CET (PG)-2015

Sr. No. : 183700

Question Booklet Series : A

Important: Please consult your Admit Card / Roll No. Slip before filling your Roll Number on the Test Booklet and Answer Sheet.

Roll No. *In Figures* *In Words*

O.M.R. Answer Sheet Serial No.

Signature of the Candidate :

Subject : M.Sc. (Hons. School/2 Year Course)–Physics/Medical Physics/ Physics & Electronics

Time : 90 minutes **Number of Questions : 75** **Maximum Marks : 75**

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO

INSTRUCTIONS

1. Write your Roll No. on the Question Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Subject and Series Code of Question Booklet on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point / Black Gel pen.**
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. To open the Question Booklet remove the paper seal gently when asked to do so.
5. Please check that this Question Booklet contains 75 questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of test.
6. Each question has four alternative answers (A, B, C, D) of which only one is correct. For each question, darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point / Black Gel pen.**
7. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Sheet. No marks will be deducted in such cases.
8. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the questions given in the Question Booklet.
9. Negative marking will be adopted for evaluation i.e., 1/4th of the marks of the question will be deducted for each wrong answer. A wrong answer means incorrect answer or wrong filling of bubble.
10. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
11. For rough work only the sheets marked "Rough Work" at the end of the Question Booklet be used.
12. The Answer Sheet is designed for **computer evaluation**. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e., not following the instructions completely, shall be of the candidate only.**
13. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
14. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so, would be expelled from the examination.
15. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistance or found giving or receiving assistance or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
16. **Telecommunication equipment such as pager, cellular phone, wireless, scanner, etc., is not permitted inside the examination hall. Use of calculator is not allowed.**

SEAL

M.Sc. (Hons. School/2 Year Course)–Physics/Medical Physics/Physics & Electronics/A

1. **Ground state of Helium is :**
   (A) $^1P_1$ (B) $^1S_0$
   (C) $^3S_1$ (D) $^2S_{1/2}$

2. **The total degeneracy of hydrogen in a state having energy equal to $-R/16cm^{-1}$, is : (R is Rydberg constant)**
   (A) 16 (B) 4
   (C) 32 (D) 8

3. **Vibration of O_2 molecule can be studied by :**
   (A) Infrared absorption (B) Ultraviolet-visible absorption
   (C) Raman spectroscopy (D) Electron spin resonance

4. **As one goes away from the centre of an atom, the electron density :**
   (A) Decreases like a Gaussian (B) Decreases exponentially
   (C) Oscillates with slowly decreasing amplitude. (D) Remains unchanged

5. **If one interchanges the spatial coordinates of two electrons in a state of total zero spin :**
   (A) The wave function changes sign
   (B) The wave function is unchanged
   (C) The wave function changes to a completely different function
   (D) The wave function no longer exists for such a state

6. **The fine structure of sodium *D* lines arises from :**
   (A) Electron spin-orbit coupling (B) Interaction between electron and nucleus
   (C) Nuclear spin (D) Externally applied electric field

7. **The total wave function of a diatomic molecule can be resolved into the electronic and nuclear part due to :**
   (A) Born-Oppenheimer approximation (B) Spin-orbit coupling
   (C) Hund's rule (D) Thomas precession

8. **In diatomic molecular rotational transitions with $\Delta J = 0$ form the :**
   (A) O-branch (B) P–branch
   (C) Q–branch (D) R–branch

9. **In pure rotational-vibrational spectra of diatomic molecules, a missing line at $v'' = 0 \rightarrow v' = 0$, is known as :**
   (A) Band head (B) $v'' = 0$ progression
   (C) Band origin (D) Vertex

10. **The Lamb shift is :**
(A) A splitting between the 1s and 2s energy levels in hydrogen
(B) Caused by vacuum fluctuations of the electromagnetic field
(C) Caused by Thomas precession
(D) Caused by Larmer precession

11. **Evidence for the space quantization of the angular momentum of an atom was provided by :**
(A) Stern-Gerlach experiment
(B) Compton Effect
(C) Frank-Hertz Experiment
(D) Lamb-Rutherford Experiment

12. **To penetrate the Coulomb barrier of a light nucleus, a proton must have a minimum energy of the order of :**
(A) 1 GeV
(B) 1 Me V
(C) 1 Ke V
(D) 100 eV

13. **What is the isotopic spin of the deuteron ?**
(A) 1
(B) ½
(C) –½
(D) 0

14. **Electron positron pair can be produced by :**
(A) vacuum ultraviolet photon in free space
(B) vacuum ultraviolet photon in nucleus
(C) gamma ray photon in free space
(D) gamma ray photon in nucleus

15. **The spectrum of beta rays emitted in radioactive decay :**
(A) Has only one sharp peak
(B) Has only two sharp peaks
(C) Is continuous
(D) Is like a delta function

16. **If a body has gravitational mass of 5 kg, then its inertial mass will be :**
(A) 5 kg
(B) > 5 kg
(C) < 5 kg
(D) 0 kg

17. **Force F (x) acting on body having potential energy U(x) is given by :**
(A) $F(x) = -dU/dx$
(B) $F(x) = dU/dx$
(C) $F(x) = \int U/dx$
(D) $F(x) = \int U dx$

18. **A stationary body explodes into two fragments each of mass 1.0 kg at move apart at speed of 0.5 c relative to original body. Which of the following statement about the mass, m, of original body is true ?**
(A) 1 kg < m < 2kg
(B) m = 2 kg
(C) m > 2 kg
(D) m = 1 kg

19. **A photon has momentum of 1 ke V/c. The energy of photon is :**
(A) 1 MeV
(B) 2 keV
(C) 3×10^9 eV
(D) 1 keV

20. **In harmonic oscillator, the equilibrium position is given by :**
(A) $dU/dx = 0$
(B) $dU/dx > 0$
(C) $dU/dx < 0$
(D) $dU/dx = \infty$

21. **The curl of gravitation force F**
(A) Cannot be determined
(B) $ai + bj + ck$, where a, b and c non zero and i, j and k are unit vectors along x, y and z directions, respectively
(C) Gives the work done by the force
(D) Is zero

22. **If the symmetry axes of a cylindrical body coincide with the coordinates axes, then its tensor of inertia has :**
(A) Two independent and non zero components
(B) Three independent and non zero components
(C) Six independent and non zero components
(D) Nine independent and non zero components

23. **In Compton effect, the shift in wavelength at a given angle is :**
(A) Dependent of the initial photon energy
(B) Dependent of the initial photon momentum
(C) Independent of the initial photon energy
(D) Dependent of the initial photon polarization

24. **If two waves of frequencies 2 and 4 Hertz are superposed, then the beat frequency will be :**
(A) 6
(B) 3
(C) 2
(D) 1

25. **In electrical oscillation, equivalent of inertia is :**
(A) L (inductance)
(B) C (capacitance)
(C) ω (frequency)
(D) q (charge)

26. **Which of the statement about quality factor, Q, of a damped oscillator is incorrect ?**
(A) Q is inversely proportional to the damping term
(B) Q is a dimensionless quantity
(C) Q has dimensions of erg/s
(D) Q can be calculated from logarithmic decrement

27. **Light of wavelength 584 nm in air is incident upon a block of glass of refractive index equal to 1.50. The frequency of the light within the glass block is :**
(A) 5.14×10^{14} Hz
(B) 3.42×10^{14} Hz
(C) 7.71×10^{14} Hz
(D) 7.71×10^{15} Hz

28. **When laser light passes through a grating, a pattern is formed on the other side of the grating due to :**

(A) Fresnel diffraction
(B) Fraunhofer diffraction
(C) Bragg diffraction
(D) Rayleigh diffraction

29. **For an atomic system $\int \Psi(2s)\, \Psi(2p)\, d\tau =$**

(A) 1
(B) $1/\sqrt{2}$
(C) $\sqrt{2}$
(D) 0

30. **For an atomic system, the expectation value of position operator x, $\int \Psi(2s)\, x\, \Psi(2s)\, d\tau$, is**

(A) 0
(B) 1
(C) $1/\sqrt{2}$
(D) $\sqrt{2}$

31. **A 5.0 g pellet is compressed against a spring in a gun of mass 300 g. The spring is released and the gun allowed to recoil with no friction as the pellet leaves the gun. If the speed of the recoiling gun is 8.0 m/s, then the speed of the pellet is :**

(A) 8.0 m/s
(B) 480.0 m/s
(C) 0 m/s
(D) 40 m/s

32. **The instantaneous acceleration, α, in rotational motion is given by :**

(A) $d\omega/dt$; (here ω is angular velocity)
(B) $d\theta/dt$; (here θ is angle)
(C) $\Delta\omega/\Delta t$
(D) $\Delta\theta/\Delta t$

33. **A satellite of mass m_2 moves in a circular orbit of radius r about a larger planet of mass m_1. The velocity (speed) of the satellite is given by :**

(A) $\sqrt{(G\, m_1/r)}$
(B) $\sqrt{(G\, m_2/r)}$
(C) $\sqrt{(r/G\, m_1)}$
(D) $\sqrt{(r/G\, m_2)}$

34. **There are three Kepler's laws that govern planetary motion. One of the following options is not a Kepler's laws :**

(A) All planets move in elliptical orbits with the sun at one focus
(B) A line from the sun to the planet sweeps out equal areas in equal lengths of time
(C) The square of the period is proportional to the cube of the semi-major axis of the ellipse
(D) The cube of the period is proportional to the square of the semi-major axis of the ellipse

35. **A steel bridge is set in concrete pillars on opposite sides of river. The bridge is 100 m long, and the work is performed on a winter day when the temperature is 15° C. What clearance is required for the bridge not to buckle at 45°C in summer (expansion coefficient of steel = 11×10^{-6}/ °C) ?**

(A) 100.033 m
(B) 0.033 m
(C) 99.967 m
(D) 100.000 m

36. **A steam engine is operated with steam at atmospheric pressure and 100°C. Steam leaves the engine at slightly above outside temperature, 35°C. What is the efficiency of the engine ?**
(A) 35%
(B) 65%
(C) 82.6%
(D) 17.4%

37. **Two moles of an ideal gas at a pressure of 1.0×10^5 N/m² has 400 J of heat added in expanding from a volume of 4.7×10^{-3} m³ to 7.0×10^{-3} m³. What is the amount of work performed ?**
(A) 400 J
(B) 230 J
(C) 170 J
(D) 570 J

38. **What is the change in entropy for 10 kg of water going from liquid to vapor at 100°C ? The heat of vaporization of water is 3.3×10^5 J/kg.**
(A) 8.847×10^2 J/K
(B) 8.847×10^3 J/K
(C) 3.300×10^4 J/K
(D) 3.300×10^2 J/K

39. **In phase diagram of water, the triple point exists at temperature :**
(A) 0 K
(B) 373 K
(C) 273 K
(D) 300 K

40. **Second-order phase change of a substance is characterised by :**
(A) No change in the specific volume between the two phases and no accompanying latent heat
(B) Change in the specific volume between the two phases and no accompanying latent heat
(C) No change in the specific volume between the two phases but change in accompanying latent heat
(D) Change in the specific volume between the two phases and also change in accompanying latent heat

41. **In canonical ensemble :**
(A) Systems in thermal equilibrium, the temperature, T, and number of particles, N, are well defined
(B) Systems in thermal and chemical contact, the temperature, T, and chemical potential, p, is well defined
(C) Systems in thermal equilibrium, the temperature, T, and number of particles, N, are not well defined
(D) Systems in thermal and chemical contact, the temperature, T, and chemical potential, p, are not well defined

42. **The zero-point energy of each electron in metals is result of :**
(A) Particle nature of electrons
(B) Negative charge on electrons
(C) Spin-orbit coupling
(D) Wave nature of electrons

43. **In solids, the holes (empty states not occupied by electrons for example in conduction band) are :**
(A) Bosons
(B) Neutrons
(C) Fermions
(D) Plasmons

44. **The lowest frequency branch of lattice vibration is :**
(A) P branch
(B) R branch
(C) Acoustic branch
(D) Optical branch

45. **A four-band colour coded resistor is having bands starting from red, violet, orange, silver in sequence. Its value is :**
(A) 27,000 Ω
(B) 27,000 Ω ± 10%
(C) 2,700 Ω ± 20%
(D) 2,700 Ω ± 10%

46. **A typical operational amplifier (op-amp) such as a 741 has :**
(A) Two inputs and one output
(B) Two outputs and one input
(C) Four inputs and three outputs
(D) One input and one output

47. **Visible light is converted into electricity :**
(A) In a dry cell
(B) In a wet cell
(C) In an incandescent bulb
(D) In a photovoltaic cell

48. **Half-wave rectification means that :**
(A) Half of the ac wave is inverted
(B) Half of the ac wave is cut off
(C) The whole ac wave is inverted
(D) The effective voltage is half the peak voltage

49. **In pointer type of instruments (say galvanometer) the type of damping used is :**
(A) Critical damping
(B) Light damping
(C) Over damping
(D) Very high damping

50. **Imagine three resistors, with values of 20 Ω, 30 Ω, and 50 Ω, connected in series with a 50–V dc generator. The total power consumed by this network of resistors is :**
(A) 250 mW
(B) 25 mW
(C) 25 W
(D) 100 mW

51. **Suppose two coils, having inductances of 5 μH and 20 μH, are connected is series so that their fields reinforce. Suppose that the coefficient of coupling is 0.500. What is the total inductance of the combination ?**
(A) 25 μH
(B) 30 μH
(C) 35 μH
(D) 45 μH

52. **A substance with high retentivity :**
(A) Can make a good ac electromagnet
(B) Repels both north and south magnetic poles
(C) Is always a diamagnetic material
(D) Is well suited to make a permanent magnet

53. **The magnetic flux around a straight, current-carrying wire :**
(A) Gets stronger with increasing distance from the wire
(B) Is strongest near the wire
(C) Does not vary in strength with distance from the wire
(D) Consists of straight lines parallel to the wire

54. **A student measures peak to peak voltage of an AC source as 20 V with the help of an oscilloscope. What is the RMS value of the AC voltage ?**
(A) 7 V
(B) 14 V
(C) 20 V
(D) 10 V

55. **Zener voltage is specialized manifestation of :**
(A) Forward break-over voltage
(B) Peak forward voltage
(C) Avalanche voltage
(D) Forward bias

56. **An example of a device that is commonly used as an oscillator at microwave frequencies is :**
(A) A rectifier diode
(B) A Gunn diode
(C) A zener diode
(D) An avalanche diode

57. **When both inputs of an R-S flip-flop are 0 :**
(A) The outputs stay as they are
(B) Q= 0 and –Q = 1
(C) Q= 1 and –Q= 0
(D) The resulting outputs can be absurd

58. **In an experiment, a student takes observations N times. The standard error in the mean of N observations is :**
(A) 1/N times the standard error in a single observation
(B) $1/\sqrt{N}$ times the standard error in a single observation
(C) Equal to the standard error in a single observation
(D) N times the standard error in a single observation

59. **Resultant amplitude of two harmonic waves $\psi_1 = X \cos (kx-wt)$ and $\psi_2 = X \cos (kx-wt+\pi)$ after superposition will be :**
(A) 2X
(B) 0
(C) X
(D) $X/\sqrt{2}$

60. **When light passes through the dispersive medium having refractive index more than 1, its wavelength in medium compared to vacuum :**
(A) Increases
(B) Decreases
(C) Remains same
(D) Can not be determined due to insufficient data

61. **When unpolarized light is incident on an ideal polarizer, the intensity of the transmitted light is :**
(A) Exactly equal to that of the incident unpolarized light
(B) Zero
(C) More than the incident unpolarized light
(D) Exactly half that of the incident unpolarized light

62. **If the E vector of a wave coming toward you appears to be rotating counterclockwise, its is called a :**
(A) Right circularly polarized electromagnetic wave
(B) Plane polarized electromagnetic wave
(C) Unpolarized electromagnetic wave
(D) Left circularly polarized electromagnetic wave

63. **A concave mirror forms an image, on a wall 3.00 m from the mirror, of the filament of headlight lamp 10.0 cm in front of the mirror. The lateral magnification of mirror is :**
(A) –30.0
(B) 19.4
(C) 9.7
(D) 150

64. **A phase difference of π corresponds to path difference of (in terms of wavelength λ) :**
(A) 0
(B) $\lambda/4$
(C) $\lambda/2$
(D) λ

65. **A plane grating with 500 slits per millimeter is used to record visible spectrum in wavelength region of 400 nm (violet) to 700 nm (red). How much is the grating element (grating spacing) ?**
(A) 500 mm
(B) 2×10^{-4} m
(C) 1.2×10^{-6} m
(D) 0.6×10^{-6} m

66. **In an X-ray diffraction experiment a student directs a beam of X-rays with wavelength 0.154 nm at certain planes of a silicon crystal. As he increases the angle of incidence from zero, he finds the first strong interference maximum from planes, which are 0.136 nm apart, when the beam makes an angle of 34.5°C with the planes. Will he find next higher order interference maxima from these planes at any other angle ?**
(A) Yes, next higher order interference will also occur at 34.5°
(B) Yes, next higher order interference will occur at 69.0°
(C) Yes, next higher order interference will occur at 17.25°
(D) No

67. **Which statement is correct ?**
The natural width of spectral line
(A) Can not be explained quantum mechanically
(B) Can be explained by uncertainty relation, $\Delta x \Delta p_x \geq \hbar$
(C) Can be explained by uncertainty relation, $\Delta E \Delta t \geq \hbar$
(D) Can be explained by uncertainty relation, $\Delta\theta \Delta J \geq \hbar$

68. **Which of the following is not a valid stationary state wave function of a free particle ? Here a and b are some constants.**
(A) $a x^2$
(B) $a e^{ikx}$
(C) $a e^{-ikx}$
(D) $a e^{ikx} + b e^{-ikx}$

69. **The orbital angular-momentum quantum number of an electron is 2, its orbital angular momentum will be :**
(A) $2\hbar$
(B) Any value out of $-2\hbar, -1\hbar, 0, 1\hbar, 2\hbar$
(C) $\sqrt{6}\hbar$
(D) $\sqrt{6}\hbar$

70. **In *M* shell, which of the orbital angular-momentum quantum number is not possible ?**
(A) 0
(B) 1
(C) 2
(D) 3

71. **In hydrogen the probability of finding an electron in a shell having inner radius *r* and outer radius $r + dr$ in terms of wavefunction ψ is :**
(A) $|\psi|^2 dr$
(B) $|\psi|^2 4\pi r^2 dr$
(C) $|\psi|^2 2\pi r^2 dr$
(D) $|\psi|^2 2\pi r\, dr$

72. **Which one of the following crystals represents the ionic crystal ?**
(A) Silicon
(B) Diamond
(C) Graphite
(D) Sodium Chloride

73. **In a *p* -type semiconductor, the correct variation of Hall coefficient with temperature is :**
(A) Hall coefficient increases with temperature increase
(B) Hall coefficient remains constant with temperature increase
(C) Hall coefficient initially decreases with increase in temperature and becomes negative with further increase in temperature
(D) Hall coefficient initially decreases with increase in temperature and then increases once again after a certain temperature

74. **If there are *dn* number of quantum states having energies in a given range *dE*. The *dn/dE* is called as :**
(A) The density of states
(B) Energy density
(C) Surface energy density
(D) Phase space energy

75. **Using the free-electron model, suppose the Fermi energy for solid copper is 1.822×10^{-18} J. What is the speed of an electron occupying the Fermi level ? (You can neglect all interactions of electron for calculation purpose. Mass of electron can be taken as 9.11×10^{-31} kg.) :**
(A) 4.5×10^{6} m/s
(B) 2×10^{6} m/s
(C) $\sqrt{2} \times 10^{6}$ m/s
(D) 9.1×10^{-6} m/s