Question Booklet No.: 6909 Question Booklet Series: **A**

ENTRANCE TEST - 2025

School of Physical & Mathematical Sciences

5-year Integrated B.Sc.-M.Sc. in Physics & Energy Studies

Total Questions: 60 **Roll No.**

Time Allowed: 70 Minutes

Important Instructions for Candidates:

1. Candidates shall compulsorily use only **blue/ black ball point pen**. In no case gel/ink pen or pencil should be used.
2. Compulsorily write your **roll number** in the space provided at the top of this page of the question booklet.
3. Fill up the necessary information in the spaces provided on OMR Answer sheet including **Question Booklet Number** and **Question Booklet Series**.
4. OMR Answer sheet has an original copy and a candidate's copy glued beneath it at the top. While making entries in the original copy, candidate should ensure that the **two copies are aligned properly** so that the entries made in the original copy against each item are exactly copied in the candidate's copy.
5. All entries in the OMR Answer Sheet, including answers to questions, are to be recorded in the Original Copy only.
6. **Choose only one correct/most appropriate response** for each question among the options A, B, C and D and darken the circle of the appropriate response completely. Incompletely darkened circle is not correctly read by the OMR scanner and no complaint to this effect shall be entertained.
7. **Do not darken more the one circle of option for any question. A question with more than one darkened response shall be considered wrong.**
8. **There will be negative marking for wrong answers. Each wrong answer will lead to deduction of 0.25 marks per wrong answer from the score.**
9. Only those candidates who obtain positive score in Entrance Test shall be eligible for admission.
10. Do not make any stray mark on the OMR sheet as this may lead to errors while scanning.
11. OMR answer sheet must be handled carefully and it should not be folded or mutilated, as in such case it will not be properly evaluated by the machine.
12. No Electronic gadgets including calculators, mobiles, smart watches, blue tooth etc. shall be permitted inside the examination hall.
13. Rough work, if any, should be done on the blank sheets provided with the question booklet.
14. Ensure that the OMR Sheet is signed by the Examinee as well as by the invigilator.
15. At the end of the examination, fold the OMR Sheet along the crease on the top and tear off the top strip to separate the Original OMR Sheet from the Duplicate Copy.
16. Hand over the Original OMR answer sheet to the invigilator and retain the candidate's copy of OMR, Question Booklet and Admit card for your reference.
17. If any of the information in the response Sheet/Question Paper has been found missing or not mentioned as stated above, the candidate is solely responsible for that lapse.
18. Any deficiency on the OMR shall be the responsibility of the candidate himself/herself.

SEAL

Q1. The Kinetic energy of a particle of mass m moving with velocity V is $\frac{1}{2}mV^2$. Its dimensions are

(A) $M^1L^1T^{-2}$

(B) $M^1L^2T^{-2}$

(C) $M^2L^1T^1$

(D) $M^1L^2T^{-1}$

Q2. Which of the following statements is wrong?

(A) Speed is a scalar quantity.

(B) Velocity is speed with direction.

(C) Velocity is a vector quantity.

(D) Acceleration is a scalar quantity.

Q3. Let $\vec{A}$ and $\vec{B}$ be two vectors. The angle between them is characterized by

(A) $Cos\theta = \frac{\vec{A}.\vec{B}}{|\vec{A}||\vec{B}|}$

(B) $Sin\,\theta = \frac{\vec{A}.\vec{B}}{|\vec{A}||\vec{B}|}$

(C) $Cot\theta = \frac{\vec{A}.\vec{B}}{|\vec{A}||\vec{B}|}$

(D) $tan\,\theta = \frac{\vec{A}.\vec{B}}{|\vec{A}||\vec{B}|}$

Q4. A cricket ball is thrown at a speed of 28 m/s in a direction 30^0 above horizontal. The maximum height attained by the ball is

(A) 100 m

(B) 30 m

(C) 10 m

(D) 0 m

Q5. A bullet of mass 0.04 kg moving with a speed of 90m/s enters a heavy wooden block and is stopped after a distance of 60 cm. The average resistive force exerted by the block on the bullet is

(A) 10 N

(B) 150 N

(C) 110 N

(D) 270 N

Q6. Choose the incorrect statement in light of Newton's laws of motion

(A) To every action, there is an equal and opposite reaction

(B) The force acting on a body A by body B is never equal to the force on B by A

(C) Forces always occur in pairs

(D) The total momentum of an isolated system of masses is conserved.

Q7. The maximum acceleration of the train in which a box lying on its floor will remain stationary, given that the coefficient of static friction between the box and train is 0.15:

(A) 1.47 m/s^2

(B) 2.47 m/s^2

(C) 0 m/s^2

(D) 10 m/s^2

Q8. The amount of work done by the force $\vec{F} = (3\hat{\imath} + 4\hat{\jmath} - 5\hat{k})$ units through a displacement $\vec{d}$= $(5\hat{\imath} + 4\hat{\jmath} + 3\hat{k})$ units:

(A) 10 units

(B) 16 units

(C) 20 units

(D) 100 units

Q9. The center of mass of a triangular lamina lies at

(A) one side of the triangle

(B) at the centroid of the triangle

(C) outside the triangle

(D) the vertex of the triangle

Q10. The moment of inertia of a thin circular ring of radius R and mass M about the perpendicular to the plane through the center is

(A) MR^2

(B) MR

(C) $\frac{1}{2}MR^2$

(D) MR^3

Q11. Kepler's law of orbits for planetary motion is

(A) All planets move in elliptical orbits with sun situated at one of the foci of the ellipse

(B) All planets move in a straight line

(C) The sun moves around the planets with earth as center

(D) The earth is not a planet.

Q12. The escape velocity from the surface of the earth of mass M and radius R is

(A) $v_e = \sqrt{\frac{GM}{R}}$

(B) $v_e = \sqrt{\frac{2GR}{M}}$

(C) $v_e = \sqrt{\frac{M}{R}}$

(D) $v_e = \sqrt{\frac{2GM}{R}}$

Q13. Hook's law for elastic material is

(A) Stress never produces any strain

(B) Stress is directly proportional to the strain

(C) Stress is inversely proportional to the strain

(D) Stress has no relation with strain

Q14. The density of atmosphere at sea level is 1.29 Kg/m^3. Assume that it does not change with altitude. Then how high would be the atmosphere if atmospheric pressure is 1.01×10^5 Pa:

(A) 1000 m

(B) 200 m

(C) 7989 m

(D) 840 m

Q15. Which of the following is not a law of thermodynamics?

(A) Equilibrium can never be attained by bringing hot and cold bodies in contact.

(B) Two bodies in thermal equilibrium with a third body separately are in thermal equilibrium with each other.

(C) Energy is conserved in a given process.

(D) We cannot transfer heat from cold body to hot body.

Q16. The efficiency of a Carnot engine with T_1 and T_2 as temperature of source and sink respectively, is:

(A) $\eta = 1 - \frac{T_2}{T_1}$

(B) $\eta = \frac{T_2}{T_1}$

(C) $\eta = T_1 \times T_2$

(D) 0

Q17. What is the unit of electric current?

(A) Ampere

(B) Volt

(C) Ohm

(D) Watt

Q18. Two point charges of magnitude 3×10^{-8} C and $-2 \times 10^{-8} C$ are located at 15 cm apart. The point between the charges on the line joining them at which electric potential is zero:

(A) 1cm

(B) 15cm

(C) 10 cm

(D) 9cm

Q19. A slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor but has thickness of $\frac{3}{4}d$, where d is the separation between the plates. The new capacitance of the capacitor when this slab is inserted between the plates is (C_0 is original capacitance)

(A) $\frac{4K}{3}C_0$

(B) $\frac{K}{3}C_0$

(C) $\frac{4K}{K+3}C_0$

(D) 0

Q20. Electric field due to charge on the spherical shell of radius r is $\vec{E} = \frac{q}{4\pi\epsilon_0 r}\hat{r}$, then choose the wrong statement

(A) Electric field is always directed inwards for any value of charge

(B) Electric field is directed outwards for $q > 0$

(C) Electric field is directed inwards if $q < 0$

(D) Electric field outside the shell is as if the entire charge is concentrated at the center.

Q21. A magnetic needle is kept in a non-uniform magnetic field. It experiences

(A) no force and torque.

(B) both the force and torque.

(C) only torque.

(D) only force.

Q22.The resistance of the platinum wire of a platinum resistance thermometer at the ice point is 5Ω and at steam point is 5.23 Ω. When the thermometer is inserted in a hot bath, the resistance of platinum wire is 5.795Ω. The temperature of the bath is

(A) 345.65^0C

(B) 30^0C

(C) 100^0C

(D) 445.65^0C

Q23. The induction coil works on the principle of

(A) mutual resistance

(B) mutual induction

(C) power law

(D) mutual capacitance

Q24.The depth upto which a vessel can be filled with water for that it appears half-filled:

(A) $\frac{2}{3}h$

(B) $\frac{3}{2}h$

(C) $\frac{1}{4}h$

(D) $\frac{1}{3}h$

Q25. Two waves of intensity I undergo interference. The maximum intensity obtained is

(A) 0

(B) $2I$

(C) $4I$

(D) $10I$

Q26.When exposed to sunlight, thin films of oil on water often exhibit brilliant colors due to the phenomenon of

(A) reflection

(B) dispersion

(C) Interference

(D) refraction

Q27. If the Kinetic Energy of a free electron doubles then its de-Broglie wavelength changes by a factor

(A) $\frac{3}{\sqrt{2}}$

(B) $\sqrt{2}$

(C) 2

(D) $\frac{1}{\sqrt{2}}$

Q28. Bohr's atom model assumes

(A) the nucleus is of infinite mass and is at rest.

(B) electron in a quantized orbit will not radiate energy.

(C) mass of the electron remains constant.

(D) all of these

Q29. The maximum work function a metal can have so that light from Balmer series can cause emission.

(A) 13.6eV

(B) 11.2 eV

(C) 3.4 eV

(D) 1.1 eV

Q30. The phenomenon of radioactivity

(A) is an exothermic change which increases or decreases with temperature

(B) increases on applied pressure.

(C) is a nuclear process that does not depend upon external factors.

(D) none of the above

Q31. The nucleus of most of the substances consist of

(A) protons only

(B) protons and neutrons

(C) protons and electrons

(D) neutrons and electrons

Q32. The beta-particles emitted by the radioactive substances are

(A) positively charged.

(B) negatively charged.

(C) neutral.

(D) sometimes positively charged and sometimes negatively charged.

Q33. Heat required to raise the temperature of 1 mole of a substance by 1 degree is called

(A) Specific heat

(B) Molar specific heat

(C) Water equivalent

(D) Specific gravity

Q34. At equilibrium, the concentration of N_2 is 3.0×10^{-3}M, $O_2 = 4.2 \times 10^{-3} M$ and $NO = 2.8 \times 10^{-3} M$ in a sealed container at 800 K. The equilibrium constant K_c for this reaction is:

(A) 1.0

(B) 0.622

(C) 2.622

(D) 3.622

Q35. The conjugate bases for HF and H_2SO_4 are

(A) F^+& HSO_4^-

(B) F^-& HSO^-

(C) F^+ &$H^+SO_4^-$

(D) F^-& HSO_4^-

Q36. The amount of heat required to vaporize one mole of a liquid at constant temperature and standard pressure is called

(A) standard enthalpy of vaporization

(B) standard enthalpy of sublimation

(C) standard entropy of vaporization

(D) standard entropy of sublimation

Q37. The geometry of molecule of $BeCl_2$ has

(A) linear structure and no lone pair of electrons

(B) linear structure with one lone pair of electrons

(C) Dumble shaped with no lone pair of electrons

(D) linear structure with four lone pair of electrons

Q38. In sp^3- hybridization, we have

(A) some d-orbitals hybridizing with p-orbitals

(B) two s-orbitals and three p-orbitals undergo hybridization

(C) one s-orbital and three p-orbitals undergo hybridization

(D) only 2s and 2p orbitals are involved.

Q39. Using stock notation, Fe_2O_3 and MnO_2 can be written as

(A) $Fe_2(III)O_3$ and $Mn(IV)O_2$

(B) $Fe_2(IV)O_3$ and $Mn(IV)O_2$

(C) $Fe_2(I)O_3$ and $Mn(II)O_2$

(D) $Fe_2(I)O_3$ and $Mn(IV)O_2$

Q40. The conditions for hybridization is

(A) the orbitals undergoing hybridization should have same energy

(B) the orbitals undergoing hybridization must have different energies

(C) promotion of electron is essential condition for hybridization

(D) none of the above

Q41. An isomer of ethanol is

(A) Methanol

(B) Diethyl Ether

(C) Acetone

(D) Dimethyl Ether

Q42. In a hydrocarbon, mass ratio of hydrogen and carbon is 1:3, the empirical formula of hydrocarbon is

(A) CH_2

(B) CH_4

(C) CH_3

(D) CH

Q43. The IUPAC name for $CH_3CH_2CH(Cl)CH_3$ is

(A) 2-cholorobutane

(B) 4-cholorobutane

(C) 2-cholorooctane

(D) 2-choloropropane

Q44. The Vinylic halides are

(A) compounds in which halogen atom is bonded to a sp^2-hybridized carbon atom of carbon-carbon triple bond.

(B) compounds in which halogen atom is bonded to a sp^3-hybridized carbon atom of carbon-carbon double bond.

(C) compounds in which halogen atom is bonded to a sp^2-hybridized carbon atom of carbon-carbon double bond.

(D) compounds in which halogen atom is bonded to a sp hybridized carbon atom of carbon-carbon single bond.

Q45. Let $A = \{1,2,3,4,5,6\}$ and $B = \{2,4,6,8\}$, then

(A) A-B={1,3,5}

(B) A-B={8}

(C) A-B= {1,2,5}

(D) A-B={4,5,6}

Q46. Let $A = \{1,2,3\}, B = \{3,4\}$ and $C = \{4,5,6\}$. Then $A \times (B \cap C)$ is

(A){(1,4),(2,4),(3,4)}

(B){(1,1),(1,4),(3,4)}

(C){(2,4),(2,4),(4,4)}

(D){(1,4),(2,2),(4,4)}

Q47. If $cosx = -\frac{3}{5}$ and x lies in the third quadrant. Then $Sinx$ is

(A) 1

(B) 0

(C) $-\frac{4}{5}$

(D) $\frac{4}{5}$

Q48. If $i^2 = -1$, then the value of $(2i)^4$ is

(A) -1

(B) 1

(C) -16

(D) 16

Q49. The determinant and inverse of the matrix $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

(A) -1 and $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

(B) 1 and $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

(C) -1 and $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

(D) -1 and $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Q50. If $A = \begin{bmatrix} cos\,x & sin\,x \\ -sin\,x & cos\,x \end{bmatrix}$. Then for $n \in N$, A^n is

(A) $\begin{bmatrix} cos\,x & sin\,x \\ -sin\,x & cos\,x \end{bmatrix}$

(B) $\begin{bmatrix} cosn\,x & sin\,nx \\ -sin\,n\,x & cos\,nx \end{bmatrix}$

(C) $\begin{bmatrix} cos\,2x & sin\,x \\ -sin\,x & cos2\,x \end{bmatrix}$

(D) $\begin{bmatrix} cos\,nx & sin\,x \\ -sin\,x & cos\,x \end{bmatrix}$

Q51. If M_{ij} represent minor of a matrix M. Then M_{21} of the 3×3 matrix $\begin{pmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{pmatrix}$ is

(A) -4

(B) 4

(C) 0

(D) -7

Q52. If $x = a(\theta + cos\theta)$, $y = a(1 - cos\theta)$, then $\frac{dy}{dx}$ is

(A) $sin\,\theta$

(B) $tan\frac{\theta}{2}$

(C) $cos\frac{\theta}{2}$

(D) $cos\,\theta$

Q53. The function $f(x) = x^3 - 3x^2 + 4x$, $x \in R$ is

(A) an increasing function.

(B) a decreasing function.

(C) remains constant always.

(D) vanishes for every $x \in R$.

Q54. The critical point c of a function $f(x)$ is defined as

(A) $f'(c) = 0$

(B) $f'(c) > 0$

(C) $f'(c) < 0$

(D) $f'(c) = \infty$

Q55. What is true for the function $f(x) = 3 + |x|$, $x \in R$

(A) $x = 0$ is a local maximum with a local maximum value of 3.

(B) $x = 0$ is local minimum with a local minimum value of 0.

(C) function diverges at $x = 0$.

(D) $x = 0$ is a local minimum with a local minimum value of 3.

Q56. The area of a triangle with vertices (3,8), (−4,2) and (5,1) is

(A) 30.5

(B) 61

(C) 21.5

(D) 20

Q57. .....met more than ten years ago at a mutual friends birthday party.

(A) Her and I

(B) Her and me

(C) She and me

(D) She and I

Q58. My parents approved of ..... taking guitar lessons

(A) my

(B) me

(C) I

(D) mine

Q59. If you don't stop playing .....video games, you will miss the bus

(A) that

(B) those

(C) them

(D) this

Q60. Alice and Bob left .....note books at school

(A) his

(B) their

(C) there

(D) its