

PHYSICAL SCIENCES

Paper - II

OCT-10/02

Signature of Invigilators

Roll No.

(In figures as in Admit Card)

1.

Roll No.

2.

(in words)

Time Allowed : 75 Minutes]

[Maximum Marks : 100

Instructions for the Candidates

1. Write your Roll Number in the space provided on the top of this page.
2. This paper consists of **fifty (50)** multiple choice type questions. **All** questions are compulsory.
3. Each item has upto four alternative responses marked (A), (B), (C) and (D). The answer should be a capital letter for the selected option. The answer letter should entirely be contained within the corresponding square.

Correct method



Wrong method



OR



4. Your responses to the items for this paper are to be indicated on the ICR Answer Sheet under Paper II only.
5. Read instructions given inside carefully.
6. Extra sheet is attached at the end of the booklet for rough work.
7. You should return the test booklet to the invigilator at the end of paper and should not carry any paper with you outside the examination hall.
8. There shall be no negative marking.
9. Use of calculator or any other electronic devices is prohibited.

પરીક્ષાર્થીઓ માટે સૂચનાઓ :

૧. આ પાનાની ટોચમાં દર્શાવેલી જગ્યામાં તમારો રોલનંબર લખો.
૨. આ પ્રશ્નપત્રમાં બહુવૈકલ્પિક ઉત્તરો ધરાવતા કુલ **પચાસ (૫૦)** પ્રશ્નો આપેલા છે. **બધા જ** પ્રશ્નો ફરજિયાત છે.
૩. પ્રત્યેક પ્રશ્ન વધુમાં વધુ ચાર બહુવૈકલ્પિક ઉત્તરો ધરાવે છે. જે (A), (B), (C) અને (D) વડે દર્શાવવામાં આવ્યા છે. પ્રશ્નનો ઉત્તર કેપીટલ સંજ્ઞા વડે આપવાનો રહેશે. ઉત્તરની સંજ્ઞા આપેલ પાનામાં બરાબર સમાઈ જાય તે રીતે લખવાની રહેશે.

ખરી રીત :



ખોટી રીત :



૪. આ પ્રશ્નપત્રના જવાબ આપેલ ICR Answer Sheet ના Paper II વિભાગની નીચે આપેલ પાનાઓમાં આપવાના રહેશે.
૫. અંદર આપેલ સૂચનાઓ કાળજીપૂર્વક વાંચો.
૬. આ બુકલેટની પાછળ આપેલું પાનું રફ કામ માટે છે.
૭. પરીક્ષા સમય પૂરો થઈ ગયા પછી આ બુકલેટ જે તે નિરીક્ષકને સોંપી દેવી. કોઈપણ કાગળ પરીક્ષા ખંડની બહાર લઈ જવો નહીં.
૮. ખોટા જવાબ માટે નેગેટિવ ગુણાંકન પ્રથા નથી.
૯. કેલ્ક્યુલેટર અને ઈલેક્ટ્રોનિક યંત્રોનો પ્રયોગ કરવાની મનાઈ છે.

PHYSICAL SCIENCES

PAPER-II

Note : This paper contains **FIFTY (50)** multiple-choice/Assertion and Reasoning/Matching questions, each question carrying **two (2)** marks. Attempt **ALL** the questions.

1. If a coin is tossed 6 times in succession, the probability of getting at least one head is :
- (A) $\frac{1}{64}$ (B) $\frac{3}{32}$
(C) $\frac{1}{2}$ (D) $\frac{63}{64}$
2. The eigenvalues of the matrix $\begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{pmatrix}$ are given by λ_1, λ_2 and λ_3 . Which of the following statements is *not* true ?
- (A) $\lambda_1 + \lambda_2 + \lambda_3 = 0$
(B) All eigenvalues are real
(C) Product of the eigenvalues is 1
(D) $\lambda_1\lambda_2 + \lambda_2\lambda_3 + \lambda_3\lambda_1 = 0$
3. If $\vec{A} \cdot (\vec{B} \times \vec{C}) = 0$ in 3-dimensional space, then :
- (A) $\vec{A}, \vec{B}, \vec{C}$ are coplanar
(B) \vec{A} is a null vector
(C) $\vec{A}, \vec{B}, \vec{C}$ form a complete set of vectors in 3-dimensional space
(D) Three vectors \vec{A}, \vec{B} and \vec{C} are mutually orthogonal

4. $f(x) = 1$ for $0 < x < \pi$
 $= 0$ for $-\pi < x < 0$

when $f(x)$ is represented by corresponding Fourier series, then the value of the Fourier series at $x = 0$ is :

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

5. Pauli matrices form a set of generators for group :

- (A) SU(2) (B) SU(3)
(C) symmetric (D) O(3)

6. The order of differential equation representing Newton's second law of motion is :

- (A) 0 (B) 2
(C) 1 (D) 3

7. The unit of moment of inertia is :

- (A) kg.m (B) kg.m/s^2
(C) kg.m^2 (D) kg.m/s

8. In the rigid body dynamics, the number of Euler angles are :

- (A) 2 (B) 3
(C) 4 (D) 6

9. The length of the rod (in meter) moving with velocity $0.8c$ (c is the velocity of light and proper length of rod is 1 m) can be given as :

- (A) 1 (B) 0.4
(C) 0.6 (D) 0.8

10. The unit of Lagrangian is the unit of :

- (A) energy (B) angular momentum
(C) torque (D) force

11. Which of the following suggests that the electrostatic field is conservative ?

- (A) $\nabla \cdot \vec{E} = 0$ (B) $\nabla \times \vec{E} = 0$
(C) $\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0}$ (D) $\nabla^2 \vec{E} = 0$

12. A point charge ' q ' is kept at a vertical distance ' d ' from an infinite neutral conducting plane (XY plane). If the plane is grounded, which of the following is true ?

- (A) The net charge on the sheet is ' $-q$ '
(B) The electric field is not zero below the plane
(C) The charge density on the plane is independent of ' d '
(D) There is no force between the plane and the point charge

13. If the relative permittivity of a non-magnetic material ($\mu_r = 1$) is ϵ_r , its refractive index is :

(A) $\frac{1}{\sqrt{\epsilon_r}}$

(B) $\frac{1}{\epsilon_r}$

(C) $\frac{\epsilon_r}{2}$

(D) $\sqrt{\epsilon_r}$

14. A negatively charged particle is moving near a long straight wire carrying a current. The force between the wire and the charge will be along the direction of the current if the charge moves :

(A) Towards the wire

(B) Away from the wire

(C) In the same direction of current

(D) Opposite to the current direction

15. The resonance frequency of an LCR circuit is :

(A) $\frac{1}{\sqrt{LCR}}$

(B) $\frac{1}{\sqrt{LC}}$

(C) $\frac{1}{LC}$

(D) \sqrt{LC}

16. Which of the following experiments gave the indication about the existence of electron spin ?

(A) Photoelectric effect

(B) Frank and Hertz experiment

(C) Davisson and Germer experiment

(D) Stern and Gerlach experiment

17. The total degeneracy of the state with principal quantum number ' n ' is :
- (A) n^2 (B) $n - 1$
(C) n (D) $2n^2$
18. Which of the following is an eigenfunction of linear momentum operator, such that it describes a particle moving in free space in +ve X-direction with a definite linear momentum :
- (A) $\cos kx$ (B) $\sin kx$
(C) e^{-kx} (D) e^{ikx}
19. Parity of wave function is associated with :
- (A) space translation
(B) space rotation
(C) space inversion
(D) space exchange of two particles
20. Which of the following processes involves tunneling through a potential barrier ?
- (A) α -decay (B) β -decay
(C) γ -decay (D) pair production
21. The first law of thermodynamics is a statement of :
- (A) conservation of heat
(B) conservation of work
(C) conservation of momentum
(D) conservation of energy

22. An ideal black body-surface object is initially at room temperature and is thrown into a furnace at a temperature much higher than room temperature. It is then observed that :
- (A) initially it appears as the darkest body and later the brightest
 - (B) it is the darkest body at all times
 - (C) it cannot be distinguished at all times
 - (D) initially it is the darkest body and later it cannot be distinguished
23. Consider a system, consisting of N particles, in contact with a heat reservoir at a temperature T . For the canonical ensemble of systems, therefore :
- (A) The energy of the system in the ensemble is constant
 - (B) The energy of the system and the number of particles of the system are constant
 - (C) The energy of the system and the number of particles can both vary
 - (D) The energy of the system can vary, but the number of particles is constant
24. Three distinguishable particles have a total energy of 9ϵ . These particles are distributed over the energy states with energy $0, \epsilon, 2\epsilon, 3\epsilon$ and 4ϵ . The total number of microstates will be :
- (A) 3
 - (B) 1
 - (C) 10
 - (D) 6
25. The de Broglie wavelength of a helium atom at 300 K is 0.6×10^{-8} cm. Hence the de Broglie wavelength of a neon atom (5 times heavier than helium atom) at 600 K will be :
- (A) 6×10^{-8} cm
 - (B) 0.06×10^{-8} cm
 - (C) $0.6 \times \sqrt{10} \times 10^{-8}$ cm
 - (D) $\frac{0.6}{\sqrt{10}} \times 10^{-8}$ cm

26. When negative feedback is applied to an amplifier, its gain-bandwidth product will :
- (A) reduce (B) increase
(C) remain the same (D) become infinite
27. When a square-wave is differentiated, the resulting output waveform would be :
- (A) Sine-wave (B) Triangle-wave
(C) Spikes at transition (D) Cosine-wave
28. Which of the following is the fastest light sensor ?
- (A) *p-i-n* photodiode (B) Photovoltaic diode
(C) Phototransistor (D) Avalanche photodiode
29. The slew rate for a 741 op-amp is $0.5 \text{ V}/\mu\text{s}$. The maximum frequency of undistorted sine-wave output voltage of $+5 \text{ V}$ to -5 V is :
- (A) 20 kHz (B) 25 kHz
(C) 50 kHz (D) 10 kHz

30. The K-map for a 3 input circuit is shown below :

		C	
		0	1
AB	00		1
	01	1	
	11		1
	10	1	

What would be its logical expression ?

- (A) $\bar{A}\bar{B} + \bar{C}$ (B) $\bar{A}BC + ABC + A\bar{B}C$
 (C) $A \oplus B \oplus C$ (D) $\bar{A}B + A\bar{C} + \bar{B}C$

31. To measure the temperature of an object having temperatures higher than 4000 K, the most suitable method is :

- (A) using a thermocouple
 (B) using an optical pyrometer
 (C) using a resistance thermometer
 (D) using gas thermometer based on Boyle's law

32. A 0-150 voltmeter has a guaranteed accuracy of 1% full scale reading. If the voltage measured by this instrument is 60 V, the limiting error in percent is :

- (A) 1% (B) 1.5%
 (C) 2% (D) 2.5%

33. If a resonant LC circuit is fed square wave signals of appropriate frequency through a coupling resistance, its output waveform would be :
- (A) Triangular wave (B) Square wave
(C) Sine wave (D) Sawtooth wave
34. The noise signal generated from the movement of charge carriers as they cross the $p-n$ junction or arrive at electrode surfaces is :
- (A) Thermal noise (B) Shot noise
(C) Flicker noise (D) Environmental noise
35. The linear variable differential transformer is used to measure :
- (A) Voltage fluctuations
(B) Distance
(C) Radio frequency oscillations
(D) Angle
36. The electronic configuration of an atom in the ground state is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$. Which of the following is *true* ?
- (A) Its $n = 3$ shell is completely filled
(B) Its electronic cloud is spherically symmetric
(C) Its most loosely bound electron has $l = 4$
(D) Its most loosely bound electron is in the K-shell
37. Which of the following represents Mosely's law of X-ray spectra ? Z is the atomic number and M is the mass no.
- (A) $\sqrt{\nu} \propto Z$ (B) $\sqrt{\nu} \propto M$
(C) $\nu \propto \sqrt{Z}$ (D) $\nu \propto \sqrt{M}$

38. Rotational energy levels of a diatomic molecule lie in :
- (A) Infrared region (B) Microwave region
(C) Visible region (D) X-ray region
39. Which of the following *does not* represent a Laser system ?
- (A) CO₂ (B) Hg
(C) Semiconductor (D) He-Ne
40. Which of the following has the lowest ionization potential ?
- (A) ${}^4_2\text{He}$ (B) ${}^{14}_7\text{N}$
(C) ${}^{133}_{55}\text{Cs}$ (D) ${}^{16}_8\text{O}$
41. The co-ordination number for the fcc lattice is :
- (A) 3 (B) 4
(C) 8 (D) 12
42. The thermal vibrations of atoms in crystals are responsible for producing :
- (A) photons (B) plasmons
(C) phonons (D) magnons
43. In the case of *n*-type semiconductors the Fermi level lies :
- (A) above conduction band
(B) below valence band
(C) near the conduction band
(D) near the valence band
44. In a paramagnetic material, the nuclear magnetic moments of the nuclei are :
- (A) infinite
(B) zero
(C) more than those of electrons
(D) less than those of electrons

45. The value of the energy gap parameter of a superconductor in its ground state is :
- (A) zero (B) infinite
(C) 0.5 eV (D) 1 eV
46. The ratio of nuclear radii for ${}_{26}\text{Fe}^{56}$ and ${}_{14}\text{Si}^{28}$ is approximately :
- (A) 2 (B) $2^{1/2}$
(C) $2^{1/3}$ (D) $\sqrt{\frac{26}{14}}$
47. There are very few stable nuclei with odd number of protons and odd number of neutrons. This is manifestation of :
- (A) Charge independence of nuclear force
(B) Pairing nature of nuclear force
(C) Coulomb force dominance
(D) Saturation property of nuclear force
48. Parity non-conservation is associated to :
- (A) gravitational force (B) magnetic force
(C) strong nuclear force (D) weak nuclear force
49. The ground state spin and parity of ${}_{8}\text{O}^{17}$ is :
- (A) $\frac{1}{2}, +$ (B) $\frac{5}{2}, +$
(C) $\frac{5}{2}, -$ (D) $\frac{3}{2}, -$
50. Which of the quark combination corresponds to a proton ?
- (A) uud (B) udd
(C) uds (D) uuu

ROUGH WORK

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