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(Answer ALL questions)

56. A force of 100 N makes an angle of s with the x-axis and has a y-component of 30N. The x-component of the force and the angle s is given as
1. 75.4 N, 16.5^0
2. 85.4 N, 26.5^0
3. 95.4 N, 17.5^0
4. 105.4 N, 27.5^0

57. An object, originally at the point (2,5,1) cm, is given a displacement 8i-2j+k cm. The coordinates of its new position is
1. (10,2,3) cm
2. (2,3,10) cm
3. (10,3,2) cm
4. (2,2,3) cm

58. A truck starts from rest and moves with a constant acceleration of $5m/s^2$. The distance travelled by it after 4 s has elapsed is
1. 40 m
2. 30 m
3. 20 m
4. 10 m

59. Sinusoidal water waves are generated in a large ripple tank. The waves travel at 20 cm/s and their adjacent crests are 5 cm apart. The time required for each new whole cycle to be generated is
1. 4.0 s
2. 2.0 s
3. 0.25 s
4. 0.125 s

60. A fire whistle emits a tone of 170 Hz. Take the speed of sound in air to be 340 m/s. The wavelength of this sound is about
1. 1.0 m
2. 2.0 m
3. 3.0 m
4. 4.0 m

61. A source emits sound with a frequency of 1 KHz. It is moving at 20 m/s toward a stationary reflecting wall. If the speed of sound is 340 m/s an observer at rest directly behind the source hears a beat frequency of
1. 11 Hz
2. 86 Hz
3. 97 Hz
4. 118 Hz

62. It is more difficult to measure the coefficient of expansion of a liquid than that of a solid because
1. A liquid expands too much when heated
2. the containing vessel also expands
3. the containing vessel also shrinks
4. A liquid tends to evaporate

63. A 70 dB intensity level sound about _____ as loud as a 60 dB level.
1. two times
2. four times
3. seven times
4. ten times

64. For antireflection coatings on eyeglasses, if the design wavelength is 500 nm (in air), the appropriate thickness of the film would be about
1. 200 nm
2. 100 nm
3. 50 nm
4. 25 nm

65. As light goes from one medium to another, it is bent away from the normal. Then
1. The second medium has a higher index of refraction than the first
2. Dispersion must occur
3. The speed of the light has decreased
4. The speed of the light has increased

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

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67. No fringes are seen in a single-slit diffraction pattern if
1. the slit width is less than a wavelength
2. the screen is far away
3. the slit width is greater than a wavelength
4. the wavelength is less than the distance to the screen

68. Bernoulli's equation can be derived from the conservation of
1. mass
2. angular momentum
3. energy
4. pressure

69. The equation of continuity for fluid flow can be derived from the conservation of
1. mass
2. energy
3. volume
4. pressure

70. Detergent ———— of a fluid.
1. Increases the surface tension
2. reduces the surface tension
3. decreases the viscosity
4. increases the viscosity

71. Liquid flow through a smooth pipe is laminar as long as the Reynolds number is
1. greater than 2000
2. less than 2000
3. zero
4. between 5000 to 10000

72. Charge is distributed uniformly on the surface of a spherical balloon with a point charge inside. The electrical force on a point charge is greatest when
1. It is near the inside surface of the balloon
2. It is at the center of the balloon
3. It is halfway between the balloon center and the inside surface
4. it is anywhere inside

73. What is the flux through one side of a cube that has a point charge – 2.0 μC at its center?
1. -3.8×10^4 N.m^2/C
2. -3.8×10^3 N.m^2/C
3. -3.8×10^2 N.m^2/C
4. -3.8×10^{-6} N.m^2/C

74. When finding the potential energy due to four point charges, how many pairs of charges are there?
1. Two pairs
2. Four pairs
3. Six pairs
4. Eight pairs

75. A current of 0.5 A exists in a 60-ohm lamp. The applied potential difference is
1. 15 V
2. 30 V
3. 60 V
4. 120 V

76. A magnetic flied cannot
1. exert a force on a charge
2. accelerate a charge
3. change the momentum of a charge
4. change the kinetic energy of a charge

77. The emf developed in a coil X due to the current in a neighboring coil Y is proportional to the
1. Thickness of the wire in X
2. Rate of change of current in Y
3. Magnetic field in X
4. Rate of change of magnetic field in X

78. The energy of a magnetic dipole in an external magnetic field is least when
1. the dipole moment is parallel to the field
2. the dipole moment is perpendicular to the field
3. the dipole moment is anti-parallel to the filed
4. the same energy is associated with all orientations

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79. A current of 10 A in a certain inductor results in a stored energy of 40 J. When the current is changed to 5 A in the opposite direction, the stored energy changes by
1. 10 J
2. 20 J
3. 30 J
4. 50 J

80. The area under the spectral radiancy curve has the significance of
1. Energy
2. Power/temperature
3. Energy/temperature
4. Power/area

81. How many of the 228 nucleons 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 Compton scattering from stationary particles the maximum change in wavelength can be made smaller by using
1. higher frequency radiation
2. more massive particles
3. lower frequency radiation
4. particles with greater charge

83. Of the following which is the best evidence for the wave nature of matter?
1. the Compton effect
2. the photoelectric effect
3. the relationship between momentum and energy for an electron
4. the reflection of electron by crystals

84. An electron in an L shell of an atom has the principal quantum number
1. n = 1
2. n = 2
3. n = 3
4. n = infinity

85. The barrier to fusion comes about because protons
1. repel each other electrically
2. attract each other via the strong nuclear force
3. attract neutrons via the strong nuclear force
4. attract electrons electrically

86. Which of the following particles is stable?
1. Proton
2. Neutron
3. Pion
4. Muon

87. A muon cannot decay into two neutrinos. Of the following conservation laws, which would be violated if it did?
1. energy
2. Linear momentum
3. Angular momentum
4. acceleration

88. The nucleus of a copper atom contains how many protons?
1. 1
2. 6
3. 16
4. 29

89. For semiconductor material, its valence orbit is saturated when it contains
1. 1 electron
2. equal + and – ions
3. 4 electrons
4. 8 electrons

90. When comparing the energy gap of germanium and silicon atoms, a silicon atom's energy gap is
1. About the same
2. lower
3. higher
4. unpredictable

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91. The reverse current consists of minority-carrier current and
1. Avalanche current
2. Forward current
3. Zener current
4. Surface leakage current

92. Which of the best description of a zener diode?
1. It is a rectifier diode
2. It is a constant voltage device
3. It is a constant current device
4. It works in the forward region

93. The base-emitter voltage of an ideal transistor is
1. 0 V
2. 0.3 V
3. 0.7 V
4. 1.2 V

94. To reduce the distortion of an amplified signal, you can increase the
1. Collector resistance
2. Emitter feedback resistance
3. Generator resistance
4. Load resistance

95. The emitter is at ac ground in a
1. CB stage
2. CC stage
3. CE stage
4. EE stage

96. Electrical conductivity of intrinsic Si is of the order of
1. $10^{-3}(\Omega m)^{-2}$
2. $10^{-3}\ (\Omega m)^{-1}$
3. $10^{3}\ (\Omega m)^{-1}$
4. $10^{3}\ (\Omega m)^{-2}$

97. At room temperature, a pure silicon crystal has hole concentration of the order of
1. $1.5 \times 10^{10}\ cm^{-6}$
2. $1.5 \times 10^{10}\ cm^{3}$
3. $1.5 \times 10^{10}\ cm^{6}$
4. $1.5 \times 10^{10}\ cm^{-3}$

98. Conduction in a metal is due to the drift of electrons
1. Above the Fermi level
2. Around the Fermi level
3. Below the Fermi level
4. Bottom of the valence band

99. In lithium the effective mass of the electron is equal to ————. (m is the mass of the electron)
1. 1.28m
2. 1.10m
3. 0.99m
4. 0.85m

100. For a bulk metal the density of states increases with energy as ———— from bottom of the band.
1. 1/E
2. $1/E^{1/2}$
3. $E^{1/2}$
4. E

101. Fermi energy for a one-dimensional copper system, such as a wire is
1. 0.82 eV
2. 1.82 eV
3. 2.82 eV
4. 3.82 eV

102. The room temperature value of kT, (where k is the Boltzmann constant) is about
1. 0.0013eV
2. 0.0026eV
3. 0.013eV
4. 0.026eV

103. The Fermi temperature corresponding to Fermi energy = 7.0 eV for copper is about
1. 71,900 K
2. 81,900 K
3. 1,900 K
4. 8,100 K

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104. _____ can be described by the Lorentz oscillator model.
1. dielectric resonance
2. ionic polarization
3. electronic polarization
4. dipolar polarization

105. _____ provides a way to calculate the electric displacement.
1. Local field
2. Gauss's law for free charges
3. Boltzmann distribution
4. Induced dipole moment

106. Lorentz relation does not apply to
1. dipolar dielectrics
2. glasses
3. cubic crystals
4. noncrystalline materials

107. Total current threaded per unit current is called as
1. susceptibility
2. inductance
3. capacitance
4. magnetization

108. Antiferromagnetic materials are typically
1. Organic materials
2. ferrites
3. salts and oxides of transition metals
4. transition and rare earth metals

109. For iron the energy of the exchange interaction is approximately
1. 0.7 eV
2. 0.3 eV
3. 0.02 eV
4. 0.09 eV

110. For higher resistivity and lower eddy current losses type applications, _____ magnetic materials are used.
1. silicon iron
2. ferrite
3. metallic glasses
4. supermalloy

111. Type II superconductors have _____ critical magnetic field.
1. one
2. four
3. three
4. two

112. When a sample of mercury is cooled below _____, then it behaves as a superconductor.
1. 4.2 K
2. 6.2 K
3. 8.2 K
4. 10 K

113. The superconductor is a perfect _____.
1. paramagnet
2. diamagnet
3. ferromagnet
4. ferrite

114. Chiral angle determines the _____ properties of the carbon nanotube.
1. optical
2. electronic
3. magnetic
4. dielectric

115. The transportation of electrons inside a carbon nanotube is called
1. random transport
2. diffusive transport
3. ballistic transport
4. quantum transport