

CET (PG)-2018

Sr. No. :110265.....

Booklet Series Code : A

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

(In Figures)

(In Words)

Roll No.

O.M.R. Answer Sheet Serial No.

Signature of the Candidate :

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

Time : 90 minutes]

[Maximum Marks : 75

No. of Questions : 75]

[Total No. of Printed Pages : 16

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.**

1. **If there exists continuous space translation symmetry, then :**
 - (A) neither energy nor angular momentum are conserved
 - (B) energy is conserved
 - (C) angular momentum is conserved
 - (D) linear momentum is conserved

2. **When a person opens a door, he applies :**

(A) Force	(B) Torque
(C) Moment	(D) None of the above

3. **Compared to the gravitational force with which the Earth pulls you, the gravitational force with which you pull the Earth is :**

(A) Equal	(B) Zero
(C) Greater	(D) Less

4. **When trying to turn a key into a lock, following is applied :**

(A) coplanar force	(B) moment
(C) lever	(D) couple

5. **D'Alembert's principle is used for :**
 - (A) reducing the problem of kinetics to equivalent statics problem
 - (B) determining stresses in the truss
 - (C) stability of floating bodies
 - (D) solving kinematic problems

6. **Bernoulli's principle states that, for streamline motion of an incompressible non-viscous fluid :**
 - (A) pressure at any part + kinetic energy per unit volume = constant
 - (B) kinetic energy per unit volume + potential energy per unit volume = constant
 - (C) pressure at any part + potential energy per unit volume = constant
 - (D) pressure at any part + kinetic energy per unit volume + potential energy per unit volume = constant

7. A filter in frequency domain is mathematically given by :

$$G(\omega) = \begin{cases} 1 & \text{if } |\omega| \leq \omega_0 \\ 0 & \text{if } |\omega| > \omega_0 \end{cases}$$

Here ω_0 is cut-off frequency. This filter is known as :

- (A) low pass filter (B) high pass filter
(C) band pass filter (D) band block filter

8. Consider that Fourier transform of a function in time domain $f(t)$ is $F(\omega)$ in frequency domain. If translation of $f(t)$ in time domain by τ amount is $f(t - \tau)$, then the function in frequency domain will be :

- (A) $F(\omega)$ (B) $F(\omega) e^{i\omega\tau}$
(C) $F(\omega) e^{-i\omega\tau}$ (D) $f(t - \tau) F(\omega)$

9. If a number of forces act simultaneously on a particle, it is possible :

- (A) to replace them by a couple
(B) to replace them by a single force
(C) to replace them by a single force through centre of gravity
(D) to replace them by a couple and a force

10. Spherical coordinate components of u are related to the Cartesian coordinates by the following transformation rule :

(A)
$$\begin{pmatrix} u_r \\ u_\theta \\ u_\phi \end{pmatrix} = \begin{pmatrix} \sin\theta \cos\phi & \sin\theta \sin\phi & \cos\theta \\ \cos\theta \cos\phi & \cos\theta \sin\phi & -\sin\theta \\ -\sin\phi & \cos\phi & 0 \end{pmatrix} \begin{pmatrix} u_x \\ u_y \\ u_z \end{pmatrix}$$

(B)
$$\begin{pmatrix} u_r \\ u_\theta \\ u_\phi \end{pmatrix} = \begin{pmatrix} \sin\theta \sin\phi & \sin\theta \cos\phi & \cos\theta \\ \cos\theta \cos\phi & \cos\theta \sin\phi & -\sin\theta \\ -\sin\phi & \cos\phi & 0 \end{pmatrix} \begin{pmatrix} u_x \\ u_y \\ u_z \end{pmatrix}$$

(C)
$$\begin{pmatrix} u_r \\ u_\theta \\ u_\phi \end{pmatrix} = \begin{pmatrix} \sin\theta \sin\phi & \sin\theta \cos\phi & \cos\theta \\ \cos\theta \cos\phi & \cos\theta \sin\phi & \sin\theta \\ -\sin\phi & \cos\phi & 0 \end{pmatrix} \begin{pmatrix} u_x \\ u_y \\ u_z \end{pmatrix}$$

(D)
$$\begin{pmatrix} u_r \\ u_\theta \\ u_\phi \end{pmatrix} = \begin{pmatrix} \sin\theta \cos\phi & \sin\theta \sin\phi & \cos\theta \\ \cos\theta \cos\phi & \cos\theta \sin\phi & \sin\theta \\ -\sin\phi & \cos\phi & 0 \end{pmatrix} \begin{pmatrix} u_x \\ u_y \\ u_z \end{pmatrix}$$

11. A planet moves slowest in its orbit :

- (A) the closer it is to its satellites
(B) when it is farthest from the Sun
(C) when it is closest to the Sun
(D) when it is in opposition

12. Which of the following is not a solution of the differential equation, $y''(x) + k^2 y(x) = 0$?

- (A) $\exp(-ikx)$
(B) $\exp(-kx)$
(C) $\sin(kx)$
(D) $\cos(kx)$

13. Waves associated with electrons are referred to as :

- (A) plasma waves
(B) UV waves
(C) gamma rays
(D) matter waves

14. The full Schrodinger's equation in compact form is :

- (A) $\hat{H}\psi = \hbar \frac{\partial \psi}{\partial t}$
(B) $\hat{H}\psi = i\hbar \frac{\partial \psi}{\partial t}$
(C) $\hat{H}\psi = i \frac{\partial \psi}{\partial t}$
(D) $\hat{H}\psi = i\hbar \frac{\partial \psi}{\partial x}$

15. The momentum operator in one-dimension is :

- (A) $-i\hbar \frac{\partial}{\partial t}$
(B) $-i\hbar \frac{\partial}{\partial x}$
(C) $i\hbar \frac{\partial}{\partial t}$
(D) $i\hbar \frac{\partial}{\partial x}$

16. In the probabilistic interpretation of wave function ψ , the quantity $|\psi|^2$ is :

- (A) 1
(B) probability amplitude
(C) a probability density
(D) negative probability amplitude

17. When two particles are entangled and it is observed that one has its spin up, how long does it take for the other's spin to be down ?

- (A) instantaneously
(B) few microseconds
(C) few nanoseconds
(D) time taken by the light to travel between them

18. Spherical polar coordinates are used in the solution of the hydrogen atom Schrodinger equation because :
- (A) the Laplacian operator has its simplest form in spherical polar coordinates
 - (B) the Schrodinger equation is then separable into 3 ordinary differential equations
 - (C) Cartesian coordinates would give particle-in-a-box wavefunctions
 - (D) otherwise the atomic orbitals would violate the Pauli exclusion principle
19. Solution of Schrodinger equation $\psi(x,t) = \psi(x)e^{-iE_t/\hbar}$ is often called a stationary state because :
- (A) probability amplitude is independent of time
 - (B) probability amplitude is dependent on time
 - (C) probability density is independent of time
 - (D) probability density is dependent on time
20. Which one of the following quantum mechanical entities (A) to (D) (with some exceptions) must be single-valued (and their derivatives too), finite (and their derivatives too), continuous (and their derivatives too), and normalizable or square-integrable ?
- (A) observables
 - (B) wave functions
 - (C) expectation values
 - (D) energy and momentum
21. In coupled oscillator (e.g. triatomic molecule), the mode that has the highest symmetry will have the :
- (A) imaginary frequency
 - (B) frequency equal to the frequency of asymmetric mode
 - (C) frequency higher than the frequency of asymmetric mode
 - (D) frequency lower than the frequency of asymmetric mode
22. The wave velocity of a wave with displacement $y = 0.1 \sin(0.1x - 0.1t)$ m, is :
- (A) 0.1 m/s
 - (B) 0.01 m/s
 - (C) 20 m/s
 - (D) 1 m/s
23. The group velocity of a wave is defined as :
- (A) ω/k
 - (B) k/ω
 - (C) $d\omega/dk$
 - (D) $dk/d\omega$

24. Consider that the source and the observer are in motion along the same straight line in same direction with velocities v_s and v_o , respectively. The source is emitting waves of frequency f_s . Velocity of the waves through the stationary medium is v . The frequency of these waves measured by the observer is given by :

(A) $f_s \frac{v-v_o}{v-v_s}$

(B) $f_s \frac{v}{v+v_s}$

(C) $f_s \frac{v}{v-v_s}$

(D) $f_s \frac{v-v_o}{v+v_s}$

25. A wave of frequency 100 Hz travels along a string towards its fixed end. When this wave travels back, after reflection, a node is formed at a distance of 5 cm from the fixed end. The speed of the wave (incident and reflected) is :

(A) 20 m/s

(B) 5 m/s

(C) 10 m/s

(D) 2.5 m/s

26. A wave has simple harmonic motion whose period is 4 seconds while another wave which also possesses simple harmonic motion has its period 3 seconds. If both are combined, then the resultant wave will have the period equal to :

(A) 7s

(B) 1s

(C) 12s

(D) 3.5s

27. A particle of mass m is attached to an ideal spring of force constant K . If the mass is made to oscillate, its total energy is :

(A) Maximum at extreme position

(B) Maximum at mean position

(C) Minimum at mean position

(D) Same at all positions

28. Ratio of the principal heat capacities of a monoatomic gas at constant pressure to the

constant volume $\left(\frac{C_p}{C_v}\right)$ is :

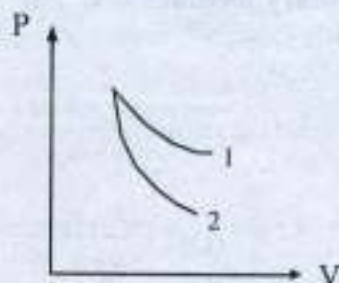
(A) 7/5

(B) 3/5

(C) 5/3

(D) 5/7

29. Qualitative P-V plots for two gases (monoatomic and/or diatomic) during adiabatic processes are shown in the figure below. Plots 1 and 2 should correspond respectively to :



- (A) He and O_2 (B) O_2 and He
 (C) He and Ar (D) O_2 and N_2
30. Suppose the heat capacity of a solid at constant pressure is C_p . What would be the entropy change if the solid is heated from T_i to T_f ?
- (A) $C_p \ln\left(\frac{T_f}{T_i}\right)$ (B) $C_p \ln\left(\frac{T_i}{T_f}\right)$
 (C) $C_p (T_f - T_i)$ (D) $C_p \left(\frac{T_f + T_i}{T_f - T_i}\right)$
31. The chemical potential can be defined as :
- (A) Total Gibbs free energy of all particles, provided only one type of particle is present
 (B) Gibbs free energy per particle, provided only one type of particle is present
 (C) Sum of Helmholtz and Gibbs free energies, provided only one type of particle is present
 (D) Helmholtz free energy per particle, provided only one type of particle is present
32. The thermodynamic probability of a system is given by :
- (A) The product of number of possible microstates with the all possible macrostates
 (B) The number of all possible macrostates
 (C) The number of possible microstates for a given macrostate
 (D) The ratio of the number of possible microstates to the all possible macrostates

33. **Example of a second-order phase change is :**
- (A) The transition of a solid melting into a liquid
 - (B) The transition of a liquid boiling into a gas
 - (C) The transition from ferro-magnet to para-magnet at the Curie temperature
 - (D) The change from superconductor to normal conductor, provided the change occurs in an applied magnetic field
34. **Average kinetic energy of gas molecules is proportional to :**
- (A) internal energy
 - (B) thermodynamic temperature
 - (C) enthalpy
 - (D) condensation point
35. **A Carnot engine takes 2000 J of heat from a reservoir at 200°C, does some work, and releases some heat into a second reservoir at 20°C. Efficiency of the engine is :**
- (A) 4%
 - (B) 10%
 - (C) 38%
 - (D) 90%
36. **If the absolute temperature of a radiating object is doubled, by what factor does the rate of energy emission change ?**
- (A) 2
 - (B) 4
 - (C) 16
 - (D) 32
37. **Volume of the unit cell in the reciprocal space is equal to the :**
- (A) the reciprocal of the volume of the unit cell in the direct lattice
 - (B) 2π times the reciprocal of the volume of the unit cell in the direct lattice
 - (C) $(2\pi)^3$ the reciprocal of the volume of the unit cell in the direct lattice
 - (D) $1/2\pi$ times the reciprocal of the volume of the unit cell in the direct lattice
38. **The number of allowed k vectors in the first Brillouin zone :**
- (A) equals the number of primitive unit cells of the crystal
 - (B) equals to half of the number of primitive unit cells of the crystal
 - (C) equals to two times of the number of primitive unit cells of the crystal
 - (D) are more than the number of primitive unit cells of the crystal but less than two times of the number of primitive unit cells of the crystal

39. A material which is slightly repelled by a magnetic field is known as :
- (A) diamagnetic material (B) ferromagnetic material
(C) paramagnetic material (D) conducting material
40. The Brillouin zone is a :
- (A) region in a crystals within which crystal acts as a zone plate
(B) unit cell in real space
(C) Wigner-Seitz cell of the real lattice
(D) Wigner-Seitz cell of the reciprocal lattice
41. The number of nearest neighbours in diamond is :
- (A) 4 (B) 6
(C) 8 (D) 12
42. Packing efficiency of a crystal structure is the ratio of :
- (A) Volume occupied by particles to total volume of unit cell
(B) Volume occupied by particles to that by voids
(C) Total volume of unit cell to volume occupied by particles
(D) Volume occupied by voids to that by particles
43. Which of the following is a property of amorphous solids ?
- (A) Sharp melting point (B) Isotropy
(C) Long range order (D) Definite heat of fusion
44. The lowest level energy band in a solid is :
- (A) Valence band (B) Conduction band
(C) Fermi level (D) Rydberg energy level
45. Materials subjected to rapid reversal of magnetism should have :
- (A) large area of B-H loop (B) high permeability and low hysteresis loss
(C) high coercivity and high retentivity (D) high coercivity and low density

46. In order to resolve the sodium D lines by a given grating in first order, the minimum required lines in the grating should be approximately equal to :
- (A) 990 (B) 495
(C) 5893 (D) 600
47. The initial and final readings of a Michelson interferometer screw attached to the movable mirror are 10.7347 mm and 10.7051 mm as 100 fringes pass. The wavelength of the light used is :
- (A) 296 nm (B) 592 nm
(C) 589 nm (D) 633 nm
48. A law, that states that the polarity of the induced voltage will oppose the change in magnetic flux causing the induction, is known as :
- (A) Lorentz's law (B) Faraday's law
(C) Coulomb's law (D) Lenz's law
49. Significance of the Poynting vector in optics is :
- (A) It gives the direction of displacement vector
(B) It gives the direction of wave propagation
(C) It gives the ray direction
(D) It gives the direction of electric vector
50. Choose the correct option in which substances according to their dielectric constants increasing order are arranged :
- (A) vacuum, air, paper, water (B) air, vacuum, paper, water
(C) air, vacuum, water, paper (D) vacuum, air, water, paper
51. The maximum efficiency of a half-wave rectifier is :
- (A) 40.6% (B) 81.2%
(C) 50.0% (D) 25%
52. The output impedance of a transistor is :
- (A) high (B) zero
(C) low (D) very low

53. The point of intersection of d.c. and a.c. load lines represents :
- (A) operating point (B) current gain
(C) voltage gain (D) none of these
54. The input impedance of a MOSFET is of the order of :
- (A) Ω (B) a few hundred Ω
(C) $k\Omega$ (D) several $M\Omega$
55. If the gate of a JFET is made less negative, the width of the conducting channel:
- (A) remains the same (B) is decreased
(C) is increased (D) none of these
56. The bandwidth of an ideal op-amp is of the order of :
- (A) 10 kHz (B) near to zero
(C) infinity (D) 100 MHz
57. Output of OR gate is 0 when both inputs are :
- (A) 0 (B) 1
(C) first input 0 and second 1 (D) first input 1 and second 0
58. The time base of a CRO is developed by :
- (A) Square wave (B) Sine wave
(C) Sawtooth wave (D) Gaussian wave
59. Process by which gamma ray photons energy is neither absorbed nor lost :
- (A) Photoelectric effect (B) Compton effect
(C) Pair formation (D) Particle-antiparticle annihilation
60. When ${}_{92}\text{U}^{238}$ is bombarded with slow neutrons, it produces :
- (A) ${}_{92}\text{U}^{232}$ (B) ${}_{92}\text{U}^{234}$
(C) ${}_{92}\text{U}^{235}$ (D) ${}_{92}\text{U}^{239}$

61. If a C^{14} has a half life of 5730 years, then how long will it take for quantity of C^{14} in a sample to drop to $1/8$ of initial quantity ?
- (A) 2.58×10^4 years (B) 1.44×10^4 years
(C) 1.72×10^4 years (D) 2.58×10^2 years
62. Gamma (γ) radiation are fast moving :
- (A) electrons (B) protons
(C) photons (D) neutrons
63. In air, alpha particles have range of :
- (A) few centimeters (B) several thousand meters
(C) several hundred meters (D) several meters
64. Which of the forces given below is not considered as a fundamental force ?
- (A) gravitational (B) van der Waal
(C) electro-weak (D) strong
65. The energies of electrons emitted in β -decays have a continuous spectrum because :
- (A) the original neutron has a continuous spectrum
(B) neutrino can carry off energy
(C) the emitted electron is free
(D) the daughter nucleus may have any energy
66. Continuous X-ray spectrum is emitted by the target due to :
- (A) retardation of the impinging electrons of X-ray tube
(B) falling of electrons from L shell to K vacant shell
(C) falling of electrons from M shell to L vacant shell
(D) falling of electrons from M shell to L vacant shell and subsequently falling of electrons from L shell to K vacant shell
67. The energy levels of the linear harmonic oscillator are :
- (A) n-fold degenerate (B) $n + \frac{1}{2}$ fold degenerate
(C) all nondegenerate (D) n^2 -fold degenerate

68. How many different levels are possible for an atom with total angular momentum quantum number $J = 3/2$ and nuclear spin quantum number $I = 1/2$?
- (A) No splitting (B) 2
(C) 3 (D) 4
69. How many different spectroscopic terms are possible for two equivalent electrons in pp configuration ?
- (A) 1 (B) 3
(C) 5 (D) 12
70. A given cavity mode of a 3-dimensional rectangular cavity is a superposition of how many plane waves ?
- (A) 1 (B) 3
(C) 6 (D) 8
71. Line shape of the naturally broadened line is :
- (A) Gaussian (B) Lorentzian
(C) Square (D) Voigt
72. Example of 3-level laser system is :
- (A) Ruby laser (B) He-Ne laser
(C) CO_2 laser (D) Dye laser
73. Molecular wave functions can be resolved into electronic and nuclear wave functions by :
- (A) Franck-Condon Principle (B) Herzberg-Taylor approximation
(C) Relativistic correction (D) Born-Oppenheimer approximation
74. The population of rotational level of a molecule is given by :
- (A) rigid rotator model (B) non-rigid rotator model
(C) vibrating-rotator model (D) Boltzmann's distribution law
75. Coherence length of a light source is related to :
- (A) spatial coherence (B) temporal coherence
(C) coherence width (D) spatial as well as temporal coherence