(Answer ALL questions)

56. A vector of magnitude 3 cannot be added to a vector of magnitude 4 so that the magnitude of the resultant is
1. 5
2. 3
3. 1
4. 0

57. A certain room has a floor which is 5 × 6 m and the ceiling height is 3 m. For the vector distance from one corner of the room to the corner diagonally opposite it, the magnitude of the distance is given by
1. 4.8 m
2. 8.4 m
3. 2.4 m
4. 16.0 m

58. A ball dropped from a bridge strikes the water in 5 s. The height of the bridge is calculated as
1. 1230 m
2. 123 m
3. 62 m
4. 620 m

59. The speed of a comet in an elliptical orbit about the sun:
1. decreases while it is receding from the sun
2. is constant
3. is greatest when farthest from the sun
4. varies sinusoidally with time

60. To produce beats it is necessary to use two waves:
1. of equal amplitudes
2. of equal wavelengths
3. traveling in opposite directions
4. of slightly different frequencies

61. The intensity of sound wave A is 100 times that of sound wave B. Relative to wave B the sound level of wave A is:
1. –2 dB
2. +2 dB
3. +20 dB
4. +100 dB

62. When the temperature of a copper coin is increased by 100° C, its diameter increases by 0.17 %. The area of one of its faces increases by:
1. 0.17 %
2. 0.34 %
3. 0.51 %
4. 0.27 %

63. You are riding a bicycle directly away from a stationary source of sound and hear a frequency that is 1% lower than the emitted frequency. The speed of sound is 343 m/s. What is your speed?
1. 68 m/s
2. 6.8 m/s
3. 3.4 m/s
4. 34.3 m/s

64. The frequency of a light wave with a wavelength of 6×10^{-7} m is equal to
1. 5×10^{4} Hz
2. 5×10^{10} Hz
3. 5×10^{12} Hz
4. 5×10^{14} Hz

65. Red light with a wavelength of 630 nm strikes a double slit with a spacing of 0.5 mm. If the interference pattern is observed on a screen located 1 m from the double slit, how far from the center of the screen is the second bright line from the central bright line?
1. 4.0 mm
2. 3.5 mm
3. 2.5 mm
4. 1.0 mm

66. If you draw a small dot on a piece of paper and view this dot through a calcite crystal, you will see
1. one dot
2. two dots
3. three dots
4. no dots

67. A wire of length L, Young's modulus Y, and cross-sectional area A is stretched elastically by a small amount l,. What is the work done in stretching the wire by an small amount?

1. YAl^2 / L
2. $2YAl^2 / L$
3. $LAl^2 / 2Y$
4. $YAl^2 / 2L$

68. _____ gives the viscous drag force on a spherical object moving in a fluid.

1. Poiseuille's law
2. Stoke's law
3. Bernoulli's law
4. Surface tension

69. The viscosity of a liquid _____ with _____ temperature.

1. becomes zero, decreasing
2. decreases, decreasing
3. increases, increasing
4. decreases, increasing

70. A Pascal is equal to

1. Joule per cubic meter
2. Joule per square meter
3. Joule per meter
4. Newton per meter

71. A water line with an internal radius of 0.0065 m is connected to a shower head that has 12 holes. The speed of the water in the line is 1.2 m/s. At what speed does the water leave one of the holes (effective hole radius is 0.00064 m) in the head?

1. 2000 m/s
2. 200 m/s
3. 20 m/s
4. 2 m/s

72. A charged insulator can be discharged by passing it just above a flame. This is because the flame:

1. contains ions
2. warms it
3. contains more rapidly moving atoms
4. dries it

73. Three identical point charges $q = -2.0\ nC$ are at the vertices of an equilateral triangle with sides of length $L = 1.0\ cm$. What is the magnitude of the electric force acting on any one of them?

1. 0.0062N
2. 0.00062 N
3. 0.00013 N
4. 0.0013 N

74. If the dielectric were replaced with one having twice the dielectric constant and half the dielectric strength, what would happen to the capacitance?

1. C decreases by four times
2. C decreases by two times
3. C increases by four times
4. C increases by two times

75. If 0.320 mA of current flow through a calculator, how many electrons pass through per second?

1. 2.0×10^{10} electrons
2. 2.0×10^{12} electrons
3. 2.0×10^{15} electrons
4. 2.0×10^{17} electrons

76. Two long parallel straight wires carry equal currents in opposite directions. At a point midway between the wires, the magnetic field they produce is:

1. zero and perpendicular to the plane of the two wires
2. non-zero and perpendicular to the plane of the two wires
3. non-zero and parallel to the plane of the two wires
4. zero

77. The emf that appears in Faraday's law is:

1. around a conducting circuit
2. around the boundary of the surface used to compute the magnetic flux
3. perpendicular to the surface used to compute the magnetic flux
4. throughout the surface used to compute the magnetic flux

78. Magnetization vectors in neighboring ferromagnetic domains are:
1. always in opposite directions
2. always in the same direction
3. always in different directions
4. sometimes in opposite directions and sometimes in the same direction

79. A 3.5 mH inductor and a 4.5 mH inductor are connected in parallel. The equivalent inductance is
1. 1.0 mH
2. 2.0 mH
3. 8.0 mH
4. 0.51 mH

80. The quantization of energy for mechanical oscillators was first used to explain:
1. the photoelectric effect
2. line spectra
3. frequencies of atomic oscillators
4. spectral radiancy curves

81. How many of the 90 protons in the thorium nucleus are carried off by the alpha particles?
1. $N_{alpha}(1)$
2. $N_{alpha}(2)$
3. $N_{alpha}(3)$
4. $N_{alpha}(4)$

82. In a photoelectric effect experiment at a frequency above cut off, the stopping potential is proportional to:
1. the energy of the least energetic electron before it is ejected
2. the energy of the least energetic electron after it is ejected
3. the energy of the most energetic electron before it is ejected
4. the energy of the most energetic electron after it is ejected

83. The number of states in a subshell with orbital quantum number $l = 3$ is:
1. 14
2. 9
3. 3
4. 2

84. High temperatures are required in thermonuclear fusion so that:
1. there is a high probability some nuclei will strike each other head on
2. electrons are boiled from the atoms
3. some nuclei are moving fast enough to overcome the barrier to fusion
4. the Pauli exclusion principle does not prohibit fusion

85. Most magnetic confinement project attempt:
1. proton-deuteron fusion
2. triton-triton fusion
3. proton-proton fusion
4. deuteron-triton fusion

86. An example of a fermion is a:
1. photon
2. pion
3. neutrino
4. kaon

87. Two particles interact to produce only photons, with the original particles disappearing. The particles must have been:
1. Mesons
2. A antiparticle, antiparticle pair
3. Leptons
4. A particle, antiparticle pair

88. Assume the valence electron removed from a copper atom. The net charge of the atom becomes
1. 0
2. +1
3. –1
4. +4

89. When an electron is moved to a higher orbit level, its energy level with respect to the nucleus
1. increases
2. decreases
3. remains the same
4. depends on the type of atom

90. While maintaining a constant temperature, a silicon diode has its reverse-bias voltage increases. The diode's saturation current will
1. increases
2. decreases
3. remains the same
4. equals its surface leakage current

91. The knee voltage of a diode is approximately equal to the
1. applied voltage
2. barrier potential
3. breakdown voltage
4. forward voltage

92. The voltage across the zener resistance is usually
1. small
2. large
3. measured in volts
4. subtracted from the breakdown voltage

93. Most of the electrons that flow through the base will
1. flow into the collector
2. flow out of the base lead
3. recombine with base holes
4. recombine with collector holes

94. The ac base voltage of an emitter follower is across the
1. Emitter diode
2. DC emitter resistor
3. Load resistor
4. Emitter diode and external ac emitter resistance

95. A common-base amplifier has a voltage gain that is
1. much less than one
2. equal to one
3. greater than one
4. zero

96. If x is defined as the mean probability per unit time that an electron is scattered, then the mean time between collisions is
1. x
2. $1/x$
3. $x/2$
4. $1/2x$

97. The Lorenz number is equal to
1. $1.44 \times 10^{-8} W \Omega K^2$
2. $1.44 \times 10^{-8} W \Omega K^{-2}$
3. $2.44 \times 10^{-8} W \Omega K^2$
4. $2.44 \times 10^{-8} W \Omega K^{-2}$

98. Density of states is equal to
1. number of states per square meter per Joule of energy
2. number of states per cubic meter per Joule of energy
3. number of states per cubic meter times Joule energy
4. number of states per cubic meter

99. The product of density of states function and Fermi-Dirac function is
1. the hole concentration per unit energy.
2. the electron concentration per unit energy.
3. the electron concentration per unit volume
4. the hole concentration per unit volume

100. The drift velocity for unit electrical field is called
1. collision time
2. random speed
3. mobility
4. conductivity

101. The residual resistivity will be high if
1. the metal is pure
2. the metal is impure
3. if it is a liquid metal
4. if the metal is a superconductor

102. For a long thin metal wire, the allowed energies are given by (E_1 is the ground state energy):
1. nE_1
2. nE_2
3. n^2E_2
4. n^2E_1

103. Fermi temperature is given as, (E_F = Fermi energy and k = Boltzmann constant)
1. E_F/k
2. $E_F(k)$
3. $2E_F(k)$
4. $E_F/2k$

104. Many solids exhibit ———— behavior.
1. Pauli's law
2. Boltzmann's law
3. Fermi's law
4. Curie's law

105. An atom is said to be ———— if it possesses an effective dipole moment.
1. ionized
2. polarized
3. energized
4. unpolarized

106. Clausius-Mossotti equation allows the calculation of the ———— property, namely relative permittivity from ———— polarization phenomena.
1. microscopic, macroscopic
2. macroscopic, microscopic
3. microscopic, microscopic
4. macroscopic, macroscopic

107. Grain boundaries frequently lead to ———— polarization.
1. normal
2. orientational polarization
3. interfacial
4. ionic

108. Typical polarization mechanism occurs in water is:
1. ionic
2. orientational
3. energized
4. electronic

109. The unit for magnetic dipole moment is:
1. H/m
2. Wb
3. A/m^2
4. $A\ m^2$

110. A magnetic field of 2T corresponds to a magnetostatic energy density of
1. $1.6\ J/m^3$
2. $1.6\ mJ/m^3$
3. $1.6\ MJ/m^3$
4. $1.6\ KJ/m^3$

111. For manufacturing low-loss transformer cores ———— soft magnetic material is used.
1. Ideal soft
2. Silicon iron
3. Glassy metals
4. Ferrites

112. A solenoid carrying a current experiences ———— pushing the coil apart.
1. axial forces
2. radial forces
3. polarized forces
4. unpolarized forces

113. A superconductor cooled below its critical temperature ———— all magnetic field lines from the bulk.
1. maintains
2. polarizes
3. attracts
4. expels

114. When an electric dipole is kept in a uniform electric field, the dipole experiences
1. a net force
2. a torque
3. no force
4. no torque

115. A carbon nanotube is a rolled-up form of grapheme plane with ————.
1. normal vectors
2. parallel vectors
3. plane vectors
4. chiral vectors