

MIZORAM PUBLIC SERVICE
COMMISSION

*Technical Competitive Examinations for
Recruitment to the post of
Inspector of Legal Metrology
under Food, Civil Supplies & Consumer
Affairs Department*

Time Allowed : 2 hours
Full Marks : 150

Electrical & Electronics Engineering Paper-I

INVIGILATOR

CENTRE SUPERINTENDENT

Date of Exam. : 26/03/2010

Instructions to candidates:

- Enter your Roll No. in the box provided on the front page.
- Attempt all the questions.
- Each question is followed by probable answers. Choose the appropriate answer and mark it by putting '✓' mark on the corresponding box.
- If more than one answer boxes are marked for a question, the answer will be treated as wrong.
- On completion, you are to submit the booklet to the Invigilator.

Code Number :
(For Official Use)

Marks Obtained :

Examiner

Scrutiniser

MIZORAM PUBLIC SERVICE
COMMISSION

*Technical Competitive Examinations for
Recruitment to the post of
Inspector of Legal Metrology
under Food, Civil Supplies & Consumer
Affairs Department*

Time Allowed : 2 hours
Full Marks : 150

Electrical & Electronics Engineering Paper-I

Roll Number :

Date of Exam. : 26/03/2010

Code Number :
(For Official Use)

1. Quantum effects have to be taken into account in determining the properties of materials if
 - (a) $E_r=3/2kT$
 - (b) $E_r<3/2kT$
 - (c) $E_r>3/2kT$
 - (d) $E_r>>3/2kT$

2. The magnetic moment in units of Bohr magnetron of a ferrous ion in any ferrite is
 - (a) Zero
 - (b) 2
 - (c) 4
 - (d) 6

3. For a permanent magnetic material
 - (a) the residual induction and the coercive field should be large
 - (b) the residual induction and the coercive field should be small
 - (c) the area of hysteresis loop should be small
 - (d) the initial relative permeability should be large

4. Consider the following statements regarding an insulating material connected to an a.c. signal
 - (i) Dielectric constant increases with frequency
 - (ii) Dielectric constant decreases with frequency
 - (iii) Atomic polarization decreases with frequencyWhich of the following is correct?
 - (a) (iii) alone
 - (b) (ii) alone
 - (c) (ii) and (iii)
 - (d) (i) and (iii)

5. A piezoelectric crystal has Young's modulus of 130 GPa. The uniaxial stress that must be applied to increase the polarization from 550 to 555 Cm^{-2} is, nearly
 - (a) 2.798 GPa
 - (b) 2.175 GPa
 - (c) 1.593 GPa
 - (d) 1.182 GPa

6. The outermost electronic configuration of a cobalt atom is $3d^74s^2$. Its magnetic moment is
 - (a) 9 Bohr magnetrons
 - (b) 7 Bohr magnetrons
 - (c) 5 Bohr magnetrons
 - (d) 3 Bohr magnetrons

7. When BCC iron is heated, it changes to FCC iron resulting in
 - (a) Contraction in volume
 - (b) Increase in volume
 - (c) No change in volume
 - (d) Crack in the material

8. Amplification of ultrasonic waves is possible in a piezoelectric semiconductor under applied field. The basic phenomenon involved is known as-
 - (a) Electrostriction
 - (b) Acousto-optic interaction
 - (c) Acousto-electric interaction
 - (d) Simulated Brillouin scattering

9. In a silicon crystal, the arrangement of atoms repeats periodically. This type of material is classified as
- (a) Amorphous and non-crystalline (b) Non-crystalline and epitaxial
(c) Epitaxial and single crystal (d) Amorphous and single crystal
10. Even though carbon is in the IV group of the periodic table, it is not used as a semiconductor because it has
- (a) High dielectric constant (b) Large energy gap > 5 eV
(c) Low temperature coefficient (d) Low thermal conductivity
11. An electric field on a plane described by its potential $V = 20(r^{-1} + r^{-2})$ where r is the distance from the source. The field is due to
- (a) A monopole (b) A dipole
(c) Both a monopole and a dipole (d) A quadrupole
12. Assuming perfect conductors of a transmission line, pure TEM propagation is NOT possible in
- (a) Coaxial cable (b) Air-filled cylindrical waveguide
(c) Parallel twin wire line in air (d) Semi-infinite parallel plate waveguide
13. Indicate which one of the following will NOT exist in a rectangular cavity
- (a) TE_{110} (b) TE_{011}
(c) TM_{110} (d) TM_{111}
14. Identify which of the following will not satisfy the wave equation
- (a) $50 \exp[j(\omega t - 3z)]$ (b) $\sin[\omega(10z + 5t)]$
(c) $\cos(y^2 + 5t)$ (d) $s \sin(x) \cos(t)$
15. In a twin wire transmission line in air, the adjacent voltage maxima are at 12.5 cm and 27.5 cm. The operating frequency is
- (a) 300 MHz (b) 1 GHz
(c) 2 GHz (d) 6.28 GHz
16. In air the lossless transmission line of length 50 cm with $L=10 \mu\text{H/m}$, $C=40 \text{ pF/m}$ is operated at 25 MHz. Its electrical path length is
- (a) 0.5 meters (b) 1 meters
(c) $\pi/2$ radians (d) 180 degrees
17. A plane wave propagation through the medium $\epsilon_r = 8$, $\mu_r = 2$ and $\sigma=0$ has electric field given by $E = 0.5e^{-(z/3)} \sin(10^8 t - \beta z)$ v/m. The wave impedance, in ohms is
- (a) 377 (b) $198.5 \angle 180^\circ$
(c) $182.9 \angle 14^\circ$ (d) 188.3

18. The magnitude of open circuit and short circuit impedances of a transmission line are 100W and 25W respectively. The characteristic impedance of the of the line is
- (a) 25 W (b) 50 W
(c) 75 W (d) 100 W
19. A TEM is incident normally upon a conductor. The E and H field at boundary will be respectively
- (a) Minimum and minimum (b) Maximum and maximum
(c) Minimum and maximum (d) Maximum and minimum
20. A uniform plane wave in air impinges at a 45° on a lossless dielectric material with dielectric constant ϵ_r . The transmitted wave propagates in a 30° direction with respect to the normal. The value of ϵ_r
- (a) 1.5 (b) $\sqrt{1.5}$
(c) 2 (d) $\sqrt{2}$
21. A rectangular waveguide has dimensions 1cmx0.5cm. Its cut-off frequency is
- (a) 5 GHz (b) 10 GHz
(c) 15 GHz (d) 12 GHz
22. Two coaxial cables 1 and 2 are filled with different dielectric constants ϵ_{r1} and ϵ_{r2} respectively. The ratio of the wavelengths in the two cables
- (a) $[\epsilon_{r1}/\epsilon_{r2}]^{1/2}$ (b) $[\epsilon_{r2}/\epsilon_{r1}]^{1/2}$
(c) $\epsilon_{r1}/\epsilon_{r2}$ (d) $\epsilon_{r2}/\epsilon_{r1}$
23. A transmission line is distortionless if
- (a) $RL=1/GC$ (b) $RL=GC$
(c) $LG=RC$ (d) $RG=LC$
24. If a plane electromagnetic wave satisfies the equation $\frac{\partial^2 E_x}{\partial z^2} = c^2 \frac{\partial^2 E_x}{\partial t^2}$, the wave propagates in the
- (a) x-direction
(b) z-direction
(c) y-direction
(d) xy plane at an angle of 45° between the x and z direction
25. The phase velocity of waves propagating in a hollow metal waveguide is
- (a) greater than the velocity of light in free space
(b) less than the velocity of light in free space
(c) equal to the velocity of light in free space
(d) equal to the group velocity

26. The dominant mode in a rectangular waveguide is TE_{10} because this mode has
- (a) no attenuation (b) no cut-off
(c) no magnetic field component (d) the highest cut-off wavelength
27. A material has a conductivity of 10^{-2} mho/m and a relative permittivity of 4. The frequency in which the conduction current in the medium is equal to the displacement current is
- (a) 45 MHz (b) 90 MHz
(c) 450 MHz (d) 900 MHz
28. A uniform plane electromagnetic wave incident normally on a plane surface of a dielectric material is reflected with a VSWR of 3. What is the percentage of incident power that is reflected?
- (a) 10% (b) 25%
(c) 50% (d) 75%
29. A medium radio transmitter operating at a wavelength of 492 m has a tower of antenna height 124 m. What is the radiation resistance of the antenna?
- (a) 25 W (b) 36.5 W
(c) 50 W (d) 73 W
30. In a uniform linear array, four isotropic radiating antennas are spaced $\lambda/4$ apart. The progressive phase shift between the antennas required for forming the main beam at 60° off the end-fire is
- (a) $-\pi$ radians (b) $-\pi/2$ radians
(c) $-\pi/4$ radians (d) $-\pi/8$ radians
31. The VSWR can have any value between
- (a) 0 and 1 (b) -1 and +1
(c) 0 and ∞ (d) 1 and ∞
32. In an impedance Smith chart, a clockwise movement along a constant resistance circle gives rise to
- (a) A decrease in the value of reactance (b) An increase in the value of reactance
(c) No change in the reactance value (d) No change in the impedance value
33. The unit of $\nabla \times H$ is
- (a) ampere (b) ampere/meter
(c) ampere/meter² (d) ampere-meter
34. The depth of penetration of electromagnetic wave in a medium having conductivity s at a frequency of 1 MHz is 25 cm. The depth of penetration at a frequency of 4 MHz will be
- (a) 6.25 cm (b) 12.5 cm
(c) 50.0 cm (d) 100.0 cm

35. If the electric field intensity is given by $E = (xu_x + yu_y + zu_z)$ volt/m, the potential difference between X(2,0,0) and Y(1,2,3) is
- (a) + 1 V (b) - 1 V
(c) + 5 V (d) + 6 V
36. If the electric field intensity associated with a uniform plane electromagnetic wave travelling in a perfect dielectric medium is given by $E(z,t) = 10 \cos(2\pi 10^7 t - 0.1\pi z)$ volt/m, the velocity of the travelling wave is
- (a) 3×10^8 m/sec (b) 2×10^8 m/sec
(c) 6.28×10^7 m/sec (d) 2×10^7 m/sec
37. A parallel plate air filled capacitor has plate area of 10^{-4} m² and plate separation of 10^{-3} m. It is connected to a 0.5V, 3.6GHz source. Magnitude of displacement current is $\epsilon_0 = (1/36)\pi 10^{-9}$ F/m
- (a) 10 mA (b) 100 mA
(c) 10 A (d) 1.59 mA
38. A medium of relative permittivity $\epsilon_{r2}=2$ forms an interface with free space. A point source of electromagnetic energy is located in the medium at a depth of 1 m from the interface. Due to the total internal reflection, the transmitted beam has a circular cross section over the interface. The area of the beam cross section at the interface is given by
- (a) $2\pi m^2$ (b) $\pi^2 m^2$
(c) $(\pi/2)m^2$ (d) πm^2
39. Two small diameter 5 g dielectric balls can slide freely on a vertical non-conducting thread. Each ball carries a negative charge of 2 μ C. If the lower ball is restrained from moving, then the separation between the two balls will be
- (a) 8570 mm (b) 857 mm
(c) 85.7 mm (d) 8.57 mm
40. Solutions of Laplace's equation, which are continuous through the second derivative, are called
- (a) Bessel function (b) Odd functions
(c) Harmonic functions (d) Fundamental functions
41. The region between two concentric conducting cylinders with radii of 2 and 5 cm contains a volume charge distribution $-10^{-8}(1+10r)$ C/m³. If E_r and V both are zero at the inner cylinder and $e = e_0$, the potential V at the outer cylinder will be
- (a) 0.506 V (b) 5.06 V
(c) 50.6 V (d) 506 V

42. For an elliptically polarized wave incident on the surface of a dielectric at the Brewster angle, the reflected wave will be
- (a) Elliptically polarized (b) Linearly polarized
(c) Right circularly polarized (d) Left circularly polarized
43. A vertical wire of 1 m length carries a current of 1A at 10 MHz. The total radiating power is nearly
- (a) 0.13W (b) 0.88W
(c) 7.3W (d) 73W
44. The Poynting Vector $\mathbf{p}=\vec{\mathbf{E}} \times \vec{\mathbf{H}}$ has the dimensions of
- (a) Power/unit area (b) Volts
(c) Power (d) Volts/unit length
45. In a hundred turn coil, if the flux through each turn is $(t^3 - 2t)$ mWb, the magnitude of the induced emf in the coil at a time of 4 sec is
- (a) 46 mV (b) 56 mV
(c) 4.6 mV (d) 5.6 V
46. Basic function of a transformer is to change
- (a) Level of voltage (b) Power level
(c) Power factor (d) Frequency
47. In a transformer electrical power is transferred from one circuit to another circuit without change in
- (a) Voltage (b) Current
(c) Frequency (d) Turns
48. Transformer action requires a
- (a) Constant magnetic flux (b) Increasing magnetic flux
(c) Alternating magnetic flux (d) Alternating electric flux
49. The iron core in a transformer provides a _____ path to the main flux
- (a) Low reluctance (b) High reluctance
(c) Low resistance (d) High conductivity
50. The value of flux involved in the emf equation for a transformer is
- (a) Instantaneous (b) Maximum
(c) Average (d) rms

- 51.** In a transformer operating at a constant voltage, if the input frequency increases, the core loss
- (a) increases (b) decreases
(c) remains constant (d) increases as square of the frequency .
- 52.** Power factor of a transformer at no load is poor because
- (a) Magnetizing reluctance of the transformer
(b) Open circuited secondary
(c) Low primary winding resistance
(d) Low no-load current
- 53.** Magnetizing current, for sinusoidal input applied voltage will be
- (a) always non-sinusoidal
(b) always sinusoidal
(c) sinusoidal or non-sinusoidal depending upon the saturation point
(d) none of the above
- 54.** Mutual flux in a loaded transformer can be varied by varying the
- (a) Primary current (b) Load impedance
(c) Secondary current (d) Reluctance of the magnetic path
- 55.** Regulation of a transformer is defined as
- (a) Rise in transformer voltage
(b) Fall in terminal voltage when loaded
(c) Change in secondary terminal voltage from no load to full load as a percentage of the secondary no load terminal voltage
(d) Change in flux from no load to full load
- 56.** Alternators operate on the principle of
- (a) Electro-magnetic induction (b) Self-induction
(c) Mutual induction (d) Self or mutual induction
- 57.** A synchronous machine can operate
- (a) only as a generator (b) only as a motor
(c) both as motor and generator (d) none of the above

58. Armature of an alternator

- (a) is a stationary member
- (b) is a revolving member
- (c) is the frame
- (d) consists of the winding into which current is induced

59. For small generators

- (a) armature is revolving member
- (b) magnetic field is produced by dc electromagnets placed on the stationary member (stator)
- (c) current induced in the rotating member armature is collected by means of brushes and slip rings on the revolving member (rotor)
- (d) all of the above

60. In a synchronous machine stator frame is made up of

- (a) Stainless steel
- (b) CRGO Steel
- (c) Cast iron or welded steel plates
- (d) Laminated silicon steel

61. Slot provided on the stator core of a synchronous machine are of _____ type

- (a) Open
- (b) Semi-closed
- (c) Totally closed
- (d) Either open or semi closed

62. Field system of an alternator is usually excited at

- (a) 1250/250 V_{DC}
- (b) 110/220 V_{DC}
- (c) 3-phase, 50 Hz, 400V
- (d) 230 V_{AC}

63. Slip rings employed in a 3-phase synchronous machine are insulated for

- (a) Output rated voltage
- (b) Low voltage
- (c) Very low voltage
- (d) Very high voltage

64. An alternator driven by a steam turbine is known as a

- (a) Turbo-generator
- (b) Hydro-generator
- (c) Steam generator
- (d) None of the above

65. The maximum possible speed at which an alternator can be driven to generate 50 Hz and 4000V is

- (a) 4000 rpm
- (b) 3600 rpm
- (c) 3000 rpm
- (d) 1500 rpm

66. Distributed winding is preferred over concentrated winding as it
- (a) reduces noise
 - (b) reduces the machine size
 - (c) reduces the amount of copper required
 - (d) improves the generated waveform and adds rigidity and mechanical strength to the winding
67. Chording and distribution of armature windings for an ac machine result in
- (a) Reduction in air gap mmf harmonics
 - (b) Reduction in fundamental components of induced emf
 - (c) Increase in the fundamental components of induced emf
 - (d) Both (a) and (b)
68. Skew of rotor bar eliminates
- (a) Effect of space harmonics
 - (b) Entire effect of crawling
 - (c) Magnetic noise
 - (d) Vibration due to unequal force developed on rotor
69. EMF generated due to n-th harmonic component of the flux in an alternator will be _____ the fundamental EMF in magnitude
- (a) Less than
 - (b) More than
 - (c) Equal to
 - (d) Can not be comparable
70. The ratio of phasor sum of induced emfs per coil to the arithmetic sum of induced emfs per coil is known as
- (a) distribution factor
 - (b) winding factor
 - (c) coil span or pitch factor
 - (d) breadth factor
71. Power scale of circle diagram of an induction motor can be determined from _____ test data only
- (a) Open circuit
 - (b) Stator resistance
 - (c) Short circuit
 - (d) Slip
72. If an induction motor with certain ratio of rotor to stator slots, runs at $1/7^{\text{th}}$ of the normal rated speed, the motor is said to be
- (a) Hunting
 - (b) Crawling
 - (c) Cogging
 - (d) Jogging

73. An increase in the number of poles of an induction motor results in

- (a) decrease in maximum pf (b) increase in maximum pf
(c) no change in maximum pf (d) unpredictable

74. Leakage reactance per phase of the stator of a polyphase induction motor is 1.0ω . The turns per phase of the stator are increased by 10%. The leakage reactance is then equal to

- (a) $(1.1)^2$ (b) $(0.9)^2$
(c) $1/(1.1)^2$ (d) $1/(0.9)^2$

75. The 3-phase induction motor provided with open slot has

- (a) Reduced leakage reactance (b) Increased starting torque
(c) Better pf (d) Both (a) and (b)

76. Stator of a small (upto 5 HP) induction motor is provided with

- (a) Open slots with parallel teeth (b) Open slots with tapered teeth
(c) Semi-closed slots with parallel teeth (d) Totally closed slots with parallel teeth

77. The difference between number of stator slots and that of rotor slots in an induction motor should not be equal to P, 2P or 5P. It is essential in order to avoid

- (a) Synchronous cusps (b) Crawling
(c) Magnetic locking (d) Noise and vibrations

78. In induction machines, it is usually a standard practice to employ

- (a) integral-slot winding with full pitch coil
(b) integral slots winding with chorded coils
(c) fractional slot winding with fractional pitch coils
(d) fractional slot winding with full pitch coils

79. In 3-phase induction motor, sometimes copper bars are placed deep in the rotor. It is done to improve

- (a) efficiency (b) starting torque
(c) power factor (d) none of the above

80. A double squirrel cage induction motor has

- (a) two series winding in stator (b) two series winding in rotor
(c) two parallel winding in rotor (d) two parallel winding in stator

- 81.** Slip ring induction motor has the advantages of
- (a) High starting torque and high overload capacity
 - (b) Nearly constant speed
 - (c) Low starting current in comparison to squirrel cage induction motor
 - (d) all of the above
- 82.** If the full load speed of a 3-phase induction motor is 960 rpm, its speed at half load will be approximately
- (a) 960 rpm
 - (b) 1000 rpm
 - (c) 975 rpm
 - (d) 900 rpm
- 83.** If a 3-phase induction motor is operated on unbalanced supply, then it should be operated at
- (a) Higher loads
 - (b) Lower loads
 - (c) Higher speeds
 - (d) Lower speeds
- 84.** Single phase preventer
- (a) Suppresses negative sequence current
 - (b) Compensates for voltage drop
 - (c) Provides protection in the event of non-availability of one of the phases
 - (d) None of the above
- 85.** If a 3-phase 350V, 50 Hz, 1440 rpm induction motor is operated on 420V, 60 Hz supply, then the torque will
- (a) Increase
 - (b) Decrease
 - (c) Remain unchanged
 - (d) None of the above
- 86.** A dc generator can be considered as
- (a) Rotating amplifier
 - (b) Power pump
 - (c) Rectifier
 - (d) Prime mover
- 87.** The direction of emf generated in a dc generator can be found by
- (a) Fleming's right rule
 - (b) Fleming's left hand rule
 - (c) Lenz's law
 - (d) Kirchoff's law
- 88.** The induced voltage in a single loop reverses
- (a) Once each revolution
 - (b) Once each half revolution
 - (c) Once each one-quarter revolution
 - (d) 8 times each revolution

89. The yoke of a large machine is invariably made of fabricated steel because of its

- (a) High permeability
- (b) Low permeability
- (c) Low cost
- (d) Low specific gravity

90. Pole of a dc machine is laminated for the purpose

- (a) Decreasing hysteresis loss
- (b) Decreasing eddy current loss
- (c) Decreasing both eddy current and hysteresis loss
- (d) Manufacturing ease

91. The flux per pole is ϕ , then the flux in the yoke section will be

- (a) 2ϕ
- (b) ϕ
- (c) $\phi/2$
- (d) 1.1ϕ

92. The function(s) of pole shoes in a dc machine is/are to

- (a) support the pole coils
- (b) reduce the reluctance of the magnetic path
- (c) spread out the flux to achieve uniform flux distribution in the air gap
- (d) all of the above

93. For both lap and wave windings, there are as many commutator bars as the number of

- (a) Armature conductors
- (b) Winding elements
- (c) Poles
- (d) Slots

94. In dc machine, fractional pitch winding is employed to

- (a) Increase generated voltage
- (b) Reduce sparking
- (c) Save copper
- (d) Both (b) and (c)

95. In a dc machine, on no load the magnetic neutral axis

- (a) moves from geometrical neutral axis in the direction of rotation
- (b) moves from geometrical neutral axis in the opposite direction of rotation
- (c) coincides with the geometrical neutral axis
- (d) none of the above

96. In a dc generator, demagnetizing component of armature reaction causes

- (a) reduction in generated emf
- (b) increase in speed
- (c) sparking trouble
- (d) none of the above

97. Air gap at the pole of a dc machine is kept more than that at the centre of the pole mainly to reduce
- (a) reactance voltage (b) effect of armature reaction
(c) losses of armature core (d) noise of the machine
98. Current in a coil undergoing commutation is not able to get reversed completely by the end of the commutation period, it is due to
- (a) Reactance voltage induced in the coil
(b) Coil resistance
(c) Armature emf
(d) None of the above
99. In a dc machine sparking between brushes and commutator surface may be due to
- (a) Under commutation (b) Over commutation
(c) Too rapid reversal of current (d) Any of the above
100. The function of interpole in a dc machine is due to
- (a) reduce field winding heating (b) improve commutation
(c) compensate for air gap variation (d) reduce losses
101. In large dc machines the compensating windings are provided to
- (a) compensate for the decrease in speed due to increase in load
(b) neutralize the voltage induced in the coil due to high fluctuations of load
(c) reduce eddy current losses by providing local short circuits
(d) none of the above
102. A dc generator beyond critical resistance will generate
- (a) maximum power (b) maximum voltage
(c) maximum current (d) no voltage
103. The factor that is not responsible for drop in terminal voltage of a dc shunt generator on load is
- (a) commutation (b) armature reaction
(c) armature resistance drop (d) field weakening due to (b) and (c) ...
104. DC compound motors are generally
- (a) level compound (b) cumulative compound
(c) differential compound (d) none of these

105. When the supply terminal of a dc shunt motor are interchanged

- (a) the motor will stop
- (b) the motor will run at its normal speed in the same direction as before
- (c) direction of rotation will reverse
- (d) motor will run much faster in the same direction

106. In a dc series motor, torque developed is

- (a) inversely proportional to armature current
- (b) directly proportional to armature current
- (c) proportional to square of armature current
- (d) proportional to the square root of armature current

107. The horse power obtained from the motor shaft is called

- (a) IHP (b) BHP
- (c) Useful output (d) None of these

108. The speed of a dc shunt motor may be increased above its normal speed by

- (a) increasing the field current (b) decreasing the field current
- (c) decreasing the terminal voltage (d) increasing the armature resistance

109. The speed of a 4-pole dc series motor at no load will be

- (a) zero (b) 300 rpm
- (c) Infinite (d) 1500 rpm

110. Which of the following dc motors will have the highest percentage increase of input current, for the same percentage increase in torque

- (a) Series (b) Shunt
- (c) Cumulative compound (d) All equal

111. The resolution of a Michelson interferometer operating with a light source of 640 nm wavelength is

- (a) 1280 nm (b) 640 nm
- (c) 80 nm (d) 1 nm

112. When a terminal is at virtual ground, then

- (a) both current and voltage are zero (b) only voltage will be zero
- (c) only current will be zero (d) both voltage and current are not zero

113. Platinum resistor (PTR) and a thermistor (THR) are used to measure room temperature. Which of the following is true?

- (a) PTR offers more accuracy, THR more resolution
- (b) PTR offers more resolution, THR more accuracy
- (c) Both offer same accuracy, THR offers more resolution
- (d) Both offer same resolution, PTR offers more accuracy

114. A four bit A/D converter is used to convert an analog voltage of 8V. The maximum error is

- (a) 0.5 V (b) 1.0 V
- (c) 2.0 V (d) 0.25

115. A voltage of 2300 volts is applied to a cylindrical counter with an anode wire of radius 0.01 cm and a cathode inner radius of 1.0 cm. The electric field at the anode surface is

- (a) 5×10^4 V/cm (b) 5×10^3 V/cm
- (c) 5×10^5 V/cm (d) 5×10^2 V/cm

116. A γ -ray of energy 1 keV is passed through a solid absorber of thickness 3 cm and mass attenuation coefficient $3 \text{ cm}^2/\text{gm}$ at temperature T_1 . If the same absorber is melted at temperature T_2 , the mass attenuation coefficient will be

- (a) $3(T_1/T_2)^2 \text{ cm}^2/\text{gm}$ (b) $1/3 \text{ cm}^2/\text{gm}$
- (c) $3 \text{ cm}^2/\text{gm}$ (d) $3(T_2/T_1)^2 \text{ cm}^2/\text{gm}$

117. Five panelists are required to elect a sixth member to the panel. If any of the panelists votes against a member, the member is disqualified. What would be the appropriate electronic circuit to be used in the electronic voting machine to implement the above rule?

- (a) XOR (b) XNOR
- (c) OR (d) AND

118. In an op-amp, when the input signal drives the output at a rate of voltage change greater than the slew rate, then the resulting signal

- (a) is enhanced
- (b) is clipped
- (c) is unaffected
- (d) remains the same, but with 90° phase difference

119. Sensitive experiments are often performed inside a metal enclosure known as a Faraday cage. Which of the following of Maxwell's equations governs the principle of operation of the cage?

- (a) $\nabla \cdot \vec{E} = \rho / \epsilon_0$ (b) $\nabla \cdot \vec{B} = 0$
- (c) $\nabla \times \vec{B} = -\frac{\partial \vec{B}}{\partial t}$ (d) $\nabla \times \vec{H} = \mu_0 (J + \epsilon_0 \frac{\partial \vec{E}}{\partial t})$

120. For the ground state of a particle moving freely in a one-dimensional box $0 \leq X \leq L$ with rigid reflecting end-points, the uncertainty product $(\Delta X)(\Delta p)$ is
- (a) $\frac{h}{2}$ (b) $\sqrt{2}h$
(c) $> \frac{h}{2}$ (d) $\frac{h}{\sqrt{3}}$
121. The energy of a 200 nm photon is
- (a) 0.01 eV (b) 100 eV
(c) 10 eV (d) 1 eV
122. The ground state energy of a particle in an infinite square-well potential of width L is E . If the width of the well is reduced to $L/2$, then the ground state energy becomes
- (a) $2E$ (b) $E/2$
(c) $4E$ (d) $E/4$
123. Let k be the wave number of the incident plane wave in a scattering experiment. If the scattering is purely a p-wave with the phase shift $\delta_1 = p/4$, then the total scattering cross-section is
- (a) $2p/k^2$ (b) $6p/k^2$
(c) 0 (d) k^2
124. Plane polarized light will be rotated when it is passed through a solution of
- (a) NaClO_3 (b) CHClF_2
(c) HCBrClF (d) BrCH_3
125. The specific heat of silicon monoxide at high temperatures, as compared to silicon dioxide is
- (a) Larger
(b) Smaller
(c) Equal
(d) Dependent on other parameters not specified here
126. You are shown a spectrum consisting of a series of equally spaced lines. This could be
- (a) the rotational spectrum of CO (b) the vibrational spectrum of N_2
(c) the NMR spectrum of CH_4 (d) the Mossbauer spectrum of Fe_3O_4

127. The ratio $\frac{\kappa}{\sigma T}$ (where κ is the thermal conductivity, σ is the electrical conductivity and T is the temperature) for metals
- (a) is strongly dependent on the number density of the charge carriers
 - (b) is independent of the temperature T
 - (c) varies widely from one metal to another
 - (d) is approximately independent of the particular metal
128. Consider a gas of non-interacting electrons at $T = 0$. If the electrons (of mass m) are replaced by neutrons (of mass M) keeping the density $n = N/V$ the same, the Fermi energy e_F is changed by a factor
- (a) M/m
 - (b) $(M/m)^{2/3}$
 - (c) $(M/m)^{3/2}$
 - (d) m/M
129. Two protons are placed at a distance of about 10^{-13} cm from each other. The ratio of the strength of strong and electromagnetic forces between them is roughly
- (a) 10
 - (b) 1
 - (c) 1000
 - (d) 10^{-5}
130. Which of the following is true for β -decay of the neutron? The process
- (a) violates both parity and charge conjugation symmetry
 - (b) violates parity but conserves charge conjugation symmetry
 - (c) conserves parity but violates charge conjugation symmetry
 - (d) conserves both parity and charge conjugation symmetry
131. Blackbody radiation is enclosed inside a spherical cavity of radius r at a temperature T . What would be the temperature of the enclosure if the radius expands to $2r$ adiabatically?
- (a) $T/2$
 - (b) T
 - (c) $T/\sqrt{2}$
 - (d) $2T$
132. Which of the following is not a periodic function of ϕ ?
- (a) $\sin \phi + \pi \cos \phi$
 - (b) $\sin(\pi\phi) + \cos(\pi\phi)$
 - (c) $\sin(\phi) + \cos(\pi\phi)$
 - (d) $\sin(\pi) + \cos(\pi + \phi)$
133. Consider a parallel plate capacitor connected to an AC voltage source. A conducting slab is introduced in the space between the plates. The capacitance of the parallel plate capacitor
- (a) goes to zero
 - (b) increases to a finite value
 - (c) decreases to a non-zero value
 - (d) becomes infinite

134. The volume of a thermodynamic system increases irreversibly by an incremental amount δV . If P is the pressure, the work done on the system is

- (a) $\delta W = P\delta V$ (b) $\delta W = -P\delta V$
(c) $\delta W < -P\delta V$ (d) $\delta W > -P\delta V$

135. A thermodynamic system is classified as closed if it can

- (a) exchange energy with its surroundings, but not matter
(b) exchange both energy and matter with its surroundings
(c) exchange neither energy nor matter with its surroundings
(d) exchange only matter, but not energy, with its surroundings

136. The formula that determines the number of electrons which can be accommodated in any level is

- (a) $2n^2$ (b) n^2
(c) $4n$ (d) $4n^2$

137. Rutherford's atomic model based on experimental observations could not be accepted. This is because

- (a) It does not take into consideration the quantization condition of angular momentum of an electron
(b) It does not consider orbital motion of an electron
(c) It does not explain hydrogen spectrum
(d) The statement is false

138. Magnetization vector M is expressed in

- (a) Tesla (b) A/m
(c) A/m² (d) A-m

139. For ferromagnetic materials the susceptibility is

- (a) Constant, positive, very high
(b) Positive and very high but not constant
(c) Always negative
(d) Positive but very low

140. Soft magnetic materials have

- (a) Steeply rising magnetization curve
(b) Relatively small and narrow hysteresis loop
(c) Small energy loss per cycle of magnetization
(d) All of the above

141. Which material is used for making permanent magnet?

- (a) Carbon steel (b) Germanium
(c) Silicon (d) Copper

142. Ceramic resonators use which one of the following?

- (a) Barium titanate (b) Silicon
(c) Piezo-electric-quartz crystal (d) Zirconium titanate

143. Air filled parallel plate capacitor made of square plates, each $10\text{cm} \times 10\text{cm}$, has a capacitance C . If the plates are reduced in size to $2.5\text{cm} \times 2.5\text{cm}$, what would be the new capacitance?

- (a) $C/4$ (b) $C/8$
(c) $C/16$ (d) $C/32$

144. Which among the following have capacitance values from few mF to high mF?

- (a) Mica, glass, low loss ceramic (b) High permittivity ceramic
(c) Paper (d) Electrolytic

145. How much (approximate) is the frequency independent power factor of a plastic dielectric capacitor?

- (a) 0.00002 (b) 0.0002
(c) 0.002 (d) 0.02

146. The velocity of light in a particular medium is 108 m/sec . What is the relative permittivity of the medium?

- (a) 1.732 (b) 3
(c) 9 (d) 0.333

147. What does the quality factor of a dielectric mean?

- (a) It is related to the permittivity of the material
(b) It is related to the breakdown voltage of the dielectric
(c) It is related to the resistivity of the material
(d) It is related to the ratio between maximum stored energy and average power loss in the dielectric

148. In Curie law for paramagnetic materials, how is susceptibility related to absolute temperature?

- (a) $\chi \propto T$ (b) $\chi \propto 1/T$
(c) $\chi \propto T^2$ (d) $\chi \propto 1/T^2$

149. Transition temperature of superconducting material is changed by which of the following?

- (a) Electric field (b) Magnetic field
(c) Mechanical stress (d) None of these

150. Capacitance per unit volume is maximum for

- | | | | |
|-----------------------------|--------------------------|----------------------------------|--------------------------|
| (a) Air capacitor | <input type="checkbox"/> | (b) Mica capacitor | <input type="checkbox"/> |
| (c) Ceramic capacitor | <input type="checkbox"/> | (d) Electrolytic capacitor | <input type="checkbox"/> |

* * * * *