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PG-EE-2016

SUBJECT : Physics

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11857

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

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SEAL

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1. A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in nth second to the distance covered in n seconds is :

(1) $\frac{2}{n}-\frac{1}{n^2}$ (2) $\frac{1}{n^2}-\frac{1}{n}$

(3) $\frac{2}{n^2}-\frac{1}{n}$ (4) $\frac{2}{n}+\frac{1}{n^2}$

2. A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x=(t-2)^2(t-5)$. Then :

(1) after 2 sec., velocity of particle is zero

(2) after 2 sec., the particle reaches O

(3) the acceleration is negative, for $t < 3$ sec.

(4) all the three before

3. A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 - k\varphi$; ω_0 and k being positive constants & at $t = 0$, $\varphi = 0$. The time dependence of the rotational angle is :

(1) $k\omega_0 e^{-kt}$ (2) $\frac{\omega_0}{k}e^{-kt}$

(3) $\frac{\omega_0}{k}\left(1-e^{-kt}\right)$ (4) $\frac{k}{\omega_0}\left(e^{-kt}-1\right)$

4. A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then :

(1) the total energy is $(-k/2r)$

(2) the kinetic energy is (k/r)

(3) the potential energy is $(k/2r)$

(4) the kinetic energy is $(-k/r)$

5. An elastic string of length 'L' and force constant 'k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is :

(1) $ky^2/2$ (2) $k(x^2+y^2)/2$

(3) $k(x+y)^2/2$ (4) $ky(2x+y)/2$

6. A smooth steel ball strikes a fixed smooth steel plate at an angle 'θ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be :

(1) θ (2) $\tan^{-1}(\tan\theta/e)$

(3) $e\tan\theta$ (4) $\tan^{-1}(e/\tan\theta)$

7. Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are :

(1) (1, 1) (2) (2.1, 3.9) (3) (0.5, 0.7) (4) (0.41, 0.93)

8. A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω. The centrifugal force on the particle is :

(1) $m\omega^2 a$ (2) $m\omega_0^2 a$

(3) $m[(\omega+\omega_0)/2]^2 a$ (4) $m\omega\omega_0 a$

9. A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then :

(1) at points away from the origin, the particle is in unstable equilibrium

(2) for any non zero value of x, there is a force directed away from the origin

(3) if its total mechanical energy is $k/2$, it has the minimum kinetic energy at origin

(4) for small displacement from $x = 0$, it executes SHM

10. If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1 : 8, then the value of 'n' is :

(1) 2 (2) $2\sqrt{2}$ (3) 4 (4) 1/2

11. A highly rigid cubical block of mass *'m'* and side *'L'* is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force *F* is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period :

(1) $2\pi(\eta mL)^{1/2}$ (2) $2\pi(m\eta / L)^{1/2}$

(3) $2\pi(mL/\eta)^{1/2}$ (4) $2\pi(m/\eta L)^{1/2}$

12. In a steady incomprehensible flow of a liquid :

(1) the speed does not change if the area of cross-section changes

(2) the speed increases if the area of cross-section increases

(3) the speed decreases if the area of cross-section increases

(4) bubbles are produced when the area of cross-section increases

13. 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is :

(1) $2\times10^3 N/m^2$ (2) $2\times10^5 N/m^2$

(3) $10^7 N/m^2$ (4) $2\times10^7 N/m^2$

14. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be :

(1) 6 (2) $3\sqrt{3}$ (3) $3(2-\sqrt{3})$ (4) 3

15. An electronic transition in hydrogen atom results in the formation of H_α line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are :

(1) –313.6, 34.84 (2) –313.6, –78.38

(3) –78.4, –34.84 (4) –78.4, –19.6

16. In case two bubbles of radii 'r_1' and 'r_2' come in contact with each other to form a single bubble, the resulting radius of curvature 'r' will be :

(1) $(r_1 + r_2)/2$ (2) $(r_1 r_2)/(r_1 - r_2)$

(3) $(r_1 r_2)/(r_1 + r_2)$ (4) $(r_1 r_2)^{1/2}$

17. If a transverse wave is represented as $y = y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$, then for what value of 'λ' the maximum particle velocity is equal to four times the wave velocity ?

(1) $y_0\pi$ (2) $(y_0\pi)/2$

(3) $2y_0\pi$ (4) $(3y_0\pi)/2$

18. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = 0.91 J/g°C] :

(1) 103°C (2) 130°C

(3) 105°C (4) 30°C

19. Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be :

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$ (2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

20. During an adiabatic process, the specific heat is :

(1) zero (2) greater than zero

(3) less than zero (4) infinity

21. Select the ***incorrect*** statement :

(1) The angular momentum is conserved for systems possessing rotational symmetry

(2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved

(3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum

(4) None of these

22. A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$) :

(1) –0.20 (2) 0.60 (3) –0.60 (4) 0.20

23. If electric permittivity and magnetic permeability of free space are ε_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ε and μ will be :

(1) $(\varepsilon\mu/\varepsilon_0\mu_0)$ (2) $(\varepsilon\mu/\varepsilon_0\mu_0)^{1/2}$

(3) $(\varepsilon_0\mu_0/\varepsilon\mu)$ (4) $(\varepsilon_0\mu_0/\varepsilon\mu)^{1/2}$

24. A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :

(1) $\tan^{-1}(1.62)$ (2) $\tan^{-1}(1/1.62)$

(3) $1/\tan^{-1}(1.62)$ (4) $\tan^{2}(1.62)$

25. A point charge Q is placed at the centre of a hemisphere. The electric flux passing through the flat surface of hemisphere is :

(1) Q/ε_0 (2) zero (3) $Q/2\varepsilon_0$ (4) $Q/4\varepsilon_0$

26. A length 'l' of a wire is bent to form a circular coil of few turns. The maximum torque acting on the coil it is placed in a magnetic field B and a current I is passed through it, will be :

(1) IBl^2 (2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$

27. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT respectively. The beam then strikes a grounded target. If the beam current is I = 80mA, the force with which the beam strikes the target will be :

(1) 80 μN (2) 25 μN (3) 20 μN (4) 35 μN

28. Magnetic field of an infinitely long ideal solenoid of radius R carrying current I :

(1) increases radially inside, zero outside

(2) is constant inside and zero outside

(3) is constant inside and decays as $1/r$ outside

(4) is constant inside and decays as $e^{-(1/r)}$ outside

29. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation :

(1) the entire rod is at same potential

(2) there is an electric field in the rod

(3) the electric potential is highest at the centre of the rod and decreases towards the ends

(4) the electric potential is lowest at the centre of the rod and increases towards the ends

30. The average value of electric energy density in an electromagnetic wave is :

(1) $\varepsilon_0 E^2/2$ (2) $E^2/2\varepsilon_0$ (3) $\varepsilon_0 E^2$ (4) $\varepsilon_0 E^2/4$

31. Which of the following statements is ***correct*** ?

(1) the displacement current is produced only by varying magnetic field

(2) the displacement current is produced only by varying electric field

(3) the displacement current is produced by varying magnetic field as well as varying electric field

(4) the displacement current is produced neither by varying magnetic field nor by varying electric field

32. Two wires one of copper and another of steel having the same cross-sectional area and lengths 1.0 and 0.5 m respectively, are fastened end to end and stretched by a load M. If copper wire is stretched by 1 mm, the total extension of the combination is :

[$Y_{copper} = 1 \times 10^{11} n/m^2$, $Y_{steel} = 2 \times 10^{11} n/m^2$]

(1) 0.125 cm (2) 0.20 cm (3) 0.120 cm (4) 0.25 cm

33. If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is :

(1) $9.88 \times 10^3 N/m^2$ (2) $10.88 \times 10^3 N/m^2$

(3) $1.088 \times 10^3 N/m^2$ (4) $4.48 \times 10^3 N/m^2$

34. Which of the following is correct order in respect of r.m.s. velocity (v_{rms}), average velocity (v_{av}) and most probable velocity (v_{mp}) ?

(1) $v_{mp} > v_{av} > v_{rms}$ (2) $v_{rms} > v_{av} > v_{mp}$

(3) $v_{av} > v_{mp} > v_{rms}$ (4) $v_{mp} > v_{rms} > v_{av}$

35. 12 gms of a gas occupy a volume of 4×10^{-3} m^3 at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm^3. The temperature to which the gas is heated is :

(1) 1000 *K* (2) 1400 *K* (3) 1200 *K* (4) 800 *K*

36. If rest mass of an electron is 9.1×10^{-31} kg, then its mass equivalent energy is :

(1) 0.511 erg (2) 0.511 J (3) 0.511 eV (4) 0.511 MeV

37. A reference frame attached to the earth :

(1) is an inertial frame by definition

(2) can not be an inertial frame because the earth is revolving round the sun

(3) is an inertial frame as Newton's laws are applicable

(4) can not be an inertial frame because the earth is rotating about its own axis

38. A particle with a mean proper life of 1 μs moves through the laboratory with a velocity 2.7×10^{10} cm/sec. Its lifetime as measured by an observer in the laboratory is :

(1) more than one micro-second (2) 1.0 μ sec

(3) less than one micro-second (4) 0.09 μ sec

39. In an L-C circuit :

(1) the energy stored in L as well as in C is magnetic energy

(2) the energy stored in L is magnetic but in C it is electrical energy

(3) the energy stored in L is electrical but in C it is magnetic energy

(4) the energy stored in L as well as in C is electrical energy

40. A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be :

(1) halved (2) the same (3) doubled (4) quadrupled

41. The depletion region of a junction diode is formed :

(1) when forward bias is applied to it

(2) when the temperature of the junction is reduced

(3) under reverse bias

(4) during the manufacturing process

42. In a full wave rectifier with R – C filter, the conduction angle of the diode is :

(1) 0 (2) $< \pi$ (3) $> \pi$ (4) $= \pi$

43. A BJT with h_{FE} value of 100 is found to be operating at $I_B = 100\ \mu A$ and $I_C = 5$ mA. The transistor is operating in the :

(1) active region (2) active or saturation region

(3) saturation region (4) cut-off region

44. Faster switching OFF of a p-n junction :

(1) requires zero current in the reverse direction

(2) requires reverse saturation current in the reverse direction

(3) requires a large current in the reverse direction

(4) is independent of the reverse current

45. The collector to base bias method in amplifier circuit :

(1) requires low dc supply

(2) requires high dc supply

(3) makes operating point independent of variation in I_{co}

(4) makes operating point independent of variation in β

46. In a R-C coupled CE amplifier, emitter lead resistance R_E is used to :

(1) increase the load
(2) decrease the load
(3) attain proper stability factor
(4) decrease V_{CE} voltage

47. In a multi stage amplifier, on increasing the number of stages, the gain-bandwidth product :

(1) remains constant
(2) increases
(3) decreases
(4) becomes zero

48. A common collector amplifier has :

(1) high voltage gain but low current gain
(2) low voltage gain and low current gain
(3) high output impedance but low input impedance
(4) low output impedance but high input impedance

49. Which of the following is most suitable for generating 1 kHz frequency ?

(1) Wien bridge oscillator
(2) Colpitt's oscillator
(3) Hartley oscillator
(4) Tuned collector oscillator

50. During an isothermal expansion of an ideal gas :

(1) its internal energy decreases
(2) its internal energy does not change
(3) the work done by the gas is equal to the quantity of heat absorbed by it
(4) both (2) and (3) are correct

51. The inside and outside temperatures of a refrigerator are 270 K and 303 K respectively. Assuming the refrigerator cycle to be reversible, for every joule of work done, the heat delivered to the surrounding is :

(1) 10 J (2) 20 J (3) 30 J (4) 50 J

52. If a gas is heated at constant pressure, then what percentage of total heat supplied is used for up for external work [γ for gas = 4/3] :

(1) 25% (2) 50% (3) 75% (4) 57%

53. The enthalpy of vaporization of water is 186.5 J/mol. The entropy of its vaporization will be :

(1) $0.5\,JK^{-1}mol^{-1}$ (2) $1.0\,JK^{-1}mol^{-1}$

(3) $1.5\,JK^{-1}mol^{-1}$ (4) $2.0\,JK^{-1}mol^{-1}$

54. In a biprism experiment, if the wavelength of red light used is 6.5×10^{-7} m and that of green light is 5.2×10^{-7} m, the value of 'n' for which $(n+1)^{th}$ green bright band coincides with n^{th} red bright band for the same setting is given by :

(1) 2 (2) 3 (3) 4 (4) 1

55. The contrast in the fringes in any interference pattern depends on :

(1) fringe width (2) wavelength

(3) intensity ratio of the sources (4) distance between the sources

56. Yellow light emitted by a sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity, then :

(1) the fringe width will decrease

(2) the fringe width will increase

(3) the fringe width will be unchanged

(4) the intensity of the fringes will decrease

57. Ratio of adiabatic elasticity to isothermal elasticity is :

(1) 0 (2) 1 (3) γ (4) $1/\gamma$

58. The enthalpy 'H' along an isothermal curve for an ideal gas is :

(1) constant (2) variable

(3) infinite (4) unpredictable

59. A system of non-interacting Fermi particles with Fermi energy ε_f has density of states proportional to $\sqrt{\varepsilon}$, where ε is the energy of a particle. The average energy per particle at T = 0 K is :

(1) $\varepsilon_f/6$ (2) $\varepsilon_f/5$

(3) $2\varepsilon_f/5$ (4) $3\varepsilon_f/5$

60. Gibb's potential remains constant in which of the following ?

(1) isothermal process (2) isobaric process

(3) both (1) and (2) (4) adiabatic process

61. The coefficient of diffusion is :

(1) directly proportional to pressure and inversely proportional to (temperature)^2

(2) inversely proportional to pressure and directly proportional to (temperature)^2

(3) directly proportional to pressure and inversely proportional to (temperature)$^{3/2}$

(4) inversely proportional to pressure and directly proportional to (temperature)$^{3/2}$

62. The ratio of average speed of hydrogen and bromine gas molecules at 27°C will be [$M_{Br} = 80\ M_H$]

(1) $\sqrt{1/80}$ (2) $\sqrt{80}$

(3) $\sqrt{40}$ (4) $\sqrt{1/40}$

63. Which of the following is the correct Clapeyron's latent heat relation ?

(1) $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$ (2) $\frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

(3) $\frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$ (4) $\frac{dP}{dT} = \frac{L(V_2 - V_1)}{T}$

64. In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :

(1) 3 (2) 2 (3) 6 (4) 8

65. Polarisation of light proves the :

(1) corpuscular nature of light (2) quantum nature of light

(3) transverse nature of light (4) longitudinal nature of light

66. For two coherent monochromatic light beams of intensities I and $4I$ super imposed on each other, the maximum and minimum possible intensities in the resulting beams are :

(1) $5I$ and I (2) $5I$ and $3I$ (3) $9I$ and I (4) $9I$ and $3I$

67. The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is :

(1) 30° (2) 45° (3) 60° (4) 15°

68. Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å , the limit of resolution will be :

(1) 0.80 mm (2) 0.12 mm

(3) 0.10 mm (4) 0.08 mm

69. A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewster's angle φ. If μ represents the refractive index of glass, the angle between the reflected and refracted rays is :

(1) $90° + \varphi$ (2) $\sin^{-1}(\mu \cos \varphi)$

(3) $90°$ (4) $\sin^{-1}(\mu \sin \varphi)$

70. Two Nicol prisms are first crossed and then one of them is rotated through 60°. The percentage of light transmitted is :

(1) 1.25 (2) 25.0

(3) 37.5 (4) 50.0

71. The ratio of de-Broglie wavelength of an α-particle and a proton of same kinetic energy is :

(1) 1 : 2 (2) 1 : 1

(3) $1 : \sqrt{2}$ (4) 4 : 1

72. X-rays are used for structural analysis of crystals as these :

(1) have the wavelength of the order of the inter-atomic spacing

(2) are highly penetrating radiations

(3) have the wavelength of the order of the nuclear size

(4) are highly coherent in nature

73. A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will :

(1) increase (2) decrease

(3) remain the same (4) fluctuate

74. The fission of uranium nuclide :

(1) always leads to same pair of fission products, say barium and krypton

(2) does not always produce barium and krypton but different pair of fission products

(3) produces barium and any other fission product

(4) always produces at least one radioactive fission product

75. Mirror nuclei are those which have :

(1) the same number of protons

(2) the same number of neutrons

(3) the number of protons equal to the number of neutrons

(4) the number of neutrons in one equal to the number of protons in the other

76. Beta rays emitted in a radioactive material are :

(1) electromagnetic radiations

(2) electrons orbiting around the nucleus

(3) charged particles emitted by the nucleus

(4) neutral particles in the nucleus

77. The radio active decay of an element X to elements Y and K is represented by the equation $\frac{A}{Z}X \rightarrow \frac{A}{Z+1}Y \rightarrow \frac{A-4}{Z-1}K \rightarrow \frac{A-4}{Z-1}K$. The sequence of emitted radiations is :

(1) α, β, γ (2) β, α, γ

(3) γ, α, β (4) β, γ, α

78. Atomic explosion is the result of :

(1) uncontrolled chain reaction in fission

(2) controlled chain reaction in fusion

(3) uncontrolled chain reaction in fusion

(4) controlled chain reaction in fission

79. X-rays of wavelength λ are incident on a crystal and the second order reflection on diffraction from the crystal is observed at an angle of 45°. The lattice constant of the crystal is :

(1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$ (3) λ (4) 2λ

80. The amount of a substance that gives 3.7×10^7 disintegration per second (dps) is :

(1) one becquerel (2) one curie

(3) one mili-curie (4) one rutherford

81. Only $1/8^{th}$ of the original amount of a radioactive material remains after 96 minutes. The value of $t_{1/2}$ of the material is :

(1) 12 minutes (2) 32 minutes

(3) 24 minutes (4) 48 minutes

82. The weight of 1 curie $_{82}Pb^{214}$ ($t_{1/2}$ = 26.8 min.) in grams is :

(1) 3.1×10^{-8} g (2) 1.55×10^{-8} g

(3) 6.2×10^{-8} g (4) 3.1×10^{-10} g

83. The final product, if $_{92}U^{235}$ emits two α and one β particle, will be :

(1) $_{87}Ac^{221}$ (2) $_{89}Ac^{235}$

(3) $_{89}Ac^{225}$ (4) $_{89}Ac^{227}$

84. Stern Gerlach experiment proves the existence of :

(1) electronic charge
(2) electron dipole moment
(3) electron spin
(4) electron mass

85. An electron with energy E incident upon a potential barrier of V such that V > E and thickness l, then the transmission coefficient :

(1) is zero
(2) proportional to l^2
(3) increases exponentially with thickness
(4) decreases exponentially with thickness

86. The probability of finding an electron in a hydrogen atom is :

(1) independent of r
(2) independent of θ
(3) independent of φ
(4) independent of all the three before

87. In case of a rigid rotator, the rotational frequency is given as :

(1) $\hbar L^2/2\pi I$
(2) $\hbar L/2\pi I$
(3) $\hbar L/2\pi I^2$
(4) $\hbar L/2\pi(2I + 1)$

88. The energy between two adjacent levels is given by :

(1) (2n + 1) times the zero point energy
(2) (2n – 1) times the zero point energy
(3) $2n^2$ times the zero point energy
(4) n^2 times the zero point energy

89. The ionization potential of Li^{+2} ions using Bohr's theory is :

(1) 13.6 eV (2) 27.2 eV

(3) 40.8 eV (4) 122.4 eV

90. The wave function considered to be confined within a box of length L is $\psi(x) = \sqrt{2/L}\sin(\pi x/L)$ in the region $0 < x < L$. The probability of finding the particle in the region $0 < x < L/2$ is :

(1) 0 (2) 1/2 (3) 1 (4) 0.66

91. The axial parameter $a = b \neq c$ and $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ correspond to the following system :

(1) Tetragonal (2) Cubic

(3) Hexagonal (4) Rhombohedral

92. If the Lagrangian L is not an explicit function of time, the Hamiltonian H is :

(1) Zero (2) Constant of motion

(3) Infinity (4) Variable with motion

93. For Bose-Einstein condensation to happen, which of the following is ***true*** ?

(1) Number of particles decreases rapidly in lower energy levels at high temperatures and low pressures

(2) Number of particles increases rapidly in lower energy levels at high temperatures and low pressures

(3) Number of particles decreases rapidly in lower energy levels at low temperatures and high pressures

(4) Number of particles increases rapidly in lower energy levels at low temperatures and high pressures

94. The value of radius of the Fermi sphere of a degenerate free electron gas at zero temperature, having N particles contained in volume V is given as :

(1) $(3\pi^2)^{1/3}(N/V)^{2/3}\hbar$ (2) $(3\pi^2)^{1/3}(N/V)^{1/6}\hbar$

(3) $(3\pi^2)^{1/3}(N/V)^{1/3}\hbar$ (4) $(3\pi^2)^{1/3}(N/V)^{1/2}\hbar$

95. The hyperfine splitting of spectral lines of an atom is due to :

(1) coupling between spins of two or more electrons

(2) coupling between spins and orbital angular momenta of the electrons

(3) coupling between electron spins and the nuclear spins

(4) None of the above

96. The energy separation between two consecutive stokes lines in Raman scattering depends on :

(1) Wavelength of the incident light

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97. The Debye theory of specific heat is valid at :

(1) room temperature (2) low temperature

(3) intermediate temperature (4) all temperature

98. For a bcc crystal, the first Brillouin zone is a :s

(1) cube (2) Rectangular parallelepiped

(3) Truncated octahedron (4) Regular rhombic dodecahedron

99. Which of the following is ***not*** the use of Hall's effect ?

(1) Determination of the sign of charge carriers

(2) Determination of number density of charge carriers

(3) Measurement of potential difference

(4) Measurement of magnetic field

100. What is the behaviour of the pure *Si* crystal at absolute zero temperature ?

(1) behaves as perfect conductor (2) behaves as perfect insulator

(3) contains no electron (4) none of the above

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PG-EE-2016

SUBJECT : Physics

B

Sr. No. 11894

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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6. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
7. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. The depletion region of a junction diode is formed :

   (1) when forward bias is applied to it

   (2) when the temperature of the junction is reduced

   (3) under reverse bias

   (4) during the manufacturing process

2. In a full wave rectifier with R – C filter, the conduction angle of the diode is :

   (1) 0 (2) $< \pi$ (3) $> \pi$ (4) $= \pi$

3. A BJT with h_{FE} value of 100 is found to be operating at $I_B = 100\ \mu A$ and $I_C = 5$ mA. The transistor is operating in the :

   (1) active region (2) active or saturation region

   (3) saturation region (4) cut-off region

4. Faster switching OFF of a p-n junction :

   (1) requires zero current in the reverse direction

   (2) requires reverse saturation current in the reverse direction

   (3) requires a large current in the reverse direction

   (4) is independent of the reverse current

5. The collector to base bias method in amplifier circuit :

   (1) requires low dc supply

   (2) requires high dc supply

   (3) makes operating point independent of variation in I_{co}

   (4) makes operating point independent of variation in β

6. In a R-C coupled CE amplifier, emitter lead resistance R_E is used to :

(1) increase the load
(2) decrease the load
(3) attain proper stability factor
(4) decrease V_{CE} voltage

7. In a multi stage amplifier, on increasing the number of stages, the gain-bandwidth product :

(1) remains constant
(2) increases
(3) decreases
(4) becomes zero

8. A common collector amplifier has :

(1) high voltage gain but low current gain
(2) low voltage gain and low current gain
(3) high output impedance but low input impedance
(4) low output impedance but high input impedance

9. Which of the following is most suitable for generating 1 kHz frequency ?

(1) Wien bridge oscillator
(2) Colpitt's oscillator
(3) Hartley oscillator
(4) Tuned collector oscillator

10. During an isothermal expansion of an ideal gas :

(1) its internal energy decreases
(2) its internal energy does not change
(3) the work done by the gas is equal to the quantity of heat absorbed by it
(4) both (2) and (3) are correct

11. The ratio of de-Broglie wavelength of an α-particle and a proton of same kinetic energy is :

(1) 1 : 2 (2) 1 : 1 (3) $1 : \sqrt{2}$ (4) 4 : 1

12. X-rays are used for structural analysis of crystals as these :

(1) have the wavelength of the order of the inter-atomic spacing

(2) are highly penetrating radiations

(3) have the wavelength of the order of the nuclear size

(4) are highly coherent in nature

13. A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will :

(1) increase (2) decrease

(3) remain the same (4) fluctuate

14. The fission of uranium nuclide :

(1) always leads to same pair of fission products, say barium and krypton

(2) does not always produce barium and krypton but different pair of fission products

(3) produces barium and any other fission product

(4) always produces at least one radioactive fission product

15. Mirror nuclei are those which have :

(1) the same number of protons

(2) the same number of neutrons

(3) the number of protons equal to the number of neutrons

(4) the number of neutrons in one equal to the number of protons in the other

16. Beta rays emitted in a radioactive material are :

(1) electromagnetic radiations

(2) electrons orbiting around the nucleus

(3) charged particles emitted by the nucleus

(4) neutral particles in the nucleus

17. The radio active decay of an element X to elements Y and K is represented by the equation $\frac{A}{Z}X \rightarrow \frac{A}{Z+1}Y \rightarrow \frac{A-4}{Z-1}K \rightarrow \frac{A-4}{Z-1}K$. The sequence of emitted radiations is :

(1) α, β, γ (2) β, α, γ

(3) γ, α, β (4) β, γ, α

18. Atomic explosion is the result of :

(1) uncontrolled chain reaction in fission

(2) controlled chain reaction in fusion

(3) uncontrolled chain reaction in fusion

(4) controlled chain reaction in fission

19. X-rays of wavelength λ are incident on a crystal and the second order reflection on diffraction from the crystal is observed at an angle of 45°. The lattice constant of the crystal is :

(1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$ (3) λ (4) 2λ

20. The amount of a substance that gives 3.7×10^7 disintegration per second (dps) is :

(1) one becquerel (2) one curie

(3) one mili-curie (4) one rutherford

21. The axial parameter $a = b \neq c$ and $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ correspond to the following system :

(1) Tetragonal (2) Cubic

(3) Hexagonal (4) Rhombohedral

22. If the Lagrangian L is not an explicit function of time, the Hamiltonian H is :

(1) Zero (2) Constant of motion

(3) Infinity (4) Variable with motion

23. For Bose-Einstein condensation to happen, which of the following is ***true*** ?

(1) Number of particles decreases rapidly in lower energy levels at high temperatures and low pressures

(2) Number of particles increases rapidly in lower energy levels at high temperatures and low pressures

(3) Number of particles decreases rapidly in lower energy levels at low temperatures and high pressures

(4) Number of particles increases rapidly in lower energy levels at low temperatures and high pressures

24. The value of radius of the Fermi sphere of a degenerate free electron gas at zero temperature, having N particles contained in volume V is given as :

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(1) room temperature

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(1) cube

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(3) Measurement of potential difference

(4) Measurement of magnetic field

30. What is the behaviour of the pure *Si* crystal at absolute zero temperature ?

(1) behaves as perfect conductor

(2) behaves as perfect insulator

(3) contains no electron

(4) none of the above

31. A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in nth second to the distance covered in n seconds is :

(1) $\frac{2}{n}-\frac{1}{n^2}$ (2) $\frac{1}{n^2}-\frac{1}{n}$

(3) $\frac{2}{n^2}-\frac{1}{n}$ (4) $\frac{2}{n}+\frac{1}{n^2}$

32. A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x=(t-2)^2(t-5)$. Then :

(1) after 2 sec., velocity of particle is zero

(2) after 2 sec., the particle reaches O

(3) the acceleration is negative, for $t < 3$ sec.

(4) all the three before

33. A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 - k\varphi$; ω_0 and k being positive constants & at $t = 0$, $\varphi = 0$. The time dependence of the rotational angle is :

(1) $k\omega_0 e^{-kt}$ (2) $\frac{\omega_0}{k} e^{-kt}$

(3) $\frac{\omega_0}{k}\left(1 - e^{-kt}\right)$ (4) $\frac{k}{\omega_0}\left(e^{-kt} - 1\right)$

34. A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then :

(1) the total energy is $(-k/2r)$

(2) the kinetic energy is (k/r)

(3) the potential energy is $(k/2r)$

(4) the kinetic energy is $(-k/r)$

35. An elastic string of length 'L' and force constant 'k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is :

(1) $ky^2/2$ (2) $k\left(x^2 + y^2\right)/2$

(3) $k(x+y)^2/2$ (4) $ky(2x + y)/2$

36. A smooth steel ball strikes a fixed smooth steel plate at an angle 'θ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be :

(1) θ (2) $\tan^{-1}(\tan\theta/e)$

(3) $e\tan\theta$ (4) $\tan^{-1}(e/\tan\theta)$

37. Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are :

(1) (1, 1) (2) (2.1, 3.9) (3) (0.5, 0.7) (4) (0.41, 0.93)

38. A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω. The centrifugal force on the particle is :

(1) $m\omega^2 a$ (2) $m\omega_0^2 a$

(3) $m[(\omega+\omega_0)/2]^2 a$ (4) $m\omega\omega_0 a$

39. A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then :

(1) at points away from the origin, the particle is in unstable equilibrium

(2) for any non zero value of x, there is a force directed away from the origin

(3) if its total mechanical energy is $k/2$, it has the minimum kinetic energy at origin

(4) for small displacement from $x = 0$, it executes SHM

40. If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1 : 8, then the value of 'n' is :

(1) 2 (2) $2\sqrt{2}$ (3) 4 (4) 1/2

41. The inside and outside temperatures of a refrigerator are 270 K and 303 K respectively. Assuming the refrigerator cycle to be reversible, for every joule of work done, the heat delivered to the surrounding is :

(1) 10 J (2) 20 J (3) 30 J (4) 50 J

42. If a gas is heated at constant pressure, then what percentage of total heat supplied is used for up for external work [γ for gas = 4/3] :

(1) 25% (2) 50% (3) 75% (4) 57%

43. The enthalpy of vaporization of water is 186.5 J/mol. The entropy of its vaporization will be :

(1) $0.5\,JK^{-1}mol^{-1}$ (2) $1.0\,JK^{-1}mol^{-1}$

(3) $1.5\,JK^{-1}mol^{-1}$ (4) $2.0\,JK^{-1}mol^{-1}$

44. In a biprism experiment, if the wavelength of red light used is 6.5×10^{-7} m and that of green light is 5.2×10^{-7} m, the value of 'n' for which $(n+1)^{th}$ green bright band coincides with n^{th} red bright band for the same setting is given by :

(1) 2 (2) 3 (3) 4 (4) 1

45. The contrast in the fringes in any interference pattern depends on :

(1) fringe width (2) wavelength

(3) intensity ratio of the sources (4) distance between the sources

46. Yellow light emitted by a sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity, then :

(1) the fringe width will decrease

(2) the fringe width will increase

(3) the fringe width will be unchanged

(4) the intensity of the fringes will decrease

47. Ratio of adiabatic elasticity to isothermal elasticity is :

(1) 0 (2) 1 (3) γ (4) $1/\gamma$

48. The enthalpy 'H' along an isothermal curve for an ideal gas is :

(1) constant (2) variable

(3) infinite (4) unpredictable

49. A system of non-interacting Fermi particles with Fermi energy ε_f has density of states proportional to $\sqrt{\varepsilon}$, where ε is the energy of a particle. The average energy per particle at T = 0 K is :

(1) $\varepsilon_f/6$ (2) $\varepsilon_f/5$

(3) $2\varepsilon_f/5$ (4) $3\varepsilon_f/5$

50. Gibb's potential remains constant in which of the following :

(1) isothermal process (2) isobaric process

(3) both (1) and (2) (4) adiabatic process

51. The coefficient of diffusion is :

(1) directly proportional to pressure and inversely proportional to (temperature)^2

(2) inversely proportional to pressure and directly proportional to (temperature)^2

(3) directly proportional to pressure and inversely proportional to (temperature)$^{3/2}$

(4) inversely proportional to pressure and directly proportional to (temperature)$^{3/2}$

52. The ratio of average speed of hydrogen and bromine gas molecules at 27°C will be $[M_{Br} = 80\ M_H]$

(1) $\sqrt{1/80}$ (2) $\sqrt{80}$

(3) $\sqrt{40}$ (4) $\sqrt{1/40}$

53. Which of the following is the correct Clapeyron's latent heat relation ?

(1) $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$ (2) $\frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

(3) $\frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$ (4) $\frac{dP}{dT} = \frac{L(V_2 - V_1)}{T}$

54. In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :

(1) 3 (2) 2 (3) 6 (4) 8

55. Polarisation of light proves the :

(1) corpuscular nature of light (2) quantum nature of light

(3) transverse nature of light (4) longitudinal nature of light

56. For two coherent monochromatic light beams of intensities I and $4I$ super imposed on each other, the maximum and minimum possible intensities in the resulting beams are :

(1) $5I$ and I (2) $5I$ and $3I$ (3) $9I$ and I (4) $9I$ and $3I$

57. The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is :

(1) 30° (2) 45° (3) 60° (4) 15°

58. Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å , the limit of resolution will be :

(1) 0.80 mm (2) 0.12 mm

(3) 0.10 mm (4) 0.08 mm

59. A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewster's angle φ. If μ represents the refractive index of glass, the angle between the reflected and refracted rays is :

(1) $90° + \varphi$ (2) $\sin^{-1}(\mu \cos \varphi)$

(3) 90° (4) $\sin^{-1}(\mu \sin \varphi)$

60. Two Nicol prisms are first crossed and then one of them is rotated through 60°. The percentage of light transmitted is :

(1) 1.25 (2) 25.0 (3) 37.5 (4) 50.0

61. Select the ***incorrect*** statement :

(1) The angular momentum is conserved for systems possessing rotational symmetry

(2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved

(3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum

(4) None of these

62. A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$) :

(1) –0.20 (2) 0.60 (3) –0.60 (4) 0.20

63. If electric permittivity and magnetic permeability of free space are ε_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ε and μ will be :

(1) $(\varepsilon\mu/\varepsilon_0\mu_0)$ (2) $(\varepsilon\mu/\varepsilon_0\mu_0)^{1/2}$

(3) $(\varepsilon_0\mu_0/\varepsilon\mu)$ (4) $(\varepsilon_0\mu_0/\varepsilon\mu)^{1/2}$

64. A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :

(1) $\tan^{-1}(1.62)$ (2) $\tan^{-1}(1/1.62)$

(3) $1/\tan^{-1}(1.62)$ (4) $\tan^{2}(1.62)$

65. A point charge Q is placed at the centre of a hemisphere. The electric flux passing through the flat surface of hemisphere is :

(1) Q/ε_0 (2) zero (3) $Q/2\varepsilon_0$ (4) $Q/4\varepsilon_0$

66. A length 'l' of a wire is bent to form a circular coil of few turns. The maximum torque acting on the coil it is placed in a magnetic field B and a current I is passed through it, will be :

(1) IBl^2 (2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$

67. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT respectively. The beam then strikes a grounded target. If the beam current is I = 80mA, the force with which the beam strikes the target will be :

(1) 80 μN (2) 25 μN (3) 20 μN (4) 35 μN

68. Magnetic field of an infinitely long ideal solenoid of radius R carrying current I :

(1) increases radially inside, zero outside

(2) is constant inside and zero outside

(3) is constant inside and decays as $1/r$ outside

(4) is constant inside and decays as $e^{-(1/r)}$ outside

69. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation :

(1) the entire rod is at same potential

(2) there is an electric field in the rod

(3) the electric potential is highest at the centre of the rod and decreases towards the ends

(4) the electric potential is lowest at the centre of the rod and increases towards the ends

70. The average value of electric energy density in an electromagnetic wave is :

(1) $\varepsilon_0 E^2/2$ (2) $E^2/2\varepsilon_0$

(3) $\varepsilon_0 E^2$ (4) $\varepsilon_0 E^2/4$

71. A highly rigid cubical block of mass *'m'* and side *'L'* is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force *F* is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period :

(1) $2\pi(\eta mL)^{1/2}$ (2) $2\pi(m\eta/L)^{1/2}$

(3) $2\pi(mL/\eta)^{1/2}$ (4) $2\pi(m/\eta L)^{1/2}$

72. In a steady incomprehensible flow of a liquid :

(1) the speed does not change if the area of cross-section changes

(2) the speed increases if the area of cross-section increases

(3) the speed decreases if the area of cross-section increases

(4) bubbles are produced when the area of cross-section increases

73. 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is :

(1) $2\times10^3 N/m^2$ (2) $2\times10^5 N/m^2$

(3) $10^7 N/m^2$ (4) $2\times10^7 N/m^2$

74. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be :

(1) 6 (2) $3\sqrt{3}$ (3) $3(2-\sqrt{3})$ (4) 3

75. An electronic transition in hydrogen atom results in the formation of H_α line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are :

(1) –313.6, 34.84 (2) –313.6, –78.38

(3) –78.4, –34.84 (4) –78.4, –19.6

76. In case two bubbles of radii 'r_1' and 'r_2' come in contact with each other to form a single bubble, the resulting radius of curvature 'r' will be :

(1) $(r_1 + r_2)/2$ (2) $(r_1 r_2)/(r_1 - r_2)$

(3) $(r_1 r_2)/(r_1 + r_2)$ (4) $(r_1 r_2)^{1/2}$

77. If a transverse wave is represented as $y = y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$, then for what value of 'λ' the maximum particle velocity is equal to four times the wave velocity ?

(1) $y_0\pi$ (2) $(y_0\pi)/2$

(3) $2y_0\pi$ (4) $(3y_0\pi)/2$

78. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = 0.91 J/g°C] :

(1) 103°C (2) 130°C

(3) 105°C (4) 30°C

79. Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be :

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$ (2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

80. During an adiabatic process, the specific heat is :

(1) zero (2) greater than zero

(3) less than zero (4) infinity

81. Only $1/8^{th}$ of the original amount of a radioactive material remains after 96 minutes. The value of $t_{1/2}$ of the material is :

(1) 12 minutes (2) 32 minutes

(3) 24 minutes (4) 48 minutes

82. The weight of 1 curie $_{82}Pb^{214}$ ($t_{1/2}$ = 26.8 min.) in grams is :

(1) 3.1×10^{-8} g (2) 1.55×10^{-8} g

(3) 6.2×10^{-8} g (4) 3.1×10^{-10} g

83. The final product, if $_{92}U^{235}$ emits two α and one β particle, will be :

(1) $_{87}Ac^{221}$ (2) $_{89}Ac^{235}$

(3) $_{89}Ac^{225}$ (4) $_{89}Ac^{227}$

84. Stern Gerlach experiment proves the existence of :

(1) electronic charge (2) electron dipole moment

(3) electron spin (4) electron mass

85. An electron with energy E incident upon a potential barrier of V such that V > E and thickness l, then the transmission coefficient :

(1) is zero

(2) proportional to l^2

(3) increases exponentially with thickness

(4) decreases exponentially with thickness

86. The probability of finding an electron in a hydrogen atom is :

(1) independent of r (2) independent of θ

(3) independent of φ (4) independent of all the three before

87. In case of a rigid rotator, the rotational frequency is given as :

(1) $\hbar L^2/2\pi I$ (2) $\hbar L/2\pi I$ (3) $\hbar L/2\pi I^2$ (4) $\hbar L/2\pi(2I+1)$

88. The energy between two adjacent levels is given by :

(1) (2n + 1) times the zero point energy

(2) (2n – 1) times the zero point energy

(3) $2n^2$ times the zero point energy

(4) n^2 times the zero point energy

89. The ionization potential of Li^{+2} ions using Bohr's theory is :

(1) 13.6 eV (2) 27.2 eV (3) 40.8 eV (4) 122.4 eV

90. The wave function considered to be confined within a box of length L is $\psi(x)=\sqrt{2/L}\sin(\pi x/L)$ in the region $0 < x < L$. The probability of finding the particle in the region $0 < x < L/2$ is :

(1) 0 (2) 1/2 (3) 1 (4) 0.66

91. Which of the following statements is ***correct*** ?

(1) the displacement current is produced only by varying magnetic field

(2) the displacement current is produced only by varying electric field

(3) the displacement current is produced by varying magnetic field as well as varying electric field

(4) the displacement current is produced neither by varying magnetic field nor by varying electric field

92. Two wires one of copper and another of steel having the same cross-sectional area and lengths 1.0 and 0.5 m respectively, are fastened end to end and stretched by a load M. If copper wire is stretched by 1 mm, the total extension of the combination is :

[$Y_{copper} = 1 \times 10^{11} n/m^2$, $Y_{steel} = 2 \times 10^{11} n/m^2$]

(1) 0.125 cm (2) 0.20 cm

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93. If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is :

(1) $9.88 \times 10^3 N/m^2$ (2) $10.88 \times 10^3 N/m^2$

(3) $1.088 \times 10^3 N/m^2$ (4) $4.48 \times 10^3 N/m^2$

94. Which of the following is correct order in respect of r.m.s. velocity (v_{rms}), average velocity (v_{av}) and most probable velocity (v_{mp}) ?

(1) $v_{mp} > v_{av} > v_{rms}$ (2) $v_{rms} > v_{av} > v_{mp}$

(3) $v_{av} > v_{mp} > v_{rms}$ (4) $v_{mp} > v_{rms} > v_{av}$

95. 12 gms of a gas occupy a volume of 4×10^{-3} m^3 at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm^3. The temperature to which the gas is heated is :

(1) 1000 *K* (2) 1400 *K*

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96. If rest mass of an electron is 9.1×10^{-31} kg, then its mass equivalent energy is :

(1) 0.511 erg (2) 0.511 J

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97. A reference frame attached to the earth :

(1) is an inertial frame by definition

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98. A particle with a mean proper life of 1 μs moves through the laboratory with a velocity 2.7×10^{10} cm/sec. Its lifetime as measured by an observer in the laboratory is :

(1) more than one micro-second (2) 1.0 μ sec

(3) less than one micro-second (4) 0.09 μ sec

99. In an L-C circuit :

(1) the energy stored in L as well as in C is magnetic energy

(2) the energy stored in L is magnetic but in C it is electrical energy

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100. A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be :

(1) halved (2) the same

(3) doubled (4) quadrupled

Total No. of Printed Pages : 21

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PG-EE-2016

SUBJECT : Physics

C

Sr. No. 11895

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means/misbehaviour will be registered against him/her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
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5. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
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7. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

SEAL

1. Select the ***incorrect*** statement :

   (1) The angular momentum is conserved for systems possessing rotational symmetry

   (2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved

   (3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum

   (4) None of these

2. A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$) :

   (1) –0.20 (2) 0.60 (3) –0.60 (4) 0.20

3. If electric permittivity and magnetic permeability of free space are ε_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ε and μ will be :

   (1) $(\varepsilon\mu/\varepsilon_0\mu_0)$ (2) $(\varepsilon\mu/\varepsilon_0\mu_0)^{1/2}$

   (3) $(\varepsilon_0\mu_0/\varepsilon\mu)$ (4) $(\varepsilon_0\mu_0/\varepsilon\mu)^{1/2}$

4. A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :

   (1) $\tan^{-1}(1.62)$ (2) $\tan^{-1}(1/1.62)$

   (3) $1/\tan^{-1}(1.62)$ (4) $\tan^{2}(1.62)$

5. A point charge Q is placed at the centre of a hemisphere. The electric flux passing through the flat surface of hemisphere is :

   (1) Q/ε_0 (2) zero

   (3) $Q/2\varepsilon_0$ (4) $Q/4\varepsilon_0$

6. A length 'l' of a wire is bent to form a circular coil of few turns. The maximum torque acting on the coil it is placed in a magnetic field B and a current I is passed through it, will be :

(1) IBl^2 (2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$

7. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT respectively. The beam then strikes a grounded target. If the beam current is I = 80mA, the force with which the beam strikes the target will be :

(1) 80 μN (2) 25 μN (3) 20 μN (4) 35 μN

8. Magnetic field of an infinitely long ideal solenoid of radius R carrying current I :

(1) increases radially inside, zero outside

(2) is constant inside and zero outside

(3) is constant inside and decays as $1/r$ outside

(4) is constant inside and decays as $e^{-(1/r)}$ outside

9. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation :

(1) the entire rod is at same potential

(2) there is an electric field in the rod

(3) the electric potential is highest at the centre of the rod and decreases towards the ends

(4) the electric potential is lowest at the centre of the rod and increases towards the ends

10. The average value of electric energy density in an electromagnetic wave is :

(1) $\varepsilon_0 E^2/2$ (2) $E^2/2\varepsilon_0$ (3) $\varepsilon_0 E^2$ (4) $\varepsilon_0 E^2/4$

11. The inside and outside temperatures of a refrigerator are 270 K and 303 K respectively. Assuming the refrigerator cycle to be reversible, for every joule of work done, the heat delivered to the surrounding is :

(1) 10 J (2) 20 J (3) 30 J (4) 50 J

12. If a gas is heated at constant pressure, then what percentage of total heat supplied is used for up for external work [γ for gas = 4/3] :

(1) 25% (2) 50% (3) 75% (4) 57%

13. The enthalpy of vaporization of water is 186.5 J/mol. The entropy of its vaporization will be :

(1) $0.5\,JK^{-1}mol^{-1}$ (2) $1.0\,JK^{-1}mol^{-1}$

(3) $1.5\,JK^{-1}mol^{-1}$ (4) $2.0\,JK^{-1}mol^{-1}$

14. In a biprism experiment, if the wavelength of red light used is 6.5×10^{-7} m and that of green light is 5.2×10^{-7} m, the value of 'n' for which $(n+1)^{th}$ green bright band coincides with n^{th} red bright band for the same setting is given by :

(1) 2 (2) 3 (3) 4 (4) 1

15. The contrast in the fringes in any interference pattern depends on :

(1) fringe width (2) wavelength

(3) intensity ratio of the sources (4) distance between the sources

16. Yellow light emitted by a sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity, then :

(1) the fringe width will decrease

(2) the fringe width will increase

(3) the fringe width will be unchanged

(4) the intensity of the fringes will decrease

17. Ratio of adiabatic elasticity to isothermal elasticity is :

(1) 0 (2) 1 (3) γ (4) $1/\gamma$

18. The enthalpy 'H' along an isothermal curve for an ideal gas is :

(1) constant (2) variable

(3) infinite (4) unpredictable

19. A system of non-interacting Fermi particles with Fermi energy ε_f has density of states proportional to $\sqrt{\varepsilon}$, where ε is the energy of a particle. The average energy per particle at T = 0 K is :

(1) $\varepsilon_f/6$ (2) $\varepsilon_f/5$ (3) $2\varepsilon_f/5$ (4) $3\varepsilon_f/5$

20. Gibb's potential remains constant in which of the following :

(1) isothermal process (2) isobaric process

(3) both (1) and (2) (4) adiabatic process

21. Only $1/8^{th}$ of the original amount of a radioactive material remains after 96 minutes. The value of $t_{1/2}$ of the material is :

(1) 12 minutes (2) 32 minutes

(3) 24 minutes (4) 48 minutes

22. The weight of 1 curie $_{82}Pb^{214}$ ($t_{1/2}$ = 26.8 min.) in grams is :

(1) 3.1×10^{-8} g (2) 1.55×10^{-8} g

(3) 6.2×10^{-8} g (4) 3.1×10^{-10} g

23. The final product, if $_{92}U^{235}$ emits two α and one β particle, will be :

(1) $_{87}Ac^{221}$ (2) $_{89}Ac^{235}$

(3) $_{89}Ac^{225}$ (4) $_{89}Ac^{227}$

24. Stern Gerlach experiment proves the existence of :

(1) electronic charge
(2) electron dipole moment
(3) electron spin
(4) electron mass

25. An electron with energy E incident upon a potential barrier of V such that V > E and thickness l, then the transmission coefficient :

(1) is zero
(2) proportional to l^2
(3) increases exponentially with thickness
(4) decreases exponentially with thickness

26. The probability of finding an electron in a hydrogen atom is :

(1) independent of r
(2) independent of θ
(3) independent of φ
(4) independent of all the three before

27. In case of a rigid rotator, the rotational frequency is given as :

(1) $\hbar L^2/2\pi I$
(2) $\hbar L/2\pi I$
(3) $\hbar L/2\pi I^2$
(4) $\hbar L/2\pi(2I + 1)$

28. The energy between two adjacent levels is given by :

(1) (2n + 1) times the zero point energy
(2) (2n – 1) times the zero point energy
(3) $2n^2$ times the zero point energy
(4) n^2 times the zero point energy

29. The ionization potential of Li^{+2} ions using Bohr's theory is :

(1) 13.6 eV (2) 27.2 eV

(3) 40.8 eV (4) 122.4 eV

30. The wave function considered to be confined within a box of length L is $\psi(x) = \sqrt{2/L}\sin(\pi x/L)$ in the region $0 < x < L$. The probability of finding the particle in the region $0 < x < L/2$ is :

(1) 0 (2) 1/2

(3) 1 (4) 0.66

31. The ratio of de-Broglie wavelength of an α-particle and a proton of same kinetic energy is :

(1) 1 : 2 (2) 1 : 1

(3) $1 : \sqrt{2}$ (4) 4 : 1

32. X-rays are used for structural analysis of crystals as these :

(1) have the wavelength of the order of the inter-atomic spacing

(2) are highly penetrating radiations

(3) have the wavelength of the order of the nuclear size

(4) are highly coherent in nature

33. A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will :

(1) increase (2) decrease

(3) remain the same (4) fluctuate

34. The fission of uranium nuclide :

(1) always leads to same pair of fission products, say barium and krypton

(2) does not always produce barium and krypton but different pair of fission products

(3) produces barium and any other fission product

(4) always produces at least one radioactive fission product

35. Mirror nuclei are those which have :

(1) the same number of protons

(2) the same number of neutrons

(3) the number of protons equal to the number of neutrons

(4) the number of neutrons in one equal to the number of protons in the other

36. Beta rays emitted in a radioactive material are :

(1) electromagnetic radiations

(2) electrons orbiting around the nucleus

(3) charged particles emitted by the nucleus

(4) neutral particles in the nucleus

37. The radio active decay of an element X to elements Y and K is represented by the equation $\frac{A}{Z}X \rightarrow \frac{A}{Z+1}Y \rightarrow \frac{A-4}{Z-1}K \rightarrow \frac{A-4}{Z-1}K$. The sequence of emitted radiations is :

(1) α, β, γ (2) β, α, γ

(3) γ, α, β (4) β, γ, α

38. Atomic explosion is the result of :

(1) uncontrolled chain reaction in fission

(2) controlled chain reaction in fusion

(3) uncontrolled chain reaction in fusion

(4) controlled chain reaction in fission

39. X-rays of wavelength λ are incident on a crystal and the second order reflection on diffraction from the crystal is observed at an angle of 45°. The lattice constant of the crystal is :

(1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$ (3) λ (4) 2λ

40. The amount of a substance that gives 3.7×10^7 disintegration per second (dps) is :

(1) one becquerel (2) one curie

(3) one mili-curie (4) one rutherford

41. A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in nth second to the distance covered in n seconds is :

(1) $\frac{2}{n}-\frac{1}{n^2}$ (2) $\frac{1}{n^2}-\frac{1}{n}$

(3) $\frac{2}{n^2}-\frac{1}{n}$ (4) $\frac{2}{n}+\frac{1}{n^2}$

42. A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x=(t-2)^2(t-5)$. Then :

(1) after 2 sec., velocity of particle is zero

(2) after 2 sec., the particle reaches O

(3) the acceleration is negative, for $t < 3$ sec.

(4) all the three before

43. A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 - k\varphi$; ω_0 and k being positive constants & at $t = 0$, $\varphi = 0$. The time dependence of the rotational angle is :

(1) $k\omega_0 e^{-kt}$ (2) $\frac{\omega_0}{k} e^{-kt}$

(3) $\frac{\omega_0}{k}\left(1 - e^{-kt}\right)$ (4) $\frac{k}{\omega_0}\left(e^{-kt} - 1\right)$

44. A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then :

(1) the total energy is $(-k/2r)$ (2) the kinetic energy is (k/r)

(3) the potential energy is $(k/2r)$ (4) the kinetic energy is $(-k/r)$

45. An elastic string of length 'L' and force constant 'k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is :

(1) $ky^2/2$ (2) $k\left(x^2 + y^2\right)/2$

(3) $k(x+y)^2/2$ (4) $ky(2x + y)/2$

46. A smooth steel ball strikes a fixed smooth steel plate at an angle 'θ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be :

(1) θ (2) $\tan^{-1}(\tan\theta/e)$

(3) $e\tan\theta$ (4) $\tan^{-1}(e/\tan\theta)$

47. Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are :

(1) (1, 1) (2) (2.1, 3.9)

(3) (0.5, 0.7) (4) (0.41, 0.93)

48. A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω. The centrifugal force on the particle is :

(1) $m\omega^2 a$ (2) $m\omega_0^2 a$

(3) $m[(\omega+\omega_0)/2]^2 a$ (4) $m\omega\omega_0 a$

49. A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then :

(1) at points away from the origin, the particle is in unstable equilibrium

(2) for any non zero value of x, there is a force directed away from the origin

(3) if its total mechanical energy is $k/2$, it has the minimum kinetic energy at origin

(4) for small displacement from $x = 0$, it executes SHM

50. If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1 : 8, then the value of 'n' is :

(1) 2 (2) $2\sqrt{2}$ (3) 4 (4) 1/2

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60. A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be :

(1) halved (2) the same (3) doubled (4) quadrupled

61. A highly rigid cubical block of mass *'m'* and side *'L'* is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force *F* is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period :

(1) $2\pi(\eta mL)^{1/2}$ (2) $2\pi(m\eta / L)^{1/2}$ (3) $2\pi(mL/\eta)^{1/2}$ (4) $2\pi(m/\eta L)^{1/2}$

62. In a steady incomprehensible flow of a liquid :

(1) the speed does not change if the area of cross-section changes

(2) the speed increases if the area of cross-section increases

(3) the speed decreases if the area of cross-section increases

(4) bubbles are produced when the area of cross-section increases

63. 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is :

(1) $2\times10^{3}N/m^{2}$ (2) $2\times10^{5}N/m^{2}$

(3) $10^{7}N/m^{2}$ (4) $2\times10^{7}N/m^{2}$

64. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be :

(1) 6 (2) $3\sqrt{3}$ (3) $3(2-\sqrt{3})$ (4) 3

65. An electronic transition in hydrogen atom results in the formation of H_{α} line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are :

(1) –313.6, 34.84 (2) –313.6, –78.38

(3) –78.4, –34.84 (4) –78.4, –19.6

66. In case two bubbles of radii 'r_1' and 'r_2' come in contact with each other to form a single bubble, the resulting radius of curvature 'r' will be :

(1) $(r_1+r_2)/2$ (2) $(r_1 r_2)/(r_1-r_2)$

(3) $(r_1 r_2)/(r_1+r_2)$ (4) $(r_1 r_2)^{1/2}$

67. If a transverse wave is represented as $y = y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$, then for what value of 'λ' the maximum particle velocity is equal to four times the wave velocity ?

(1) $y_0\pi$ (2) $(y_0\pi)/2$

(3) $2y_0\pi$ (4) $(3y_0\pi)/2$

68. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = 0.91 J/g°C] :

(1) 103°C (2) 130°C

(3) 105°C (4) 30°C

69. Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be :

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$ (2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

70. During an adiabatic process, the specific heat is :

(1) zero (2) greater than zero

(3) less than zero (4) infinity

71. The depletion region of a junction diode is formed :

(1) when forward bias is applied to it

(2) when the temperature of the junction is reduced

(3) under reverse bias

(4) during the manufacturing process

72. In a full wave rectifier with R – C filter, the conduction angle of the diode is :

(1) 0 (2) $< \pi$ (3) $> \pi$ (4) $= \pi$

73. A BJT with h_{FE} value of 100 is found to be operating at $I_B = 100\ \mu A$ and $I_C = 5$ mA. The transistor is operating in the :

(1) active region (2) active or saturation region

(3) saturation region (4) cut-off region

74. Faster switching OFF of a p-n junction :

(1) requires zero current in the reverse direction

(2) requires reverse saturation current in the reverse direction

(3) requires a large current in the reverse direction

(4) is independent of the reverse current

75. The collector to base bias method in amplifier circuit :

(1) requires low dc supply

(2) requires high dc supply

(3) makes operating point independent of variation in I_{co}

(4) makes operating point independent of variation in β

76. In a R-C coupled CE amplifier, emitter lead resistance R_E is used to :

(1) increase the load (2) decrease the load

(3) attain proper stability factor (4) decrease V_{CE} voltage

77. In a multi stage amplifier, on increasing the number of stages, the gain-bandwidth product :

(1) remains constant (2) increases

(3) decreases (4) becomes zero

78. A common collector amplifier has :

(1) high voltage gain but low current gain

(2) low voltage gain and low current gain

(3) high output impedance but low input impedance

(4) low output impedance but high input impedance

79. Which of the following is most suitable for generating 1 kHz frequency ?

(1) Wien bridge oscillator (2) Colpitt's oscillator

(3) Hartley oscillator (4) Tuned collector oscillator

80. During an isothermal expansion of an ideal gas :

(1) its internal energy decreases

(2) its internal energy does not change

(3) the work done by the gas is equal to the quantity of heat absorbed by it

(4) both (2) and (3) are correct

81. The axial parameter $a = b \neq c$ and $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ correspond to the following system :

(1) Tetragonal (2) Cubic

(3) Hexagonal (4) Rhombohedral

82. If the Lagrangian L is not an explicit function of time, the Hamiltonian H is :

(1) Zero (2) Constant of motion

(3) Infinity (4) Variable with motion

83. For Bose-Einstein condensation to happen, which of the following is *true* ?

(1) Number of particles decreases rapidly in lower energy levels at high temperatures and low pressures

(2) Number of particles increases rapidly in lower energy levels at high temperatures and low pressures

(3) Number of particles decreases rapidly in lower energy levels at low temperatures and high pressures

(4) Number of particles increases rapidly in lower energy levels at low temperatures and high pressures

84. The value of radius of the Fermi sphere of a degenerate free electron gas at zero temperature, having N particles contained in volume V is given as :

(1) $(3\pi^2)^{1/3}(N/V)^{2/3}\hbar$ (2) $(3\pi^2)^{1/3}(N/V)^{1/6}\hbar$

(3) $(3\pi^2)^{1/3}(N/V)^{1/3}\hbar$ (4) $(3\pi^2)^{1/3}(N/V)^{1/2}\hbar$

85. The hyperfine splitting of spectral lines of an atom is due to :

(1) coupling between spins of two or more electrons

(2) coupling between spins and orbital angular momenta of the electrons

(3) coupling between electron spins and the nuclear spins

(4) None of the above

86. The energy separation between two consecutive stokes lines in Raman scattering depends on :

(1) Wavelength of the incident light

(2) Energy separation between vibrational levels in the excited states

(3) Intensity of the incident light

(4) Energy separation between vibrational levels in the ground state

87. The Debye theory of specific heat is valid at :

(1) room temperature (2) low temperature

(3) intermediate temperature (4) all temperature

88. For a bcc crystal, the first Brillouin zone is a :

(1) cube (2) Rectangular parallelepiped

(3) Truncated octahedron (4) Regular rhombic dodecahedron

89. Which of the following is ***not*** the use of Hall's effect ?

(1) Determination of the sign of charge carriers

(2) Determination of number density of charge carriers

(3) Measurement of potential difference

(4) Measurement of magnetic field

90. What is the behaviour of the pure *Si* crystal at absolute zero temperature ?

(1) behaves as perfect conductor

(2) behaves as perfect insulator

(3) contains no electron

(4) none of the above

91. The coefficient of diffusion is :

(1) directly proportional to pressure and inversely proportional to $(\text{temperature})^2$

(2) inversely proportional to pressure and directly proportional to $(\text{temperature})^2$

(3) directly proportional to pressure and inversely proportional to $(\text{temperature})^{3/2}$

(4) inversely proportional to pressure and directly proportional to $(\text{temperature})^{3/2}$

92. The ratio of average speed of hydrogen and bromine gas molecules at 27°C will be $[M_{Br} = 80\ M_H]$

(1) $\sqrt{1/80}$ (2) $\sqrt{80}$

(3) $\sqrt{40}$ (4) $\sqrt{1/40}$

93. Which of the following is the correct Clapeyron's latent heat relation ?

(1) $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$ (2) $\frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

(3) $\frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$ (4) $\frac{dP}{dT} = \frac{L(V_2 - V_1)}{T}$

94. In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :

(1) 3 (2) 2 (3) 6 (4) 8

95. Polarisation of light proves the :

(1) corpuscular nature of light (2) quantum nature of light

(3) transverse nature of light (4) longitudinal nature of light

96. For two coherent monochromatic light beams of intensities I and $4I$ super imposed on each other, the maximum and minimum possible intensities in the resulting beams are :

(1) $5I$ and I (2) $5I$ and $3I$

(3) $9I$ and I (4) $9I$ and $3I$

97. The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is :

(1) 30° (2) 45° (3) 60° (4) 15°

98. Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å , the limit of resolution will be :

(1) 0.80 mm
(2) 0.12 mm
(3) 0.10 mm
(4) 0.08 mm

99. A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewster's angle φ. If μ represents the refractive index of glass, the angle between the reflected and refracted rays is :

(1) $90° + \varphi$
(2) $\sin^{-1}(\mu \cos \varphi)$
(3) $90°$
(4) $\sin^{-1}(\mu \sin \varphi)$

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(1) 1.25
(2) 25.0
(3) 37.5
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Total No. of Printed Pages : 21

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PG-EE-2016

SUBJECT : Physics

D

11892

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

Name _____ Father's Name _____

Mother's Name_____ Date of Examination_____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means/misbehaviour will be registered against him/her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing **within two hours** after the test is over. No such complaint(s) will be entertained thereafter.
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5. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
6. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
7. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. The axial parameter $a = b \neq c$ and $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ correspond to the following system :

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(1) behaves as perfect conductor

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(3) contains no electron

(4) none of the above

11. Which of the following statements is ***correct*** ?

(1) the displacement current is produced only by varying magnetic field

(2) the displacement current is produced only by varying electric field

(3) the displacement current is produced by varying magnetic field as well as varying electric field

(4) the displacement current is produced neither by varying magnetic field nor by varying electric field

12. Two wires one of copper and another of steel having the same cross-sectional area and lengths 1.0 and 0.5 m respectively, are fastened end to end and stretched by a load M. If copper wire is stretched by 1 mm, the total extension of the combination is :

[$Y_{copper} = 1 \times 10^{11} n/m^2$, $Y_{steel} = 2 \times 10^{11} n/m^2$]

(1) 0.125 cm (2) 0.20 cm

(3) 0.120 cm (4) 0.25 cm

13. If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is :

(1) $9.88\times10^3 N/m^2$ (2) $10.88\times10^3 N/m^2$

(3) $1.088\times10^3 N/m^2$ (4) $4.48\times10^3 N/m^2$

14. Which of the following is correct order in respect of r.m.s. velocity (v_{rms}), average velocity (v_{av}) and most probable velocity (v_{mp}) ?

(1) $v_{mp} > v_{av} > v_{rms}$ (2) $v_{rms} > v_{av} > v_{mp}$

(3) $v_{av} > v_{mp} > v_{rms}$ (4) $v_{mp} > v_{rms} > v_{av}$

15. 12 gms of a gas occupy a volume of 4×10^{-3} m^3 at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm^3. The temperature to which the gas is heated is :

(1) 1000 *K* (2) 1400 *K*

(3) 1200 *K* (4) 800 *K*

16. If rest mass of an electron is 9.1×10^{-31} kg, then its mass equivalent energy is :

(1) 0.511 erg (2) 0.511 J

(3) 0.511 eV (4) 0.511 MeV

17. A reference frame attached to the earth :

(1) is an inertial frame by definition

(2) can not be an inertial frame because the earth is revolving round the sun

(3) is an inertial frame as Newton's laws are applicable

(4) can not be an inertial frame because the earth is rotating about its own axis

18. A particle with a mean proper life of 1 μs moves through the laboratory with a velocity 2.7×10^{10} cm/sec. Its lifetime as measured by an observer in the laboratory is :

(1) more than one micro-second
(2) 1.0 μ sec
(3) less than one micro-second
(4) 0.09 μ sec

19. In an L-C circuit :

(1) the energy stored in L as well as in C is magnetic energy
(2) the energy stored in L is magnetic but in C it is electrical energy
(3) the energy stored in L is electrical but in C it is magnetic energy
(4) the energy stored in L as well as in C is electrical energy

20. A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be :

(1) halved
(2) the same
(3) doubled
(4) quadrupled

21. The ratio of de-Broglie wavelength of an α-particle and a proton of same kinetic energy is :

(1) 1 : 2
(2) 1 : 1
(3) $1 : \sqrt{2}$
(4) 4 : 1

22. X-rays are used for structural analysis of crystals as these :

(1) have the wavelength of the order of the inter-atomic spacing
(2) are highly penetrating radiations
(3) have the wavelength of the order of the nuclear size
(4) are highly coherent in nature

23. A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will :

(1) increase (2) decrease

(3) remain the same (4) fluctuate

24. The fission of uranium nuclide :

(1) always leads to same pair of fission products, say barium and krypton

(2) does not always produce barium and krypton but different pair of fission products

(3) produces barium and any other fission product

(4) always produces at least one radioactive fission product

25. Mirror nuclei are those which have :

(1) the same number of protons

(2) the same number of neutrons

(3) the number of protons equal to the number of neutrons

(4) the number of neutrons in one equal to the number of protons in the other

26. Beta rays emitted in a radioactive material are :

(1) electromagnetic radiations

(2) electrons orbiting around the nucleus

(3) charged particles emitted by the nucleus

(4) neutral particles in the nucleus

27. The radio active decay of an element X to elements Y and K is represented by the equation $\frac{A}{Z}X \rightarrow \frac{A}{Z+1}Y \rightarrow \frac{A-4}{Z-1}K \rightarrow \frac{A-4}{Z-1}K$. The sequence of emitted radiations is :

(1) α, β, γ (2) β, α, γ (3) γ, α, β (4) β, γ, α

28. Atomic explosion is the result of :

(1) uncontrolled chain reaction in fission

(2) controlled chain reaction in fusion

(3) uncontrolled chain reaction in fusion

(4) controlled chain reaction in fission

29. X-rays of wavelength λ are incident on a crystal and the second order reflection on diffraction from the crystal is observed at an angle of 45°. The lattice constant of the crystal is :

(1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$ (3) λ (4) 2λ

30. The amount of a substance that gives 3.7×10^7 disintegration per second (dps) is :

(1) one becquerel (2) one curie

(3) one mili-curie (4) one rutherford

31. Select the ***incorrect*** statement :

(1) The angular momentum is conserved for systems possessing rotational symmetry

(2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved

(3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum

(4) None of these

32. A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$) :

(1) –0.20 (2) 0.60 (3) –0.60 (4) 0.20

33. If electric permittivity and magnetic permeability of free space are ε_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ε and μ will be :

(1) $(\varepsilon\mu/\varepsilon_0\mu_0)$ (2) $(\varepsilon\mu/\varepsilon_0\mu_0)^{1/2}$

(3) $(\varepsilon_0\mu_0/\varepsilon\mu)$ (4) $(\varepsilon_0\mu_0/\varepsilon\mu)^{1/2}$

34. A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :

(1) $\tan^{-1}(1.62)$ (2) $\tan^{-1}(1/1.62)$

(3) $1/\tan^{-1}(1.62)$ (4) $\tan^{2}(1.62)$

35. A point charge Q is placed at the centre of a hemisphere. The electric flux passing through the flat surface of hemisphere is :

(1) Q/ε_0 (2) zero (3) $Q/2\varepsilon_0$ (4) $Q/4\varepsilon_0$

36. A length '*l*' of a wire is bent to form a circular coil of few turns. The maximum torque acting on the coil it is placed in a magnetic field *B* and a current *I* is passed through it, will be :

(1) IBl^2 (2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$

37. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT respectively. The beam then strikes a grounded target. If the beam current is I = 80mA, the force with which the beam strikes the target will be :

(1) 80 μN (2) 25 μN (3) 20 μN (4) 35 μN

38. Magnetic field of an infinitely long ideal solenoid of radius R carrying current I :

(1) increases radially inside, zero outside

(2) is constant inside and zero outside

(3) is constant inside and decays as $1/r$ outside

(4) is constant inside and decays as $e^{-(1/r)}$ outside

39. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation :

(1) the entire rod is at same potential

(2) there is an electric field in the rod

(3) the electric potential is highest at the centre of the rod and decreases towards the ends

(4) the electric potential is lowest at the centre of the rod and increases towards the ends

40. The average value of electric energy density in an electromagnetic wave is :

(1) $\varepsilon_0 E^2/2$ (2) $E^2/2\varepsilon_0$ (3) $\varepsilon_0 E^2$ (4) $\varepsilon_0 E^2/4$

41. The coefficient of diffusion is :

(1) directly proportional to pressure and inversely proportional to (temperature)^2

(2) inversely proportional to pressure and directly proportional to (temperature)^2

(3) directly proportional to pressure and inversely proportional to (temperature)$^{3/2}$

(4) inversely proportional to pressure and directly proportional to (temperature)$^{3/2}$

42. The ratio of average speed of hydrogen and bromine gas molecules at 27°C will be [$M_{Br} = 80\ M_H$]

(1) $\sqrt{1/80}$ (2) $\sqrt{80}$ (3) $\sqrt{40}$ (4) $\sqrt{1/40}$

43. Which of the following is the correct Clapeyron's latent heat relation ?

(1) $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$ (2) $\frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

(3) $\frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$ (4) $\frac{dP}{dT} = \frac{L(V_2 - V_1)}{T}$

44. In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :

(1) 3 (2) 2 (3) 6 (4) 8

45. Polarisation of light proves the :

(1) corpuscular nature of light (2) quantum nature of light

(3) transverse nature of light (4) longitudinal nature of light

46. For two coherent monochromatic light beams of intensities I and $4I$ super imposed on each other, the maximum and minimum possible intensities in the resulting beams are :

(1) $5I$ and I (2) $5I$ and $3I$ (3) $9I$ and I (4) $9I$ and $3I$

47. The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is :

(1) 30° (2) 45° (3) 60° (4) 15°

48. Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å , the limit of resolution will be :

(1) 0.80 mm (2) 0.12 mm

(3) 0.10 mm (4) 0.08 mm

49. A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewster's angle φ. If μ represents the refractive index of glass, the angle between the reflected and refracted rays is :

(1) $90° + \varphi$ (2) $\sin^{-1}(\mu \cos \varphi)$

(3) $90°$ (4) $\sin^{-1}(\mu \sin \varphi)$

50. Two Nicol prisms are first crossed and then one of them is rotated through 60°. The percentage of light transmitted is :

(1) 1.25 (2) 25.0

(3) 37.5 (4) 50.0

51. Only $1/8^{th}$ of the original amount of a radioactive material remains after 96 minutes. The value of $t_{1/2}$ of the material is :

(1) 12 minutes (2) 32 minutes

(3) 24 minutes (4) 48 minutes

52. The weight of 1 curie $_{82}Pb^{214}$ ($t_{1/2}$ = 26.8 min.) in grams is :

(1) 3.1×10^{-8} g (2) 1.55×10^{-8} g

(3) 6.2×10^{-8} g (4) 3.1×10^{-10} g

53. The final product, if $_{92}U^{235}$ emits two α and one β particle, will be :

(1) $_{87}Ac^{221}$ (2) $_{89}Ac^{235}$

(3) $_{89}Ac^{225}$ (4) $_{89}Ac^{227}$

54. Stern Gerlach experiment proves the existence of :

(1) electronic charge (2) electron dipole moment

(3) electron spin (4) electron mass

55. An electron with energy E incident upon a potential barrier of V such that V > E and thickness l, then the transmission coefficient :

(1) is zero

(2) proportional to l^2

(3) increases exponentially with thickness

(4) decreases exponentially with thickness

56. The probability of finding an electron in a hydrogen atom is :

(1) independent of r

(2) independent of θ

(3) independent of φ

(4) independent of all the three before

57. In case of a rigid rotator, the rotational frequency is given as :

(1) $\hbar L^2/2\pi I$

(2) $\hbar L/2\pi I$

(3) $\hbar L/2\pi I^2$

(4) $\hbar L/2\pi(2I + 1)$

58. The energy between two adjacent levels is given by :

(1) (2n + 1) times the zero point energy

(2) (2n – 1) times the zero point energy

(3) $2n^2$ times the zero point energy

(4) n^2 times the zero point energy

59. The ionization potential of Li^{+2} ions using Bohr's theory is :

(1) 13.6 eV

(2) 27.2 eV

(3) 40.8 eV

(4) 122.4 eV

60. The wave function considered to be confined within a box of length L is $\psi(x) = \sqrt{2/L}\sin(\pi x/L)$ in the region $0 < x < L$. The probability of finding the particle in the region $0 < x < L/2$ is :

(1) 0 (2) 1/2 (3) 1 (4) 0.66

61. The depletion region of a junction diode is formed :

(1) when forward bias is applied to it

(2) when the temperature of the junction is reduced

(3) under reverse bias

(4) during the manufacturing process

62. In a full wave rectifier with R – C filter, the conduction angle of the diode is :

(1) 0 (2) $< \pi$ (3) $> \pi$ (4) $= \pi$

63. A BJT with h_{FE} value of 100 is found to be operating at $I_B = 100\ \mu A$ and $I_C = 5$ mA. The transistor is operating in the :

(1) active region (2) active or saturation region

(3) saturation region (4) cut-off region

64. Faster switching OFF of a p-n junction :

(1) requires zero current in the reverse direction

(2) requires reverse saturation current in the reverse direction

(3) requires a large current in the reverse direction

(4) is independent of the reverse current

65. The collector to base bias method in amplifier circuit :

(1) requires low dc supply

(2) requires high dc supply

(3) makes operating point independent of variation in I_{co}

(4) makes operating point independent of variation in β

66. In a R-C coupled CE amplifier, emitter lead resistance R_E is used to :

(1) increase the load

(2) decrease the load

(3) attain proper stability factor

(4) decrease V_{CE} voltage

67. In a multi stage amplifier, on increasing the number of stages, the gain-bandwidth product :

(1) remains constant

(2) increases

(3) decreases

(4) becomes zero

68. A common collector amplifier has :

(1) high voltage gain but low current gain

(2) low voltage gain and low current gain

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(1) Wien bridge oscillator

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(1) its internal energy decreases

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(3) the work done by the gas is equal to the quantity of heat absorbed by it

(4) both (2) and (3) are correct

71. The inside and outside temperatures of a refrigerator are 270 K and 303 K respectively. Assuming the refrigerator cycle to be reversible, for every joule of work done, the heat delivered to the surrounding is :

(1) 10 J (2) 20 J (3) 30 J (4) 50 J

72. If a gas is heated at constant pressure, then what percentage of total heat supplied is used for up for external work [γ for gas = 4/3] :

(1) 25% (2) 50% (3) 75% (4) 57%

73. The enthalpy of vaporization of water is 186.5 J/mol. The entropy of its vaporization will be :

(1) $0.5\,JK^{-1}mol^{-1}$ (2) $1.0\,JK^{-1}mol^{-1}$

(3) $1.5\,JK^{-1}mol^{-1}$ (4) $2.0\,JK^{-1}mol^{-1}$

74. In a biprism experiment, if the wavelength of red light used is 6.5×10^{-7} m and that of green light is 5.2×10^{-7} m, the value of 'n' for which $(n+1)^{th}$ green bright band coincides with n^{th} red bright band for the same setting is given by :

(1) 2 (2) 3 (3) 4 (4) 1

75. The contrast in the fringes in any interference pattern depends on :

(1) fringe width (2) wavelength

(3) intensity ratio of the sources (4) distance between the sources

76. Yellow light emitted by a sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity, then :

(1) the fringe width will decrease

(2) the fringe width will increase

(3) the fringe width will be unchanged

(4) the intensity of the fringes will decrease

77. Ratio of adiabatic elasticity to isothermal elasticity is :

(1) 0 (2) 1 (3) γ (4) $1/\gamma$

78. The enthalpy 'H' along an isothermal curve for an ideal gas is :

(1) constant (2) variable (3) infinite (4) unpredictable

79. A system of non-interacting Fermi particles with Fermi energy ε_f has density of states proportional to $\sqrt{\varepsilon}$, where ε_i is the energy of a particle. The average energy per particle at T = 0 K is :

(1) $\varepsilon_f/6$ (2) $\varepsilon_f/5$ (3) $2\varepsilon_f/5$ (4) $3\varepsilon_f/5$

80. Gibb's potential remains constant in which of the following :

(1) isothermal process (2) isobaric process

(3) both (1) and (2) (4) adiabatic process

81. A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in nth second to the distance covered in n seconds is :

(1) $\frac{2}{n}-\frac{1}{n^2}$ (2) $\frac{1}{n^2}-\frac{1}{n}$

(3) $\frac{2}{n^2}-\frac{1}{n}$ (4) $\frac{2}{n}+\frac{1}{n^2}$

82. A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x=(t-2)^2(t-5)$. Then :

(1) after 2 sec., velocity of particle is zero

(2) after 2 sec., the particle reaches O

(3) the acceleration is negative, for $t < 3$ sec.

(4) all the three before

83. A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 - k\varphi$; ω_0 and k being positive constants & at $t = 0$, $\varphi = 0$. The time dependence of the rotational angle is :

(1) $k\omega_0 e^{-kt}$

(2) $\frac{\omega_0}{k}e^{-kt}$

(3) $\frac{\omega_0}{k}\left(1-e^{-kt}\right)$

(4) $\frac{k}{\omega_0}\left(e^{-kt}-1\right)$

84. A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then :

(1) the total energy is $(-k/2r)$

(2) the kinetic energy is (k/r)

(3) the potential energy is $(k/2r)$

(4) the kinetic energy is $(-k/r)$

85. An elastic string of length 'L' and force constant 'k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is :

(1) $ky^2/2$

(2) $k\left(x^2+y^2\right)/2$

(3) $k(x+y)^2/2$

(4) $ky(2x+y)/2$

86. A smooth steel ball strikes a fixed smooth steel plate at an angle 'θ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be :

(1) θ (2) $\tan^{-1}(\tan\theta / e)$

(3) $e \tan\theta$ (4) $\tan^{-1}(e / \tan\theta)$

87. Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are :

(1) (1, 1) (2) (2.1, 3.9)

(3) (0.5, 0.7) (4) (0.41, 0.93)

88. A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω. The centrifugal force on the particle is :

(1) $m\omega^2 a$ (2) $m\omega_0^2 a$

(3) $m[(\omega + \omega_0)/2]^2 a$ (4) $m\omega\omega_0 a$

89. A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then :

(1) at points away from the origin, the particle is in unstable equilibrium

(2) for any non zero value of x, there is a force directed away from the origin

(3) if its total mechanical energy is $k/2$, it has the minimum kinetic energy at origin

(4) for small displacement from $x = 0$, it executes SHM

90. If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1 : 8, then the value of 'n' is :

(1) 2 (2) $2\sqrt{2}$ (3) 4 (4) 1/2

91. A highly rigid cubical block of mass *'m'* and side *'L'* is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force *F* is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period :

(1) $2\pi(\eta mL)^{1/2}$ (2) $2\pi(m\eta / L)^{1/2}$

(3) $2\pi(mL/\eta)^{1/2}$ (4) $2\pi(m/\eta L)^{1/2}$

92. In a steady incomprehensible flow of a liquid :

(1) the speed does not change if the area of cross-section changes

(2) the speed increases if the area of cross-section increases

(3) the speed decreases if the area of cross-section increases

(4) bubbles are produced when the area of cross-section increases

93. 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is :

(1) $2\times10^3 N/m^2$ (2) $2\times10^5 N/m^2$

(3) $10^7 N/m^2$ (4) $2\times10^7 N/m^2$

94. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be :

(1) 6 (2) $3\sqrt{3}$ (3) $3(2-\sqrt{3})$ (4) 3

95. An electronic transition in hydrogen atom results in the formation of H_α line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are :

(1) –313.6, 34.84 (2) –313.6, –78.38

(3) –78.4, –34.84 (4) –78.4, –19.6

96. In case two bubbles of radii 'r_1' and 'r_2' come in contact with each other to form a single bubble, the resulting radius of curvature 'r' will be :

(1) $(r_1 + r_2)/2$ (2) $(r_1 r_2)/(r_1 - r_2)$

(3) $(r_1 r_2)/(r_1 + r_2)$ (4) $(r_1 r_2)^{1/2}$

97. If a transverse wave is represented as $y = y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$, then for what value of 'λ' the maximum particle velocity is equal to four times the wave velocity ?

(1) $y_0\pi$ (2) $(y_0\pi)/2$ (3) $2y_0\pi$ (4) $(3y_0\pi)/2$

98. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = 0.91 J/g°C] :

(1) 103°C (2) 130°C (3) 105°C (4) 30°C

99. Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be :

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$ (2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

100. During an adiabatic process, the specific heat is :

(1) zero (2) greater than zero

(3) less than zero (4) infinity

SET : A

1. 1	16. 2	31. 3	46. 3	61. 4	76. 3	91. 3
2. 4	17. 2	32. 1	47. 1	62. 2	77. 2	92. 2
3. 3	18. 1	33. 2	48. 4	63. 1	78. 1	93. 4
4. 1	19. 3	34. 2	49. 1	64. 3	79. 2	94. 1
5. 4	20. 1	35. 2	50. 4	65. 3	80. 3	95. 3
6. 2	21. 3	36. 4	51. 1	66. 3	81. 2	96. 2
7. 3	22. 3	37. 1	52. 1	67. 1	82. 1	97. 2
8. 2	23. 2	38. 1	53. 1	68. 4	83. 4	98. 4
9. 4	24. 1	39. 2	54. 3	69. 3	84. 3	99. 3
10. 1	25. 3	40. 4	55. 3	70. 4	85. 1	100. 2
11. 4	26. 3	41. 4	56. 1	71. 1	86. 3	
12. 3	27. 3	42. 2	57. 3	72. 1	87. 2	
13. 4	28. 2	43. 3	58. 1	73. 3	88. 1	
14. 3	29. 2	44. 3	59. 4	74. 2	89. 4	
15. 2	30. 1	45. 3	60. 3	75. 4	90. 2	

SET : B

1. 4	16. 3	31. 1	46. 1	61. 3	76. 2	91. 3
2. 2	17. 2	32. 4	47. 3	62. 3	77. 2	92. 1
3. 3	18. 1	33. 3	48. 1	63. 2	78. 1	93. 2
4. 3	19. 2	34. 1	49. 4	64. 1	79. 3	94. 2
5. 3	20. 3	35. 4	50. 3	65. 3	80. 1	95. 2
6. 3	21. 3	36. 2	51. 4	66. 3	81. 2	96. 4
7. 1	22. 2	37. 3	52. 2	67. 3	82. 1	97. 1
8. 4	23. 4	38. 2	53. 1	68. 2	83. 4	98. 1
9. 1	24. 1	39. 4	54. 3	69. 2	84. 3	99. 2
10. 4	25. 3	40. 1	55. 3	70. 1	85. 1	100. 4
11. 1	26. 2	41. 1	56. 3	71. 4	86. 3	
12. 1	27. 2	42. 1	57. 1	72. 3	87. 2	
13. 3	28. 4	43. 1	58. 4	73. 4	88. 1	
14. 2	29. 3	44. 3	59. 3	74. 3	89. 4	
15. 4	30. 2	45. 3	60. 4	75. 2	90. 2	

SET : C

1. 3	16. 1	31. 1	46. 2	61. 4	76. 3	91. 4
2. 3	17. 3	32. 1	47. 3	62. 3	77. 1	92. 2
3. 2	18. 1	33. 3	48. 2	63. 4	78. 4	93. 1
4. 1	19. 4	34. 2	49. 4	64. 3	79. 1	94. 3
5. 3	20. 3	35. 4	50. 1	65. 2	80. 4	95. 3
6. 3	21. 2	36. 3	51. 3	66. 2	81. 3	96. 3
7. 3	22. 1	37. 2	52. 1	67. 2	82. 2	97. 1
8. 2	23. 4	38. 1	53. 2	68. 1	83. 4	98. 4
9. 2	24. 3	39. 2	54. 2	69. 3	84. 1	99. 3
10. 1	25. 1	40. 3	55. 2	70. 1	85. 3	100. 4
11. 1	26. 3	41. 1	56. 4	71. 4	86. 2	
12. 1	27. 2	42. 4	57. 1	72. 2	87. 2	
13. 1	28. 1	43. 3	58. 1	73. 3	88. 4	
14. 3	29. 4	44. 1	59. 2	74. 3	89. 3	
15. 3	30. 2	45. 4	60. 4	75. 3	90. 2	

SET : D

1. 3	16. 4	31. 3	46. 3	61. 4	76. 1	91. 4
2. 2	17. 1	32. 3	47. 1	62. 2	77. 3	92. 3
3. 4	18. 1	33. 2	48. 4	63. 3	78. 1	93. 4
4. 1	19. 2	34. 1	49. 3	64. 3	79. 4	94. 3
5. 3	20. 4	35. 3	50. 4	65. 3	80. 3	95. 2
6. 2	21. 1	36. 3	51. 2	66. 3	81. 1	96. 2
7. 2	22. 1	37. 3	52. 1	67. 1	82. 4	97. 2
8. 4	23. 3	38. 2	53. 4	68. 4	83. 3	98. 1
9. 3	24. 2	39. 2	54. 3	69. 1	84. 1	99. 3
10. 2	25. 4	40. 1	55. 1	70. 4	85. 4	100. 1
11. 3	26. 3	41. 4	56. 3	71. 1	86. 2	
12. 1	27. 2	42. 2	57. 2	72. 1	87. 3	
13. 2	28. 1	43. 1	58. 1	73. 1	88. 2	
14. 2	29. 2	44. 3	59. 4	74. 3	89. 4	
15. 2	30. 3	45. 3	60. 2	75. 3	90. 1	