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TEST BOOKLET

Sl. No. : **2232**

Subject : **PHYSICS**

Post : **Lab. Asst.-cum-Storekeepers**

**WRITTEN EXAMINATION FOR RECRUITMENT OF NON-TEACHING POSTS
(JUNIOR ASSISTANTS, PHYSICAL EDUCATION TEACHERS (P.E.Ts) AND
LABORATORY ASSISTANT-CUM-STOREKEEPERS) IN GOVT. DEGREE
COLLEGES, ODISHA**

Time Allowed : 2 Hours

Maximum Marks: 150

: INSTRUCTIONS TO CANDIDATES :

1. **IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET CONTAINS 18 PAGES AND DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.**
2. You have to enter your **Roll No.** on the Test Booklet in the Box provided alongside. **DO NOT** write anything else on the Test Booklet.

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3. The Test Booklet contains **100** questions. Each question comprises four options. You have to select the correct answer which you want to mark (darken) on the OMR Answer Sheet. In any case, choose **ONLY ONE** answer for each question. If more than one answer is darkened, it will be considered wrong.
4. You have to mark (darken) all your answers only on the **OMR Answer Sheet using BLACK BALL POINT PEN** provided by the State Selection Board. You have to do rough work only in the space provided at the end of the Test Booklet. See instructions in the OMR Answer Sheet.
5. All questions carry equal marks. While **1.5** marks will be awarded for each correct answer, each wrong answer will result in negative marking of **0.50** mark.
6. Before you proceed to mark (darken) the answers in the OMR Answer Sheet to the questions in the Test Booklet, you have to fill in some particulars in the OMR Answer Sheet as per the instructions in your Admit Card.
7. On completion of the Examination, you should hand over the **original copy of OMR Answer Sheet** issued to you to the Invigilator before leaving the Examination Hall. You are allowed to take with you the candidate's copy (second copy) of the OMR Answer Sheet along with the Test Booklet for your reference.

Candidate's full signature

Invigilator's signature

P.T.O.

SEAL

1. In a damped oscillator, the damping force is always -
 - (A) directed opposite to the direction of the restoring force.
 - (B) proportional to the displacement from the equilibrium position.
 - (C) directed opposite to the direction of velocity.
 - (D) directed opposite to the direction of acceleration.

2. The zeroth law of thermodynamics describes -
 - (A) the relation between the heat received and the work done by a system
 - (B) the thermal equilibrium of two systems.
 - (C) the thermal efficiency of a heat engine.
 - (D) work done by an ideal gas at constant pressure.

3. A proton moves along a straight line with a constant kinetic energy E . The de Broglie wavelength of the matter wave associated with the proton is proportional to -
 - (A) E
 - (B) $\frac{1}{E}$
 - (C) $\sqrt{E}$
 - (D) $\frac{1}{\sqrt{E}}$

4. A point charge Q is surrounded by a sphere of radius R . The total electric flux over the surface of the sphere -
 - (A) is zero when the charge is at the centre of the sphere.
 - (B) has the maximum value when the charge is at the centre of the sphere and decreases as the charge moves away from the centre.
 - (C) has the minimum value when the charge is at the centre of the sphere and increases as the charge moves away from the centre.
 - (D) has a constant non-zero value irrespective of the position of the charge within the sphere.

5. Which of the following optical phenomena can be explained using Fermat's principle?
 - (A) Dispersion of light
 - (B) Young's double slit interference
 - (C) Reflection of light at plane interface
 - (D) Diffraction of light through a narrow slit

6. The temperature of an intrinsic semiconductor is increased from absolute zero temperature. Its electrical resistivity -
 - (A) increases
 - (B) remains unchanged
 - (C) decreases
 - (D) vanishes

7. The shock absorbers in automobiles are designed for -
 (A) zero damping (B) underdamping
 (C) overdamping (D) critical damping
8. Which of the following is an intensive property of a thermodynamic system?
 (A) entropy (B) volume
 (C) internal energy (D) pressure
9. In photoelectric effect, the photoelectric work function of the material -
 (A) is independent of the intensity of the incident light but depends on its frequency
 (B) is independent of both the intensity and frequency of the incident light
 (C) is independent of the frequency of the incident light but depends on its intensity
 (D) depends on both the intensity and frequency of the incident light
10. An electric dipole of dipole moment $\vec{p}$ is enclosed in a conical region of base area A and height h . The electric flux over the total surface area of the cone is equal to -
 (A) $\frac{1}{2} pAh$ (B) $\sqrt{2} p^2 Ah$ (C) zero (D) $\frac{1}{3} pAh$
11. In a coaxial optical system, the determinant of the system matrix is -
 (A) equal to zero
 (B) equal to 1
 (C) directly proportional to the refractive index of the medium in which the system is placed
 (D) inversely proportional to the refractive index of the medium in which the system is placed
12. In a compound pendulum, the equivalent length of the pendulum is equal to the distance between -
 (A) the centre of oscillation and the centre of suspension
 (B) the centre of oscillation and the centre of gravity
 (C) the centre of suspension and the centre of gravity
 (D) the two extreme ends of the pendulum
13. The work done by an ideal gas is W_1 when it undergoes an isothermal expansion from volume V_1 to V_2 . When the same gas undergoes expansion from volume V_1 to V_2 under adiabatic and isobaric processes, the work done are W_2 and W_3 respectively. Which of the following relations is correct?
 (A) $W_3 > W_1 > W_2$ (B) $W_1 = W_2 = W_3$
 (C) $W_3 > W_2 > W_1$ (D) $W_1 = W_2, W_3 > W_1$

14. The powers of two thin lenses in contact and placed in air are P_1 and P_2 respectively. The system matrix for the lens combination is -
- (A) $\begin{pmatrix} P_1 & 0 \\ 0 & P_2 \end{pmatrix}$ (B) $\begin{pmatrix} P_1 + P_2 & 0 \\ 0 & 1 \end{pmatrix}$
 (C) $\begin{pmatrix} 1 & -(P_1 + P_2) \\ 0 & 1 \end{pmatrix}$ (D) $\begin{pmatrix} 1 & 0 \\ P_1 P_2 & 1 \end{pmatrix}$
15. Which of the following experiments demonstrates the particle nature of electromagnetic waves?
- (A) Young's double slit experiment
 (B) diffraction of light through a single slit
 (C) photoelectric effect
 (D) nuclear fusion
16. Maxwell's electromagnetic equation $\vec{\nabla} \times \vec{E} + \frac{\partial \vec{B}}{\partial t} = 0$ corresponds to -
- (A) Ampere's circuital law
 (B) Biot-Savart law
 (C) Fleming's left hand rule
 (D) Faraday's law of electromagnetic induction
17. In the Michelson interferometer, the compensating plate is used to -
- (A) ensure that circular fringes are always produced
 (B) introduce an additional path difference of $\frac{\lambda}{2}$ between the two interfering beams
 (C) enhance the contrast between the dark and bright fringes
 (D) make the paths of the two interfering beams symmetrical
18. The orbital angular momentum of a planet about the sun -
- (A) has the maximum value at the perihelion
 (B) has the maximum value at the aphelion
 (C) is inversely proportional to the aerial velocity of the planet
 (D) has the same value throughout its revolution about the sun
19. During an adiabatic process undergone by an ideal gas, the pressure is proportional to the cube of the absolute temperature. The ratio $\frac{C_p}{C_v}$ of the molar specific heat at constant pressure to the molar specific heat at constant volume of the gas is equal to -
- (A) 3/2 (B) 5/2 (C) 3 (D) 1/3
20. A monochromatic light of wavelength λ undergoes Rayleigh scattering. The intensity of the scattered light wave is proportional to
- (A) λ^2 (B) $\frac{1}{\lambda}$ (C) $\frac{1}{\lambda^2}$ (D) $\frac{1}{\lambda^4}$

21. Which of the following states that both the position and the corresponding linear momentum of a moving particle cannot be determined with unlimited accuracy -

- (A) Pauli exclusion principle
- (B) de Broglie hypothesis of matter wave
- (C) Newton's second law of motion
- (D) Heisenberg's uncertainty principle

22. If $\vec{j}$ and ρ represent the electric current density and the electric charge density respectively, the equation of continuity is given by -

- (A) $\vec{j} + \vec{\nabla}\rho = 0$
- (B) $\vec{\nabla} \cdot \vec{j} + \frac{\partial \rho}{\partial t} = 0$
- (C) $\vec{\nabla}\rho + \frac{\partial \vec{j}}{\partial t} = 0$
- (D) $\vec{\nabla} \times \vec{j} + \vec{\nabla}\rho = 0$

23. In an ideal coaxial optical system, placed in air -

- (A) the distance between the principal points is equal to the distance between the nodal points
- (B) the distance between the principal points is equal to the distance between the focal points
- (C) the distance between the focal points is equal to the distance between the nodal points
- (D) the principal points and the focal points are conjugates of each other.

24. A planet revolves round the sun in an elliptic orbit of semimajor axis a and semiminor axis b . If T is the period of revolution of the planet round the sun -

- (A) $T \propto a^2$
- (B) $T^2 \propto a^3$
- (C) $T \propto a^2 b$
- (D) $T^2 \propto \sqrt{ab}$

25. The pressure P_1 and the volume V_1 of one mole of an ideal gas undergo the following changes.

$$(P_1, V_1) \rightarrow (P_2, V_2) \rightarrow (P_1, V_1)$$

The total change in the internal energy of the gas is

- (A) $P_2 V_2 - P_1 V_1$
- (B) $P_2 V_1 - P_1 V_2$
- (C) $\ln \frac{P_2 V_2}{P_1 V_1}$
- (D) zero

26. In Newton's rings, the radii of the bright fringes are proportional to -

- (A) n^2
- (B) $(2n + 1)$
- (C) $\sqrt{n + 1}$
- (D) $\sqrt{2n + 1}$

where $n = 0, 1, 2, \dots$

27. According to Bohr's theory of hydrogen atom, the transition of electrons from higher energy states to the first excited state gives rise to the spectrum of -

- (A) Lyman series
- (B) Balmer series
- (C) Pfund series
- (D) Neumann series

28. In a given electromagnetic field, $\vec{A}$ and ϕ represent the vector potential and the scalar potential respectively. The electric field $\vec{E}$ is given by -

- (A) $\vec{E} = \vec{\nabla} \times \vec{A} - \vec{\nabla} \phi$ (B) $\vec{E} = -\vec{A} + \vec{\nabla} \phi$
 (C) $\vec{E} = -\frac{\partial \vec{A}}{\partial t} - \vec{\nabla} \phi$ (D) $\vec{E} = -\vec{\nabla} \left(\frac{\partial \phi}{\partial t} \right) + (\vec{\nabla} \times \vec{A})$

29. Which of the following processes is utilized to achieve population inversion in a LASER source?

- (A) Spontaneous emission (B) Photoelectric emission
 (C) Optical pumping (D) Resonant decay

30. A particle moves under a central force field with the magnitude of the force inversely proportional to the square of its distance from the force centre. If $\langle T \rangle$ is the average kinetic energy and $\langle V \rangle$ is the average potential energy, then according to the Virial theorem,

- (A) $\langle T \rangle = \langle V \rangle$ (B) $\langle T \rangle = \frac{1}{2} \langle V \rangle$
 (C) $2\langle T \rangle + \langle V \rangle = 0$ (D) $\langle T \rangle + \langle V \rangle = 0$

31. For isothermal process of an ideal gas, the value of the polytropic index is-

- (A) zero (B) 1 (C) infinity (D) 1.5

32. In an AC circuit, the phase difference between the voltage and the current is θ . The power factor of the AC circuit is proportional to -

- (A) $\tan \theta$ (B) $\tan^{-1} \theta$ (C) $\cos^2 \theta$ (D) $\cos \theta$

33. In Bohr's theory of hydrogen atom, the velocity v of the electron in the n th stationary state orbit is proportional to -

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

34. In a propagating electromagnetic wave, the dimension of the Poynting vector is the same as the dimension of -

- (A) power per unit area (B) force per unit time
 (C) energy per unit area (D) intensity of the e.m. wave

35. The interference fringes produced by a wedge-shaped thin film are called fringes of equal -

- (A) intensity (B) inclination (C) thickness (D) amplitude

36. The gravitational potential at the centre of a solid homogeneous sphere of radius R and mass M is -

- (A) zero (B) $-\frac{GM}{R}$ (C) $-\frac{3GM}{2R}$ (D) $-\frac{2GM}{5R}$

where G is the universal gravitational constant.

37. The efficiency of a Carnot engine operating between the temperatures

27°C and 327°C is -

- (A) 45 % (B) 66.3 % (C) 50 % (D) 12.5 %

38. A monochromatic unpolarized beam of light is incident from air on a transparent medium of refractive index n . The reflected light is completely plane polarized when the angle of incidence is θ . The refractive index n of the transparent medium is equal to -

- (A) $\frac{1}{\sin \theta}$ (B) $\sin \theta$ (C) $\cos \theta$ (D) $\tan \theta$

39. α ray, β ray and γ ray, emitted from a radioactive source, pass through a strong, uniform magnetic field. Which of the following ray/rays undergo deviation in the magnetic field?

- (A) both α ray and γ ray (B) only γ ray
(C) both α ray and β ray (D) only β ray

40. In an electromagnetic field $\vec{E}$, $\vec{B}$, $\vec{A}$ and ϕ represent the electric field, the magnetic field, the vector potential and the scalar potential respectively. Which of the following is correct under gauge transformation?

- (A) $\vec{E}$ and $\vec{B}$ change but $\vec{A}$ and ϕ remain unchanged
- (B) $\vec{E}$ and ϕ change but $\vec{A}$ and $\vec{B}$ remain unchanged
- (C) $\vec{A}$ and ϕ change but $\vec{E}$ and $\vec{B}$ remain unchanged
- (D) all $\vec{E}$, $\vec{B}$, $\vec{A}$ and ϕ change

41. In a transistor, α_{dc} and β_{dc} are related by

- (A) $\alpha_{dc} = \frac{\beta_{dc}}{1+\beta_{dc}}$
- (B) $\beta_{dc} = \frac{\alpha_{dc}}{1+\alpha_{dc}}$
- (C) $2\alpha_{dc} = \beta_{dc}$
- (D) $\sqrt{\alpha_{dc} + \beta_{dc}} = \frac{1}{\sqrt{\alpha_{dc}}} + \frac{1}{\sqrt{\beta_{dc}}}$

42. Ultrasonic waves are -

- (A) sound waves with frequency greater than that of audible sound
- (B) sound waves with intensity greater than that of audible sound
- (C) sound waves with the speed of propagation greater than that of audible sound
- (D) intense electromagnetic waves with frequency greater than that of microwaves.

43. Which of the following is the statement of Carnot's theorem?

- (A) The total change in the internal energy of an ideal gas, during a reversible process, is zero.
- (B) No heat engine, unaided by an external agency, can transfer heat from a body at a lower temperature to a body at a higher temperature.
- (C) The entire heat energy supplied to a heat engine cannot be completely converted to mechanical work.
- (D) All reversible heat engines, operating between the same two limits of temperature, have the same efficiency.

44. A plane polarized monochromatic light is incident normally on a quarter wave plate. The electric field corresponding to the wave makes an angle 45° with the optic axis of the quarter wave plate. The emerging light is -

- (A) plane polarized
- (B) elliptically polarized
- (C) circularly polarized
- (D) unpolarized

45. The half-life of a radioactive substance is 2 hours. What fraction of the radioactive substance undergoes radioactive decay during a period of 8 hours?
- (A) $3/4$ (B) $7/8$ (C) $5/6$ (D) $15/16$
46. In a given electromagnetic field, $\vec{A}$ and ϕ are the vector potential and the scalar potential respectively. Which of the following is the Lorenz gauge condition for the potentials?
- (A) $\vec{\nabla} \cdot \vec{A} + \frac{1}{c^2} \frac{\partial \phi}{\partial t} = 0$ (B) $\vec{\nabla} \times \vec{A} + \vec{A} \frac{\partial \phi}{\partial t} = 0$
 (C) $\vec{\nabla}^2 \vec{A} + \frac{\partial^2 \phi}{\partial t^2} = 0$ (D) $\vec{\nabla} \cdot \vec{A} - \frac{1}{c} \frac{\partial \phi}{\partial t} = 0$
47. A zone plate is illuminated by monochromatic light of wavelength λ . The area of each half period zone is proportional to -
- (A) λ^2 (B) $\frac{1}{\lambda^2}$ (C) $\sqrt{\lambda}$ (D) λ
48. Two orthogonal simple harmonic motions with frequency ratio 2:1 superpose to produce a Lissajous figure having the shape of the digit eight (8). The phase difference between the two simple harmonic motions is -
- (A) 0 (B) π (C) 2π (D) $\pi/2$
49. Which of the following processes represents a first order phase transition?
- (A) melting of ice
 (B) heating of an ideal gas under constant pressure
 (C) transfer of heat from the interior of a refrigerator to its exterior region
 (D) expansion of an ideal gas without supply of external heat

50. The formation of rainbow is due to the phenomena of -
 (A) interference (B) diffraction and polarisation
 (C) refraction and dispersion (D) double refraction
51. Which of the following is not true for the nuclear force?
 (A) Both the strength and range of the nuclear force are greater than those of the electrostatic force
 (B) Nuclear force is a short-range force
 (C) Nuclear force between two protons or neutrons is independent of their electric charge
 (D) Nuclear force between two protons or neutrons depends on their spin orientation.
52. A plane monochromatic electromagnetic wave propagates in free space. The unit vectors along the electric field and the magnetic fields are $\frac{1}{\sqrt{2}}(\hat{x} + \hat{y})$ and $\hat{z}$ respectively. The unit vector along the direction of propagation is -
 (A) $-\hat{y}$ (B) $\hat{x}$ (C) $\frac{1}{\sqrt{2}}(\hat{x} - \hat{y})$ (D) $\frac{1}{\sqrt{3}}(\hat{x} + \hat{y} - \hat{z})$
53. In Fabry-Perot interferometer, the reflectivity of the films deposited on the plates is R . The ratio of the minimum intensity to the maximum intensity of the fringes is proportional to -
 (A) $\left(\frac{1-R}{1+R}\right)^2$ (B) $\frac{1-R^2}{1+R^2}$ (C) $\sqrt{\frac{1-R^2}{1+R^2}}$ (D) $\sqrt{\frac{1-R}{1+R}}$
54. A stretched string of uniform thickness is plucked at its mid point. Which of the following harmonics are absent in the sound produced by the string?
 (A) 1st, 2nd, 3rd, ... (B) 1st, 3rd, 5th, ...
 (C) 2nd, 4th, 6th, ... (D) 3rd, 6th, 9th, ...
55. In a combination of two thin lenses in air, the spherical aberration is the minimum if -
 (A) the lenses are in contact
 (B) the focal length of one lens is double the focal length of the other
 (C) the distance between the lenses is equal to the difference between their focal lengths
 (D) the focal length of one lens is three times the focal length of the other
56. In which of the following modulation processes, is the frequency of the modulated wave the same as the frequency of the carrier wave?
 (A) amplitude modulation (B) power modulation
 (C) frequency modulation (D) phase modulation

57. If c is the speed of light in vacuum, the ratio of the mass defect to binding energy of an atomic nucleus is equal to -
 (A) $\frac{1}{c}$ (B) $\frac{1}{c^2}$ (C) c^2 (D) $\sqrt{c}$
58. In a series LCR circuit, L , C and R represent the inductance, capacitance and resistance respectively. If ω is the resonant angular frequency, the impedance of the circuit at resonance is -
 (A) $R + \omega(L - C)$ (B) $\sqrt{R^2 + \omega^2(L - C)^2}$
 (C) R (D) $R + \omega\left(\frac{1}{L} - \frac{1}{C}\right)$
59. In a full wave rectifier, the frequency of the load current is -
 (A) equal to the frequency of the input voltage
 (B) equal to half of the frequency of the input voltage
 (C) equal to twice the frequency of the input voltage
 (D) equal to $\sqrt{2}$ times the frequency of the input voltage
60. A thick spherical shell has mass M , external diameter a and internal diameter b . The magnitude of the gravitational field at a point outside the sphere, at a distance r from the centre is -
 (A) $GM \frac{a+b}{2r^2}$ (B) $\frac{GM}{r^2}$ (C) $GM \frac{b}{ar^2}$ (D) $GM \frac{a}{br^2}$
 where G is the universal gravitational constant.
61. An interference fringe pattern is produced in a Young's double slit arrangement. If the screen is shifted to a position away from the slits,
 (A) the fringes will disappear
 (B) the fringe width will increase
 (C) the fringe width will decrease
 (D) the fringe width will remain unchanged but the intensity of the fringes will be reduced
62. In a npn transistor, in the CE configuration, the equation of the load line is -
 (A) $I_C = R_C V_{CE} + \frac{V_{CC}}{R_C}$ (B) $I_C = -\frac{V_{CE}}{R_C} + \frac{V_{CC}}{R_C}$
 (C) $I_C = \frac{V_{CE}}{R_C}$ (D) $I_C = \frac{V_{CC}}{R_C}$
 (The symbols carry their usual meaning.)
63. The major process of production of energy in the sun is -
 (A) nuclear fission (B) radioactive decay
 (C) nuclear fusion (D) solar magnetic storm

64. In a ballistic galvanometer, B is the magnitude of the magnetic induction. The ballistic constant of the galvanometer is proportional to -
 (A) B (B) $\sqrt{B}$ (C) B^2 (D) $\frac{1}{B}$
65. Maxwell's thermodynamic relations relate the partial derivatives of which of the following variables?
 (A) Helmholtz free energy, entropy, volume, temperature
 (B) Pressure, volume, internal energy, entropy
 (C) Entropy, pressure, volume, temperature
 (D) Enthalpy, entropy, pressure, temperature
66. In a forced damped oscillator, the frequency of the driving force is equal to the natural frequency of the oscillator. The phase difference between the displacement of the oscillator and the driving force is equal to -
 (A) zero (B) π (C) 2π (D) $\pi/2$
67. The electric permittivity of a dielectric medium is ϵ . If $\vec{E}$ is the electric field in the medium, the electrostatic energy density in the medium is equal to -
 (A) $\epsilon^2 E^2$ (B) $\frac{E^2}{\epsilon}$ (C) $\frac{E^2}{4\pi\epsilon}$ (D) $\frac{1}{2} \epsilon E^2$
68. In a two input AND gate, the output is 1. The inputs are -
 (A) 1, 0 (B) 0, 1 (C) 1, 1 (D) 0, 0
69. Which one of the following components is the most difficult to fabricate on an integrated circuit?
 (A) transistor (B) resistor (C) inductor (D) capacitor
70. The magnetic susceptibility of a paramagnetic material is -
 (A) independent of its temperature
 (B) directly proportional to its absolute temperature
 (C) directly proportional to the square root of its absolute temperature
 (D) inversely proportional to its absolute temperature
71. In a thermodynamic system, U, P, V, T, S and G represent the internal energy, pressure, volume, absolute temperature, entropy and Gibb's free energy respectively. Which of the following relations is correct?
 (A) $G = U + PV - TS$ (B) $U = G + PV + TS$
 (C) $PV + TS = G - 2U$ (D) $U + PV = 2G - TS$
72. In an RC phase shift oscillator, all the resistors have the value R and all the capacitors have the value C . The frequency of oscillation is -
 (A) $\frac{1}{2\pi RC}$ (B) $\frac{1}{2\pi\sqrt{RC}}$ (C) $\frac{1}{2\pi RC \sqrt{6}}$ (D) $\frac{1}{2\pi\sqrt{6RC}}$

73. If $\vec{E}$ and $\vec{D}$ are the electric field and the electric displacement respectively, the boundary conditions on their components at the interface of two linear, homogeneous, isotropic dielectric media are as follows.
- (A) The normal components of $\vec{D}$ and the tangential components of $\vec{E}$ are continuous
 - (B) The normal components of $\vec{E}$ and the tangential components of $\vec{D}$ are continuous
 - (C) The normal components of both $\vec{D}$ and $\vec{E}$ are continuous
 - (D) The tangential components of both $\vec{D}$ and $\vec{E}$ are continuous
74. A rectifier converts an AC signal into -
- (A) pure DC
 - (B) pulsating DC
 - (C) AC signal of a higher frequency
 - (D) AC signal of a higher amplitude
75. Which of the following are universal logic gates?
- (A) AND, OR, NOT
 - (B) NOR, NAND
 - (C) OR, NOT
 - (D) AND, NOR
76. A uniform electric field $\vec{E}$ exists in a region of free space. A homogeneous, isotropic and uncharged dielectric sphere of relative permittivity ϵ_r is placed in the electric field. The electric field inside the sphere is -
- (A) $\epsilon_r \vec{E}$
 - (B) $\frac{1}{4\pi\epsilon_r} \vec{E}$
 - (C) $\frac{\vec{E}}{\epsilon_r + 4\pi}$
 - (D) $\frac{3\vec{E}}{\epsilon_r + 2}$
77. If L is the latent heat of vapourisation of water, then according to the Clausius-Clapeyron relation, $\left(\frac{dP}{dT}\right)$ is proportional to -
- (A) $\frac{1}{L}$
 - (B) L
 - (C) $\sqrt{L}$
 - (D) $L\sqrt{L}$
78. In a plane transmission grating, the width of each slit is equal to the spacing between the slits. Which of the following orders will be missing in the grating spectrum?
- (A) 1, 2, 3, ...
 - (B) 2, 4, 6, ...
 - (C) 4, 8, 12, ...
 - (D) 1, 3, 5, ...
79. A capacitor C is charged with a resistor R in series with it. The time constant of the RC circuit is the time during which the capacitor is charged to -
- (A) its maximum value
 - (B) 50 % of its maximum value
 - (C) 37 % of its maximum value
 - (D) 63 % of its maximum value

80. The hybrid parameters of a transistor amplifier in the CE configuration are h_{ie} , h_{re} , h_{fe} and h_{oe} . If R is the load resistance, the current amplification factor is -
- (A) $\frac{h_{fe}}{1+Rh_{oe}}$ (B) $\frac{h_{re}h_{fe}}{\frac{1}{R}+h_{oe}}$ (C) $\frac{h_{ie}}{h_{oe}}$ (D) $h_{ie} - \frac{h_{re}}{R+h_{oe}}$
81. Two thin lenses in air, of focal lengths f_1 and f_2 , have the same refractive index. The two lens system will form an achromatic doublet if the distance between them is equal to -
- (A) $\sqrt{f_1 f_2}$ (B) $\frac{1}{2} (f_1 + f_2)$ (C) $f_1 + f_2$ (D) zero
82. The frequency response curve of a transistor amplifier is the graph of -
- (A) voltage gain versus input current
(B) power gain versus input current
(C) output current versus signal frequency
(D) voltage gain versus signal frequency
83. The Joule-Thomson coefficient of a gas is zero. The gas -
- (A) is an ideal gas
(B) cools during expansion
(C) heats up during expansion
(D) does not obey the equation of state of an ideal gas
84. A point charge Q moves with velocity $\vec{v}$ in a region having electric field $\vec{E}$ and magnetic field $\vec{B}$. The force $\vec{F}$ on the charge is equal to -
- (A) $vQ(\vec{E} + \vec{B})$ (B) $\vec{v}(\vec{E} \cdot \vec{B})$
(C) $Q(\vec{E} + \vec{v} \times \vec{B})$ (D) $Q(\vec{v} \times \vec{E} + \vec{B})$
85. A steady current flows through a circular conductor of radius R . A point P lies on a straight line passing through the centre of the conductor and perpendicular to its plane. If d is the distance of the point P from the centre of the circular conductor, the magnitude of the magnetic induction $\vec{B}$ at the point P is proportional to -
- (A) $\frac{d}{R^2+d^2}$ (B) $\frac{R}{\sqrt{R^2+d^2}}$ (C) $\frac{R^2}{(R^2+d^2)^{\frac{3}{2}}}$ (D) $\frac{d^{\frac{3}{2}}}{\sqrt{R^2+d^2}}$
86. In a transistor amplifier, the biasing voltage for base-emitter junction is chosen in such a way that the collector current flows for the entire cycle of the input signal. The amplifier is a -
- (A) class A amplifier (B) class B amplifier
(C) class AB amplifier (D) class C amplifier

87. The binary equivalent of the decimal number 47.75 is -
 (A) 110011.01 (B) 101111.11 (C) 111010.11 (D) 101011.01
88. In a transistor amplifier, the voltage gain is greater than or equal to 70.7 % of the maximum midfrequency gain, when the signal frequency lies between the values f_1 and f_2 where $f_2 > f_1$. The frequency bandwidth of the amplifier is equal to -
 (A) $\frac{1}{2}(f_1 + f_2)$ (B) $\sqrt{f_1 f_2}$
 (C) $f_2 - f_1$ (D) $1 + \frac{f_2}{f_1}$
89. A microcanonical ensemble -
 (A) does not exchange energy or particles with its surroundings
 (B) can exchange energy but not particles with its surroundings
 (C) can exchange both energy and particles with its surroundings
 (D) can receive heat energy from its surroundings but does not perform any mechanical work
90. The electric susceptibility and permittivity of a dielectric medium are χ and ϵ respectively. If ϵ_0 is the permittivity of free space, then -
 (A) $\epsilon = \epsilon_0 \chi$ (B) $\epsilon = \epsilon_0(1 + \chi)$
 (C) $\chi = \frac{\epsilon - 1}{\epsilon_0}$ (D) $\frac{1}{\epsilon} = \left(\frac{1}{\chi} + \epsilon_0\right)$
91. Which of the following is true for JFET?
 (A) It is a unipolar device
 (B) The pn junction between the gate and the source is always forward biased
 (C) It is a current controlled voltage device
 (D) The gate current in JFET is very high.
92. When a pentavalent impurity is added to a pure semiconductor, it becomes -
 (A) an insulator (B) an n-type semiconductor
 (C) a p-type semiconductor (D) an intrinsic semiconductor
93. The magnetic susceptibility of a diamagnetic material is -
 (A) zero
 (B) greater than that of paramagnetic material
 (C) a negative quantity
 (D) directly proportional to the absolute temperature of the material
94. The breakdown voltage of a Zener diode is determined by -
 (A) the external voltage
 (B) the external current
 (C) both the external voltage and the external current
 (D) the level of doping

95. The relation between the entropy S of a thermodynamic system and the thermodynamic probability W is -
 (A) $S = e^{-kW}$ (B) $S = k \ln W$ (C) $S = kW^{3/2}$ (D) $S = \sqrt{kW}$
 where k is the Boltzmann constant.
96. An air-core solenoid of length L has n turns of closely wound wire. Its length is very large in comparison with its diameter. The self inductance of the solenoid is proportional to -
 (A) nL (B) $\frac{n}{L}$ (C) $\frac{n^2}{L}$ (D) nL^2
97. In a transistor amplifier in CB configuration -
 (A) the phase difference between the input voltage and the output voltage is $\frac{\pi}{2}$
 (B) the input voltage and the output voltage are in phase
 (C) the input resistance is very high
 (D) the output resistance is very low
98. In Ramsden's eyepiece -
 (A) both the eye lens and the field lens are plano convex lenses of equal focal length
 (B) the focal length of the field lens is three times the focal length of the eye lens
 (C) the chromatic aberration is absent
 (D) the cross wire is mounted between the eye lens and the field lens
99. When a pn junction is forward biased, the width of the depletion layer -
 (A) becomes zero
 (B) increases
 (C) decreases
 (D) remains unchanged
100. A diffraction pattern is produced by a narrow slit illuminated by a monochromatic blue light. If the source of light is replaced by a source of red light, the diffraction pattern will -
 (A) expand (B) shrink
 (C) disappear (D) remain unchanged.

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