Booklet Sl. No. : 4298

oklet Series **B**

12PT-12

TEACHERS RECRUITMENT BOARD, CHENNAI - 6

ITTEN COMPETITIVE EXAMINATION FOR DIRECT RECRUITMENT OF LECTURERS IN GOVERNMENT POLYTECHNIC COLLEGES — 2012

PHYSICS

e Allowed : 3 Hours] [Maximum Marks : 190

Each question carries four options namely A, B, C and D. Choose one correct option and mark in appropriate place in the OMR Answer Sheet.

SECTION – A

(1 mark each)

A free particle is moving in + x direction with a linear momentum p. The wavefunction of the particle normalised in a length L is

A) $\frac{1}{\sqrt{L}} \sin \frac{p}{\hbar} x$ B) $\frac{1}{\sqrt{L}} \cos \frac{p}{\hbar} x$

C) $\frac{1}{\sqrt{L}} e^{-ipx/\hbar}$ D) $\frac{1}{\sqrt{L}} e^{ipx/\hbar}$.

The Poisson's equation is CGS Gaussian system is

A) $\nabla^2 V = -\frac{\rho}{\epsilon_0}$ B) $\nabla^2 V = -4\pi\rho$

C) $\nabla^2 V = -4\pi\sigma$ D) $\nabla^2 V = 0$.

Which of the following is correct ?

A) $\vec{D} = \varepsilon \vec{E}$ B) $\Delta \vec{V} = -\vec{E}$

C) $\vec{J} = \sigma \vec{E}$ D) All of these are correct.

The colour of a star is an indication of its

A) size B) weight

C) distance from the earth D) temperature.

[Turn over

13. The capacitance of a parallel plate condenser does not depend upon

A) area of the plate

B) medium between the plates

C) distance between the plates

D) nature of the metal used as plates.

14. Conductivity of metal in terms of relaxation time is given by the relation

A) $\sigma = \frac{Ne^2\tau}{m}$ B) $\frac{Ne\tau}{m} = \sigma$

C) $\sigma = \frac{N\tau}{m}$ D) $\sigma = \frac{m}{Ne^2\tau}$.

15. Size of the nucleus is estimated to be of the order of

A) one fermi B) 10 Å

C) 10 μm D) none of these.

16. The $\frac{c}{a}$ ratio for an ideal hexagonal closed packed structure is

A) $\frac{2\sqrt{2}}{\sqrt{3}}$ B) $\sqrt{8}$

C) $\sqrt{5}$ D) $\frac{\sqrt{8}}{3}$.

17. Classically the oscillating particle is most likely to be found at the ends of the path and least likely in the middle. Wave mechanically, behaviour is just

A) opposite to each other B) like to each other

C) competitive to each other D) none of these.

18. The weight of a body at the centre of earth is

A) same as on surface of earth B) zero

C) infinite D) half of that on surface.

19. Which of the following is an eigenfunction of L_z ?

A) $\cos\phi$ B) $\sin\phi$

C) $e^{i\phi}$ D) $\cos^2\phi$.

20. No two electrons will have all the four quantum numbers equal. This statement is known as

A) uncertainty principle
B) Aufbau's principle
C) Pauli's exclusion principle
D) Hund's rule.

21. A star emitting yellow light starts accelerating towards the earth. Its colour as seen from the earth will turn gradually

A) blue
B) red
C) yellow
D) dark.

22. The electric field inside a conducting material of radius R is

A) $\frac{q}{4\pi \epsilon_0 r^2}$
B) zero
C) $\frac{q}{4\pi \epsilon_0 R^2}$
D) none of these.

23. The energy density in static magnetic field is

A) $W_m = \frac{1}{2} \frac{B}{\mu}$
B) $W_m = \frac{1}{2} \frac{B^2}{\mu}$
C) $W_m = \frac{1}{2} \frac{BH}{\mu}$
D) $W_m = \frac{1}{2} \frac{H^2}{\mu}$

24. The mean free path is

A) inversely proportional to the pressure
B) directly proportional to the pressure
C) proportional to p^2
D) proportional to p^4.

25. Newton's law of cooling is a special case of

A) Wien's law
B) Kirchhoff's law
C) Stefan's law
D) Planck's law.

26. The fusion reaction occurs at

A) low pressure
B) high temperature
C) extremely high temperature
D) none of these.

27. Heat energy produced in the nuclear fission reaction can be used to produce

A) nuclear energy
B) electricity
C) electrochemical energy
D) solar energy.

28. A reciprocal lattice vector has the form

A) $\overline{G} = h\overline{a^*} + k\overline{b^*} + l\overline{c^*}$
B) $\overline{G} = h\overline{a} + k\overline{b^*} + l\overline{c^*}$
C) $\overline{G} = h\overline{a} + k\overline{b^*} + lc$
D) $\overline{G} = h\overline{a^*} + kb + lc^*$.

29. A nibble is equal to

A) 2 bits
B) 8 bits
C) 4 bits
D) 16 bits.

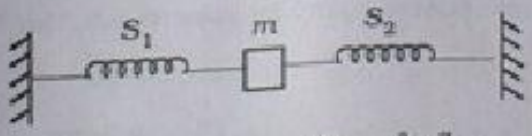
30. The correct relation between α and β in a transistor is

A) $\alpha = \frac{\beta}{1-\beta}$
B) $\beta = \frac{\alpha}{1-\alpha}$
C) $\alpha = \frac{\beta}{1+\beta}$
D) $1-\alpha = \frac{1}{1+\beta}$.

31. If $\vec{A} = \hat{i}x$ and $\vec{B} = \hat{j}y$ then $\vec{\nabla}\left(\vec{A}.\vec{B}\right)$ is equal to

A) $\hat{i}y + \hat{j}x$
B) 0
C) 2
D) $yx^2\,\hat{i} + xy^2\,\hat{j}$.

32. In the figure S_1 and S_2 are identical springs. The oscillation frequency of the mass m is f. If one spring is removed, the frequency will become



A) f
B) $f \times 2$
C) $\frac{f}{\sqrt{2}}$
D) $f \times \sqrt{2}$.

33. Two wave functions ψ_1 and ψ_2 are orthogonal if

A) $\int \psi_2^* \psi_1 \, d\tau = 0$
B) $\int \psi_2^* \psi_1 \, d\tau = 1$
C) $\int |\psi_2|^2 \, d\tau = 0$
D) $\int |\psi_1|^2 \, d\tau = 1$.

34. Which one of the following statements is correct ?

A) $\nabla \times \vec{J} + \frac{\partial \rho}{\partial t} = 0$

B) $\nabla \times \vec{J} + \frac{\partial^2 \rho}{\partial t^2} = 0$

C) $\nabla \times \vec{J} + \frac{\partial^2 \rho}{\partial t} = 0$

D) $\nabla \times \vec{J} + \frac{\partial \rho}{\partial t^2} = 0$.

35. When temperature is gradually decreased, the specific heat of a substance

A) increases

B) decreases

C) remains unchanged

D) nothing can occur.

36. The most commonly used thermometric substance is

A) water

B) alcohol

C) mercury

D) gallium.

37. In nuclear reaction, which of the following is conserved ?

A) Atomic number only

B) Mass number only

C) Energy only

D) Atomic number, mass number and energy.

38. Which one of the following nuclear reactions is possible ?

A) ${}^{14}_{7}N \rightarrow {}^{13}_{6}C + \beta^{+} + \gamma_e$

B) ${}^{13}_{7}N \rightarrow {}^{13}_{6}C + \beta^{+} + \gamma_c$

C) ${}^{13}_{7}N \rightarrow {}^{13}_{6}C + \beta^{+}$

D) ${}^{13}_{7}N \rightarrow {}^{13}_{7}C + \beta^{+} + \gamma_c$.

39. The value of magnetic susceptibility for superconductor is

A) -1

B) zero

C) $+1$

D) infinity.

40. When subjected to a transverse electric field cathode rays move

A) along a hyperbolic path

B) down the potential gradient

C) up the potential gradient

D) along a circular path.

41. Neutron diffraction is a form of

A) elastic scattering

B) inelastic scattering

C) thermal absorption

D) proton scattering.

42. Absorption spectroscopy measures the absorption of radiation as a function of

A) velocity
B) angular momentum
C) frequency or wavelength
D) mass.

43. Among the following the frequency is minimum for

A) X-rays
B) microwaves
C) cosmic rays
D) infrared rays.

44. The phase difference between the current and voltage at resonance is

A) π
B) $-\pi$
C) $\frac{\pi}{2}$
D) zero.

45. If $\hat{n}$ is a unit vector in the direction of the vector $\vec{p}$ then which of the following is true ?

A) $\hat{n} = \vec{p} \cdot |\vec{p}|$
B) $\hat{n} = \frac{|\vec{p}|^2}{\vec{p}}$
C) $\hat{n} = \frac{\vec{p}}{|\vec{p}|}$
D) $\hat{n} = \frac{|\vec{p}|}{\vec{p}}$

46. If A is a real square matrix, then AA^T is

A) unsymmetric
B) always symmetric
C) skew symmetric
D) sometimes symmetric.

47. Fourier transform of which of the following functions does not exist ?

A) $e^{-|x|}$
B) e^{x^2}
C) xe^{-x^2}
D) e^{-x^2}.

48. Which physical quantity is constant for a satellite in orbit ?

A) Angular momentum
B) Angular acceleration
C) Angular velocity
D) Kinetic energy.

49. If the earth be one half of its present distance from the sun, the number of days in one year will be

A) 182
B) 365
C) 730
D) 129.

[Turn over

50. Davisson-Germer experiment relates to

A) interference B) polarisation

C) electron diffraction D) reflection.

51. The de Broglie wavelength of an electron accelerated by voltage of 1·25 kV is

A) 0·3 Å B) 0·4 Å

C) 0·5 Å D) 0·2 Å.

52. The characteristics of isobars are

A) same A, different N and Z B) same Z, different N

C) same Z, different A D) same A and same Z.

53. A Hall effect transducer can be used for measurement of

A) power B) electric current

C) displacement D) all of these.

54. Which one of the following can be achieved by using the reset terminals in a tuner chip ?

A) Keyed oscillation B) Delayed monostable action

C) Square wave generation D) Pulse generation.

55. In Boolean expression, which gate be expressed as $Y = \overline{A.B}$?

A) NOT gate B) AND gate

C) NAND gate D) NOR gate.

56. In which of the following decays, does the element not change ?

A) β-decay B) γ-decay

C) α-decay D) None of these.

57. Quantum mechanically a zero angular momentum of the electron means that the electron cloud is

A) elliptically symmetrical B) circularly unsymmetrical

C) spherically symmetrical D) spherically unsymmetrical.

58. Hall angle is

A) $\theta_H = \tan(\mu B)$ B) $\theta_H = \tan^{-1}(\mu B)$

C) $\theta_H = \tan^{-1}(B)$ D) $\theta_H = \tan(B)$.

59. Which particle is with zero Baryon number ?

A) Pion
B) Neutron
C) Proton
D) Δ^+.

60. The Fourier transform of $f(t)$ is $2\int_0^{\infty} \phi(t) \cos \omega t \, dt$ if and only if

A) t is real and $f(t)$ is real
B) $f(t)$ is real and $f(t)$ is even
C) $f(t)$ is real and $f(t)$ is odd
D) the function is $f(t) e^{-j\omega t}$.

61. Which one of the following disintegration series of the heavy elements will give ^{209}Bi as a stable nucleus ?

A) Thorium series
B) Neptunium series
C) Uranium series
D) Actinium series.

62. The expression for mass defect is

A) $\Delta m = Z . m_H + (A - Z) m_n - M$
B) $\Delta m = Z + (A - Z) m_n$
C) $\Delta m = Z . m_H + (A) m_n - M$
D) $\Delta m = Z . m_H + (A - Z) - M$.

63. Op-Amp used as a tuned amplifier has the tuned circuit connected

A) across input
B) across series impedance at the input
C) across feedback impedance Z_f
D) across output.

64. To obtain very high input and output impedances in a feedback amplifier, the topology must be

A) voltage series
B) current series
C) current shunt
D) voltage shunt.

65. For hard X-rays

A) the wavelength is higher
B) the frequency is higher
C) the intensity is higher
D) the photon energy is lower.

6. Moseley measured the frequency (f) of the characteristic X-rays from many metals of different atomic numbers (z) and repeated his results by the relation known as Moseley's law. The law is

A) $f = a(z-b)^2$ B) $z = a(f-b)^2$

C) $f = a(z-b)$ D) $f = a(z-b)^4$.

7. The residue of $\cot x$ at $z = 0$ is

A) -1 B) $\frac{1}{4}\sin h$

C) 1 D) π.

8. The inverse of a matrix $\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$ is

A) $\begin{bmatrix} a & 0 \\ 0 & a \end{bmatrix}$ B) $\begin{bmatrix} b & 0 \\ a & b \end{bmatrix}$

C) $\begin{bmatrix} \frac{1}{a} & 0 \\ 0 & \frac{1}{b} \end{bmatrix}$ D) $\begin{bmatrix} a & 0 \\ 0 & \frac{1}{b} \end{bmatrix}$.

69. One fermi is equal to

A) 10^{-3} Å B) 10^{-4} Å

C) 10^{-5} Å D) 10^{5} Å.

70. Energy of a particle of mass M is E and its momentum is P. Then the relation between E and P is

A) $E = \frac{P}{2M}$ B) $E = \sqrt{2PM}$

C) $P = \sqrt{2ME}$ D) $P = \frac{2M}{E}$.

71. Half-life of radioactive element depends upon

A) amount of element present B) temperature

C) pressure D) nature of element.

72. In dielectrics, local field is

A) $E_{loc} = E + \frac{P}{3\varepsilon_0}$ B) $E_{loc} = E + \frac{1}{3\varepsilon_0}$

C) $E_{loc} = E + \frac{1}{2\varepsilon_0}$ D) $E_{loc} = E + \frac{P}{\varepsilon_0}$.

73. Positrons are produced during

A) ionisation
B) annihilation
C) pair-production
D) X-rays production.

74. Zener diode is used for

A) rectification
B) stabilization
C) amplification
D) all of these.

75. Half adder is also known as

A) AND gate
B) NAND gate
C) NOR gate
D) EX-OR gate.

76. Least square problem falls in the category of

A) non-linear least square
B) linear least square
C) both (A) and (B)
D) none of these.

77. Proportional counter can detect

A) mass
B) velocity
C) position and or angle of incident radiation
D) none of these.

78. The Laplace transform of the function $f(t) = e^{at}$ when $t > 0$ and when a is a constant is

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

79. The direction of grad ϕ is

A) tangential to level surface
B) arbitrary
C) inclined at 45° to level surface
D) normal to level surface.

80. The trace of a 3×3 matrix is 2. Two of its eigenvalues are 1 and 2. The third eigenvalue is

A) -2
B) -1
C) 1
D) 0.

81. For arbitrary matrices E, F, G and H, if $EF - FE = 0$ then Trace ($EFGH$) is equal to

A) Trace ($HGFE$)

B) Trace (E) . Trace (F) . Trace (G) . Trace (H)

C) Trace ($GFEH$)

D) Trace ($EGHF$).

82. A system executing SHM must possess

A) inertia as well as elasticity

B) inertia only

C) elasticity only

D) inertia, elasticity and external impulse.

83. Kinetic energy (E) and angular momentum (J) of a rigid of moment of intertia I are related through the relation

A) $J = \frac{E^2}{2I}$

B) $E = \sqrt{2\pi}$

C) $B = \sqrt{\frac{2J}{I}}$

D) $E = \frac{J^2}{2I}$.

84. At the centre of a current carrying single turn circular loop, magnetic field is

A) $\vec{B} = \frac{I}{2\mu\pi R}$

B) $\vec{B} = \frac{\mu I}{2R}$

C) $\vec{B} = \frac{\mu I}{2\pi R}$

D) $\vec{B} = \frac{\mu I}{2\pi R^2}$.

85. Which of the following is correct ?

A) $\frac{T_1}{H_2} + \frac{T_2}{H_1} = 0$

B) $H_1 T_1 = H_2 T_2$

C) $\frac{H_1}{T_1} = \frac{H_2}{T_2}$

D) $H_1 T_1 + H_2 T_2 = 0$.

86. In Rutherford experiment, the path of scattered α particle is

A) circular

B) linear

C) elliptic

D) parabolic.

87. The magnitude of susceptibility for diamagnetic material is

A) negative nature

B) positive nature

C) from negative to positive nature

D) none of these.

88. According to Moseley's law, the wavelength or frequency of a given spectral line is related with the atomic number of the target as

A) $\gamma = a(z - b)$

B) $\gamma = (z - b)$

C) $\gamma = a(z - b)^2$

D) $\gamma = (z - b)^2$.

89. In an amplifier maximum voltage gain is obtained when load resistance is equal to

A) zero

B) infinite

C) plate resistance

D) unity.

90. 100 + 1011 in binary system is equal to

A) 1110

B) 1000

C) 1111

D) 1011.

91. The hydrogen atom is in d state. For this state the values of m are

A) 2, 1, 0

B) -1, 0, 1

C) -2, -1, 0, $+1$, $+2$

D) -3, -1, 0, 1, 3.

92. For a particle moving in a central field

A) the motion is confined in a plane

B) the P.E. is velocity dependent

C) the K.E. is a constant of motion

D) the total energy is not conserved.

93. A potential function is defined as

$$V(x) = \begin{cases} 0 & \text{for } x = 0 \\ V_0 & \text{for } x = 0 \end{cases}$$

This is defined as

A) square potential well

B) potential step

C) rectangular potential barrier

D) none of these.

94. By induction we produce

A) equal charges

B) equal and like charges

C) equal and opposite charges

D) unequal and similar charges.

95. A body in a room cools from 85°C to 80°C in 5 minutes. The time taken to cool from 80°C to 75°C is

A) 5 minutes

B) more than 5 minutes

C) less than 5 minutes

D) none of these.

96. Fermi-Dirac distribution function is

A) $\frac{g_r}{n_r} - 1 = e^{\alpha + \beta\epsilon}$ B) $\frac{g_r}{n_r} + 1 = e^{\alpha + \beta\epsilon}$

C) $\frac{g_r}{n_r} = e^{\alpha + \beta\epsilon}$ D) none of these.

97. Maxwell's law of distribution of velocities shows that the number of molecules with average velocity is

A) very small B) zero

C) large D) exactly equal to 1.

98. Thermal neutrons can cause fission in

A) U^{238} B) U^{235}

C) Pu^{238} D) Th^{232}.

99. In nucear fission, the percentage of mass converted into energy is about

A) 10% B) 0·01%

C) 0·1% D) 1%.

100. When the light is incident on the metallic bounded solids they behave as

A) transparent B) opaque

C) partially transparent D) none of these.

101. Who got the Nobel Prize for Peace in the year 2011 ?

A) Thomas Sargent

B) Christopher Sims

(C) Ellen Johnson Sirleaf, Leymah Gbowee and Tawakkol Karman.

D) Domas Transtroma.

102. Which country won the Kabaddi World Cup, 2011 ?

A) United Kingdom B) India

C) Canada D) Germany.

103. The Raman effect is used in the study of

A) X-rays B) Cells

C) Chromosomes D) Molecular energy.

104. Green India Programme is the National Action plan on

A) Pollution
B) Climate change
C) Rainfall
D) Environment.

105. In which district is Adichanallur which had been the habitat of human race during 1000-2000 BC located ?

A) Ariyalur
B) Ramanathapuram
C) Tirunelveli
D) Virudhunagar.

106. Which of the following is measured on the Richter scale ?

A) Density of liquids
B) Intensity of earthquakes
C) Velocity of tornadoes
D) Height of mountains.

107. Which work is known as an encyclopaedia of social life in the Eleventh Century ?

A) Dasakumaracharita by Dandin
B) Kathasaritsagara by Somadeva
C) Karpuramanjari by Rajasekhara
D) Rajatarangini by Kalhana.

108. Who led the French forces during the battle of Waterloo ?

A) Duke of Wellington
B) Duke of Cornwall
C) Napoleon Bonaparte
D) Duke of Scotland.

109. What is zero hour ?

A) When matters of utmost importance are raised
B) When money bill is introduced in the Lok Sabha
C) When proposals of opposition are considered
D) Interval between morning and evening sessions.

110. Which of the following is a direct tax ?

A) Excise duty
B) Sales tax
C) Income tax
D) Both (B) & (C).

SECTION – B

(2 marks each)

111. A field is irrotational if

A) $grad\ A = 0$ B) $div\ \vec{A} = 0$

C) $curl\ \vec{A} = \vec{0}$ D) None of these.

112. The sum of the infinite series $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$ is

A) $\frac{1}{2}$ B) $\frac{\pi^2}{8}$

C) $\frac{\pi^2}{6}$ D) $\frac{\pi^2}{2}$.

113. The distance travelled by the burst of π^+ meson at $V = 0{\cdot}73c$ during its mean life of $3{\cdot}6 \times 10^{-8}$ sec is

A) 7·9 m B) 10 m

C) 6·2 m D) 4 m.

114. Lagrangian for a charged particle in an electromagnetic field is given as

A) $\frac{1}{2}mv^2 + q\phi + \frac{q}{c}\ \overline{v}\ .\ \overline{A}$ B) $\frac{1}{2}mv^2 + q\phi - \frac{q}{c}\ \overline{v}\ .\ \overline{A}$

C) $\frac{1}{2}mv^2 - q\phi + \frac{q}{c}\ \overline{v}\ .\ \overline{A}$ D) $\frac{1}{2}mv^2 - q\phi - q\ \overline{v}\ .\ \overline{A}$

115. The time dependent Schroedinger wave equation is given by

A) $\left(-\frac{\hbar^2}{2m}\nabla + V\right)\psi = i\hbar\frac{\partial\psi}{\partial t}$

B) $\left(\hbar^2\nabla^2 + V\right)\psi = i\hbar\frac{\partial\psi}{\partial t}$

C) $\left(-\frac{\hbar^2}{2m}\nabla^2 + V\right)\psi = i\hbar\frac{\partial\psi}{\partial t}$

D) None of these.

116. The electric flux passing through a hemispherical surface of radius R placed in an electric field $\overline{E}$ with the axis parallel to the field is

A) $E\pi R^2$ B) $2\pi R^2 E$

C) $2\pi RE$ D) $2\pi R^3 E$

117. Correct identity is

A) $[L_x, L_y] = 0$

B) $[L^2, L_x] = 0$

C) $[L_y, L_z] = i\hbar L_y$

D) $[L_y, L_z] = i\hbar L_x$

118. The uncertainty in the location of a particle is equal to de Broglie wavelength. The uncertainty in its velocity is

A) V

B) $\frac{V}{2}$

C) $2V$

D) $\frac{3}{2}V$.

119. The α-particle scattering cross-section and hence the number of α-particle scattered must be proportional to

A) E

B) E^{-1}

C) E^2

D) E^{-2}.

120. Hamilton's canonical equation of motion is

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

B) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = -\frac{\partial H}{\partial q_i}$

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

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

121. Hall coefficient of the material is

A) $R_H = \frac{V_H \cdot t}{I \cdot B_z}$

B) $R_H = \frac{V_H}{B_x}$

C) $R_H = \frac{V_H \cdot t}{B_z}$

D) $R_H = \frac{V_H}{I \cdot B_z}$

122. A substance shows a Raman line at 4567 Å when exciting line 4358 Å is used. The wave number displacement is

A) 980 cm^{-1}

B) 1050 cm^{-1}

C) 1100 cm^{-1}

D) 1150 cm^{-1}.

[Turn over

123. The ground state of chlorine is $^2P_{\frac{3}{2}}$. The value of Lande's g factor is

A) $\frac{3}{4}$ B) $\frac{2}{3}$

C) $\frac{4}{3}$ D) $\frac{3}{2}$.

124. One kg of ice melts at 0°C into water at the same temperature. The change in entropy is (in cal/K)

A) ∞ B) 0

C) 0·293 D) 293.

125. The ground state entropy of a Bose-Einstein gas is zero. The number of molecules in the ground state level at a finite temperature will be

A) zero

B) half the total number

C) maximum, nearly equal to total number

D) nothing is matched.

126. If $\vec{F} = x\hat{i} + y\hat{j} + z\hat{k}$, then its divergence is

A) $\hat{i} + \hat{j} + \hat{k}$ B) 3

C) $x + y + z$ D) none of these.

127. Pirani gauge measures the pressure between

A) 10^{-4} to 10^{-6} Torr B) 10^{-3} to 10^{+2} Torr

C) 0·5 to 10^{-4} Torr D) 10^{-3} to 10^{-5} Torr.

128. The approximate ratio of resistance in the forward and reverse bias of the *PN* junction diode is

A) $10^2 : 1$ B) $10^{-2} : 1$

C) $1 : 10^{-4}$ D) $1 : 10^4$.

129. Which of the following is a fusion reaction ?

A) ${}_0n^1 + {}_7N^{14} \rightarrow {}_6C^{14} + {}_1H^1$

B) ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4$

C) ${}_0n^1 + {}_{92}U^{238} \rightarrow {}_{93}Np^{239} + \beta^{-1} + \gamma$

D) ${}_1H^3 \rightarrow {}_2He^3 + \beta^{-1} + \gamma$.

130. A black body radiates energy at the rate of E watt/m^2 at a high temperature TK. When the temperature is reduced to $\frac{T}{2}$ K, the radiant energy will be

A) $\frac{E}{64}$ B) $\frac{E}{32}$

C) $\frac{E}{16}$ D) $\frac{E}{8}$.

131. The process $\pi^- + p \rightarrow \Lambda^0 + k^0$ is

A) isospin conserved

B) strangeness conserved

C) third component of isospin only conserved

D) all of these.

132. The strangeness quantum number is conserved in

A) strong and weak electromagnetic interactions

B) weak electromagnetic interactions only

C) strong and weak magnetic interactions

D) strong electromagnetic interactions only.

133. Dielectric susceptibility is

A) $\chi = \frac{P}{E}$ B) $\chi = \frac{E}{P}$

C) $\chi = \frac{P}{2E}$ D) $\chi = \frac{2E}{P}$.

134. For a transistor parameter $\beta = 99$, the value of parameter α is

A) 0·9 B) 0·99

C) 9·0 D) 99·0.

135. For the 555 timer circuit in astable operation, the frequency of oscillation, if $R_1 = 1K$, $R_2 = 4.7K$ and $C = 10nF$, is

A) 13·64 kHz B) 10 kHz

C) 14·5 kHz D) None of these.

136. The sum of two vectors $\vec{A}$ and $\vec{B}$ is at right angles to their difference. This is possible if

A) $A = 2B$ B) $A = B$

C) $A = 3B$ D) $B = 2A$.

137. The primitive cell volume for a *bcc* lattice is

A) $\frac{1}{2}a$ B) $\frac{1}{2}a^3$

C) $\frac{1}{2}a^2$ D) $\frac{1}{2}a^4$.

138. If magnetic monopole existed, then which of the following Maxwell's equations will be modified ?

A) $div\ \overline{D} = P$ B) $div\ \overline{B} = 0$

C) $curl\ \overline{E} = -\frac{\partial B}{\partial t}$ D) $curl\ \overline{H} = \overline{J} + \frac{\partial \overline{D}}{\partial t}$.

139. The work function of a metal is ϕ and λ is the wavelength of the incident radiation. There is no emission of photoelectrons when

A) $\lambda > \frac{hc}{\phi}$ B) $\lambda = \frac{hc}{\phi}$

C) $\lambda < \frac{hc}{\phi}$ D) None of these.

140. The combination of quarks which compose the π^+ is $d + \overline{d}$. The charge of π^+ is

A) 1 B) 2

C) 0 D) 3.

141. When a lossy capacitor with a dielectric of permittivity ε and conductivity σ operates at a frequency ω, the loss tangent for the capacitor is given by

A) $\frac{\omega\sigma}{\varepsilon}$ B) $\frac{\omega\varepsilon}{\sigma}$

C) $\frac{\sigma}{\omega\varepsilon}$ D) $\sigma\omega\varepsilon$.

142. The effect of the dielectric is to

A) increase the capacitance

B) decrease the capacitance

C) reduce the working voltage

D) increase the distance between the plates.

143. One mole of a perfect gas expands adiabatically. As a result of this, its pressure, temperature and volume change from P_1, T_1, V_1 to P_2, T_2 and V_2 respectively. If molar specific heat at constant volume is C_V then the work done by the gas is

A) $2{\cdot}303\ P_1 V_1 \log \frac{V_2}{V_1}$

B) $RT_1 \log \frac{V_2}{V_1}$

C) $\frac{P_1 V_1 - P_2^2 V_2^2}{R(T_2 - T_1)}$

D) $C_V(T_1 - T_2)$

144. The reduced mass of $H\,{}^{1}Br^{79}$ is $1{\cdot}64 \times 10^{-24}$ gm. The moment of inertia of the molecule is $3{\cdot}29 \times 10^{-40}$ gm-cm^2. The inter-nuclear distance is

A) 1 Å

B) 1·42 Å

C) 3 Å

D) 5 Å.

145. In a thermocouple pressure gauge, the temperature of heater element is a function of pressure for pressure range

A) above atmosphere

B) below 1 mm of Hg

C) below 10^{-3} mm of Hg

D) below 1 µm of Hg.

146. Gases begin to conduct electricity at low pressure because

A) at low pressure gases turn to plasma

B) colliding electrons can acquire higher K.E. due to increased mean free path leading to ionisation of atoms

C) atoms break up into electrons freely at low pressure

D) the electrons in atoms can move freely at low pressure.

147. A stationary particle in free space is observed to spontaneously decay into two photons. This implies that

A) the particle carries electric charge

B) the spin of the particle must be greater than or equal to 2

C) the particle is a boson

D) the mass of the particle must be greater than or equal to the mass of the hydrogen atoms.

148. Fourier transform of a function $f(at)$ is given by

A) $f(at) = \frac{2}{a} F(\omega)$

B) $f(at) = \frac{1}{a} F\left(\frac{\omega}{a}\right)$

C) $f(at) = aF(\omega)$

D) none of these.

149. In Compton scattering, the angle θ at which the recoil electron appears is

A) $\tan\theta = \frac{\lambda \sin\theta}{\lambda' - \lambda\cos\phi}$

B) $\tan\theta = \frac{\lambda \cos\theta}{\lambda' - \lambda\sin\phi}$

C) $\tan\theta = \frac{\lambda \sin\theta}{\lambda' - \lambda\sin\phi}$

D) None of these.

150. A long cylindrical conductor of radius R and $\sigma = \infty$ carries a current $I = I_0 \sin\omega t$. As a function of radius r (for $r \geq R$), the conduction current density $J(r)$ is

A) $\sigma \overline{E}$

B) $\frac{I_0 r}{\pi R^2}$

C) zero

D) $\frac{I_0}{2\pi r}$.