Paper Code No- M25

Question Booklet No. **625312**

ENTRANCE EXAMINATION-2017

M.Sc (PHYSICS)

[Set B]

ROLL NO. | M | 2 | 5 | 3 | 1 | 3 | 0 | 6 | |

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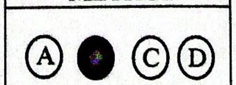
Signature of Invigilator

Time: 1 Hour 45 Minutes **Total Marks: 100**

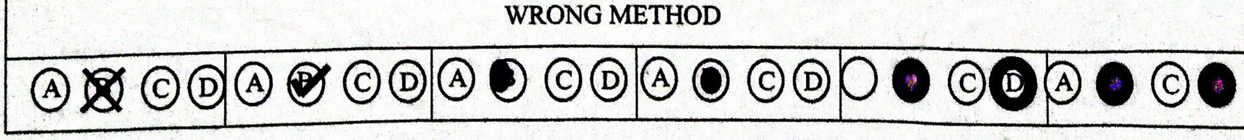
Instructions to Candidates

1. Do not write your name or put any other mark of identification anywhere in the OMR Answer Sheet. **IF ANY MARK OF IDENTIFICATIONS IS DISCOVERED ANYWHERE IN OMR ANSWER SHEET, the OMR sheet will be cancelled, and will not be evaluated.**
2. This Question Booklet contains this cover page and a total of **100 Multiple Choice Questions of 1mark.** Space for rough work has been provided at the beginning and end. Available space on each page may also be used for rough work.
3. Each correct answer carries one mark.
4. There is negative marking in Multiple Choice Questions. For each wrong answer 0.25 marks will be deducted.
5. USE OF CALCULATOR IS NOT PERMITTED.
6. USE/POSSESSION OF ELECTRONIC GADGETS LIKE MOBILE PHONE, iphone, iPad, pager ETC. is not permitted.
7. Candidate should check the serial order of questions at the beginning of the test. If any question is found missing in the serial order, it should be immediately brought to the notice of the Invigilator. No pages should be torn out from this question booklet.
8. Answers must be marked in the OMR answer sheet which is provided separately. OMR answer sheet must be handed over to the invigilator before you leave the seat.
9. The OMR answer sheet should not be folded or wrinkled. The folded or wrinkled OMR/Answer Sheet will not be evaluated.
10. Write your Roll Number in the appropriate space (above) and on the OMR Answer Sheet. Any other details, if asked for, should be written only in the space provided.
11. There are four alternative answers to each question marked A, B, C and D. Select one of the answers you consider most appropriate and fill up the corresponding oval/circle in the OMR Answer Sheet provided to you. The correct procedure for filling up the OMR Answer Sheet is mentioned below.
12. Use Black or Blue Ball Pen only for filling the ovals/circles in OMR Answer Sheet while answering the Questions. For your Choice of answers darken the correct oval/circle completely. If the correct answer is 'B', the corresponding oval/circle should be completely filled and darkened as shown below.

CORRECT METHOD



WRONG METHOD



1. In electrostatics a field line and an equipotential surface are

(A) Always perpendicular
(B) Always parallel
(C) Makes any possible angle
(D) None of the above

2. If a dielectric is inserted between the plates of an air filled capacitor, the capacitance will

(A) Increase
(B) Decrease
(C) Remain same
(D) May increase or decrease depending upon type of dielectric

3. A capacitor stores .076 Coulombs of charge at 10 V. It's capacitance is

(A) 7.6 F
(B) 0.76 F
(C) 0.00076 F
(D) 0.0076 F

4. Which of the following electrostatic problems can be solved exactly?

(A) A charge placed above a grounded infinite conducting plane
(B) A charge placed away from a grounded conducting sphere
(C) None of (A) & (B)
(D) Both of (A) & (B)

5. The materials having low retentivity is suitable for making

(A) A permanent magnet
(B) A temporary magnet
(C) Weak magnets
(D) None of the above

6. Ferrites are which type of materials

(A) Paramagnetic
(B) Diamagnetic
(C) Ferromagnetic
(D) None of the above

7. What is the reluctance of air gap as compared to same gap filled with iron

(A) Reluctance of air gap is much lower as compared to iron
(B) Reluctance of air gap is much higher as compared to iron
(C) Reluctance of air gap is slightly lower as compared to iron
(D) Reluctance of air gap is slightly higher as compared to iron

8. The Biot-Savart's law is a general modification of

(A) Kirchhoff's law
(B) Lenz's law
(C) Ampere's law
(D) Faraday's law

9. A rectangular magnet of magnetic moment M is cut into two pieces of same length, the magnetic moment of each piece will be

(A) M
(B) M/2
(C) 2M
(D) M/4

10. Energy stored in an inductor of inductance L carrying a current I is

(A) $\frac{1}{2}LI^2$
(B) $\frac{1}{2}L^2I$
(C) $\frac{1}{2}L^2I^2$
(D) $\frac{1}{2}LI$

11. In an electromagnetic wave in free space

(A) E and B fields are in phase and perpendicular
(B) E and B fields are out of phase by 90° and perpendicular
(C) E and B fields are in phase and parallel
(D) E and B fields are out of phase by 90^0 and parallel

12. Divergence of magnetic field is zero. This statement implies

(A) Absence of magnetic monopole
(B) Absence of magnetic quadrupole
(C) Presence of magnetic monopole
(D) Presence of magnetic quadrupole

13. In a system of charged particles in an EM field, which of the following statement is correct?

(A) Total linear momentum of all the charged particles is conserved
(B) Total energy of all the charged particles is conserved
(C) Both A & B
(D) None of A & B

14. Electromagnetic waves are transverse in nature because these waves can be

(A) Reflected
(B) Refracted
(C) Diffracted
(D) Polarized

15. Poynting vector gives

(A) Energy density in a given EM field
(B) Energy flux density in a given EM field
(C) Momentum density in a given EM field
(D) Momentum flux density in a given EM field

16. A square matrix through similarity transformation can always be

(A) Diagonalized
(B) Triagonalized
(C) Made an identity matrix
(D) Made a null matrix

17. According to determinant properties, X times multiple of one row is added to another row, then determinant

(A) Remains same
(B) Becomes X times of original determinant
(C) Becomes X/2 times of original determinant
(D) Becomes 2X times of original determinant

18. Necessary and sufficient condition for M(x,y)dx + N(x,y)dy to be total differential is

(A) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$
(B) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$
(C) $\frac{\partial M}{\partial x}\frac{\partial N}{\partial y} = 1$
(D) $\frac{\partial M}{\partial y}\frac{\partial N}{\partial x} = 1$

19. Integrating factor of equation xdy-ydx = 0 is

(A) $1/y^2$
(B) $1/(xy)$
(C) $1/(x^2+y^2)$
(D) All of above

20. Cross product of two vectors is

(A) Commutative
(B) Associative
(C) Both A & B
(D) None of A & B

21. f(z) is a function of a complex variable z. f(z) is said to be analytic in a domain D if

(A) f(z) is defined at all points of D
(B) f(z) is defined and continuous at all points of D
(C) f(z) is defined and differentiable at all points of D
(D) None of the above

22. Value of exp(i3π/4) where i = √-1, is

(A) $(-1/\sqrt{2})+(1/\sqrt{2})i$
(B) $(1/\sqrt{2})+(1/\sqrt{2})i$
(C) $(1/\sqrt{2})+(-1/\sqrt{2})i$
(D) $(-1/\sqrt{2})+(-1/\sqrt{2})i$

23. Complex function which is infinite valued is

(A) sin(z)
(B) cos(z)
(C) exp(z)
(D) log(z)

24. A mapping w = f(z) is conformal at every point where

(A) f(z) is defined
(B) f(z) is continuous
(C) f(z) is analytic
(D) f(z) is analytic, except at points where derivative f′(z) is zero

25. If f(z) is analytic in a simply connected bounded domain D, then the integral of f(z) over a simple closed path in D is

(A) Zero
(B) πi
(C) 2πi
(D) 4πi

26. An example of a coherent source is

(A) Two bulbs of same power
(B) Two LEDs of different power
(C) One bulb and one LED of same power
(D) Light coming from a bulb by two different paths

27. A thin film of oil on water looks coloured due to

(A) Diffraction of light
(B) Interference of light
(C) Scattering of light
(D) Refraction of light

28. In a Nicole prism made from Calcite crystal, if N_O, N_E and N_B are refractive indices of ordinary ray, extraordinary ray and Canada balsam, respectively, then

(A) $N_O > N_B > N_E$
(B) $N_O < N_B < N_E$
(C) $N_O < N_B > N_E$
(D) $N_O > N_B < N_E$

29. An optic axis can be found in which type of crystal

(A) Simple cubic
(B) Face centered cubic
(C) Triclinic
(D) Body centered cubic

30. Blue colour of sky is due to

(A) Diffraction of light
(B) Scattering of light
(C) Interference of light
(D) Refraction of light

31. A circularly polarized light can be resolved into

(A) Two linearly polarized light beams of equal intensity in phase
(B) Two linearly polarized light beams of unequal intensity in phase
(C) Two linearly polarized light beams of equal intensity out of phase by 90°
(D) Two linearly polarized light beams of unequal intensity out of phase by 90°

32. If a white light source is used in Young's double slit experiment, then on the screen

(A) A narrow white fringe at the center, followed by few coloured fringes on either side
(B) Black and white alternating fringes with white fringe at the center
(C) Black and white alternating fringes with dark fringe at the center
(D) A large number of coloured fringes on either side of central fringe

33. Construc[illegible]ence happens when two waves are
(A) out of phase
(B) zero amplitude
(C) in phase
(D) in front

34. Certain light of wavelength 600 nm in vacuum enters glass having refractive index of 1.5. What will be wavelength of light inside glass?

(A) 900 nm
(B) 600 nm
(C) 400 nm
(D) 300 nm

35. A 2 level laser
(A) Is most efficient laser
(B) Is very difficult to operate
(C) Does not work
(D) Has very low power

36. In Schrodinger wave equation the symbol ψ represents the
(A) wavelength of the spherical wave
(B) phase of the spherical wave
(C) frequency of the spherical wave
(D) none of these

37. In the probabilistic interpretation of wave function the quantity ψ is
(A) a probability density
(B) a probability amplitude
(C) a probability wavelength
(D) a probability frequency

38. In quantum mechanics the expectation value of an operator O representing a dynamical variable is
(A) smallest of the eigenvalues of O
(B) largest of the eigenvalues of O
(C) mean value of all the eigenvalues
(D) mean value of the eigenvalues weighted by probability density

39. The energy spectrum of a particle bound in a simple harmonic potential is

(A) completely continuous
(B) both continuous and discrete
(C) completely discrete having equidistant levels
(D) completely discrete having non-equidistant levels

40. Ehrenfest theorem partially shows the connection between quantum mechanics and

(A) photonics
(B) electronics
(C) special relativity
(D) classical mechanics

41. A free particle is

(A) bound
(B) unbound
(C) both bound and unbound
(D) neither bound nor unbound

42. Schrodinger equation truly describes the behaviour of

(A) electrons
(B) electrons and atoms
(C) electrons, atoms and molecules
(D) all particles

43. In quantum mechanical tunnelling, if the barrier width is increased, tunnelling probability will

(A) increase slightly
(B) increase exponentially
(C) decrease slightly
(D) decrease exponentially

44. Which one of the following in an allowed wave function of a single particle

(A) x
(B) $\sin(x)$
(C) $\exp(-x^2)$
(D) $1/x$

45. $[p_x, p_y]$ is equal to

(A) $i\hbar$
(B) p_z
(C) iz
(D) zero

46. The number of two dimensional lattices are

(A) 3
(B) 5
(C) 7
(D) 9

47. The number of crystallographically equivalent planes in the {110} family of a cubic crystal system is

(A) 4
(B) 6
(C) 8
(D) 12

48. The potential energy of a diatomic molecule in terms of interatomic distance R is given by

$$U(R) = -A/R^m + B/R^n$$

where A, B, m and n are constants for the given molecule. The equilibrium separation R_e is obtained as:

(A) $(nA/mB)^{1/n-m}$
(B) $(nA/mB)^{1/m-n}$
(C) $(nB/mA)^{1/m-n}$
(D) $(nB/mA)^{1/n-m}$

49. The concentration of Schottky imperfections 'n' in an ionic solid at a certain temperature T is given by

(A) $N \exp(-E_p/kT)$
(B) $N \exp(E_p/kT)$
(C) $N \exp(-E_p/2kT)$
(D) $N \exp(E_p/2kT)$

50. The natural cut off frequency ω_m for a one dimensional periodic lattice with force constant K and mass M is given by

(A) (4K/M)
(B) (4M/K)
(C) $(4K/M)^{1/2}$
(D) $(4M/K)^{1/2}$

51. A crystal is subjected to a monochromatic X-ray beam; the first order diffraction is obtained at an angle of 15°. If the same X-ray beam is used, what is the angle corresponding to the third order diffraction

(A) 15°
(B) 31°
(C) 51°
(D) 61°

52. The lowest energy of an electron confined to move in a one dimensional potential well of length 0.75 Å is

(A) 150.7eV
(B) 250.7eV
(C) 350.7eV
(D) 450.7eV

53. The potential of an electron in a one dimensional arrangement of atoms is identical to that used in the Kronig–Penney model. If $V_0ab \ll h^2/4\pi^2m$, the energy band gap at $k=\pi/a$ is

(A) $2V_0b/a$
(B) $2V_0\, a/b$
(C) $V_0b/2a$
(D) $V_0a/2b$

54. The susceptibility of a piece of ferric oxide is 1.5×10^{-3}. If the material is subjected to a magnetic field of 10^6 A/m, the flux density in the material is

(A) 0.259T
(B) 1.259T
(C) 2.259T
(D) 3.259T

55. The number of slip systems in an fcc crystal is

(A) 4
(B) 8
(C) 12
(D) 16

56. Reciprocal lattice of fcc lattice is

(A) fcc
(B) bcc
(C) sc
(D) hexagonal

57. L point in the first Brillouin Zone of an fcc lattice has coordinates

(A) $2\pi/a(1,1,1)$
(B) $2\pi/a(1,0,0)$
(C) $2\pi/a(½,0,0)$
(D) $2\pi/a(½,½,½)$

58. In an intrinsic semiconductor, the Fermi level lies

(A) at exactly center of band gap
(B) approximately near center of band gap
(C) inside valence band
(D) inside conduction band

59. In a degenerate semiconductor, Fermi level lies

(A) at exactly center of band gap
(B) approximately near center of band gap
(C) inside valence or conduction band
(D) 5kT away from valence or conduction band inside the band gap

60. In case of thermal equilibrium in a semiconductor, if n, p, Nc, Nv and n_i be densities of electrons, holes, effective density of states in conduction band, effective density of states in valence band and intrinsic carriers respectively, then

(A) $np = n_i^2$
(B) $np = NcNv$
(C) $np = NcNv - n_i^2$
(D) $np = n_i^2 - NcNv$

61. According to Einstein's model, at very low temperatures specific heat of solids varies with temperature T as (a is a positive constant)

(A) T
(B) T^2
(C) T^3
(D) exp(-a/T)

62. Most probable speed in Maxwell-Boltzmann distribution of molecular velocities is

(A) $\sqrt{(2kT/m)}$
(B) $\sqrt{(3kT/m)}$
(C) $\sqrt{(8kT/\pi m)}$
(D) $\sqrt{(5kT/2m)}$

63. Specific heat at constant volume Cv of hydrogen gas at room temperature is (R is gas constant)

(A) 3R/2
(B) 5R/2
(C) 7R/2
(D) 9R/2

64. In micro canonical ensemble

(A) energy is fixed
(B) no. of particles is fixed
(C) both A & B
(D) none of A & B

65. In Bose-Einstein condensation, transition temperature Tc is given by

(A) $[h^2/(2\pi mk)][N/(2.612V)]^{1/3}$
(B) $[h^2/(2\pi mk)][N/(2.612V)]^{-1/3}$
(C) $[h^2/(2\pi mk)][N/(2.612V)]^{2/3}$
(D) $[h^2/(2\pi mk)][N/(2.612V)]^{-2/3}$

66. In spectroscopic notation, a single electron in an atom having angular momentum state l=3 is represented by

(A) s
(B) p
(C) d
(D) f

67. Vibrational and rotational motions of a molecule are independent of each other. This principle is known as

(A) Born-Oppenheimer approximation
(B) Raman effect
(C) Stoke's law
(D) Larmor precession

68. Number of vibrational degrees of freedom in N atom linear molecule is

(A) 3N – 3
(B) 3N – 4
(C) 3N – 5
(D) 3N – 6

69. In order to be Raman active a molecular rotation or vibration must cause some change in

(A) electric dipole moment
(B) magnetic dipole moment
(C) electric quadrupole moment
(D) molecular polarizability

70. Selection rule for Raman spectroscopy is

(A) $\Delta J = 0$
(B) $\Delta J = \pm 2$
(C) $\Delta J = 0$ or ± 2
(D) $\Delta J = \pm 1$

71. If a mu-meson is captured by a proton in 1s orbital, the radius of the mu-mesonic atom as compared to hydrogen atom will be about

(A) 200 times
(B) 200^2 times
(C) 1/200 times
(D) $1/200^2$ times

72. Nuclear shape can be determined from a measurement of

(A) nuclear electric dipole moment
(B) nuclear electric quadruple moment
(C) nuclear magnetic dipole moment
(D) nuclear magnetic quadruple moment

73. Ground state of deuteron is in which angular momentum state

(A) l=0
(B) combination of l=0 and l=1
(C) l=2
(D) combination of l=0 and l=2

74. Ground state of deuteron is in which spin state

(A) S = 0
(B) S = ½
(C) S = 1
(D) S = 2

75. Which of the following particles is responsible for carrying away the missing energy and momentum in the decay of neutron?

(A) alpha particle
(B) neutrino
(C) lepton
(D) proton

76. An example of a non-conservative force is

(A) Gravitational force
(B) Electrostatic force
(C) Magnetostatic force
(D) Viscous force

77. Isotropy of space gives rise to conservation of

(A) Linear momentum
(B) Angular momentum
(C) Energy
(D) Charge

78. In a collision of two fundamental particles in a center of mass frame

(A) Total energy of both particles is zero
(B) Total linear momentum is zero
(C) Total angular momentum is zero
(D) Total charge is zero

79. The negative result of Michelson-Morley experiment suggests that

(A) Space is homogeneous
(B) Light travels with a finite speed
(C) There is no special reference frame in the universe
(D) There is a special reference frame in the universe

80. In Theory of Special Relativity, if space-time interval $ds^2 = 0$ between two events A & B, then

(A) Two events are simultaneous
(B) Two events happen at the same point in space
(C) It will take zero time for signal to travel between points A & B
(D) Points are light like separated

81. If 1 A current flows through a circuit, then the number of electrons flowing through the circuit per second is

(A) 0.625×10^{19}
(B) 1.6×10^{19}
(C) 1.6×10^{-19}
(D) 0.625×10^{-19}

82. The resistivity of a conductor depends on

(A) Area of the conductor
(B) Length of the conductor
(C) Type of material
(D) None of these

83. Kirchhoff's Current Law works on the principle of which of the following

(A) Law of conservation of charge
(B) Law of conservation of energy
(C) Both
(D) None of the above

84. How much is the base to emitter voltage of a transistor in the ON state

(A) Zero
(B) 0.7 mV
(C) 0.7 V
(D) Variable

85. α and β are transistor parameters. If β = 100, then the approximate value of α is

(A) 0.99
(B) 99
(C) 1.01
(D) 101

86. The 1's compliment of a binary number is obtained by changing

(A) Each '1' to a '0'
(B) Each '0' to a '1'
(C) Each '1' to a '0' and each '0' to a '1'
(D) None of the above

87. A decimal number 6 in excess - 3 code is written as

(A) 0110
(B) 0011
(C) 1101
(D) 1001

88. The output of a 10 input OR gate is high

(A) only if even number of inputs are high
(B) only if odd number of inputs are high
(C) if any one input is high
(D) if any one input is low

89. The equivalent decimal number of a maximum binary number of length one byte is

(A) 8
(B) 64
(C) 255
(D) 256

90. The parity of the binary number 100110011 is

(A) even
(B) odd
(C) 4
(D) 5

91. The length of second's pendulum on the surface of earth is approximately 1 m. The approximate length of same pendulum on the surface of moon, where acceleration due to gravity is (1/6)th of the g on the surface of earth is

(A) 36 m
(B) 1 m
(C) 1/36 m
(D) 1/6 m

92. The displacement of particle performing simple harmonic motion is given by, x = 8 sin(wt)+6 cos(wt), where distance is in cm and time is in second. The amplitude of motion is

(A) 10 cm
(B) 14 cm
(C) 2 cm
(D) 4 cm

93. A simple pendulum is set up in a trolley which moves to the right with an acceleration "a" on a horizontal plane. Then the thread of the pendulum in the mean position makes an angle q with the vertical where q is given by

(A) $\tan^{-1}(a/g)$ in the forward direction
(B) $\tan^{-1}(a/g)$ in the backward direction
(C) $\tan^{-1}(g/a)$ in the forward direction
(D) $\tan^{-1}(g/a)$ in the backward direction

94. A particle executes Simple Harmonic Motion (SHM) of amplitude "A". At what distance from mean position its kinetic energy is equal to its potential energy

(A) 0.51 A
(B) 0.61 A
(C) 0.71 A
(D) 0.81 A

95. A second's pendulum is placed in space laboratory orbiting around the earth at a height 3R from Earth's surface where R is Earth's radius. The time period of the pendulum will be

(A) Zero
(B) $\sqrt{3}$ s
(C) 3 s
(D) Infinite

96. The zeroth law of thermodynamics allows us to define

(A) work
(B) internal energy
(C) temperature
(D) entropy

97. A constant-volume gas thermometer is used to measure the temperature of an object. When the thermometer is in contact with water at its triple point (273.16 K) the pressure in the thermometer is 8.500×10^4 Pa. When it is in contact with the object the pressure is 9.650×10^4 Pa. The temperature of the object is

(A) 37.0 K
(B) 241 K
(C) 310 K
(D) 314 K

98. The two metallic strips that constitute a thermostat must differ in

(A) length
(B) thickness
(C) mass
(D) coefficient of linear expansion

99. The coefficient of expansion of certain steel is 0.000012 per C°. The coefficient of volume expansion, in $(C°)^{-1}$, is

(A) $(0.000012)^3$
(B) $(4\pi/3)(0.000012)^3$
(C) 3×0.000012
(D) 0.000012

100. Heat from Sun reaches the Earth by

(A) Radiation
(B) Conduction
(B) Convection
(D) None of the above