, 79 B: 7(f)	35.5	**29.6 %**
U Understanding	A: 1,6	A: 9 B: 1(f)	A: 10 B: 2(f)	A: 18, 63	A: 13, 14	A: 66, 67	A: 16, 19, 25	A: 20, 28, 50 B: 5(s) C: 1(f)	A: 24, 27,69,70,72 B: 5(f) B: 6(s) C: 1(s)	A: 31,32 B: 6(f)	A: 34, 74,76 B: 2(S)	A: 38	A: 39, 48, 53, 54 B:1(s)	A: 41, 43, 45, 46, 80	62	**51.6 %**
A Application	A: 2, 3, 5, 8, 12	A: 4	A: 11, 57, 58, 59, 60	A: 55, 62, 64	A:, 17	A: 68	A: 15, 22	A: 21	A: 71, 23	A: 30, 35	A: 33, 73,75, 51 B: 4(f)	A: 37, 52 B: 4 (s)	–	–	22.5	**18.8 %**
Total Marks	4	5	7	9.5	5.5	10	2.5	13	17.5	6.5	11.5	12	7	9	**120**	
Total Percentages	3.3%	4.2%	5.8%	8%	4.6%	8.3%	2.1%	10.8%	14.6%	5.4%	9.6%	10%	5.8%	7.5%		**100%**

Note:

1. This ToS does not reflect policy, but it is particular to this model question paper.
2. Proportionate /equitable representation of the content areas may be ensured.
3. The percentage of cognitive Level is 30%, 50%, and 20% for knowledge, understanding, and application, respectively with **± 5%** variation.
4. While selecting alternative questions for Short Response Questions (SRQs) and Extended Response Questions (ERQs), it must be kept in mind that:
   - Difficulty levels of two alternative questions of the internal choice will be same
   - SLOs of the two alternative questions of the internal choice must be different

Key: Section A (Question Number) marks. Example: **A (2) 0.5**,
Section B (Question Number, part/first or second choice) marks. Example: **B (2, s) 4**
Section C (Question Number, part/first or second choice) marks. Example: **C (8, f) 6**

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