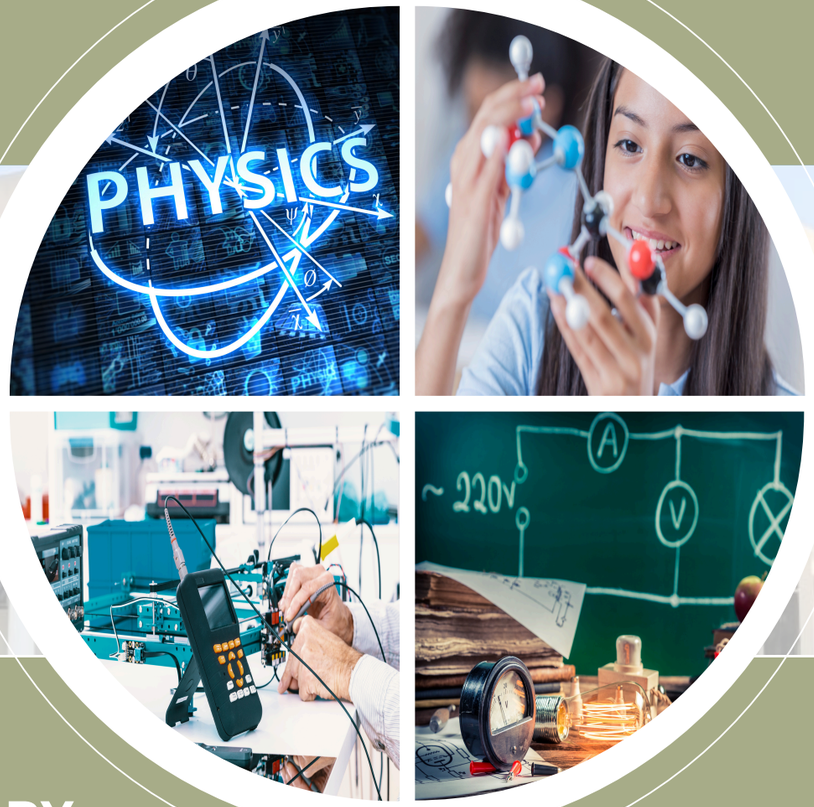
ASSESSMENT FRAMEWORK AND MODEL QUESTION PAPER

# PHYSICS

## Grade XII

NATIONAL CURRICULUM OF PAKISTAN
2022-23

SCHEME OF STUDIES 2006

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# ASSESSMENT FRAMEWORK

## FOR

## PHYSICS GRADE-XII

## CURRICULUM 2022-23

## SCHEME OF STUDIES 2006

# ACKNOWLEDGEMENT

It is a great honour that we, at Federal Board of Intermediate and Secondary Education, have developed the Assessment Framework (AF) for the subject of Physics for Grade-XII. 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-XII 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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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 (Test Development)
FBISE, Islamabad

# ASSESSMENT FRAMEWORK FOR PHYSICS GRADE-XII, 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-XII

## Details of Content Areas/ SLOs

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| **Domain: B Mechanics** | | | | |
| [SLO: P-12-B-01] Define and calculate gravitational field strength [This will include more challenging problems than in Grade 9. It will involve use of $g = GM/r^2$ ]. | Summative for theory | Knowledge + Understanding + Application | Question(s) will be asked in final examination | 07 periods |
| [SLO: P-12-B-02] Analyze gravitational fields by means of field lines. [This includes knowing that for a point outside a uniform sphere, the mass of the sphere may be considered to be a point mass at its center]. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-B-03] Apply Newton's law of gravitation to solve problems [$F=Gm_1m_2/r^2$ for the force between two-point masses to solve problems]. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-B-04] Analyze circular orbits in gravitational fields [By relating the gravitational force to the centripetal acceleration, it causes]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-B-05] Analyze the motion of geostationary satellites [This includes knowing that geostationary orbit remains at the same point above the Earth's surface, with an orbital period of 24 hours, orbiting from west to east, directly above the Equator]. | Summative for theory | Application | Question(s) will be asked in final examination. | 05 periods |
| [SLO: P-12-B-06] Derive the equation for gravitational field strength [From Newton's law of gravitation and the definition of gravitational field, the equation $g = GM/r^2$ for the gravitational field strength due to a point mass]. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-B-07] Analyze why g is approximately constant for small changes in height near the Earth's surface. | Summative for theory and PBA | Understanding + Application | Question(s) will be asked in final theory examination and PBA. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-B-08] Define and calculate gravitational potential [Use $\varphi = -\frac{GM}{r}$ for the gravitational potential in the field due to a point mass].<br><br>[At a point as the work done per unit mass in bringing a small test mass from infinity to the point]. | Summative for theory | Knowledge + Understanding + Application | Question(s) will be asked in final examination. | 10 periods |
| [SLO: P-12-B-09] Justify how the concept of gravitational potential leads to the gravitational potential energy of two-point masses [Use of $E_p$ =-G Mm/r in problems is expected]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| **Domain: C Heat and Thermodynamics** | | | | |
| [SLO: P-12-C-01] Explain how molecular movement causes the pressure exerted by gas. | Summative for theory | Understanding | Question(s) will be asked in final examination | |
| [SLO: P-12-C-02] Derive and use the relationship pV =Nm/3 $<c^2>$ [where $<c^2>$ is the mean-square speed (a simple model considering one-dimensional collisions and then extending to three dimensions. Using $1/3<c^2> = <c_x^2>$ is sufficient)]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-C-03] Calculate the root-mean-square speed of an ideal gas. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-C-04] Derive and use the formula for the average translational kinetic energy of a gas. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-C-05] Illustrate that the model of ideal gasses is used a base from which the field of statistical mechanics emerged [and has helped explain the behavior of 'non-ideal' gasses through modifications to the model e.g. the behavior of stars]. | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | 05 periods |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-C-06] State that under extreme physical conditions, atoms can break down into sub-atomic particle that can form unusual states of matter [Such as degenerate matter. Usually made of any one kind of subatomic particle such as neutron degenerate matter in neutron stars under strong gravity and heat) and Bose-Einstein condensates (Created when certain materials are taken to very low temperatures and then exhibit remarkable properties like superconductivity and super fluidity)]. | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | |
| **Domain: D Waves** | | | | |
| **Simple Harmonic Motion:** | | | | |
| [SLO: P-12-D-01] Describe simple examples of free oscillations. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-02] Use the terms displacement, amplitude, period, frequency, angular frequency and phase difference in the context of oscillations. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | 05 periods |
| [SLO: P-12-D-03] Express the period of simple harmonic motion in terms of both frequency and angular frequency. | Summative for theory and PBA | Understanding | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-D-04] Explain that simple harmonic motion occurs when acceleration is proportional to displacement from fixed point and in the opposite direction. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-05] Use $a = -\omega^2 x$ to solve problems. | Summative for theory | Application | Question(s) will be asked in final examination. | 15 periods |
| [SLO: P-12-D-06] Use the equations $v = v_o \cos(\omega t)$ and $v = \pm\omega\sqrt{x_o^2 - x^2}$ to solve problems. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-07] Analyze graphical representations of the variations of displacement, velocity and acceleration for simple harmonic motion. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-08] Analyze the interchange between kinetic and potential energy during simple harmonic motion. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-D-09] Apply $\frac{1}{2}m\omega^2x_0^2$ for the total energy of system undergoing simple harmonic motion. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-10] Describe that a resistive force acting on an oscillating system causes damping. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-11] Use the terms light, critical and heavy damping. | Summative for theory | Knowledge+ Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-12] Sketch displacement-time graphs: to illustrate light, critical and heavy damping. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-13] State that resonance involves a maximum amplitude of oscillations and that this occurs when an oscillating system is forced to oscillate at its natural frequency. | Summative for theory | Knowledge+ Understanding | Question(s) will be asked in final examination. | 32 periods |
| [SLO: P-12-D-14] Describe practical examples of free and forced oscillations. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-15] Describe practical examples of damped oscillations [with particular reference to the efforts of the degree of damping and the importance of critical damping in cases such as a car suspension system]. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-16] Justify qualitatively the factors which determine the frequency response and sharpness of the resonance. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-17] Identify the use of standing waves and resonance in applications [such as Rubens tubes, Chladni plates and acoustic levitation (knowledge of wave harmonic modes is not required)]. | Formative | Understanding | Question(s) will not be asked in final examination. | |
| [SLO: P-12-D-18] Justify the importance of critical damping in a car suspension system. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-19] Justify that there are some circumstances in which resonance is useful [such as tuning a radio, microwave oven and other circumstances in which resonance should be avoided such as airplane's wing or a suspension bridge]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| **Diffraction and Interference**: | | | | |
| [SLO: P-12-D-20] Explain experiments that demonstrate two-source interference using water waves in a ripple tank, sound, light and microwaves. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-D-21] Describe the conditions required if two-source interference fringes are to be observed. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-22] Use $\Delta y = \frac{\lambda L}{d}$ for double-slit interference using light to solve problems. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-23] Use d sin (θ) = n λ to solve problems. | Summative for theory | understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-24] Describe the use of a diffraction grating to determine the wavelength of light [the structure and use of the spectrometer are not included]. | Summative for theory | Knowledge +Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-D-25] With the context of the electron diffraction double slit experiment, explain the below two of the many interpretations of quantum mechanics:<br>(i) Copenhagen interpretation<br>(ii) Many worlds interpretation. | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | |
| **Domain: E Electricity and Magnetism** | | | | |
| [SLO: P-12-E-01] Define and calculate electric potential [At a point as the work done per unit positive charge in bringing small test charge from infinity to point. Use $V = \frac{q}{4\pi \in_o r}$ for the electric potential in the field due to a point charge]. | Summative for theory | Knowledge + Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-02] Use the fact that the electric field at a point is equal to the negative of potential gradient at that point. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-03] State how the concept of electric potential leads to the electric potential energy of two-point charges and use $E_p = \frac{Qq}{4\pi \in_o r}$. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-04] Define and calculate capacitance [as applied to both isolated spherical conductors and to parallel plate capacitors]. | Summative for theory | Knowledge + Understanding +Application | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-E-05] Derive and apply formulae for the combined capacitance of capacitors in series and in parallel. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-06] Use the capacitance formula for capacitors in series and in parallel. | Summative for theory and PBA | Application | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-E-07] Determine the electric potential energy stored in a capacitor from the area under the potential— charge graph [Use $\frac{1}{2}(QV)=\frac{1}{2}(CV^2)$ to solve physics related problems]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-08] Analyze graphs of the variation with time of potential difference, charge and current for a capacitor discharging through a resistor [use $\tau$ = RC for the time constant for a capacitor discharging through a resistor]. | Summative for PBA | Understanding + Application | Question(s) will be asked in final PBA examination. | |
| [SLO: P-12-E-09] Use equations of the form $x = x_o (\exp(\frac{-t}{RC}))$ [ where x could represent current, charge or potential difference for a capacitor discharge through a resistor]. | Summative for PBA | Application | Question(s) will be asked in final PBA examination. | |
| [SLO: P-12-E-10] list the use of capacitors in various household appliances [such as in flash guns, refrigerators, electric fans, rectification circuits, etc.]. | Summative for theory | Knowledge | Question(s) will be asked in final examination. | 30 periods |
| **Bioelectricity:** | | | | |
| [SLO: P-10-E-11] Illustrate how bioelectricity is generated in animals [- cells control the flow of specific charged elements across the membrane with proteins that sit on the cell surface and create an opening for certain ions to pass through. These proteins are called ion channels.<br>- When a cell is stimulated, it allows positive charges to enter the cell through open ion channels. The inside of the cell then becomes more positively charged, which triggers further electrical currents that can turn into electrical pulses, called action potentials.<br>- The bodies of many organisms use certain patterns of action potentials to initiate the correct movements, thoughts and behaviors]. | Formative | Knowledge | Question(s) will not be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-10-E-12] State that there are several species of aquatic life, such as Electrophorus Electricus, that can naturally generate external electric shocks through internal biological mechanisms that act as batteries. | Formative | Knowledge | Question(s) will not be asked in final examination. | |
| [SLO: P-10-E-13] Explain, with examples of animal with this ability, that electroreception is the ability to detect weak naturally occurring electrostatic fields in the environment. | Formative | Understanding | Question(s) will not be asked in final examination. | |
| **AC circuits:** | | | | |
| [SLO: P-10-E-14] Use the terms period, frequency and peak value as applied to an alternating current or voltage. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-10-E-15] Use equations of the form $x = x_o \sin(\omega t)$ representing a sinusoidally alternating current or voltage. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-10-E-16] Use the fact that the mean power in a resistive load is half the maximum power for a sinusoidal alternating current. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-10-E-17] Distinguish between root-mean-square (r.m.s.) and peak values [including stating and using $I = \frac{Io}{\sqrt{2}}$ and $V = \frac{Vo}{\sqrt{2}}$ for a sinusoidal alternating current]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-10-E-18] Distinguish graphically between half-wave and full-wave rectification. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-19] Explain the use of a single diode for the half-wave rectification of an alternating current. | Summative for theory and PBA | Understanding | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-E-20] Explain the use of four diodes (bridge rectifier) for the full-wave rectification of an alternating current. | Summative for theory and PBA | Understanding | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-E-21] Analyze the effect of a single capacitor in smoothing current flow [including the effect of the values of capacitance and the load resistance]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-22] Define mutual inductance (M) and self-inductance (L), and their unit henry. | Summative for theory | Knowledge | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-E-23] Describe the phase of A.C and how phase lags and leads in A.C Circuits. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-24] Identify inductors as important components of A.C circuits termed as chokes [devices which present a high resistance to alternating current]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-25] Calculate the reactance of capacitors and inductors. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-E-26] Describe impedance as vector summation of resistances and reactances. | Summative for theory | Knowledge+ Understanding | Question(s) will be asked in final examination. | |
| **Domain: F Modern Physics** | | | | |
| **Quantum Physics:** | | | | |
| [SLO: P-12-F-01] State that electromagnetic radiation has a particulate nature. | Summative for theory | Knowledge | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-02] Explain and apply the photonic model of light to solve problems [use E = hf to solve problems, and use the electron volt (eV) as a unit of energy]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-05] Explain that a photon has momentum [including that the momentum is given by p = E/c (connect with the idea that light can exert a force)]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-06] Describe that photoelectrons may be emitted from a metal surface when it is illuminated by electromagnetic radiation. | Summative for theory and PBA | Understanding | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-F-07] Describe and use the terms threshold frequency and threshold wavelength. | Summative for theory and PBA | Understanding + Application | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-F-08] Explain photoelectric emission in terms of photon energy and work function energy. | Summative for theory and PBA | Knowledge + Understanding | Question(s) will be asked in final theory examination and PBA. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-F-09] State and apply $hf = \emptyset + \frac{1}{2} mv^2_{max}$. | Summative for theory and PBA | Understanding +Application | Question(s) will be asked in final theory examination and PBA. | |
| [SLO: P-12-F-10] Explain why the maximum kinetic energy of photoelectrons is independent of intensity, whereas the photoelectric current is proportional to intensity. | Summative for theory and PBA | Understanding | Question(s) will be asked in final theory examination and PBA. | 26 periods |
| [SLO: P-12-F-11] Juxtapose the evidence for light as a wave and as a particle [Explain that the photoelectric effect provides evidence for a particulate nature of electromagnetic radiation while phenomena such as interference and diffraction provide evidence for wave nature]. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-12] Analyze qualitatively the evidence provided by electron diffraction for the wave nature of particles. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-13] Explain and apply the de Broglie wavelength to solve problems [use $\lambda = h / p$ to solve problems]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-14] State that there are discrete electron energy levels in isolated atoms (e.g. atomic hydrogen). | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-15] Explain the appearance and formation of emission and absorption line spectra. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-16] Use hf = ΔE to solve problems. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-17] Describe the Compton effect qualitatively. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-18] Explain the phenomena of pair production and pair annihilation. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-19] Explain how electron microscopes achieve very high resolution. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-20] State and explain Heisenberg's uncertainty principle qualitatively. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-F-21] Use the uncertainty principle to explain why empirical measurements must necessarily have uncertainty in them. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| **Particle Physics:** | | | | |
| [SLO: P-12-F-22] Recognize the equivalence between energy and mass as represented by $E = \Delta mc^2$ and state and use this equation. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-23] Define and use the terms mass defect and binding energy. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-24] Sketch the variation of binding energy per nucleon with nucleon number. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-25] Recall what is meant by nuclear fusion and nuclear fission. | Summative for theory | Knowledge | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-26] Explain the relevance of binding energy per nucleon to nuclear reactions, including nuclear fusion and nuclear fission.<br>[SLO: P-12-F-26] Explain how the neutrons produced in fission create a chain reaction and that this is controlled in a nuclear reactor [including the action of coolant, moderators and control rods]. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-27] Calculate the energy released in nuclear reactions using $E = \Delta mc^2$. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-28] Explain that fluctuations in count rate provide evidence for the random nature of radioactive decay. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-29] Explain that radioactive decay is both spontaneous and random. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-30] Define activity and decay constant and state the use of $A = \lambda N$ . | Summative for theory | Understanding Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-31] Explain half-life with examples. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-32] Use $\lambda = 0.693 / T$ to solve numerical problems. | Summative for theory | Application | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-F-33] State the exponential nature of radioactive decay. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-34] Use the relationship $x = x_o e^{\lambda t}$ [where x could represent activity, number of undecayed nuclei or received count rate to solve problems analytically and graphically]. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-35] Describe the function of the principle components of a water moderated power reactor [core, fuel, rods, moderator, control rods, heat exchange, safety rods and shielding]. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-36] Explain why uranium fuel needs to be enriched before use. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-37] Compare the amount of energy released in a fission reaction with the given energy released in a chemical reaction. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-38] Explain what is a medical tracer [a substance containing radioactive nuclei that can be introduced into the body and is then absorbed by the tissue being studied]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-39] Explain annihilation reactions [they occur when a particle interacts with its antiparticle and that mass—energy and momentum are conserved in the process]. | Summative for theory | Knowledge | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-40] Illustrate how PET scanning works [positrons emitted by the decay of the tracer annihilate when they interact with electrons in the tissue, producing a pair of gamma-ray photons traveling in opposite directions]. | Formative | Knowledge | Question(s) will not be asked in final examination. | |
| [SLO: P-12-F-41] Calculate the energy of the gamma ray photons emitted during the annihilation of an electron-positron pair. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-42] Explain that the gamma-ray photons from an annihilation event travel outside the body and can be detected [including that an image of the tracer concentration in the tissue can be created by processing the arrival times of the gamma-ray photon]. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-F-43] Explain the term luminosity [as the total power of radiation emitted by a star]. | Summative for theory | Knowledge+ Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-44] Apply the inverse square law for radiant flux intensity [F in terms of the luminosity L of the source $F = \frac{L}{4\pi d^2}$ ]. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-45] Define and apply standard candles [Explain the use of standard candles to determine distances to galaxies]. | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | |
| [SLO:P-12-F-46] Explain blackbody radiation and apply Wien's displacement law to solve problems [$\lambda_{\max} T = cons\tan t$ to estimate the peak surface temperature of a star]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-47] Apply the Stefan Boltzmann law to solve problems [ $L = 4\pi r^2 x\sigma T^4$ to solve problems]. | Summative for theory | Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-48] Estimate the radius of a star [applying Wien's displacement law and the Stefan—Boltzmann law]. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-49] Explain that the lines in the emission and absorption spectra from distant objects show an increase in wavelength from their known values. | Summative for theory | Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-50] Explain why redshift leads to the idea that the Universe is expanding [include using $\frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$ for the redshift of electromagnetic radiation from a source moving relative to an observer to solve problems relating to the expanding universe]. | Summative for theory | Understanding +Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-51] State and explain Hubble's law and how it leads to the Big Bang theory. | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | |
| [SLO: P-12-F-52] Describe Earth's climate system as a complex system having five interacting components [the atmosphere (air), the hydrosphere (water), the cryosphere (ice and permafrost), the lithosphere (earth's upper rock layer) and the biosphere (living things)]. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-F-53] Relate ocean currents and wind patterns to the climate system [as the statistical characterization of the climate system, representing the average weather, typically over a period of 30 years, and is determined by a combination of processes in the climate system, such as ocean currents and wind patterns]. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-54] Explain climate inertia [ as the phenomenon by which climate systems show resistance or slowness to changes in significant factors e.g. stabilization of greenhouse emissions might show a slow response due to the action of complex feedback systems]. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-55] Explain that climate change can be categorized into internal variations and external forcing. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-56] Explain how global climate is determined by energy transfer from the Sun [with specific reference to the below factors and terms: state and use the term Earth energy budget. Explain how the energy imbalance between the poles and the equator can affect atmospheric circulation]. | Summative for theory | Knowledge + Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-57] Explain that due to the conservation of angular momentum, the Earth's rotation diverts the air to the right in the Northern Hemisphere and to the left in the Southern hemisphere, thus forming distinct atmospheric cells. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | 18 periods |
| [SLO: P-12-F-58] Explain that ocean water that has more salt has a higher density and differences in density play an important role in ocean circulation. | Summative for theory | Knowledge + Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-59] Explain how the thermohaline circulation transports heat from the tropics to the polar regions. | Formative | Knowledge | Question(s) will not be asked in final examination. | |
| [SLO: P-12-F-60] Explain how climate science is an example of a chaotic system, [using the metaphor of a butterfly" wing flaps may cause hurricanes in another part of the world, mathematics of chaos theory is not required; just the idea that with very complex systems it is very difficult to predict outcomes and they are very sensitive to initial conditions]. | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-F-61] Explain that piezo-electric effect and its application in medical science [ultrasound waves are generated and detected by a piezoelectric transducer]. | summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-62] Explain how ultrasound can be used to obtain diagnostic information about internal body structures. | summative for theory | Knowledge + Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-63] Explain that X-rays are produced by electron bombardment of a metal target and calculate the minimum wavelength of X-rays produced from the accelerating P.d. | Summative for theory | Understanding + Application | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-64] Explain the use of X-rays in imaging internal body structures [including a describing of the term contrast in X-ray imaging]. | Summative for theory | Knowledge +Understanding | Question(s) will be asked in final examination. | |
| [SLO: P-12-F-65] Explain how computed tomography (CT) scanning works [it produces a 3D image of an internal structure by first combining multiple X-ray images taken in the same section from different angles to obtain a 2D image of the section, then repeating this process along an axis and combining 2D images of multiple sections]. | Formative | Knowledge | Question(s) will not be asked in final examination. | |
| **Domain: G Nature of Sciences** | | | | |
| **Debates about Beauty in Physics:** | | | | |
| [SLO: P-12-G-01] Explain, with examples, what do thinkers who hold the view that there is inherent mathematical beauty in the natural world mean by:<br>(i) elegance of simplicity<br>(ii) symmetry. | Formative | Knowledge | Question(s) will not be asked in final examination. | |
| [SLO: P-12-G-02] Explain, with an example, a counterargument to the claim that physical truths must be inherently mathematically elegant or display symmetry. | Formative | Application | Question(s) will not be asked in final examination. | |
| [SLO: P-12-G-03] Describe the main pros and cons in the debate about:<br>(i) Whether humans should research whether there are aliens somewhere in the universe.<br>(ii) Whether research should continue on uncovering the secrets of | Formative | Knowledge + Understanding | Question(s) will not be asked in final examination. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| subatomic particles, given the advent of nuclear weapons. | | | | |
| [SLO: P-11-G-04] Explain how the below thought experiments helped convey important physics concepts that would have been impractical to investigate empirically:<br>(i) Newton's cannonball. | Formative | Understanding | Question(s) will not be asked in final examination. | |
| **Domain: H Experimentation Skills** | | | | |
| [SLO: P-12-N-01] Develop and justify safety guidelines for a proposed procedure, that also outline the overall risks of the experiment, keeping in mind:<br>[(i) the apparatus,<br>(ii) the surrounding environment,<br>(iii) need for personal protective equipment]. | Formative for PBA | Understanding + Application | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-02] Formulate a testable hypothesis by:<br>« Identifying the independent variable in the experiment<br>« Identifying the dependent variable in the experiment<br>« Identifying the variables that are to be kept constant. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | 08 periods |
| [SLO: P-12-N-03] Explain the methods of data collection by:<br>a. describing the method to be used to vary the independent variable<br>b. describing how the independent and dependent variables are to be measured<br>c. describing how other variables are to be kept constant<br>d. describing, with the aid of a clear labeled diagram, the arrangement of apparatus for the experiment and the procedures to be followed. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-04] Explain the methods of data analysis by describing how the data should be used in order to reach a conclusion, including details of derived quantities to be calculated from graphs. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| [SLO: P-12-N-05] Suggest how technology can be used to digitize data collection by describing as appropriate:<br>a. the use of an oscilloscope (or storage oscilloscope) to measure voltage, current, time and frequency<br>b. how to use light gates connected to a data logger to determine time, velocity and acceleration<br>c. how other sensors can be used with a data logger, e.g. motion sensor | Formative for PBA | Understanding + Application | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-06] Show uncertainty estimates, in absolute terms, beside every value in a table of results. | Summative for PBA | Understanding | Question will be asked in final PBA examination. | |
| [SLO: P-12-N-07] Show error bars, in both directions where appropriate, for each point on the graph. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-08] Draw a straight line of best fit and a worst acceptable straight line through the points on the graph. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | 26 periods |
| [SLO: P-12-N-09] Rearrange expressions into the forms $y = mx + c$, $y = ax^n$ and $y = ae^{kx}$. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-10] Describe how a graph of y against x is used to find the constants m and c in an equation of the form y = mx + c. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-11] Describe how a graph of log y against log x is used to find the constants a and n in an equation of the form $y = ax^n$. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-12] Describe how a graph of In y against x is used to find the constants a and k in an equation of the form $y = ae^{kx}$. | Formative for PBA | Understanding | Question will not be asked in final | |

| NCP SLOs Description | Form of Assessment | Cognitive domain | Remarks | Number of Periods Required (1 period=40 minutes) |
|---|---|---|---|---|
| | | | examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-13] Decide what derived quantities to calculate from raw data in order to enable an appropriate graph to be plotted. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-14] Convert absolute uncertainty estimates into fractional or percentage uncertainty estimates and vice versa. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-15] Calculate uncertainty estimates in derived quantities. | Formative for PBA | Understanding + Application | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-16] Estimate the absolute uncertainty in the gradient of a graph by stating that absolute uncertainty = gradient of line of best fit — gradient of worst acceptable line. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-17] Estimate the absolute uncertainty in the y- intercept of a graph by stating that absolute uncertainty = y-intercept of line of best fit — y-intercept of worst acceptable line. | Formative for PBA | Understanding | Question will not be asked in final examination, however, it will be part of Lab work. | |
| [SLO: P-12-N-18] Express a quantity as a value, an uncertainty estimates and a unit. | Summative for PBA | Understanding | Question will be asked in PBA | |

**Note:**

i. The experiments or list of practicals will be extracted from the SLOs for Practical Based Assessment.
ii. **PBA STANDS FOR "PRACTICAL BASED ASSESSMENT"**.

# Federal Board HSSC-II Examination
# Physics Model Question Paper

**(National Curriculum of Pakistan 2022-2023)**
**(Scheme of Studies 2006)**

| ROLL NUMBER | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 5 | 5 | 5 | 5 | 5 |
| 6 | 6 | 6 | 6 | 6 | 6 |
| 7 | 7 | 7 | 7 | 7 | 7 |
| 8 | 8 | 8 | 8 | 8 | 8 |
| 9 | 9 | 9 | 9 | 9 | 9 |

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| 0 | 0 | 0 | 0 |
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| 5 | 5 | 5 | 5 |
| 6 | 6 | 6 | 6 |
| 7 | 7 | 7 | 7 |
| 8 | 8 | 8 | 8 |
| 9 | 9 | 9 | 9 |

## Section - A (Marks 17)

Time Allowed: 25 minutes

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

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

**Q1. Fill the relevant bubble against each question according to curriculum. Each part carries one mark.**

| Sr # | Question | (A) | (B) | (C) | (D) | (A) | (B) | (C) | (D) |
|---|---|---|---|---|---|---|---|---|---|
| 1. | The distance between the two identical balls is R. If the distance is reduced to half of R then the gravitational force will become: | half | quarter | double | four time | ○ | ○ | ○ | ○ |
| 2. | As we go further away from the surface of the Earth, the value of 'g': | remains same | increases | decreases | may increase or decrease depending on mass. | ○ | ○ | ○ | ○ |
| 3. | SI unit of Luminosity is | watts | cd/$m^2$ | joules | cd.$m^2$ | ○ | ○ | ○ | ○ |
| 4. | Real gases deviate from ideal behavior because gas molecules: | are colorless | are spherical | have intermolecular forces of attraction | have high speeds | ○ | ○ | ○ | ○ |
| 5. | If A is the amplitude of an oscillating system, the total distance covered during its time period is: | A/2 | A | 2A | 4A | ○ | ○ | ○ | ○ |
| 6. | The phenomenon of diffraction is more prominent when the size of the obstacle is: | larger than the wavelength of incident light | smaller than the wavelength of incident light | comparable to the wavelength of incident light | independent of the wavelength of incident light | ○ | ○ | ○ | ○ |
| 7. | Which of the following is equivalent to 1.0 volt. | newton per second | joule per second | joule per coulomb | coulomb per joule | ○ | ○ | ○ | ○ |
| 8. | Capacitor is a device used to: | store electrical energy | vary the resistance | store magnetic energy | dissipate energy | ○ | ○ | ○ | ○ |
| 9. | In a full wave bridge rectifier, how many diode(s) conduct during each half cycle of AC input? | 1 | 2 | 3 | 4 | ○ | ○ | ○ | ○ |
| 10. | Sinusoidal waveform is generated in AC system because: | it can be easily drawn | it produces least disturbance | it is natural standard | other waves cannot be | ○ | ○ | ○ | ○ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | in electrical circuits | | produced easily. | |
| **11.** | A photoelectric cell is a device which: | converts electricity into light energy. | converts light energy into electricity. | stores light energy. | stores electricity | ○ ○ ○ ○ |
| **12.** | If uncertainty in the position of an electron is zero, the uncertainty in its momentum will be | less than h/4 | greater than h/4 | zero | infinite | ○ ○ ○ ○ |
| **13.** | The process by which a heavy nucleus splits into two smaller nuclei is called: | Fission | Fusion | Alpha decay | Beta decay | ○ ○ ○ ○ |
| **14.** | Which law gives the relationship between brightness and distance from the source | Law of brightness | Direct Square Law of brightness | Inverse Square Law of brightness | Inverse Square Law of light | ○ ○ ○ ○ |
| **15.** | Which of the following statements is true about a photon? | A photon has zero mass and zero momentum. | A photon has finite mass and a finite value of momentum. | A photon has zero mass but finite value of momentum. | A photon has finite mass but zero momentum . | ○ ○ ○ ○ |
| **16.** | The drawback of conducting a medical imaging test is: | Early detection of problem. | Accurate diagnosis. | Contribution to choose of effective treatment. | Exposure to radiation. | ○ ○ ○ ○ |
| **17.** | Energy of gamma photon having a wavelength of $1A^{o}$ is: | $12.4x10^{3}$ eV | $12.4x10^{4}$ eV | $12.4x10^{-3}$ eV | $12.4x10^{-4}$ eV | ○ ○ ○ ○ |

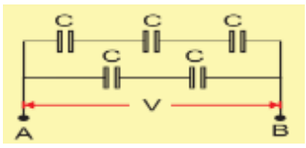
# Federal Board HSSC-II Examination Physics Model Question Paper

**(National Curriculum of Pakistan 2022-2023)**
**(Scheme of Studies 2006)**

**Time allowed: 2.45 hour** **Total Marks Sections B and C: 68**

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 (Marks 42)*

| Q. 2 | Questions | Marks | | Questions | Marks |
|---|---|---|---|---|---|
| **(i)** | Calculate the orbital speed of satellite orbiting the Earth at an altitude equal to Earth's radius. | 03 | **OR** | A body with mass 800 g attached to a spring, vibrates with amplitude 30 cm. The restoring force is 60 N when the displacement is 0.30 m. Find out its (a) angular frequency (b) velocity and acceleration at x = 12 cm. | 03 |
| **(ii)** | Explain how pressure is exerted by the movement of gas molecules? | 03 | **OR** | Write any three conditions for observing interference fringes? | 03 |
| **(iii)** | Write three examples of resonance from everyday life. | 03 | **OR** | List the use of capacitors in various household appliances. | 03 |
| **(iv)** | The fringe spacing between the central maxima and 1st minima is 2 mm. If a light of 500 mm is used then find the separation between the slits. The distance between the slit and screen is 1 m. | 03 | **OR** | A network of five capacitors of capacitance C is connected to a 100 V supply, as shown in below figure. Determine the equivalent capacitance of the network.   | 03 |
| **(v)** | Define mutual inductance. Also write its unit. | 03 | **OR** | Define gravitational field strength. Also write its formula and unit. | 03 |
| **(vi)** | When electrons are accelerated through a potential difference of $10^5$ volts in an X–ray tube. Calculate the minimum wavelength produced. | 03 | **OR** | A.C voltage across a 0.5 μF capacitor is $16\sin(2\times10^3 t)$ V. Find the capacitive reactance. | 03 |
| **(vii)** | Define (a) cryosphere (b) lithosphere. | 03 | **OR** | What is the main purpose of X-rays? | 03 |
| **(viii)** | What are the conditions required for pair production to occur? | 03 | **OR** | What is climate inertia? | 03 |
| **(ix)** | What is the application of piezo-electric effect in medical science? | 03 | **OR** | Explain how electron microscopes achieve very high resolution? | 03 |
| **(x)** | Sketch the variation of binding energy per nucleon with nucleon number. | 03 | **OR** | Explain the role of a single capacitor in output of full wave rectifier circuit. | 03 |
| **(xi)** | Explain briefly that how global climate is determined by energy transfer from the Sun? | 03 | **OR** | What is Stefan-Boltzmann law? Explain briefly. | 03 |
| **(xii)** | Explain why g is approximately constant for small changes in height near the earth's surface. | 03 | **OR** | Describe the function of the control rods in reactor. | 03 |
| **(xiii)** | How pressure is related to average translational kinetic energy of a gas? | 03 | **OR** | Describe the practical examples of free and forced oscillations. | 03 |
| **(xiv)** | What is diffraction grating? | 03 | **OR** | Distinguish between root-mean-square (r.m.s.) and peak values for a sinusoidal alternating current. | 03 |

**SECTION – C** (Marks 26)

**Note:** Attempt all questions. Marks of each question are given along with each question.

| Questions | | Marks | Questions | | Marks |
|---|---|---|---|---|---|
| **Q.3** | Define the term gravitational potential. Also derive the expression for calculating gravitational potential in the field due to a point mass. | 01+ 06 | **OR** | Analyze the interchange between kinetic and potential energy during simple harmonic motion | 05+02 |
| **Q.4** | Define interference, discuss the conditions for observing interference. Give expression for the path difference of constructive and destructive interference. | 01+ 03 +02 | **OR** | Explain the process of charging of a capacitor through a resistor (Also discuss the term time constant in the explanation). | 04 + 02 |
| **Q.5** | What is rectification? Explain the operation of a bridge rectifier, with the help of a diagram. | 01+ 06 | **OR** | What is photoelectric effect? Explain in detail. | 01+06 |
| **Q.6** | Define and explain the following terms:<br>(a) luminosity<br>(b) Annihilation reaction | 03 + 03 | **OR** | Explain half-life with examples. | 06 |

FBISE HSSC-II Examination

**Physics Model Question Paper**

(Curriculum 2022-23)

# Alignment of Questions with Curriculum Student Learning Outcomes

| Sr No | Section: Q. No. (Part no.) | Domain Title/ Content Area | Student Learning Outcomes | Cognitive Domain * | Allocated Marks in Model Paper |
|---|---|---|---|---|---|
| 1 | A: Q1(1) | Domain B | [SLO: P-12-B-03]<br>Apply Newton's law of gravitation to solve problems<br>[$F=Gm_1m_2/r^2$ for the force between two-point masses to solve problems] | A | 1 |
| 2 | A: Q1(2) | Domain B | [SLO: P-12-B-01] Define and calculate gravitational field strength<br>[this will include more challenging problems than in Grade 9. It will involve use of $g = GM/r^2$ ] | U | 1 |
| 3 | A: Q1(3) | Domain F | [SLO: P-12-F-43]<br>Explain the term luminosity [ as the total power of radiation emitted by a star] | K | 1 |
| 4 | A: Q1(4) | Domain C | [SLO: P-12-C-05]<br>Illustrate that the model of ideal gasses is used a base from which the field of statistical mechanics emerged<br>[and has helped explain the behavior of 'non-ideal' gasses through modifications to the model e.g. the behavior of stars] | U | 1 |
| 5 | A: Q1(5) | Domain D | [SLO: P-12-D-02]<br>Use the terms displacement, amplitude, period, frequency, angular frequency and phase difference in the context of oscillations. | U | 1 |
| 6 | A: Q1(6) | Domain D | [SLO: P-12-D-24]<br>Describe the use of a diffraction grating to determine the wavelength of light<br>[the structure and use of the spectrometer are not included] | K | 1 |
| 7 | A: Q1(7) | Domain E | [SLO: P-12-E-01]<br>Define and calculate electric potential<br>[At a point as the work done per unit positive charge in bringing small test charge from infinity to point. Use $V=q4\pi\epsilon or$ for the electric potential in the field due to a point charge] | K | 1 |
| 8 | A: Q1(8) | Domain E | [SLO: P-12-E-04]<br>Define and calculate capacitance<br>[as applied to both isolated spherical conductors and to parallel plate capacitors] | K | 1 |
| 9 | A: Q1(9) | Domain E | [SLO: P-12-E-20]<br>Explain the use of four diodes (bridge rectifier) for the full-wave rectification of an alternating current | U | 1 |
| 10 | A: Q1(10) | Domain E | [SLO: P-12-E-23]<br>Describe the phase of A.C and how phase lags and leads in A.C Circuits. | U | 1 |

| Sr No | Section: Q. No. (Part no.) | Domain Title/ Content Area | Student Learning Outcomes | Cognitive Domain * | Allocated Marks in Model Paper |
|---|---|---|---|---|---|
| 11 | A: Q1(11) | Domain F | [SLO: P-12-F-06]<br>Describe that photoelectrons may be emitted from a metal surface when it is illuminated by electromagnetic radiation | U | 1 |
| 12 | A: Q1(12) | Domain F | [SLO: P-12-F-20]<br>State and explain Heisenberg's uncertainty principle qualitatively | U | 1 |
| 13 | A: Q1(13) | Domain F | [SLO: P-12-F-25]<br>Recall what is meant by nuclear fusion and nuclear fission | K | 1 |
| 14 | A: Q1(14) | Domain F | [SLO: P-12-F-44]<br>Apply the inverse square law for radiant flux intensity<br>[F in terms of the luminosity L of the source F=L4πd2] | U | 1 |
| 15 | A: Q1(15) | Domain F | [SLO: P-12-F-05]<br>Explain that a photon has momentum<br>[including that the momentum is given by p = E/c (connect with the idea that light can exert a force)] | U | 1 |
| 16 | A: Q1(16) | Domain F | [SLO: P-12-F-61]<br>Explain that piezo-electric effect and its application in medical science<br>[ultrasound waves are generated and detected by a piezoelectric transducer]<br>[SLO: P-12-F-62]<br>Explain how ultrasound can be used to obtain diagnostic information about internal body structures. | K | 1 |
| 17 | A: Q1(17) | Domain F | [SLO: P-12-F-02]<br>Explain and apply the photonic model of light to solve problems<br>[use E = hf to solve problems, and use the electron volt (eV) as a unit of energy] | A | 1 |
| 18 | B: Q2(i) | Domain B<br><br><br>Domain D | [SLO: P-12-B-04]<br>Analyze circular orbits in gravitational fields<br>[By relating the gravitational force to the centripetal acceleration, it causes]<br>OR<br>[SLO: P-12-D-05]<br>Use $a = -\omega^2 x$ to solve problems | A | 3 |
| 19 | B: Q2(ii) | Domain C<br><br><br>Domain D | [SLO: P-12-C-01]<br>Explain how molecular movement causes the pressure exerted by gas.<br>OR<br>[SLO: P-12-D-21]<br>Describe the conditions required if two-source interference fringes are to be observed | U | 3 |

| Sr No | Section: Q. No. (Part no.) | Domain Title/ Content Area | Student Learning Outcomes | Cognitive Domain * | Allocated Marks in Model Paper |
|---|---|---|---|---|---|
| 20 | B: Q2(iii) | Domain D<br><br><br><br><br>Domain E | [SLO: P-12-D-13]<br>State that resonance involves a maximum amplitude of oscillations and that this occurs when an oscillating system is forced to oscillate at its natural frequency.<br>OR<br>[SLO: P-12-E-10]<br>list the use of capacitors in various household appliances [such as in flash guns, refrigerators, electric fans, rectification circuits, etc.] | K | 3 |
| 21 | B: Q2(iv) | Domain D<br><br><br><br>Domain E | [SLO: P-12-D-22]<br>Use $\Delta y=\gamma Ld$ for double-slit interference using light to solve problems<br>OR<br>[SLO: P-12-E-06]<br>Use the capacitance formula for capacitors in series and in parallel | A | 3 |
| 22 | B: Q2(v) | Domain E<br><br><br><br>Domain B | [SLO: P-12-E-22]<br>Define mutual inductance (M) and self-inductance (L), and their unit henry.<br>OR<br>[SLO: P-12-B-01] Define and calculate gravitational field strength<br>[this will include more challenging problems than in Grade 9. It will involve use of $g = GM/r^2$ ] | K | 3 |
| 23 | B: Q2(vi) | Domain F<br><br><br><br><br>Domain E | [SLO: P-12-F-63]<br>Explain that X-rays are produced by electron bombardment of a metal target and calculate the minimum wavelength of X-rays produced from the accelerating P.d.<br>OR<br>[SLO: P-12-E-25]<br>Calculate the reactance of capacitors and inductors. | A | 3 |
| 24 | B: Q2(vii) | Domain F<br><br><br><br><br><br><br>Domain F | [SLO: P-12-F-52]<br>Describe Earth's climate system as a complex system having five interacting components<br>[the atmosphere (air), the hydrosphere (water), the cryosphere (ice and permafrost), the lithosphere (earth's upper rock: layer) and the biosphere (living things).]<br>OR<br>[SLO: P-12-F-64]<br>Explain the use of X-rays in imaging internal body structures [including a describing of the term contrast in X-ray imaging] | K | 3 |
| 25 | B: Q2(viii) | Domain F<br><br><br><br>Domain F | [SLO: P-12-F-18]<br>Explain the phenomena of pair production and pair annihilation<br>OR<br>[SLO: P-12-F-54]<br>Explain climate inertia [ as the phenomenon by which climate systems show resistance | U | 3 |

| Sr No | Section: Q. No. (Part no.) | Domain Title/ Content Area | Student Learning Outcomes | Cognitive Domain * | Allocated Marks in Model Paper |
|---|---|---|---|---|---|
| | | | or slowness to changes in significant factors e.g. stabilization of greenhouse emissions might show a slow response due to the action of complex feedback systems] | | |
| 26 | B: Q2(ix) | Domain F<br><br>Domain F | [SLO: P-12-F-61]<br>Explain that piezo-electric effect and its application in medical science<br>[ultrasound waves are generated and detected by a piezoelectric transducer]<br>OR<br>[SLO: P-12-F-19]<br>Explain how electron microscopes achieve very high resolution. | U | 3 |
| 27 | B: Q2(x) | Domain F<br><br>Domain E | [SLO: P-12-F-24]<br>Sketch the variation of binding energy per nucleon with nucleon number.<br>OR<br>[SLO: P-12-E-21]<br>Analyze the effect of a single capacitor in smoothing current flow<br>[including the effect of the values of capacitance and the load resistance] | U | 3 |
| 28 | B: Q2(xi) | Domain F<br><br>Domain F | [SLO: P-12-F-56]<br>Explain how global climate is determined by energy transfer from the Sun<br>[ with specific reference to the below factors and terms: state and use the term Earth energy budget. Explain how the energy imbalance between the poles and the equator can affect atmospheric circulation]<br>OR<br>[SLO: P-12-F-48]<br>Estimate the radius of a star<br>[applying Wien's law, displacement law and the Stefan-Boltzmann law] | U | 3 |
| 29 | B: Q2(xii) | Domain B<br><br>Domain F | [SLO: P-12-B-07] Analyse why g is approximately constant for small changes in height near the earth's surface.<br>OR<br>[SLO: P-12-F-35]<br>Describe the function of the principle components of a water moderated power reactor<br>[core, fuel, rods, moderator, control rods, heat exchange, safety rods and shielding] | U | 3 |
| 30 | B: Q2(xiii) | Domain C<br><br>Domain D | [SLO: P-12-C-04]<br>Derive and use the formula for the average translational kinetic energy of a gas OR<br>[SLO: P-12-D-14]<br>Describe practical examples of free and forced oscillations. | U | 3 |
| 31 | B: Q2(xiv) | Domain D | [SLO: P-12-D-24]<br>Describe the use of a diffraction grating to determine the wavelength of light<br>[the structure and use of the spectrometer are not included]<br>OR | K | 3 |

| Sr No | Section: Q. No. (Part no.) | Domain Title/ Content Area | Student Learning Outcomes | Cognitive Domain * | Allocated Marks in Model Paper |
|---|---|---|---|---|---|
| | | Domain E | [SLO: P-10-E-17]<br>Distinguish between root-mean-square (r.m.s.) and peak values [including stating and using I=Io2 and V=Vo2 for a sinusoidal alternating current] | | |
| 32 | C: Q3 | Domain B<br><br><br><br><br><br><br>Domain D | [SLO: P-12-B-08]<br>Define and calculate gravitational potential<br>[Use φ=-GMr for the gravitational potential in the field due to a point mass]<br>[At a point as the work done per unit mass in bringing a small test mass from infinity to the point]<br>OR<br>[SLO: P-12-D-08]<br>Analyse the interchange between kinetic and potential energy during simple harmonic motion | A | 7 |
| 33 | C: Q4 | Domain D<br><br><br><br><br><br>Domain E | [SLO: P-12-D-21]<br>Describe the conditions required if two-source interference fringes are to be observed.<br>OR<br>[SLO: P-12-E-08]<br>Analyze graphs of the variation with time of potential difference, charge and current for a capacitor discharging through a resistor<br>[use $\tau$ = RC for the time constant for a capacitor discharging through a resistor] | U | 6 |
| 34 | C: Q5 | Domain E<br><br><br><br><br>Domain F | [SLO: P-12-E-20]<br>Explain the use of four diodes (bridge rectifier) for the full-wave rectification of an alternating current.<br>OR<br>[SLO: P-12-F-06]<br>Describe that photoelectrons may be emitted from a metal surface when it is illuminated by electromagnetic radiation | U | 7 |
| 35 | C: Q6 | Domain F<br><br><br><br><br><br><br>Domain F | [SLO: P-12-F-43]<br>Explain the term luminosity [ as the total power of radiation emitted by a star]<br>[SLO: P-12-F-39]<br>Explain annihilation reactions [they occur when a particle interacts with its antiparticle and that mass-energy and momentum are conserved in the process]<br>OR<br>[SLO: P-12-F-31]<br>Explain half-life with examples. | K | 6 |

*Cognitive Level
K: Knowledge U: Understanding A: Application

# Table of Specification Model Paper Physics – Grade XII

| Domain | Mechanics B | Heat and Thermodynamics C | Waves D | | Electricity and Magnetism E | | Modern Physics F | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assessment Objectives** | 15- Gravitaional Potential (B1-B9) | 16- Statistical Mechanics and Thermodynamics (C1-C6) | 17-Simple Harmonic Motion (D1-D19) | 18- Diffraction and Interference (D20-D25) | 19- Electrostatics (E1-E13) | 20-Alternating Current (E14-E26) | 21- Quantum Physics (F1-F21) | 22- Nuclear Physics (F22-F42) | 23- Cosmology (F43-F51) | 24-Earth Climate (F52-F60) | 25- Medical Imaging (F61-F65) | Total Marks | Percentage |
| **K Knowledge** | Q2(v/s)3 | | Q2(iii/f)3 | Q2(xvi/f)3<br>Q#1(vi)1 | Q2(iii/s)3<br>Q#1(vii)1<br>Q#1(viii)1 | Q2(xiv/s)3<br>Q2(v/f)3 | | Q#1(xiii)1<br>Q6(s)6 | Q6(f)6 | Q2(vii/f)3 | Q2(vii/s)3<br>Q#1(xvi)1<br>Q#1(iii)1 | 42 | 27.5% |
| **U Understanding** | Q#1(ii)1<br>Q2(xii/f)3 | Q#1(iv)1<br>Q2(ii/f)3<br>Q2(xiii/f)3 | Q#1(v)1<br>Q2(xiii/s)3 | Q2(ii/s)3<br>Q4(f)6 | Q4(s)6 | Q#1(ix)1<br>Q#1(x)1<br>Q2(x/s)3<br>Q5(f)7 | Q#1(xi)1<br>Q#1(xii)1<br>Q#1(xv)1<br>Q2(ix/s)3<br>Q5(s)7<br>Q2(viii/f)3 | Q2(x/f)3<br>Q2(xii/s)3 | Q#1(xiv)1<br>Q2(xi/s)3 | Q2(xi/f)3<br>Q2(viii/s)3 | Q2(ix/f)3 | 77 | 50.3 % |
| **Application A** | Q#1(i)1<br>Q2(i/f)3<br>Q3(f)7 | | Q2(i/s)3<br>Q3(s)7 | Q2(iv/f)3 | Q2(iv/s)3 | Q2(vi/s)3 | Q#1(xvii)1 | | | | Q2(vi/f)3 | 34 | 22.2 % |
| **Total Marks** | 18 | 7 | 17 | 16 | 14 | 21 | 17 | 13 | 10 | 9 | 11 | 153 | - |
| **Total Percentages** | 11.8 % | 4.6 % | 11 % | 10.5 % | 9.2 % | 13.7 % | 11 % | 8.5 % | 6.5 % | 5.9 % | 7.2 % | - | 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 as per the defined ranges may be ensured.

3 The percentage of cognitive domain is 30%, 50%, and 20% for knowledge, understanding, and application, respectively with **± 5%** variation.

4 While selecting alternative questions for SRQs and ERQs, it must be kept in mind that:

- Difficulty levels of both questions should also be same
- SLOs of both the alternative questions must be different

**Key:** Question Number (part/ first choice) marks example: **Q2 ( i / f ) 2**

Question Number (part/ second choice) marks example: **Q2 ( ii / s) 2**


**111 032 473**

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