COMBINED COMPETITIVE (PRELIMINARY) EXAMINATION, 2012

Serial No.

PHYSICS
Code No. 16

A

Time Allowed : Two Hours

Maximum Marks : 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C OR D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE RESPONSE SHEET.

3. You have to enter your Roll Number on this Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.

   Your Roll No.
   _____

4. This Booklet contains 120 items (questions). Each item comprises *four* responses (answers). You will select *one* response which you want to mark on the Response Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each item.

5. In case you find any discrepancy in this test booklet in any question(s) or the Responses, a written representation explaining the details of such alleged discrepancy, be submitted within three days, indicating the Question No(s) and the Test Booklet Series, in which the discrepancy is alleged. Representation not received within time shall not be entertained at all.

6. You have to mark all your responses ONLY on the separate Response Sheet provided. *See directions in the Response Sheet.*

7. All items carry equal marks. Attempt ALL items. Your total marks will depend only on the number of correct responses marked by you in the Response Sheet.

8. Before you proceed to mark in the Response Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Response Sheet as per instructions sent to you with your Admit Card and Instructions.

9. While writing Centre, Subject and Roll No. on the top of the Response Sheet in appropriate boxes use **"ONLY BALL POINT PEN".**

10. After you have completed filling in all your responses on the Response Sheet and the examination has concluded, you should hand over to the Invigilator only the Response Sheet. You are permitted to take away with you the Test Booklet.

ROUGH WORK

1. The law of conservation of angular momentum is :

   (A) $\vec{L} = \vec{r} \times \vec{p}$ (B) $d\vec{L}/dt = 0$

   (C)   (D) $d\vec{p}/dt = 0$

2. The scalar product of vectors $\vec{A} = 2\hat{i} + 5\hat{k}$ and $\vec{B} = 3\hat{j} + 4\hat{k}$:

   (A) 23   (B) 5√33

   (C) 20   (D) 26

3. Which of the following operations between two vectors can yield a vector perpendicular to either of them ?

   (A) subtraction   (B) division

   (C) addition   (D) multiplication

4. The moment of inertia of a body does not depend on :

   (A) distribution of mass of body   (B) mass of the body

   (C) angular velocity of the body   (D) axis of rotation of body

5. A projectile is fired at 30º with momentum p. Neglecting air friction, the change in its kinetic energy when it returns to the ground will be :

   (A) 100%   (B) 60%

   (C) 30%   (D) zero

6. The forces of magnitudes 8 N and 15 N act at a point. If the resultant force is 17 N, then the angle between the forces is :

   (A) 90º   (B) 30º

   (C) 45º   (D) 60º

7. The angular speed of seconds hand of a watch in radian per second is :

   (A) $\pi/3$ (B) $\pi/2$

   (C) $\pi/30$ (D) $\pi/60$

8. A liquid drop of diameter 4 mm breaks into 1000 droplets of equal size. If the surface tension of the liquid is 0.07 Nm^{-1}, then the resultant change in the surface energy is :

   (A) 31.68×10^{-6} J   (B) 34.65×10^{-6} J

   (C) 31.68×10^{-7} J   (D) 34.65×10^{-7} J

9. What force should applied on a 5.0 kg body so that it has a downward acceleration of 4 m/sec^{-1} ?

(A) 69 N ↑   (B) 69 N ↓

(C) 29 N ↑   (D) 29 N ↓

10. When a particle executing S.H.M. passes through the mean position, it has :

(A) maximum kinetic energy and minimum potential energy

(B) minimum kinetic energy and maximum potential energy

(C) maximum kinetic energy and maximum potential energy

(D) minimum kinetic energy and minimum potential energy

11. Energy required to shift a body of mass m from an orbit of radius 2R to 3R around earth (M = mass of earth and R = radius of earth) is :

(A) GMm/12R^2 (B) GMm/3R^2

(C) GMm/8R   (D) GMm/6R

12. To maintain a rotor at a uniform angular speed of 200 rad s^{-1}, an engine needs to transmit a torque of 180 M m. The power of the engine required is :

(A) 380 kW   (B) 36 kW

(C) 90 kW   (D) 900 kW

13. For Geostationary satellites :

(A) The time period is equal to that of the revolution of the earth around the sun

(B) The radius of the orbit is dependant on the mass of the earth

(C) The time period depends on the mass of the satellite

(D) The time period is equal to that of rotation of the earth about its axis

14. For a simple pendulum, the graph between the length and time period will be a :

(A) Ellipse   (B) Parabola

(C) Hyperbola   (D) Straight line

15. The total energy of a particle vibrating in S.H.M. is proportional to the square of its :

(A) velocity   (B) acceleration

(C) amplitude   (D) none of the above

16. The mass of a particle would be double of its rest mass if the particle is moving with a velocity of :

(A) 1.73 c (B) 0.93 c

(C) 0.866 c (D) 0.98 c

where c being the velocity of light.

17. Pitch of sound depends on :

(A) frequency (B) speed

(C) amplitude (D) wavelength

18. Two wires of the same material have diameters in the ratio 2 : 1 and lengths in the ratio 1 : 2. If they are stretched with same force then ratio of their elongation will be :

(A) 8 : 1 (B) 1 : 8

(C) 2 : 1 (D) 1 : 4

19. If there is no external force acting on a non rigid body, which of the following quantities must remain constant ?

(A) linear momentum (B) angular momentum

(C) kinetic energy (D) potential energy

20. The capacitance required to produce ultrasonic wave of 10^6 Hz with an inductance of 1 Henry is :

(A) 25 μF (B) 0.0025 μF

(C) 250 μF (D) 0.025 μF

21. The laws of vibrations of strings can be verified using :

(A) Pyrometer (B) Micrometer

(C) Tuning fork (D) Sonometer

22. The longest wavelength of transverse wave in a stretched string of length 25 cm is :

(A) 25 cm (B) 50 cm

(C) 100 cm (D) 12.5 cm

23. A 4 kg object is slowly lifted 1.5 m distance, then the work done against the gravity is :

(A) 39.2 J (B) 42.8 J

(C) 33.9 J (D) 58.8 J

24. The distance between one node and the next antinode is :
    (A) $\lambda/2$ (B) λ
    (C) $\lambda/4$ (D) 2λ

25. The motion of a projectile is described by an equation $y = ax - bx^2$. Then the range of the projectile will be :
    (A) b/a   (B) a + b
    (C) a – b   (D) a/b

26. Doppler shift in frequency does not depend upon :
    (A) the actual frequency of the wave
    (B) the distance of the source from the listener
    (C) the velocity of the source
    (D) the velocity of the observer

27. $x = 4 \cos \omega t + 3 \sin \omega t$ is the equation of a particle executing SHM. The initial phase angle is :
    (A) 37°   (B) 53°
    (C) 90°   (D) none of these

28. Stoke's theorem is applicable only to :
    (A) pure liquids   (B) solutions
    (C) non-viscous liquids   (D) viscous liquids

29. If the bulk modulus of water is 2100 MPa, then what is the speed of sound in water ?
    (A) 1450 m/sec   (B) 2100 m/sec
    (C) 0.21 m/sec   (D) 21 m/sec

30. Y-axis of a quartz crystal is :
    (A) Optic axis   (B) electric axis
    (C) Mechanical axis   (D) magnetic axis

31. When white light passes through a prism, seven colors can be seen in the outgoing light. These colors are produced due to the phenomenon :
    (A) absorption of light   (B) interference of light
    (C) dispersion of light   (D) scattering of light

32. To obtain the sustained interference pattern, we require two sources of light which emit radiation of :

(A) different wavelengths

(B) nearly the same frequency

(C) same frequency with definite phase relationship

(D) same frequency

33. To observe diffraction, what should be the size of the obstacle ?

(A) same as that of wavelength   (B) much larger than wavelength

(C) no size limit   (D) exactly half of the wavelength

34. The Young's experiment establishes that light has :

(A) wave nature   (B) particle nature

(C) neither wave nor particle nature   (D) both wave and particle nature

35. A slit width of 'a' is illuminated by a light of $\lambda = 6500$ Å. The first minimum falls at $\theta = 30°$. The value of 'a' is :

(A) 3250 Å   (B) 6.5×10^{-4} nm

(C) 1.3 microns   (D) 2.6×10^{-4} nm

36. In Fraunhofer diffraction, the width of the central maximum is proportional to :

(A) $1/\lambda^2$ (B) λ^2

(C) $1/\lambda$ (D) λ

37. In a Brewster experiment, the angle between the reflected and refracted rays will be :

(A) 30°   (B) 90°

(C) 60°   (D) 180°

38. Longitudinal waves do not exhibit the phenomenon of :

(A) Reflection   (B) Refraction

(C) Diffraction   (D) Polarisation

39. The device which produces highly coherent sources is :

(A) Llyod's mirror   (B) LASER

(C) Fresnel's Biprism   (D) Young's double slit

40. The radius of the first zone in a zone plate of focal length 20 cm for a light of λ = 5000 Å is given by :

(A) 0.0316 cm (B) 0.001 cm
(C) 0.0316 m   (D) 0.001 m

41. The transverse nature of light is proved by :

(A) Dispersion   (B) Interference
(C) Polarisation (D) Refraction

42. Rayleigh-Jeans formula agree for :

(A) long wavelength region   (B) short wavelength region
(C) entire range of wavelength   (D) none of the above

43. The effective focal length of Huygen's Eye piece is equal to :

(A) 2f/3 (B) 3f/2
(C) f/2   (D) 3f/5

44. A rotating calcite crystal is placed over an ink dot. On seeing through the crystal, one finds :

(A) two stationary dots
(B) two dots moving along a straight line
(C) one dot rotating about the other
(D) both dots rotating about a common axis

45. The polarising angle for glass material is :

(A) 57° (B) 90°
(C) 60° (D) 47°

46. In which of the following the final image is erect ?

(A) Astronomical telescope (B) Compound microscope
(C) Simple microscope   (D) none of these

47. The wavelength of emission from He-Ne laser is :

(A) 106.4 nm   (B) 337.1 nm
(C) 1694.3 nm (D) 632.8 nm

48. Light reflected from a surface of glass plate of refractive index 1.57 is linearly polarized. The angle of refraction in the glass is :
(A) 47.5°
(B) 57.5°
(C) 32.5°
(D) 23.5°

49. If we plot a graph between distance of object and that of image formed by a convex lens, the nature of the graph will be :
(A) parabola
(B) ellipse
(C) hyperbola
(D) straight line

50. Ruby laser belongs to :
(A) two level laser
(B) five level laser
(C) four level laser
(D) three level laser

51. Two stars A and B radiate maximum energy at wavelengths 36×10^{-8} m and 48×10^{-8} m respectively. The ratio of their absolute temperatures will be :
(A) 4 : 3
(B) 3 : 4
(C) 256 : 81
(D) 81 : 256

52. For a gas at a particular temperature on the average, which of the following quantities is the same for all the molecules ?
(A) velocities
(B) momentum
(C) angular momentum
(D) kinetic energy

53. The absolute temperature of a gas is increased three times, then the rms velocity of the molecules will increase by :
(A) 3 times
(B) 2 times
(C) 1/3 times
(D) √3 times

54. According to kinetic theory of gases, what does the quantity PV/kT represent ?
(A) mass of the gas
(B) kinetic energy of the gas
(C) number of moles of gas
(D) number of molecules of gas

55. The temperature T_1 and T_2 of heat reservoirs in the ideal Carnot engine are 1500° C and 500 ° C, respectively. If T_1 increases by 100° C, what will be the efficiency of the engine ?
(A) 62%
(B) 59%
(C) 95%
(D) 100%

56. A gas is suddenly compressed to $1/4^{th}$ of its original volume. If the original temperature is 27° C and $\gamma = 1.5$, then the rise in temperature will be :

    (A) 300° C
    (B) 600 K
    (C) 327° C
    (D) 627 K

57. At which temperature the adiabatic change is equivalent to the isothermal change ?

    (A) Zero degree Celsius
    (B) Zero Kelvin
    (C) Critical temperature
    (D) Above critical temperature

58. First law of thermodynamics is a special case of :

    (A) Charles law
    (B) Law of conservation of energy
    (C) Newton's law
    (D) Law of heat exchange

59. In an ideal gas, internal energy of system depends on :

    (A) Temperature
    (B) Pressure
    (C) Volume
    (D) Molecular size

60. The rate of cooling at 600 K, if surrounding temperature is 300 K, is R. The rate of cooling at 900 K will be :

    (A) 16/3 R
    (B) 2 R
    (C) 3 R
    (D) 2/3 R

61. The mean kinetic energy of perfect gas molecule at temperature T is :

    (A) kT/2
    (B) kT
    (C) 3kT/2
    (D) 2kT

62. When heat is added to a pure liquid :

    (A) the temperature increases and the entropy is unchanged
    (B) the temperature increases and the entropy increases
    (C) the temperature increases and the entropy decreases
    (D) the temperature is unchanged and the entropy increases

63. In a reversible process, the entropy :

    (A) does not change
    (B) decreases
    (C) increases
    (D) none of these

64. When the pressure is increased, the boiling point of the liquid :

(A) increases

(B) does not change

(C) decreases

(D) decreases first and increases later

65. The spectrum obtained from a black body is :

(A) line spectrum   (B) band spectrum

(C) continuous spectrum   (D) absorption spectrum

66. Absorption power of a black body is :

(A) 0.5   (B) 1.0

(C) 1.5   (D) 2.0

67. In which of the following processes, thermal conduction is maximum ?

(A) Radiation   (B) Convection

(C) Conduction   (D) All of these

$\vec{E} = \nabla V$ 68. The force between two charges of one Coulomb each separated by 1 m in vacuum is equal to :

(A) 9.0×10^9 N   (B) 4.6×10^{-9} N

(C) 9.0×10^{-9} N   (D) 1.5×10^{-8} N

69. The relation between electric field and potential is :

(A)   (B) $\vec{E} = -\nabla \vec{V}$

(C) $E = \nabla^2 \vec{V}$ (D) $\vec{E} = \vec{\nabla} V$

70. Energy stored in a capacitor is given by :

(A) $U = 3CV/2$ (B) $U = 1/2CV^2$

(C) $U = C^2V^2/2$ (D) $U = CV^2/2$

71. The electrical resistance in an ideal capacitor for direct current is :

(A) zero   (B) 1

(C) infinity   (D) 2

72. Self inductance of a long solenoid does not depend on :
   (A) total number of turns
   (B) length of the solenoid
   (C) area of cross section
   (D) intensity of current

73. A parallel plate capacitor is connected across a 9 Volt battery. Each plate of the capacitor has the area of 0.0016 cm² and the plate are separated by a distance of 5 mm in air. The charge on each plate is :
   (A) 2.54×10^{-8} Coulombs
   (B) 3.54×10^{-8} Coulombs
   (C) 2.54×10^{-9} Coulombs
   (D) 3.54×10^{-9} Coulombs

74. The force experienced by a wire of length 10 cm kept at an angle of 30º to the magnetic field of 0.5 T and carrying a current of 6 amperes is :
   (A) 5.48×10^{-3} N
   (B) 5.48×10^{-2} N
   (C) 0.15 N
   (D) 0.2 N

75. Potential inside a hollow spherical conductor is :
   (A) Constant
   (B) varies directly with distance from centre
   (C) varies inversely with distance
   (D) varies inversely as square of distance

76. The capacitance unit of most convenient size is :
   (A) Billion Farad
   (B) Micro Farad
   (C) Kilo Farad
   (D) Mega Farad

77. The ratio of the force between two charges in air and that in a medium of dielectric constant K is :
   (A) K : 1
   (B) 1 : K
   (C) K^2 : 1
   (D) $1 : K^2$

78. Moving charge produces :
   (A) electric field only
   (B) magnetic field only
   (C) both electric and magnetic fields
   (D) neither electric nor magnetic field

79. To convert line integral to surface integral, we use :
   (A) Stoke's law
   (B) Green's theorem
   (C) Cross product
   (D) Gauss theorem

80. Lenz law is a consequence of the law of conservation of :

(A) mass (B) charge

(C) energy (D) momentum

81. Magnetic effect of current was discovered by :

(A) Kirchhoff (B) Joule

(C) Faraday (D) Oersted

82. The eddy currents are produced in a material when it is :

(A) heated

(B) placed in an electric field

(C) placed in a time varying magnetic field

(D) placed in a uniform magnetic field

83. The phase difference between the flux linked with a coil rotating in a uniform magnetic field and induced emf produced in it is :

(A) zero (B) $\pi/4$

$\vec{E} \times \vec{H}$ (C) $\pi/2$ (D) π

84. The frequency of AC mains in India is :

(A) 30 Hz (B) 50 Hz

(C) 60 Hz (D) 110 Hz

85. If   and   are electric and magnetic field vectors, then the propagation of e.m. wave is along the direction of :

(A) (B)

(C) (D)

86. An LCR circuit contains L = 8 H, C = 0.5 μF and R = 100 ohms. What will be the resultant frequency in Hz ?

(A) $1000/\pi$ (B) $500/\pi$

(C) $250/\pi$ (D) $125/15$

87. The rms value of the a.c. current is equal to :
    (A) twice the peak value
    (B) half of the peak value
    (C)   times the peak value
    (D) equal to peak value

88. The differential form of Faraday's law is :

    (A) $-\left(\dfrac{\partial H}{\partial t}\right)$

    (B) $-\left(\dfrac{\partial B}{\partial t}\right)$

    (C) $\left(\dfrac{\partial H}{\partial t}\right)$

    (D) $\left(\dfrac{\partial B}{\partial t}\right)$

89. The energy stored in the magnetic field of a solenoid of inductance 5 mH, when maximum current of 3 amperes flows through it is :
    (A) 2.25×10^{-3} J
    (B) 2.55×10^{-4} J
    (C) 22.5×10^{-3} J
    (D) 22.5×10^{-4} J

90. Three capacitors of 1 µF, 2 µF and 3 µF are joined in series first and then in parallel. The ratio of equivalent capacitance in two cases is :
    (A) 6 : 5
    (B) 11 : 1
    (C) 1 : 11
    (D) 5 : 6

91. The value of magnetic permeability of free space is :
    (A) $2\pi \times 10^{-7}$ WbA^{-1} m^{-1}
    (B) $4\pi \times 10^{-7}$ WbA^{-1} m^{-1}
    (C) $2\pi \times 10^{-9}$ WbA^{-1} m^{-1}
    (D) $4\pi \times 10^{-9}$ WbA^{-1} m^{-1}

92. de-Broglie wavelength associated with a hydrogen molecule moving with a velocity of 3 km/sec is :
    (A) 3.6×10^{-11} m
    (B) 4.6×10^{-11} m
    (C) 3.3×10^{-12} m
    (D) 6.6×10^{-11} m

93. The work function of sodium, if its threshold wavelength is 5040 Å, is :
    (A) 3.298×10^{-19} J
    (B) 3.289×10^{-19} J
    (C) 3.982×10^{-19} J
    (D) 3.928×10^{-19} J

94. When boron is added as an impurity to silicon, the resulting material is :
   (A) n-type conductor
   (B) n-type semiconductor
   (C) p-type conductor
   (D) p-type semiconductor

95. When electron in hydrogen atom jumps to the inner most orbit, the radiation emitted belongs to :
   (A) Paschen series
   (B) Balmer series
   (C) Lyman series
   (D) Brackett series

96. Proton and alpha particle have the same de-Broglie wavelength. Which of the following is also same for them ?
   (A) the time period
   (B) energy
   (C) frequency
   (D) linear momentum

97. The energy required to remove the electron from n = 10 state in hydrogen atom is :
   (A) 13.6 eV
   (B) 1.36 eV
   (C) 0.136 eV
   (D) 0.0136 eV

98. Davisson and Germer experiment provides the :
   (A) diffraction of electron
   (B) existence of electrons
   (C) existence of nucleus
   (D) existence of proton

99. For which of the following, the ionising power is maximum ?
   (A) β-rays
   (B) α-rays
   (C) γ-rays
   (D) IR rays

100. One Fermi is equal to :
   (A) 10^{-15} cm
   (B) 10^{-15} m^2
   (C) 10^{-15} m
   (D) 10^{-15} cm^2

101. The half life period of radioactive nuclei is :
   (A) $0.693/\lambda$
   (B) $0.123/\lambda$
   (C) $\lambda/0.693$
   (D) $\lambda^2/0.693$

102. Sun releases energy by the process of :
   (A) Nuclear fission
   (B) Nuclear fusion
   (C) Nuclear repulsion
   (D) Nuclear attraction

103. The traditional unit of radioactivity is Curie (Ci). It is equivalent to :

    (A) 10^6 disintegrations/second   (B) 3.7×10^{10} disintegrations/second

    (C) one disintegration/second   (D) 3.7×10^6 disintegrations/second

104. Name the conservation law violated in $\nu_e + p \rightarrow n + e^+$.

    (A) Charge   (B) Baryon number

    (C) Strangness number   (D) Lepton number

105. Alpha particles are nothing but :

    (A) ^{3}H nuclei   (B) ^{2}H nuclei

    (C) ^{4}He nuclei   (D) ^{3}He nuclei

106. A particle with no charge and no mass is :

    (A) Proton   (B) Neutron

    (C) Positron   (D) Photon

107. Particles more than one proton are called :

    (A) mesons   (B) A-particles

    (C) hyperons   (D) Gravitons

108. Elementary particles whose mass is more than that of nucleons are called :

    (A) Laptons   (B) Mesons

    (C) Baryons   (D) Positrons

109. When a gamma-ray interacts with matter, the probability of occurring photoelectric effect is :

    (A) at lower energies   (B) at higher energies

    (C) at medium energies   (D) none of the above

110. In intrinsic semiconductor, the Fermi level lies :

    (A) near the valance band

    (B) near the conduction band

    (C) exactly in between valance and conduction bands

    (D) within the conductance band

111. The ripple factors for half wave and full wave rectifiers are :

    (A) 1.21, 0.48   (B) 0.48, 1.21

    (C) 0.46, 1.3   (D) 1.3, 0.46

112. In a p-n-p transistor circuit, the collector current is 10 mA. If 90% of the holes reach the collector, the emitter current is :

(A) 1 mA (B) 11 mA

(C) 1 A (D) 11 A

113. The turn-on voltage of a germanium junction diode is

(A) 0.1 V (B) 1.0 V

(C) 0.3 V (D) 0.7 V

114. The bulk resistance of a diode is :

(A) the resistance of the junction only

(B) the resistance of the n-type material only

(C) the resistance of p-type material only

(D) the resistance of p-type and n-type materials

115. Reverse bias applied to a junction diode :

(A) increases the minority carrier current

(B) lowers the potential barrier

(C) raises the potential barrier

(D) increases the majority carrier current

116. The value of current gain in Common Base (CB) amplifier is :

(A) greater than one (B) less or greater than one

(C) less than one (D) none of the above

117. A transistor is a :

(A) voltage device

(B) low voltage and high current device

(C) current device

(D) high voltage and low current device

118. A material with overlapping of conduction and valence bands will be :

(A) a superconductor (B) a semiconductor

(C) an insulator (D) a metal

119. Which of the following represents the logic addition ?

(A) $1 + 1 = 10$ (B) $1 + 1 = 1$

(C) $1 + 1 = 2$ (D) none of these

120. A semiconducting device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. The device may be :

(A) a p-type semiconductor   (B) an n-type semiconductor

(C) a p-n junction   (D) an intrinsic semiconductor

ROUGH WORK

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