TEST BOOKLET

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Test Booklet Series

B

Serial No. 914182

BAC-50

PHYSICS

Time Allowed : 2 Hours **Maximum Marks : 300**

INSTRUCTIONS TO CANDIDATE

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 YOUR OPTIONAL SUBJECT CODE AS MENTIONED ON THE BODY OF YOUR ADMISSION CERTIFICATE AND ADVERTISEMENT AT APPROPRIATE PLACES ON THE ANSWER SHEET.
3. ENCODE CLEARLY THE TEST BOOKLET SERIES A, B, C OR D AS THE CASE MAY BE IN THE APPROPRIATE PLACES IN THE ANSWER SHEET USING HB PENCIL.
4. You have to enter your Roll No. on the Test Booklet in the Box provided along side. DO NOT write anything else on the Test Booklet.
5. This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer 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.
6. You have to mark all your responses **ONLY** on the separate Answer Sheet provided by using HB pencil. See instruction in the Answer Sheet.
7. All items carry equal marks. All items are compulsory. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet. For each question for which a wrong answer is given by you, **one fifth (0.20) of the marks assigned to that question will be deducted as penalty.**
8. Before you proceed to mark in the Answer Sheet the responses to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your **Admission Certificate.**
9. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator the Answer Sheet, the Test Booklet issued to you.

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1. The coefficient of finesse of Fabrey-Perot interferometer depends on

   (a) the amplitude of incident wave

   (b) the phase difference between two successive waves emanating from the same plate

   (c) the film thickness

   (d) the reflectivity of plates

2. An unpolarized plane wave incident on a calcite crystal splits up into the o- and e-waves. Following statements are given about these waves.

   A. $\vec{D}.\vec{K} = 0$ for both o- and e-waves

   B. For the e-wave, $\vec{D}$ lies in the plane containing $\vec{K}$ and optic axis of the crystal

   C. The ray velocity surfaces corresponding to ordinary ray are ellipsoid of revolution

   The correct option is

   (a) A only (b) A and B

   (c) A and C (d) A, B and C

3. Which of the following phenomenon is mainly responsible for the red colour of the rising Sun and blue colour of the Sky ?

   (a) Raman scattering (b) Rayleigh scattering

   (c) Mie scattering (d) Compton scattering

4. In which process, the energy delivered by the atomic or molecular system has same field distribution and frequency as the inducing radiation ?

   (a) Spontaneous emission

   (b) Stimulated emission

   (c) Stimulated absorption

   (d) Both spontaneous and stimulated emissions

5. An atomic line of wavelength 6000 Å has a coherent length of 36 cm. The line-width of the line is

   (a) 0.01 Å (b) 0.1 Å

   (c) 1.0 Å (d) 10.0 Å

6. The lateral coherence length of an extended incoherent source of wavelength λ subtending an angle θ at the point of observation is

(a) $\lambda\theta$ (b) $\frac{\lambda}{\theta}$

(c) $\frac{\theta}{\lambda}$ (d) $\frac{\lambda^2}{\theta}$

7. The diffraction pattern due to double slit having slit-width 'a' and the separation between the slits 'd', changes to

(a) that due to a single slit pattern of width '2a' if 'd' tends to zero.

(b) fringes obtained in the Young's interference experiment if 'd' tends to zero.

(c) the single slit pattern if 'a' tends to zero.

(d) the spot of light if 'd' tends to zero.

8. The missing orders of a double slit Fraunhofer diffraction pattern for slits of width 'a' each separated by '5a' are

(a) 2, 4, 6 (b) 3, 6, 9

(c) 1, 3, 5 (d) 6, 12, 18

9. To resolve the D_1 and D_2 lines of sodium in the second order, the total number of lines in the plane diffraction grating must be at least

(a) 200 (b) 300

(c) 500 (d) 1000

10. The radii of a zone-plate are given by the expression $\gamma_n = 0.02\sqrt{n}$ cm. For the monochromatic light of wavelength 4000 Å, the most intense focal point will be at a distance

(a) 10 cm (b) 20 cm

(c) 100 cm (d) 200 cm

11. If a linearly polarized beam of light is incident on a half-wave plate making an angle of 45° with the optic axis, the

(a) beam gets converted to a circularly polarized wave

(b) beam gets converted to an elliptically polarized wave

(c) plane of polarization gets rotated by 90°

(d) plane of polarization gets rotated by 180°

12. Which of the following is/are dichroic material ?

(a) Herapathite
(b) Tourmaline
(c) Polyvinyl alcohol film
(d) All of the above

13. The temperature of the liquid hydrogen is 20 K. The equivalent temperature on the °F scale is

(a) –253
(b) – 423
(c) – 432
(d) none of these

14. A 70 L petrol tank made of steel is filled to the top with petrol at 20 °C. If the temperature of the tank rises to 40 °C, the quantity of petrol that will overflow from the tank is (given : coefficient of volume expansion of petrol $\beta = 950 \times 10^{-6}\ (C°)^{-1}$)

(a) 1.0 L
(b) 1.1 L
(c) 1.3 L
(d) 1.4 L

15. For a given quantity of gas, the corresponding statements of proportionaity for the Boyle's law, Charles's law and Gay-Lussac's law respectively, are

(a) $P \alpha T, V \alpha T, V \alpha 1/P$
(b) $V \alpha T, V \alpha 1/P, P \alpha T$
(c) $V \alpha 1/P, V \alpha T, P \alpha T$
(d) None of these

16. An automobile tire is filled to a gauge pressure of 200 kPa at 10 °C. After driving 100 km, the temperature within the tire rises to 40 °C. Assuming the atmospheric pressure = 101 kPa, the pressure within the tire now is

(a) 333 kPa
(b) 301 kPa
(c) 200 kPa
(d) 232 kPa

17. The ideal gas law is an accurate description of the behaviour of a real gas at

(a) all pressures and temperatures
(b) all pressure and at temperatures very near to the liquefaction point of the gas
(c) all temperatures and at pressure below 1 atm
(d) temperatures far from the liquefaction point of the gas and when pressure is not too high

18. A refrigerator converts 1.5 kg of water at 20 °C to ice at –12 °C, the amount of energy removed by the refrigerator is (given : specific heat of water = 4180 J/kg· C°, specific heat of ice = 2100 J/kg· C°, latent heat of fusion of water = 3.33×10^5 J/kg),

(a) 660 kJ (b) 560 kJ

(c) 460 kJ (d) none of these

19. A clock having a pendulum made of brass, is adjusted to have a period of 1 s exactly at 20 °C. The clock is then operated at 30 °C for 1 week. The clock will be in error [given : coefficient of linear expansion for brass $\alpha = 19.3 \times 10^{-6}$ $(C°)^{-1}$],

(a) 60 s slower (b) 60 s faster

(c) 20 s slower (d) 20 s faster

20. The heat needed to raise 1 kg of water by 1 C°, from 14.5 °C to 15.5 °C is called

(a) Joule (b) Calorie

(c) caloire (d) kJoule

21. The specific heat of iron is 450 J/kg · C°. The heat required to raise the temperature of an empty 20 kg vat made of iron is

(a) 7.3×10^3 J (b) 7.2×10^4 J

(c) 7.2×10^5 J (d) 7.3×10^6 J

22. The thermal conductivity of a window glass is 0.84 J/s·m·C°. The rate of heat flow through this glass window of area 2 m × 1.5 m and thickness 3.2 mm with inner temperature = 15 °C and outer temperature = 14 °C, is

(a) 680 kcal/h (b) 790 J/s

(c) 0.19 kcal/s (d) All of these

23. The process of transfer of heat by the mass movement of molecules from one place to another is termed as

(a) conduction (b) convection

(c) radiation (d) reduction

24. A 6 g bullet melts at 300 °C. It has a specific heat capacity of 0.20 cal/g·C° and heat of fusion of 0.15 cal/g. The amount of heat needed to melt the bullet if it is originally at 0 °C, is

(a) 360 calorie (b) 1504.8 J

(c) 376.2 calorie (d) 450 calorie

25. A partially inflated balloon containing 500 m^3 of helium gas at 27 °C and at 1 atm pressure rises to an altitude of 18000 ft, where the pressure is 0.5 atm and the temperature is –3 °C. The volume of this balloon is now

(a) 900 m^3 (b) 700 m^3

(c) 600 m^3 (d) none of these

26. A process in which no heat transfer takes place into or out of the system and is meaningful in both quasistatic and more violent processes is termed as

(a) isothermal process (b) isobaric process

(c) adiabatic process (d) none of these processes

27. The second law of thermodynamics can be stated as

(a) heat flows naturally from a hot object to a cold object, heat will not flow spontaneously from a cold object to a hot object.

(b) there can be no 100 percent efficient heat engine – that is, one that can change a given amount of heat completely into work.

(c) natural process tend to move toward a state of greater disorder or greater entropy.

(d) all the above mentioned statements.

28. The most probable state of air molecules in a close room will follow

(a) non-linear distribution (b) Maxwellian distribution

(c) Gaussian distribution (d) None of these

29. An ideal Carnot engine takes heat from a source at 317 °C, does some external work and delivers the remaining energy to a heat sink at 117 °C. If 500 kcal of heat is taken from the source, then the amount of work done is

(a) 831 kcal (b) 160 kcal

(c) 331 kcal (d) 169 kcal

30. Assuming the heat of vaporization of water to be 540 kcal/kg, the change in the entropy of 2.00 kg of H_2O molecules when transformed at a constant pressure of 1 atm from water at 100 °C to steam at the same temperature is

(a) 12.12 kJ/K (b) 13.12 kJ/K

(c) 14.12 kJ/K (d) 15.12 kJ/K

31. The value of Stefen-Boltzman constant is $\sigma = 5.67 \times 10^{-8}$ W/m^2K^4. A spherical blackbody of 5 cm radius is maintained at a tempeature of 327 °C. The power radiated is

(a) 231 W (b) 331 W

(c) 431 W (d) none of these

32. A steam engine operates between 500 °C and 270 °C. The carnot efficiency of this engine is

(a) 70% (b) 46%

(c) 30% (d) 54%

33. Crystal lattices act as diffraction gratings to X-rays as X-rays

(a) are highly penetrating

(b) are highly energetic

(c) are highly coherent

(d) possess matching wavelengths to lattice constants

34. X-ray diffractions occur only in

(a) single crystalline solids

(b) polycrystalline solids

(c) both in single crystalline and polycrystalline solids

(d) amorphous solids

35. The Miller indices of a set of lattice planes in a cubic crystal of lattice constant a are (1, 0, 0). The separation, d, between these lattice planes is

(a) $d = a$ (b) $d = \frac{a}{\sqrt{2}}$

(c) $d = \frac{a}{\sqrt{3}}$ (d) $d = \frac{a}{2}$

36. The separation between successive planes in a set of parallel lattice planes is

(a) directly proportional to the values of their Miller indices.

(b) inversely proportional to the values of their Miller indices.

(c) is not related to their Miller indices.

(d) none of these above.

37. Which of the following equations generate a general three dimensional lattice ?
(The symbols used have their usual significance)

(a) $\vec{T} = \vec{r} \pm n_1\vec{a} \pm n_2\vec{b} \pm n_3\vec{c}$ (b) $T = \vec{r} \pm n_1\vec{a} + n_2\vec{a} + n_3\vec{a}$

(c) $T = \vec{r} \pm nx$ (d) $T = \vec{r}.(n_1\vec{a} + n_2\vec{b} + n_3\vec{c})$

38. A f.c.c. unit cell can be converted to a b.c.c. unit cell if

(a) the direct lattice unit cell is represented in the reciprocal lattice

(b) mirror inversion is given to the direct lattice unit cell

(c) the direct lattice unit cell is given a rotation through a 4-fold axis of symmetry

(d) none of these are correct

39. If a semiconducting material is cooled to 0 K, its conductivity will be

(a) infinite (b) zero

(c) like that of an ordinary metal (d) negative

40. The electrical conductivity of an intrinsic semiconductor increases exponentially with temperature

(a) this is due to increase of carrier densities with temperature exponentially

(b) this is due to exponential increase of mobility of the carriers with temperature

(c) this is due to breaking of the bondings due to temperature increase

(d) this is due to ionization of inner electronic shells at higher temperatures

41. **Assertion (A)** : The nature of temperature dependence of electrical conductivity in intrinsic and extrinsic semiconductors is of the same type.

Reason (R) : This is due to the reason that the nature of temperature excitation of carriers in intrinsic and extrinsic semiconductors is the same.

(a) (A) is true and (R) is the correct reason for it.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

42. **Assertion (A)** : For full wave rectification a four diodes bridge circuit is preferred compared to a two diodes circuit.

Reason (R) : This is for the reason that the peak inverting voltage (PIV) needed in the four diodes bridge can be only half that of two diodes circuit.

(a) (A) is correct and (R) is the true explanation.

(b) (A) is correct but (R) is false.

(c) (A) is false but (R) is correct.

(d) Both (A) and (R) are false.

43. **Assertion (A)** : A p-n junction diode is fabricated by joining p and n blocks under pressure.

Reason (R) : In this way a proper junction layer is realised.

(a) Both (A) and (R) are false.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) (A) is true and (R) is the correct explanation of it.

44. **Assertion (A)** : In a p-n junction diode the built-in contact potential gradient is determined by the difference of the Fermi levels on the p and n sides at the instant of formation of the contact.

Reason (R) : This is due to the reason that transfer of carriers across the junction ceases when the Fermi levels on both sides of the junction coincide.

(a) (A) is true and (R) is the correct explanation for it.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

45. **Assertion (A)** : A zener diode is used as a voltage stabilizer.

Reason (R) : This is for the reason that at the zener voltage, the voltage remains unchanged.

(a) (A) is true and (R) is the correct reason for it.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

46. **Assertion (A)** : In a zener diode zener action is due to generation of large number density of charge carriers as a result of ionization of inner electronic shells of atoms.

Reason (R) : This is because the high applied bias voltage causes ionization of core electronic shells of atoms.

(a) (A) is true but (R) is false.

(b) (A) is true and (R) is the correct cause of it.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

47. **Assertion (A)** : In a transistor the base region is made comparatively thinner than the emitter and collector regions.

Reason (R) : This is to make the transit times of the charge carriers low in the base.

(a) (A) is true and (R) is the correct explanation of it.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

48. In a common emitter transistor configuration

(a) the output voltage is in phase with the input voltage.

(b) the output and input voltages differ by 180° in phase.

(c) the output is 90° out of phase with the input.

(d) the output is 45° out of phase with the input.

49. **Assertion (A)** : In a transistor amplifier the output impedance is made high.

Reason (R) : This is to achieve high voltage amplification.

(a) (A) is true and (R) is the correct explanation of it.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

50. Answer, the work function of metals is related to which component of a vacuum diode.

(a) plate current

(b) cathode – anode separation

(c) cathode to anode potential difference

(d) emission of carriers (electrons) from the filament

51. Answer, which are the Universal gates that can perform all the logic functions.

(a) NAND and NOR (b) NAND and OR

(c) OR and NOR (d) None of these combinations

52. **Assertion (A)** : Digital computers are better than analogue computers.

Reason (R) : Due to their high speed of functioning and accuracy of the work.

(a) (A) is true and (R) is the correct cause of it.

(b) (A) is true but (R) is false.

(c) (A) is false but (R) is true.

(d) Both (A) and (R) are false.

53. According to Gauss law, the number of electric field lines crossing the closed surface is

(a) Numerically equal to the enclosed charge.

(b) Equal to the enclosed positive charge.

(c) Equal to the electric field inside the surface.

(d) Equal to the charge density on the surface.

54. The potential due to a point charge -3×10^{-8} coulomb at a point which is at a distance of 30 cm from it is

(a) 900 V (b) –900 V

(c) –3000 V (d) 300 V

55. The work done by carrying a charge of 5 μC from a point A to B is 8 mJ. The difference of potential between A and B is

(a) 160 V (b) 16 V

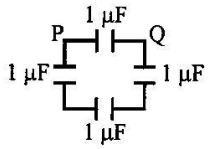
(c) 1.6 kV (d) 16 kV

56. A parallel plate capacitor is formed of two plates of area 'A' separated by a distance 'd' with air between them. The capacitance will be

(a) $\varepsilon_0 A d$ (b) $\varepsilon_0 A/d$

(c) $\varepsilon_0 d / A$ (d) $\varepsilon_0/A d$

57. Four capacitors are connected as shown in figure below, then the equivalent capacitance between point P and Q is



(a) 4 μF (b) ¼ μF

(c) ¾ μF (d) 4/3 μF

58. The electric dipole moment per unit volume of the dielectric is called

(a) Polarization of dielectric

(b) Electric displacement of vector

(c) Dipole density

(d) None of the above

59. The charge on an isolated conductor always lies

(a) Within the conductor. (b) at the centre of the conductor.

(c) on the surface of the conductor. (d) just outside the surface.

60. Two capacitors of 1 μF capacitance each are connected in parallel and are then charged by 200 V d.c. The total energy in joules is

(a) 0.01 (b) 0.02

(c) 0.04 (d) 0.06

61. Which of the following is not affected by the internal resistance ?

(a) terminal potential difference

(b) emf of the source

(c) current delivered to external circuit

(d) power output

62. The poynting vector gives the direction of

(a) Electric field (b) Magnetic field

(c) Power flow (d) None of these

63. Two circular coils have radii in the ratio 1:2 with the same number of terms. The ratio of magnetic field produced at the centre of the coils when connected in series is

(a) ¼ (b) ½

(c) 1 (d) 2

64. In a synchrotron the magnetic field must change to compensate the

(a) heating of coils.

(b) loss of energy due to air resistance.

(c) increase in the radius of circular path.

(d) None of these

65. Ferromagnetic substances have

(a) high permeability and low susceptibility.

(b) low permeability and high susceptibility.

(c) both permeability and susceptibility are low.

(d) both permeability and susceptibility are high.

66. The emf produced in a wire by its motion across a magnetic field does not depend on the

(a) length of the wire (b) composition of the wire

(c) diameter of the wire (d) orientation of the wire

67. The varying magnetic field through conductor produces electromotive force. This is in accordance with

(a) Faraday's law (b) Lenz law

(c) Laplace law (d) Ampere's law

68. The frequency for which a 5.0 μF capacitor has a reactance of 1000 Ω is given by

(a) $1000/\pi$ cycles/sec (b) $100/\pi$ cycles/sec

(c) 200 cycles/sec (d) 5000 cycles/sec

69. In a parallel LCR circuit, at resonance,

(a) current is maximum (b) voltage is maximum

(c) impedance is minimum (d) impedance is zero

70. A capacitor of 0.5 μF is discharged through a resistance of 10 MΩ. The time taken for half of the charge on capacitor to leak is

(a) 1.6 sec (b) 3.2 sec

(c) 4.8 sec (d) 6.0 sec

71. In a purely inductive circuit, the current

(a) lags behind emf by 90° (b) leads the emf by 90°

(c) is in phase with emf (d) may lead or lag the emf

72. A spherical capacitor consists of two concentric spherical shells of radii 'a' and 'b' with b>a. Its capacitance is

(a) $4\pi \varepsilon_0 (b - a)$ (b) $4\pi \varepsilon_0 ab$

(c) $4\pi \varepsilon_0 (ab / a - b)$ (d) $4\pi \varepsilon_0 (ab / b - a)$

73. According to Bohr's principle, the relation between the principal quantum number 'n' and radius of the orbit, 'r' is

(a) $r \propto 1/n$ (b) $r \propto n$

(c) $r \propto n^2$ (d) $r \propto 1/n^2$

74. Neglecting variation of mass with velocity, the de Broglie wavelength associated with an electron moving with kinetic energy E is proportional to

(a) $E^{1/2}$ (b) $E^{-1/2}$

(c) E (d) E^{-2}

75. The uncertainty relation cannot hold for the following pairs :

(a) Position and linear momentum

(b) Energy and time

(c) Angular momentum and angle

(d) Linear momentum and angle

76. The ionization potential of hydrogen atom is 13.6 eV. The energy required to remove an electron from the 3rd orbit of hydrogen is

(a) 1.51 eV (b) 3.4 eV

(c) 6.8 eV (d) 13.6 eV

77. The wavefunction of a bound particle is $\Psi(x) = A\cos^2 x$ for $-\pi/2 < x < \pi/2$. The value of A is

(a) $(8/3\pi)^{1/2}$ (b) $(3/8\pi)^{1/2}$

(c) $(1/2\pi)^{1/2}$ (d) $(3/2\pi)^{1/2}$

78. $_{90}Th^{232}$, an isotope of Thorium decays in ten stages emitting six α-particles and four β-particles in all. The end product of the entire decay process is

(a) $_{82}Pb^{206}$ (b) $_{82}Pb^{209}$

(c) $_{82}Pb^{208}$ (d) $_{83}Br^{209}$

79. After two hours, $(1/16)^{th}$ of initial amount of a certain radioactive isotope remains undecayed. The half life of the isotope is about

(a) 15 min (b) 30 min

(c) 45 min (d) 7.5 min

80. Energy levels A, B and C of a certain atom correspond to increasing values of energy i.e., $E_A < E_B < E_C$. If λ_1, λ_2 and λ_3 are wavelengths of radiation corresponding to the transitions C to B, B to A and C to A respectively, which one of the following relations is correct ?

(a) $\lambda_3 = \lambda_1 + \lambda_2$ (b) $\lambda_1 + \lambda_2 + \lambda_3 = 0$

(c) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$ (d) $\lambda_3 = \lambda_1\lambda_2 / (\lambda_1 + \lambda_2)$

81. The work functions for metals A, B and C are respectively 1.9 eV, 2.5 eV and 5.6 eV. According to Einstein's theory for photoelectric effect, the metal/metals which will emit photo-electrons for a radiation of wavelength 4100 Å is/are [given Planck's constant $h = 6.6 \times 10^{-34}$ J.sec ; 1 eV = 1.6×10^{-19}J]

(a) None (b) A only

(c) A and B only (d) all the three metals

82. The spin angular momentum of an electron (in terms of the Planck's constant h) is

(a) always the same $h/4\pi$

(b) always the same $h/2\pi$

(c) integral multiples of $h/2\pi$

(d) $(N + ½)(h/2\pi)$ where N = 1, 2, 3, ...

83. The ground state wavefunction of a particle trapped in a one-dimensional box of width L is $\Psi_0(x) = (2/L)^{1/2} \sin(\pi x/L)$. The expectation value of the coordinate of the particle, $< x >$ is

(a) 0 (b) L/2

(c) L/4 (d) L

84. Electrons with energy of 1.0 eV are incident on a potential barrier 5.0 eV high and 0.5 nm wide (1 nm = 10^{-9} m). The transmission probability T is of the order of [given mass of electron -9.1×10^{-31} kg, $\hbar = 1.054 \times 10^{-34}$ J.sec, 1 eV = 1.6×10^{-19} J]

(a) 10^{-10} (b) 10^{-6}

(c) 10^{-14} (d) 10^{-2}

85. An eigen function of the operator d^2/dx^2 is $\Psi = e^{2x}$. The corresponding eigen value is

(a) 1 (b) 2

(c) 4 (d) 8

86. X-rays of wavelength 10.0 pm (1 pm = 10^{-12} m) are scattered from a target at an angle of 45°. If the electron Compton wavelength λ_C = 2.426 pm, then the smallest wavelength of the scattered X-rays is

(a) 10.7 pm (b) 20.0 pm

(c) 9.71 pm (d) 10.0 pm

87. The distance between adjacent atomic planes in a calcite ($CaCO_3$) crystal is 0.30 pm. The smallest angle of Bragg's scattering for 0.03 nm X-rays is

(a) 1.2° (b) 1.9°

(c) 2.1° (d) 2.9°

88. The spin, charge and baryon number of the 'up' quark are respectively

(a) 1/2, 1/3, 1/3 (b) 0, 2/3, 1/3

(c) 1/2, 2/3, 1/3 (d) 1/2, –1/3, 1/3

89. In the reaction $_1H^2 + {}_1H^3 \rightarrow {}_2He^4 + {}_0n^1$, if the binding energies of $_1H^2$, $_1H^3$ and $_2He^4$ are respectively a, b and c (in MeV), then the energy (in MeV) released in this reaction is

(a) a + b + c (b) a + b – c

(c) c + a – b (d) c – a – b

90. The uncertainty product $\Delta x\ \Delta p$ for the n^{th} eigen state of a one-dimensional harmonic oscillator is

(a) $(h/2\pi)\ n$ (b) $(h/2\pi)\ (n + 1/2)$

(c) $(h/2\pi)\ (n + 1)$ (d) $(h/4\pi)$

91. The hydrogen atom is in d-state. For this state, the value of the magnetic quantum number m is

(a) 2, 1, 0 (b) –1, 0, 1

(c) –2, –1, 0 +1, +2 (d) –3, –1, 0, 1, 3

92. The wavefunction of a particle is given by $\Psi = c \exp(-x^2\alpha^2)$ where c and α are constants. The probability of finding the particle in the region $0 < x < \infty$ is

(a) 1 (b) 1/3

(c) 1/2 (d) 1/4

93. The aim of Michelson Morley experiment was to

(a) measure velocity of light

(b) measure refractive index of glass

(c) prove that special theory of relativity was wrong

(d) find variation of velocity of light in different moving frames

94. A satellite of mass M is launched into a circular orbit of radius R and time period T. A second satellite of mass 0.75 M is launched into an orbit of radius $\frac{4}{3}$R. The time period of the second satellite is given by

(a) T (b) 1.54 T

(c) 0.65 T (d) 0.75 T

95. A spherical ball of density ρ is dropped in a liquid of density $\frac{\rho}{4}$. Initial acceleration of the body will be

(a) g/4 (b) g/2

(c) 3g/4 (d) g

96. Water flows through a long horizontal tube having cross – sections A_1 and A_2 at the two end points. If the pressures at the two end points are P_1, P_2, which of the following statements is true ?

(a) $P_1 > P_2$ if $A_1 > A_2$

(b) $P_1 < P_2$ if $A_1 > A_2$

(c) always $P_1 = P_2$

(d) None of the above statements is true

97. Bernoulli's theorem is based on conservation of

(a) mass (b) energy

(c) momentum (d) angular momentum

98. A sitar wire has a fundamental frequency of 444 Hz and gives 6 beats with a second identical wire when the tension of the second wire is slightly increased. If the tension of the first wire is T, the tension in the second wire is given by

(a) $\frac{450}{444}T$ (b) $\frac{444}{450}T$

(c) $\sqrt{\frac{450}{444}}T$ (d) $\sqrt{\frac{444}{450}}T$

99. An organ pipe resonating in the fundamental mode produces sound of frequency 56 Hz in air. The new frequency of the gas when filled with a gas of density 0.83 kg/m^2 will be

(a) 256 Hz (b) 307 Hz

(c) 336 Hz (d) 353 Hz

100. Rain drops falling on the earth from high clouds reach under the influence of gravity. Just before reaching the earth the velocity of the drops

(a) is decreasing with time

(b) is increasing with time

(c) is uniform for all sizes of rain drops

(d) is uniform but is different for different drops depending on the size of the drop

101. In Poisseuille's method of measuring the viscosity, the physical quantity which needs to be measured with maximum accuracy is

(a) pressure difference at the ends of capillary tube

(b) volume of liquid collected

(c) length of capillary tube

(d) inner radius of the capillary tube

102. The viscosity is a property of liquids by virtue of which

(a) liquid molecules attract each other

(b) liquid becomes a good conductor of heat

(c) liquid becomes a good conductor of electricity

(d) liquids oppose relative motion between its parts

103. Water is flowing in a pipe whose inside diameter tapers from 20 mm to 10 mm. The speed of the water at one of end points, where the diameter is 20 mm, is 0.2 ms^{-1}. The speed of the water at the other end point will be

(a) 0.4 ms^{-1} (b) 0.2 ms^{-1}

(c) 0.1 ms^{-1} (d) 0.05 ms^{-1}

104. A lamp hangs vertically from a cord in a descending lift having a retardation of 5.2 ms^{-2}. If the tension in the cord is 36 N, mass of the lamp will be

(a) 2 kg (b) 1 kg

(c) 4.9 kg (d) 9.8 kg

105. A train moving with speed of 72 km/h crosses another train moving with speed of 54 km/h. The first train sounds a whistle of frequency 600 Hz. The change in frequency of the whistle, as heard by a person in the second train when the two trains cross each other, is approximately given by (velocity of sound in air is 340 m/s)

(a) increase by 120 Hz

(b) decrease by 120 Hz

(c) increase in frequency by 350 Hz

(d) decrease in frequency by 350 Hz

106. A cylinder of radius R length L and density ρ floats upright in a fluid of density ρ_0. If it is given a small downward displacement of amplitude x_0, the time period of resulting (undamped) oscillations is

(a) $2\pi\sqrt{\frac{\rho_0 L}{\rho g}}$ (b) $2\pi\sqrt{\frac{\rho L}{\rho_0 g}}$

(c) $2\pi\sqrt{\frac{\rho_0 x_0}{\rho g}}$ (d) $2\pi\sqrt{\frac{\rho x_0}{\rho_0 g}}$

107. The life time of μ meson is 2×10^{-6} s. A beam of μ mesons comes out from a cyclotron with velocity 0.8 c, where c is the velocity of light. The mean life of μ mesons as observed in the laboratory will be

(a) 4×10^{-6} sec (b) 3×10^{-6} sec

(c) 0.3×10^{-6} sec (d) 0.25×10^{-6} sec

108. An air – craft executes a horizontal loop of radius 1 km with a steady speed of 900 km/hr. The ratio of the horizontal acceleration of the air – craft to the acceleration due to gravity is

(a) 0 (b) 5

(c) 6 (d) 7

109. A stone of mass m is tied to one end of a string and revolves in a vertical circle of radius R. The net force acting on the stone at the highest point A and the lowest point B of the circle along the vertically downward direction are

(a) $F_A = mg + T_1 ; F_B = mg - T_2$

(b) $F_A = mg - T_1 ; F_B = mg + T_2$

(c) $F_A = mg + T_1 + \frac{mv_1^2}{R} ; F_B = mg - T_2 + \frac{mv_2^2}{R}$

(d) $F_A = mg + T_1 + \frac{mv_1^2}{R} ; F_B = mg - T_2 - \frac{mv_2^2}{R}$

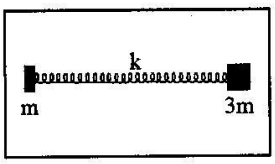
where v_1 and v_2 are the velocities at the two points A and B respectively.

110. A spherical body of mass m and radius R falls in earth's gravitational field from a height h. Assuming force due air friction to be kv^2, where k is a constant and v the velocity of the body, the terminal velocity of the body is given by

(a) $\sqrt{\frac{mg}{k}}$ (b) $\sqrt{\frac{2mg}{k}}$

(c) $\sqrt{\frac{2mgh}{kv}}$ (d) $\sqrt{\frac{mgh}{kv}}$

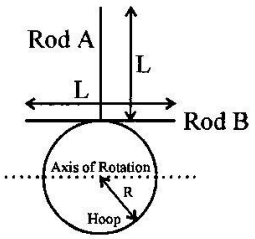
111. Two point masses M and 3M are attached to the two ends of a spring having spring constant k. The period of oscillations of this system is



(a) $\pi\sqrt{\frac{M}{k}}$ (b) $4\pi\sqrt{\frac{M}{k}}$

(c) $\pi\sqrt{\frac{3M}{k}}$ (d) $4\pi\sqrt{\frac{M}{3k}}$

112. A rigid body consists of a thin hoop of mass m and radius 0.15 m with two thin rods attached as shown in the figure each rod has mass m and length 2.0 R. The body can rotate about a horizontal axis in the plane of the hoop passing through its centre. The moment of inertia of the body about its axis of rotation is



(a) $5.83m\ R^2$ (b) $4.83m\ R^2$

(c) $4.53m\ R^2$ (d) $4.33m\ R^2$

113. The points S_1 and S_2 are two foci of an elliptical reflector. A point source is placed at S_1. All rays emanating from the point S_1 will pass through S_2 after undergoing a reflection. The time taken by each ray in reaching S_2 will be

(a) minimum (b) maximum

(c) stationary (d) zero

114. A system of two thin convex lenses of focal lengths 30 cm and 20 cm are separated by a distance of 10 cm in air. The position of unit planes are at

(a) 3 cm and 2 cm (b) 3 cm and –2 cm

(c) 7.5 cm and 5 cm (d) 7.5 cm and –5 cm

115. The system matrix elements of a lens are $a_{11} = 0.25$, $a_{12} = 0.025$, $a_{21} = -25$ and $a_{22} = 0.20$. The focal length of the lens is

(a) 4 cm (b) 5 cm

(c) 25 cm (d) 40 cm

116. Two lenses made of glasses having dispersive powers in the ratio 1:3 are used to make an achromatic doublet of focal length 30 cm. The focal lengths of the lenses are

(a) 20 cm and 60 cm (b) 20 cm and – 60 cm

(c) 30 cm and 60 cm (d) 30 cm and – 60 cm

117. Which of the following aberrations is/are minimized in the Huygen's eye-piece ?

(a) Only spherical

(b) Only chromatic

(c) Only coma

(d) Both spherical and chromatic

118. Haidinger's fringes are obtained in

(a) Michelson's interferometer

(b) Newton's rings experiment with a convex surface on a plane glass plate

(c) Biprism experiment

(d) Young's double slit experiment

119. Following statements are given about interference experiments :

A. In Michelson's interferometer fringe system, the radius of circular fringes increases as the order of interference decreases.

B. In Michelson's interferometer fringe system, the radius of circular fringes decreases as the order of interference decreases.

C. In Newton's rings, the order of interference increases as the radius of circular fringes increases.

D. In Newton's rings, the order of interference increases as the radius of circular fringes decreases.

The correct option is

(a) A and D

(b) A and B

(c) B and C

(d) A and C

120. If the source of light used in the Young's double slit experiment change from yellow to blue,

(a) fringes will become wider

(b) consecutive fringes will go farther

(c) consecutive fringes will come closer

(d) fringes will disappear

Space For Rough Work

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