Sl. No. : **10000065**

PH/12

Register Number | | | | | | | | |

2012

PHYSICS
(P.G. Standard)

Time Allowed : 3 Hours] [Maximum Marks : 300

Read the following instructions carefully before you begin to answer the questions.

IMPORTANT INSTRUCTIONS

1. This Booklet has a cover (this page) which should not be opened till the invigilator gives signal to open it at the commencement of the examination. As soon as the signal is received you should tear the right side of the booklet cover carefully to open the booklet. Then proceed to answer the questions.

2. This Question Booklet contains 200 questions.

3. Answer all questions. All questions carry equal marks.

4. You must write your Register Number in the space provided on the top right side of this page. Do not write anything else on the Question Booklet.

5. An Answer Sheet will be supplied to you separately by the Invigilator to mark the answers. You must write your Name, Register No., Question Booklet Sl. No. and other particulars on side 1 of the Answer Sheet provided, failing which your Answer Sheet will not be evaluated.

6. You will also encode your Register Number, Subject Code, Question Booklet Sl. No. etc. with Blue or Black ink Ball point pen in the space provided on the side 2 of the Answer Sheet. If you do not encode properly or fail to encode the above information, your Answer Sheet will not be evaluated.

7. Each question comprises *four* responses (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark in your Answer Sheet. In case, you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.

8. In the Answer Sheet there are four brackets [A] [B] [C] and [D] against each question. To answer the questions you are to mark with Ball point pen ONLY ONE bracket of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. *e.g.* If for any item, [B] is the correct answer, you have to mark as follows :

[A] ■ [C] [D]

9. You should not remove or tear off any sheet from this Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. After the examination is concluded, you must hand over your Answer Sheet to the Invigilator. You are allowed to take the Question Booklet with you only after the Examination is over.

10 Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

11. Do not tick-mark or mark the answers in the Question booklet.

SEAL

1. The SR flip flop does not accept the following input entry

(A) both inputs zero
(B) zero at R and one at S
(C) zero at S and one at R
(D) both inputs at one

2. The magnetic moment of proton is 2.79 nuclear magneton, then the magnetic moment of deuteron will be

(A) zero
(B) 2.79 nuclear magneton
(C) 0.86 nuclear magneton
(D) 1.79 nuclear magneton

3. WKB-quantization rule is

(A) $\int_a^b p\, dx = \left(n + \frac{1}{2}\right)\pi\hbar$
(B) $\int_a^b p\, dx = n\hbar$
(C) $\int_a^b p^2\, dx = n\hbar^2$
(D) $\int_a^b p^2\, dx = (n+1)\pi\hbar$

4. Select the correct statement among the following :

(A) In NMR, the set of nuclear levels are magnetic in origin whereas they are electrical in NQR
(B) In NMR, the set of nuclear levels are electrical in origin whereas they are magnetic in NQR
(C) both (A) and (B) are correct
(D) both (A) and (B) are not correct

5. The specific heat of an ideal Fermi gas in 3-dimension at very low temperatures (T) varies as

(A) T
(B) $T^{3/2}$
(C) T^2
(D) T^3

6. The principle of least action is associated with

(A) Hamiltonian formulation
(B) Lagrangian formulation
(C) Newtonian mechanics
(D) Relativity concept

7. Accelerated reference frames are called as

(A) non-inertial frames
(B) inertial frames
(C) Minkowski frames
(D) Galilean frames

8. The value of $P_n'(1)$ is

(A) 1 (B) n

(C) $\frac{1}{2}n(n+1)$ (D) none of the above

9. During reflection of E.M. wave on matter

(A) frequency is changed (B) frequency is unchanged

(C) energy is changed (D) none of these

10. The color information in the T.V. transmission is contained in

(A) luminance signal (B) chrominance signal

(C) luminance and chrominance signals (D) other signals

11. Vibration in polarizability is the essential criterion for

(A) NMR (B) ESR

(C) IR lines (D) Raman lines

12. Stark effect is studied using

(A) 1st order perturbation theory

(B) 2nd order perturbation theory for degenerate states

(C) 2nd order perturbation theory for non-degenerate states

(D) WKB-approximation

13. What is X in $n \rightarrow p + e^- + X$?

(A) e^+ (B) υ_μ

(C) υ_e (D) $\bar{\upsilon}_e$

14. The race hazard problem occurs due to

(A) faulty design of logic circuits

(B) non-redundant form of the circuit

(C) time delay in circuits due to high speed logic

(D) all of the above

15. In principle of least action at the end points of the path, the quantity held fixed is

(A) time (B) position co-ordinate

(C) displacement (D) both time and displacement

16. Unaccelerated reference frames are called as

(A) Galilean frames (B) Non-inertial frames

(C) Constant frames (D) Momentumless frames

17. The value of $L_n(X) - L_{n+1}(X)$ is

(A) $L_{n-1}(X)$ (B) $XL_{n-1}(X)$

(C) $L_n'(X)$ (D) $\int_0^X L_n(X)\, dX$

18. Snell's law is

(A) $\frac{n_1 \sin\theta_1}{n_2 \sin\theta_1} = 0$ (B) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

(C) $n_1 \cos\theta_1 = n_2 \cos\theta_2$ (D) none of these

19. In interlaced scanning in television each picture is divided into ———————.

(A) two fields (B) ten fields

(C) fifty fields (D) hundred fields

20. The television camera works on the principle of

(A) Compton effect (B) Zeeman effect

(C) Photoelectric effect (D) None of the above mentioned effects

21. In the propagation of EM wave in conducting medium

(A) the vectors $\bar{E}$ and $\bar{H}$ are in a plane

(B) the vectors $\bar{E}$ and $\bar{H}$ are mutually perpendicular

(C) the vector $\bar{E}$ alone perpendicular to direction of propagation

(D) the vector $\bar{H}$ alone perpendicular to direction of propagation

22. What is the modulus of $\frac{1-i}{1+i}$?

(A) $\sqrt{2}$ (B) 2

(C) $\frac{1}{\sqrt{2}}$ (D) 1

23. The value of rest energy of an electron in electron volt is

(A) 5.1 MeV (B) 51 MeV

(C) 0.51 MeV (D) 5.001 MeV

($\because$ Mass of an electron $= 9.11 \times 10^{-31}$ kg ; 1 eV $= 1.6 \times 10^{-19}$)

24. The principle of least action is

(A) $\int_{t_1}^{t_2} \sum p_k \dot{q}_k \, dt = 0$ (B) $\Delta \int \sum p_k \dot{q}_k \, dt = 0$

(C) $\Delta \int_{t_1}^{t_2} \sum p_k \dot{q}_k \, dt = 0$ (D) $\int \sum p_k q_k \, dt = 0$

25. The phenomenon of resonance fluorescence of gamma rays is known as

(A) Raman effect (B) Zeeman effect

(C) Mossbauer effect (D) Frank-Condon principle

26. Consider black body radiation in a cavity maintained at 2000 K. If the volume of the cavity is reversibly and adiabatically increased from 10 cm^3 to 640 cm^3, the temperature of the cavity changes to

(A) 800 K (B) 700 K

(C) 600 K (D) 500 K

27. Energy correction in 1st order time independent perturbation theory

(A) $E_1 = \langle m \mid H' \mid m \rangle$ (B) $E_1 = \langle m \mid H' \mid n \rangle$

(C) $E_1 = \langle m \mid H' \mid m+1 \rangle$ (D) $E_1 = \langle m \mid H' \mid n+1 \rangle$

28. The Unit of Fermi age is

(A) cm^2 (B) cm

(C) sec (D) sec^2

29. The number of flip-flops required to construct a register capable of storing $(2010)_{10}$ in binary is

(A) 4 (B) 8

(C) 11 (D) 12

30. Nowadays the screen of the television is made of

(A) CRT – Cathode Ray Tube
(B) LED – Light Emitting Diodes
(C) TFT – Thin Film Technology
(D) LCD – Liquid Crystal Display

31. Drude-Lorentz expression is

(A) $\sigma_0 = \frac{Ne^2 r}{m}$
(B) $\sigma_r = \frac{Ne^2 r}{m}$
(C) $\sigma_0 \sigma_r = \frac{Ne^2 r}{m}$
(D) $\epsilon_0 = \frac{Nr}{m}$

32. The value of $L_n'(0)$ is

(A) 0
(B) n
(C) $-n$
(D) 1

33. A point in Minkowski world is called as

(A) Minkowski point
(B) World point
(C) World line
(D) Minkowski source point

34. Analytically Δ-variation of any function can be represented as $\Delta f =$

(A) $\delta f \div \frac{df}{dt}$
(B) $\delta f + \Delta t$
(C) $\delta f + \delta t$
(D) $\delta f + \Delta t \frac{df}{dt}$

35. The equation of state of dilute gas at very high temperature is described by $pv/K_B \approx 1 + B(T)/v$, where v is the volume per particle and $B(T)$ is a negative quantity. One can conclude that this is a property of

(A) a van der Walls gas
(B) an ideal Fermi gas
(C) an ideal Bose gas
(D) an ideal inert gas

36. Which of the following relations between internal energy U and the canonical partition function Z, is true?

(A) $U = -\frac{\partial}{\partial T} \log Z$
(B) $U = +k_B T^2 \frac{\partial}{\partial T} \log Z$
(C) $U = -KT \log Z$
(D) $U = KT \frac{\partial}{\partial V} \log Z$

37. The presence of permanent dipole moment is an essential criterion for

(A) Infra-red spectra
(B) Raman spectra
(C) Emission spectra
(D) Absorption spectra

38. Bohr radius is equal to

(A) 1 Å
(B) 2.6 Å
(C) 3.0 Å
(D) 0.53 Å

39. $\pi^{\pm}$, π^{0} particles are classified as

(A) Leptons
(B) Non-strange mesons
(C) Strange mesons
(D) Non-strange baryons

40. MOD 256 counter must have ———— flip flops.

(A) 8
(B) 9
(C) 10
(D) 256

41. The Three electron guns in the color T.V. produces

(A) red, green and blue colors
(B) red, green and yellow colors
(C) red, yellow and blue colors
(D) red, green and violet colors

42. Which one of the following is not a sequential circuit?

(A) JK flip flop
(B) Counter
(C) Full adder
(D) Shift register

43. In β-decay the interactions involved are

(A) scalar
(B) scalar and vector
(C) tensor and axial vector
(D) scalar and pseudoscalar

44. Energy of the 1st excited state of Hydrogen atom

(A) 13.6 eV
(B) 6.8 eV
(C) 3.4 eV
(D) 1.7 eV

45. Which type of laser is used in laser printer and compact disc players?

(A) Helium-Neon laser
(B) Ruby laser
(C) Semiconductor laser
(D) Carbon-di-oxide laser

46. In a micro canonical ensemble, a system A of fixed volume is in contact with a large reservoir B, then

(A) A can exchange only energy with B

(B) A can exchange only particles with B

(C) A can exchange neither energy nor particles with B

(D) A can exchange both energy and particles with B

47. The Jacobi's form of the principle of least action is

(A) $\Delta\int_{t_1}^{t_2}\sum p_k\dot{q}_k\,dt = 0$

(B) $\Delta\int_{t_1}^{t_2} 2T\,dt = 0$

(C) $\Delta\int\sqrt{(H-V)}\,d\rho = 0$

(D) $\int\sqrt{(H-V)}\,d\rho = 0$

48. Transformation equation for energy of a particle moving along x direction is

(A) $E' = \dfrac{E - \upsilon Px}{\sqrt{1-\beta^2}}$

(B) $E' = \dfrac{E}{\sqrt{1-\beta^2}}$

(C) $E' = \dfrac{Px}{\sqrt{1-\beta^2}}$

(D) $E' = E\sqrt{1-\beta^2}$

[$\because$ P – momentum, $\beta^2 = \upsilon^2/c^2$, υ – velocity of a particle, c – velocity of light]

49. $XY'' + (1-X)Y' + \lambda Y = 0$ is the ———————— equation.

(A) Legendre

(B) Hermite

(C) Lagurre

(D) Bessel

50. The E.M. wave in a conducting medium

(A) the wave is longitudinal with respect to $\bar{E}$ and $\bar{H}$

(B) the wave is transverse with respect to $\bar{E}$ and $\bar{H}$

(C) the wave is in plane with respect to $\bar{E}$ and $\bar{H}$

(D) none of these

51. The viewing screen of the color television is a glass plate deposited with

(A) RGB phosphor dots

(B) RGY phosphor dots

(C) RYB phosphor dots

(D) RGV phosphor dots

52. Gibbs thermo dynamical potential can be represented as $G = H - TS$, which of the relation hold true?

(A) $\left(\frac{\partial S}{\partial V}\right)_{U, N} = -\frac{P}{T}$

(B) $\left(\frac{\partial S}{\partial V}\right)_{U, N} = \frac{P}{T}$

(C) $\left(\frac{\partial S}{\partial U}\right)_{V, N} = -\frac{P}{T}$

(D) $\left(\frac{\partial S}{\partial U}\right)_{V, N} = \frac{P}{T}$

53. Laser emission is very highly coherent

(A) in time

(B) in space

(C) both in time and space

(D) neither in time nor in space

54. Which of the following Hydrogen atom wave functions is irrelevant?

(A) $\Psi_{100}(\bar{r})$

(B) $\Psi_{200}(\bar{r})$

(C) $\Psi_{110}(\bar{r})$

(D) $\Psi_{21-1}(\bar{r})$

55. The ratio of the number of neutrons produced by fission in any one generation to the number in the immediately preceding generation is called

(A) Multiplication factor

(B) Thermal utilization factor

(C) Fast fission factor

(D) Fission fraction

56. Asynchronous counters are known as

(A) ripple counters

(B) multiple clock counters

(C) decade counters

(D) modulus counters

57. A J-K flip flop is a device to

(A) divide the frequency by 2

(B) divide the frequency by 4

(C) generate waveforms of same frequency as that of the input

(D) cannot be used for frequency division

58. The condition $\frac{dH}{dt} = 0$ states that

(A) H is the Hamiltonian

(B) H is total energy

(C) H is a constant of motion

(D) H is the equation of motion

59. $E^2 - c^2 p^2$ is (E – Energy; c – Velocity of light; p – Momentum)

(A) Einstein invariant
(B) Lorentz invariant
(C) Bucherer invariant
(D) Fitzgerald invariant

60. Bessel's functions are known as ———— harmonics.

(A) cylindrical
(B) spherical
(C) solid spherical
(D) surface

61. In the progressive wave

(A) Poynting vector is undamped
(B) Poynting vector is damped
(C) Poynting vector is forced
(D) None of these

62. In T.V. transmission system,

(A) video signals are used to amplitude modulate and audio signals are used to frequency modulate the r.f. waves
(B) video signals are used to frequency modulate and audio signals are used to amplitude modulate the r.f. waves
(C) both video and audio signals are used to amplitude modulate r.f. waves
(D) both video and audio signals are used to frequency modulate r.f. waves

63. In relation to statistical mechanics – (Choose incorrect statement)

(A) All particles of a given kind are treated as mutually indistinguishable
(B) The phase space for n degrees of freedom will have $2n$ dimensions and its unit cell volume will be h^n
(C) With a system having $N \sim 10^{23}$ particles, probability of two halves of a box having particle density difference of 0.001% is negligibly small
(D) Photons may be treated as following Fermi Dirac statistics

64. Temporal coherence is characterised by

(A) time
(B) temperature
(C) temporary space
(D) none of the above

65. $\Psi(\bar{r}, t)$ is the ———— for the particle to be found at position $\bar{r}$ and time t.

(A) probability
(B) momentum
(C) wave energy
(D) probability amplitude

66. Identify the compound nucleus for the two reactions $O^{16}(d, p)\ O^{17}$ and $N^{14}(\alpha, p)\ O^{17}$.

(A) F^{16} (B) F^{17}

(C) O^{17} (D) F^{19}

67. A J-K flip flop is in the toggle condition when

(A) J = 1; K = 0 (B) J = 1; K = 1

(C) J = 0; K = 0 (D) J = 0; K = 1

68. The modified Hamilton principle is

(A) $\delta \int \left[\sum_i p_i q_i - H(p_i, q_i, t) \right] dt = 0$ (B) $\int \left[\sum_i p_i \dot{q}_i - H(p_i, q_i, t) \right] dt = 0$

(C) $\delta \int \left[\sum_i p_i \dot{q}_i - H(p_i, q_i, t) \right] dt = 0$ (D) $\int \left[\sum_i \dot{p}_i q_i - H(\dot{p}_i, \dot{q}_i, t) \right] dt = 0$

69. $E^2 - p^2c^2$ is equal to

(A) $m_0^2 c^2$ (B) mc^2

(C) $(m^2c^8)^{1/2}$ (D) $(m_0c^2)^2$

($\because$ E – energy; m_0 – rest mass; c = velocity of light; p – momentum)

70. $\frac{d^2Y}{dX^2} + \frac{1}{X}\frac{dY}{dX} + \left(1 - \frac{n^2}{X^2}\right)Y = 0$ is the ———————— equation.

(A) Bessel's (B) Legendre's

(C) Hermite's (D) None of the above

71. In the case of propagation of E.M. wave in conducting medium

(A) the wave gets amplified (B) the wave gets phase shift

(C) the wave gets attenuated (D) none of these

72. Hamiltonian represents

(A) potential energy (B) kinetic energy

(C) total energy (D) difference energy

73. $m_0^2c^4$ is [$\because$ m_0 – rest mass; c – velocity of light]

(A) Einstein invariant (B) Lorentz invariant

(C) Bucherer invariant (D) Fitzgerald invariant

74. $(1-X^2)\frac{d^2Y}{dX^2} - 2X\frac{dY}{dX} + n(n+1)Y = 0$ is the _____ equation.

(A) Bessel
(B) Legendre
(C) Hermite
(D) Lagurre

75. Equation of telegraphy is

(A) $\nabla^2\vec{E} - \sigma\mu\frac{\partial\vec{E}}{\partial t^2} - \mu\in\frac{\partial\vec{E}}{\partial t^2} = 0$
(B) $\nabla^2\vec{V} - \sigma\mu\frac{\partial\vec{E}}{\partial t^2} - \mu\in\frac{\partial\vec{E}}{\partial t^2} = 0$
(C) $\nabla^2\vec{E} + \sigma\mu\frac{\partial\vec{E}}{\partial t^2} - \mu\in\frac{\partial\vec{E}}{\partial t^2} = 0$
(D) none of these

76. The amplitude modulated wave contains

(A) carrier frequency, f_c alone
(B) $f_s + f_c$ and $f_c - f_s$ alone, where f_s is the side band frequency
(C) f_c, $f_s + f_c$, $f_c - f_s$
(D) none of the above

77. If λ_m for solar radiation is 4753 Å, then the temperature of the photosphere of the Sun will be

(A) 6100 K
(B) 6100°C
(C) 61000 K
(D) 61000°C

78. Which type of pumping is used in He-Ne laser?

(A) Optical pumping
(B) Electrical pumping
(C) Magnetic pumping
(D) Mechanical pumping

79. Which of the following equation represents Schrödinger equation?

(A) $E^2\Psi = H^2\Psi$
(B) $i\hbar\frac{\partial^2\Psi}{\partial t^2} = H\Psi$
(C) $i\hbar\frac{\partial\Psi}{\partial t} = H\Psi$
(D) $E\Psi^2 = H\Psi^2$

80. Schmidt lines are related to the

(A) magnetic moment of the nucleus
(B) quadrupole moment of the nucleus
(C) size of the nucleus
(D) charge of the nucleus

81. The inputs to a 2-input EXOR gate are A and B. The EX-OR gate can function as a NOT gate if

(A) one of the inputs is kept high
(B) one of the inputs is kept low
(C) both inputs are kept low
(D) both inputs are kept high

82. In AM modulation, if the carrier wave power is P_C and side band power is P_S, the total power of the A.M. wave is

(A) $P_C - P_S$
(B) $P_C + P_S$
(C) $(P_C + P_S)/2$
(D) $(P_C - P_S)/2$

83. A perfect black body is radiating at $T_1 K$. Its radiation rate is to be increased to 16 times. What will be temperature $T_2 K$ for this?

(A) $T_2 = 16\ T_1$
(B) $T_2 = 8\ T_1$
(C) $T_2 = 4\ T_1$
(D) $T_2 = 2\ T_1$

84. Raman effect is useful for which type of analysis?

(A) Qualitative analysis
(B) Quantitative analysis
(C) Neither qualitative nor quantitative analysis
(D) Both qualitative and quantitative analysis

85. One of the postulate of quantum mechanics

(A) operators are substituted for dynamical variables
(B) operators have no role to play
(C) wave functions are replacing dynamical variables
(D) velocity of light is infinity

86. In singlet states the nuclear forces are

(A) central forces
(B) tensor forces
(C) combination of central and tensor forces
(D) non existing

87. In a four variable K-map, for an octet, 'N' number of variables and their complements drop out when reduced. 'N' equals

(A) one
(B) two
(C) three
(D) four

88. The power of carrier wave in A.M. is related to the amplitude as

(A) $\propto E_C / \sqrt{2}$ (B) $\propto \frac{\sqrt{2}}{E_C}$

(C) $\propto (E_C)^2 / 2$ (D) $\propto \frac{2}{(E_C)^2}$

89. The speed of electromagnetic wave in isotropic dielectrics is

(A) greater than the speed of the electromagnetic waves in free space

(B) less than the speed of the electromagnetic waves in free space

(C) equal the speed of the electromagnetic waves in free space

(D) none of these

90. The value of $(P_1^0)^2 + (P_1^1)^2$ is

(A) 0 (B) 1

(C) -1 (D) none of the above

91. Transformation equation for momentum of a particle moving along x direction is

(A) $px' = \frac{x - \upsilon E / c^2}{\sqrt{1-\beta^2}}$ (B) $px' = \frac{px}{\sqrt{1-\beta^2}}$

(C) $px' = \frac{\upsilon E}{\sqrt{1-\beta^2}}$ (D) $px' = \frac{px - \upsilon E / c^2}{\sqrt{1-\beta^2}}$

[$\because$ p – momentum, υ – velocity of a particle, E – energy, $\beta^2 = \upsilon^2 / c^2$]

92. The function $W = \int \left(\sum_j p_j \dot{q}_j \right) dt$ is

(A) Hamiltonian (B) Jacobian

(C) Lagrangian (D) Eulerian

93. The enthalpy of unit mass for any system is

(A) $H = U + PV + S$ (B) $H = U + PV - S$

(C) $H = U + PV$ (D) None of these

94. Normally the output of a Helium-Neon laser is

(A) discontinuous and stable (B) continuous and stable

(C) continuous and unstable (D) discontinuous and unstable

95. The wave function $\Psi(x, t)$ describes a particle with

(A) two degrees of freedom
(B) one degree of freedom
(C) three degrees of freedom
(D) zero velocity

96. The ground state of deuteron is a

(A) pure s state
(B) pure d state
(C) pure p state
(D) mixture of s and d states

97. Transformation equation for mass (m') is

(A) $m' = \dfrac{m_0}{\left(1 - \dfrac{\upsilon^2}{c^2}\right)^{-1/2}}$

(B) $m_0 = m'\left(1 - \dfrac{\upsilon^2}{c^2}\right)^{1/2}$

(C) $m' = \dfrac{m_0}{\left(1 - \dfrac{\upsilon^2}{c^2}\right)^{1/2}}$

(D) $m' = m_0 c$

($\because$ m_0 – rest mass, c – velocity of light, υ – velocity of a particle)

98. The lower and upper limits of Legendre polynomial is -

(A) 0, 1
(B) –1, 0
(C) –1, 1
(D) 0, infinity

99. Coulomb gauge is

(A) vector potential
(B) vector field
(C) electrostatic potential
(D) none of these

100. One kilogram of ice melts at 0°C into water. The change in entropy is (in cal/K)

(A) ∞
(B) 0
(C) 0.293
(D) 293

101. All vibrations producing a change in the electric dipole moment of a molecule yield

(A) Raman spectra
(B) Infrared spectra
(C) X-ray spectra
(D) Ultra violet spectra

102. The mathematical expression for optical theorem is σ =

(A) $\dfrac{4\pi}{k^2}\sum_{l=0}^{\infty}(2l+1)\,f(\theta)$

(B) $\dfrac{1}{k}\sum_{l=0}^{\infty}(2l+1)\,f(0)$

(C) $\dfrac{4\pi}{k}\,\mathrm{Im}\,f(0)$

(D) $\dfrac{4\pi}{k}\,\mathrm{Re}\,f(0)$

103. Energy release in a pair annihilation

(A) 20 MeV
(B) 1.02 MeV
(C) 2.02 MeV
(D) 10 MeV

104. AND-OR network is identically equivalent to which of the following networks?

(A) NOR-NOR
(B) OR-AND
(C) NAND-OR
(D) NAND-NAND

105. The phase space has

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

106. In amplitude modulation

(A) amplitude of the carrier wave is varied, frequency and phase are kept constant
(B) amplitude of the carrier wave is constant, frequency and phase is varied
(C) amplitude and phase of the carrier wave is varied and frequency is kept constant
(D) all amplitude, phase and frequency of the carrier wave are varied

107. Which of the following is not Maxwell's thermodynamic relation?

(A) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_T$
(B) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$
(C) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$
(D) $\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial T}\right)_V$

108. In scattering theory, the cross-sections are usually measured in

(A) degrees
(B) radians
(C) barns
(D) solid angles

109. Minimum energy needed for pair creation is

(A) 200 MeV
(B) 1.02 MeV
(C) 2.02 MeV
(D) 100 MeV

110. Minimized output function of $F = \Sigma_m(2, 6, 10, 11, 12, 13) + d(3, 4, 5, 14, 15)$ is

(A) $AB + C\overline{D} + AC$
(B) $AB + C\overline{D} + AC + \overline{A}\,\overline{B}C$
(C) $C\overline{D} + A\overline{B} + AC$
(D) $AB + CD + AC$

111. Hamiltonian for a charged particle in a em field interms of momentum is H =

(A) $\frac{m}{2}\left(P-\frac{q}{c}\right)A^2+qQ$ (B) $\frac{1}{2m}\left(P+\frac{q}{c}\right)A^2+qQ$

(C) $\frac{1}{2m}\left(P-\frac{q}{c}\right)A^2+qQ$ (D) $\frac{1}{2m}\left(P-\frac{q}{c}\right)A^2-qQ$

112. The velocity of a photon attains the velocity of light c. Momentum of the photon is

(A) mc (B) m_0c

(C) m_0c^2 (D) $(m-m_0)c$

113. Equation of a standing wave supported by a vibrating string is

(A) $\lambda=\frac{2n}{l}$ (B) $\lambda=\frac{2l}{n}$

(C) $\lambda=\frac{4n}{l}$ (D) $\lambda=\frac{4l}{n}$

114. Coulomb gauge equation is

(A) $\Box^2 A=\mu J_t$ (B) $\Box^2 A=-\mu J_t$

(C) $\Box^2 A=\mu_r J_t$ (D) $\Box^2 A=-\mu_r J_t$

115. Which of the following can be used as frequency divider?

(A) Astable multivibrator (B) Monostable multivibrator

(C) Bistable multivibrator (D) Schmitt trigger

116. In Boolean Algebra, if $f=(A+B)(\overline{A}+C)$, then

(A) $f=AB+\overline{A}C$ (B) $f=AB+\overline{AB}$

(C) $f=AC+\overline{A}B+BC$ (D) $f=AA+\overline{A}B$

117. Energy release per fission using Uranium

(A) 200 MeV (B) 100 MeV

(C) 500 MeV (D) 300 MeV

118. Total scattering cross section is given by

(A) $\int|f(\theta)|^2\,d\theta$ (B) $2\pi\int_0^{\infty}\sigma(\theta)\sin\theta\,d\theta$

(C) $\int_0^{\infty}\sigma(\theta)\sin\theta\,d\theta$ (D) $\frac{2\pi}{T}\int_0^{\infty}\sigma(\theta)\sin\theta\,d\theta$

119. Assuming that the L-S coupling scheme is valid, the number of permitted transitions from $^2P_{3/2}$ to $^2S_{1/2}$ due to a weak magnetic field is

(A) 2 (B) 4

(C) 6 (D) 10

120. Specific heats of a gas at constant volume (C_v) and at constant pressure (C_p) are related as

(A) $C_p / C_v = 1 - R/J$ (B) $C_p - C_v = R/J$

(C) $C_p - C_v = J/R$ (D) $C_p + C_v = R/J$

121. If a coordinate is cyclic, Hamiltonian would reduce the number of variables in new formulation by

(A) one (B) two

(C) three (D) four

122. 1 amu = ($\because$ amu = Atomic Mass Unit)

(A) 93.11 MeV (B) 9.31 MeV

(C) 931.1 MeV (D) None of these

123. The analytic function $f(z)$ of which the real part is $e^X \cos Y$ is

(A) e^z (B) e^{iz}

(C) e^{-iz} (D) $e^{|z|}$

124. The advantage of Lorentz gauge is

(A) A and ϕ are dependent (B) A and ϕ are independent

(C) A is only independent (D) None of these

125. Residue of $\frac{z}{(z-a)(z-b)}$ at infinity is

(A) 1 (B) 0

(C) -1 (D) none of the above

126. The Einstein mass-energy relation

($\because$ E – energy, m – mass, m_0 – rest mass, c – velocity of light)

(A) $E = m_0c^2 - mc^2$ (B) $E = mc^2$

(C) $E = m_0c^2$ (D) $E = (m - m_0)c^2$

127. The Hamilton's equations are

(A) $\dot{q}_i = \frac{\partial H}{\partial p_i}$, $\dot{p}_i = \frac{\partial H}{\partial q_i}$

(B) $q_i = \frac{\partial H}{\partial p_i}$, $p_i = \frac{\partial H}{\partial q_i}$

(C) $\dot{q}_i = \frac{\partial H}{\partial p_i}$, $\dot{p}_i = -\frac{\partial H}{\partial q_i}$

(D) $\dot{q}_i = -\frac{\partial H}{\partial p_i}$, $\dot{p}_i = \frac{\partial H}{\partial q_i}$

128. Phase shift oscillator contains

(A) circuit with L and C components

(B) circuit with R and C components

(C) circuit with L, C and R components

(D) none of the above components

129. According to Maxwell's law of distribution of velocity of molecules, the most probable velocity is

(A) greater than the mean velocity

(B) equal to the mean velocity

(C) less than the v_{rms}

(D) greater than the v_{rms}

(v_{rms} : root mean square velocity)

130. Consider the pure rotational spectrum of diatomic rigid rotor. The separation between two consecutive lines in the spectrum

(A) is directly proportional to the moment of inertia of the rotor

(B) is inversely proportional to the moment of inertia of the rotor

(C) depends on the angular momentum

(D) is directly proportional to the square of the interatomic separation

131. The transition amplitude due to an alteration in Hamiltonian $(H - H_0)$ for a time interval T in sudden approximation is

(A) zero

(B) minimum

(C) maximum

(D) constant

132. Nuclear reaction in Sun

(A) fission (B) fusion

(C) meson exchange (D) pion exchange

133. Boolean expression $[A\overline{B}(C+BD)+\overline{A}\,\overline{B}]C$ can be reduced to

(A) $\overline{B}C$ (B) $B\overline{C}$

(C) AB (D) $A\overline{B}$

134. A cyclic coordinate is one which does not appear in the

(A) Lagrangian (B) Hamiltonian

(C) Both Lagrangian and Hamiltonian (D) Kinetic energy

135. The rest mass of photon is

(A) one (B) zero

(C) $(3\times10^{8})^{2}$ (D) 1/2

136. What is the nature of wave equation?

(A) Elliptic (B) Parabolic

(C) Hyperbolic (D) Circular

137. Lorentz gauge transformations condition is

(A) $\triangle^{2}A=0$ (B) $\square^{2}A=0$

(C) $\square^{2}B=0$ (D) none of these

138. The frequency of oscillation of phase shift oscillator is given by

(A) $f=\frac{1}{2\pi RC}$ (B) $f=\frac{1}{2\pi\sqrt{LC}}$

(C) $f=\frac{1}{1.38RC}$ (D) $f=\frac{1}{2\pi RC\sqrt{6}}$

139. Ampere's law is

(A) $\nabla\cdot\vec{H}=\vec{J}+\frac{\partial\vec{D}}{\partial t}$ (B) $\nabla\times\vec{H}=\vec{J}+\frac{\partial\vec{D}}{\partial t}$

(C) $\nabla\times\vec{H}=\vec{J}\cdot\frac{\partial\vec{D}}{\partial t}$ (D) none of these

140. Cauchy Riemann conditions are

(A) $\frac{\partial U}{\partial X} = \frac{\partial V}{\partial Y}$; $\frac{\partial V}{\partial X} = -\frac{\partial U}{\partial Y}$ (B) $\frac{\partial U}{\partial X} = 0$; $\frac{\partial V}{\partial Y} = 0$

(C) $\frac{\partial U}{\partial X} = -\frac{\partial V}{\partial Y}$; $\frac{\partial V}{\partial X} = \frac{\partial U}{\partial Y}$ (D) Both (A) and (C)

141. The relativistic formula for kinetic energy

(A) $E_k = m_0c^2 - mc^2$ (B) $E_k = mc^2$

(C) $E_k = mc^2 - m_0c^2$ (D) $E_k = \frac{1}{2}mc^2 + v_0$

($\because$ m – mass; m_0 – rest mass; v_0 – potential energy)

142. When the Hamiltonian is cyclic in Q, then the momentum P is

(A) constant (B) maximum

(C) zero (D) minimum

143. The fundamental relation for the grand canonical ensemble is

(A) $-PV = -KT \ln \Xi(T, V, \mu)$ (B) $S = k \ln \Omega(U, V, N)$

(C) $A = -KT \ln Q(T, V, N)$ (D) $G = -KT \ln \Delta(T, P, N)$

144. Deutron in its ground state has a total angular momentum $j = 1$ and a positive parity. The corresponding orbital angular momentum L and spin S combinations are

(A) $L = 0$, $S = 1$ and $L = 2$, $S = 0$ (B) $L = 0$, $S = 1$ and $L = 1$, $S = 1$

(C) $L = 0$, $S = 1$ and $L = 2$, $S = 1$ (D) $L = 1$, $S = 1$ and $L = 2$, $S = 1$

145. The selection rule for electric quadrupole transitions is $\Delta l =$

(A) ± 1 (B) $0, \pm 1$

(C) ± 2 (D) $0, \pm 2$

146. Gamow theory deals with

(A) Alpha decay (B) Beta decay

(C) Gamma decay (D) Proton decay

147. $\overline{ABCD} + B\overline{C}D + \overline{AC} + A$ is equivalent to

(A) 1 (B) $\overline{C}$

(C) $\overline{A} + C$ (D) $A + \overline{C}$

148. The Poynting vector is

(A) $\bar{J} = (\bar{E} \cdot \bar{H})$ (B) $\bar{S} = (\bar{E} \cdot \bar{H})$

(C) $\bar{S} = (\bar{E} \times \bar{H})$ (D) none of these

149. Variation of mass with velocity of a particle expressed as (m_0 – rest mass; v – velocity of a particle; c – velocity of light)

(A) $m = \dfrac{m_0}{1 - \dfrac{v^2}{c^2}}$ (B) $m = \dfrac{m_0}{\left(1 - \dfrac{v^2}{c^2}\right)^{-1/2}}$

(C) $m = \dfrac{m_0}{\sqrt{1 - \dfrac{v^2}{c^2}}}$ (D) $m = \dfrac{m_0}{\sqrt{1 - \dfrac{v}{c^2}}}$

150. Cauchy integral theorem states

(A) $\int_C f(z)\, dz = 0$ (B) $\int_C f(z)\, dz = 1$

(C) $\int_C f(z)\, dz = -1$ (D) $\int_C f(z)\, dz = \pm 1$

151. In the equation $curl\, \bar{H} = \bar{J} + \dfrac{\partial \bar{D}}{\partial t}$, the $\dfrac{\partial \bar{D}}{\partial t}$ is called

(A) displacement voltage (B) displacement field

(C) displacement current (D) none of these

152. The common collector amplifier is also called

(A) Cascade amplifier (B) Darlington amplifier

(C) Emitter follower (D) Tuned amplifier

153. For a system of N independent, identical and indistinguishable particles, the relation between Q, the system partition function and q, the particle function is

(A) $Q = Nq$ (B) $Q = q^N / N!$

(C) $Q = q^N$ (D) $Q = N! q^N$

154. Which one of the following order is correct?

(A) $\sigma \to \sigma^* > n \to \pi^* > n \to \sigma^* > \pi \to \pi^*$

(B) $\sigma \to \sigma^* < n \to \pi^* < n \to \sigma^* < \pi \to \pi^*$

(C) $\sigma \to \sigma^* < n \to \sigma^* < \pi \to \pi^* < n \to \pi^*$

(D) $\sigma \to \sigma^* > n \to \sigma^* > \pi \to \pi^* > n \to \pi^*$

155. The behaviour of hydrogen atom in 1st excited state $(n = 2)$ is like a permanent electric dipole moment of magnitude

(A) ea_0 (B) $2ea_0$

(C) $3ea_0$ (D) $4ea_0$

156. Characteristic temperature in antiferromagnetism

(A) Neel temperature (B) Curie temperature

(C) Transition temperature (D) Inversion temperature

157. Minimum number of literals in the expression $ABC + AB + BC$ is

(A) 1 (B) 2

(C) 3 (D) 4

158. Phase shift oscillator and Wien bridge oscillator operate at

(A) high frequencies (B) low frequencies

(C) ultra high frequencies (D) medium frequencies

159. The virtual work done by the forces of constraints is given by $\sum_i f_i \delta r_i =$

(A) 1 (B) 0

(C) ∞ (D) none of the above

160. Addition of any velocity to the velocity of light C merely equal to

(A) $2C$ (B) C

(C) $C/2$ (D) $2C^2$

161. In Cauchy Residue theorem $\int_C f(z)\, dz$ is equal to

(A) $2\pi i \sum (R - Z)$ (B) $2\pi i \sum (R + Z)$

(C) $2\pi i \sum Z$ (D) $2\pi i \sum R$

162. Equation of continuity is

(A) $div\ \bar{J} + \frac{\partial \rho}{\partial t} = 0$

(B) $div\ \bar{J} + \frac{\partial K}{\partial t} = 0$

(C) $div\ \bar{K} + \frac{\partial \rho}{\partial t} = 0$

(D) $Grad\ \bar{J} + \frac{\partial P}{\partial t} = 0$

163. Consider the statements :

(I) There will be voltage phase shift of 180° in CE amplifier

(II) There will be no voltage phase shift in both CB and CC amplifiers

(III) There will be no voltage phase shift in all CB, CE and CC amplifiers

(IV) There will be voltage phase shift in all CB, CE and CC amplifiers

Of the statements

(A) I alone is correct

(B) I and II alone are correct

(C) III and IV alone are correct

(D) IV alone is correct

164. A four variable Karnaugh map has

(A) 8 min terms

(B) 16 min terms

(C) 32 min terms

(D) 24 min terms

165. Cooper pair tunneling occurs in

(A) Josephson effect

(B) Compton effect

(C) Raman effect

(D) Skin effect

166. The number of degeneracies in the first excited state hydrogen atom is

(A) 5

(B) 2

(C) 3

(D) 4

167. The nature of transition occurs in aromatic compounds

(A) $\sigma \rightarrow \sigma^*$

(B) $\pi \rightarrow \pi^*$

(C) $n \rightarrow \pi^*$

(D) $n \rightarrow \sigma^*$

168. For a system obeying Fermi-Dirac statistics, the distribution of particles in the most probable macrostate is

(A) $n_i = \frac{g_i}{\exp(\alpha + \beta\varepsilon_i)}$

(B) $n_i = \frac{g_i}{\exp(\alpha + \beta\varepsilon_i) - 1}$

(C) $n_i = g_i \exp(\alpha + \beta\varepsilon_i)$

(D) $n_i = \frac{g_i}{\exp(\alpha + \beta\varepsilon_i) + 1}$

169. In variational principle the condition for obtaining an extremum is

(A) $\left(\frac{\partial J}{\partial \alpha}\right)_{\alpha=0} = 0$ (B) $\left(\frac{\partial \alpha}{\partial J}\right)_{\alpha=0} = 0$

(C) $\left(\frac{\partial J}{\partial \alpha}\right)_{J=0} = 0$ (D) $\left(\frac{\partial J}{\partial \alpha}\right) = 0$

170. A Darlington circuit consists of

(A) two cascaded emitter follower circuits

(B) three cascaded emitter follower circuits

(C) four cascaded emitter follower circuits

(D) no emitter follower circuit

171. At a macroscopic level a thermodynamic system of a canonical ensemble is characterized by

(A) T, V, N (B) U, V, N

(C) S, V, N (D) T, P, N

172. The ESR frequency for a free electron is 9000 MHz. What is the magnetic field at which the ESR spectrometer is working ($g = 2$)

(A) 3.215 T (B) 32.15 T

(C) 0.3215 T (D) 0.03215 T

173. Two non-interacting Fermions cannot both be in the same quantum state is known as

(A) Pauli's exclusion principle (B) Fermi Golden rule

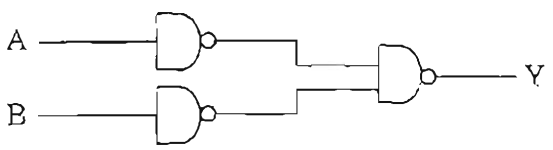
(C) Heisenberg's uncertainty principle (D) Wave-particle duality

174. Population inversion is essential for

(A) Laser action (B) Chemical reaction

(C) Raman effect (D) Doppler effect

175. The circuit shown in figure is functionally equivalent to



(A) AND gate (B) NOR gate

(C) OR gate (D) EX-OR gate

176. In the equation $Q_j = -\frac{\partial V}{\partial q_j} + \frac{d}{dt}\left(\frac{\partial U}{\partial \dot{q}_j}\right)$, U represents

(A) velocity dependent potential
(B) velocity independent potential
(C) equipotential
(D) scalar potential

177. The kinetic energy of an electron moving with the velocity 0.98 times velocity of light is

(A) $402\ m_0c^2$
(B) $4.02\ c^2$
(C) $4.02\ m_0c^2$
(D) $402\ c^2$

(c – velocity of light; m_0 – rest mass)

178. The residue of a function $f(z)$ at the pole $z = a$ is the coefficient of

(A) $z - a$
(B) $\frac{1}{z-a}$
(C) $a + z$
(D) $\frac{1}{a+z}$

179. The polarizability of a molecule is

(A) the dielectric moment of a molecule
(B) dipole moment of a molecule per unit polarizing field
(C) the dipole moment of a molecule per unit magnetizing field
(D) none of these

180. Which one of the following statement is correct?

(A) Bose-Einstein statistics is applicable when system contains identical, indistinguishable particles
(B) Bose-Einstein statistics is applicable when system contains identical, indistinguishable particles of half integral spin
(C) Bose-Einstein statistics is applicable when system contains identical, indistinguishable particles of integral spin
(D) None of them

181. Mossbauer spectroscopy deals with

(A) ground state property of the nucleus only
(B) excited state property of the nucleus only
(C) both excited and ground state properties of the nucleus
(D) none of them

182. When the inverse and adjoint of an operator are identical, then the operator is called

(A) Hermitian operator
(B) Parity operator
(C) Unitary operator
(D) Projection operator

183. An electron hole system in a solid is called

(A) exciton
(B) positronium
(C) muonium
(D) helium

184. In a certain 2-input logic gate, when $A = 0$, $B = 0$, then output $Y = 1$ and when $A = 0$, $B = 1$ then again $Y = 1$. The gate is

(A) XOR
(B) AND
(C) NAND
(D) NOR

185. Match the following :

List-I	List-II
(a) Astable multivibrator	1. Square wave from sine wave
(b) Monostable multivibrator	2. Regenerative comparator
(c) Schmitt trigger	3. Square wave generator
(d) Comparator	4. Pulse generator

Codes :

	(a)	(b)	(c)	(d)
(A)	3	4	1	2
(B)	4	3	1	2
(C)	3	4	2	1
(D)	4	3	2	1

186. Energy eigen values of hydrogen atom are proportional to

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

187. Spectral line splitting due to the influence of magnetic fields is called

(A) Boltzmann effect
(B) Zeeman effect
(C) Planck effect
(D) Zanstra's effect

188. An ensemble is a collection of all possible

(A) thermodynamic systems
(B) microstates of a given system
(C) macrostates of a given system
(D) microstates of a given macrostates

189. For a charged particle in an em field, the canonical moments are

(A) $mv + \left(\frac{q}{c}\right)A$
(B) $\frac{1}{2}mv^2 \div \left(\frac{q}{c}\right)A$
(C) $mv - \left(\frac{q}{c}\right)A$
(D) $\frac{1}{2}mv^2 - \left(\frac{q}{c}\right)A$

190. A rod 1.1 metre long is moving in space along its length with a velocity 0.6 C. The length calculated as it appears to an observer on the earth is

(A) 1 m
(B) 0.88 m
(C) 0.66 m
(D) 0.36 m

191. The integral of a analytic function round a closed contour is

(A) 0
(B) 1
(C) infinity
(D) none of the above

192. The differential form of Gauss's law is

(A) $div\ \vec{E} = \frac{K}{\epsilon_0}$
(B) $div\ \vec{E} = \frac{P}{\epsilon_r}$
(C) $div\ \vec{E} = \frac{P}{\epsilon_0}$
(D) $div\ E = P\frac{\epsilon_r}{\epsilon_0}$

193. A hoop rolling down on an inclined plane without slipping its velocity at the bottom of the inclined plane is

(A) $\left(\frac{2gl\ \sin\ \varphi}{3}\right)$
(B) $\left(\frac{4gl\ \sin\ \varphi}{3}\right)^{\frac{1}{2}}$
(C) $\left(\frac{2gl\ \sin\ \varphi}{3}\right)^{\frac{1}{2}}$
(D) $\left(\frac{4gl\ \sin\ \varphi}{3}\right)$

194. A rod 1.2 metre long is moving along its length with a velocity 0.7 C. The length calculated as it appears to an observer moving with the rod itself is

(A) 1 m
(B) 1.2 m
(C) 0.6 m
(D) 0.45 m

195. The modulus of the product of two complex number is

(A) sum of their modulii

(B) product of their modulii

(C) average of the modulii

(D) difference of their modulii

196. For an EM wave incident on a medium at the polarising angle, the angle between the reflected and refracted rays is

(A) 45° (B) 90°

(C) 180° (D) 120°

197. If β is the current gain of a single transistor, then what is the current gain in a Darlington circuit?

(A) $\beta/2$ (B) β^2

(C) β^3 (D) β^4

198. The output expression for an AND-OR circuit having one AND-gate with inputs A, B, C and D and another AND gate with inputs E and F is

(A) $ABCDEF$ (B) $A+B+C+D+E+F$

(C) $(A+B+C+D)(E+F)$ (D) $ABCD+EF$

199. Verify the correct Boolean equation

(A) $A+B=\overline{A}\cdot\overline{B}$ (B) $\overline{A\cdot B}=\overline{A}\cdot\overline{B}$

(C) $A\cdot B=\overline{A}\cdot\overline{B}$ (D) $\overline{A+B}=\overline{A}\cdot\overline{B}$

200. The L, S and J quantum numbers corresponding to the ground state electronic configuration of Boron ($Z=5$) are

(A) $L=1,\ S=1/2,\ J=3/2$

(B) $L=1,\ S=1/2,\ J=1/2$

(C) $L=0,\ S=3/2,\ J=3/2$

(D) $L=1,\ S=3/2,\ J=1/2$