B.S.ABDUR RAHMAN UNIVERSITY
B.S.ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)

DEPARTMENT OF PHYSICS

SCHOOL OF PHYSICAL AND CHEMICAL SCIENCES

Ph.D ENTRANCE EXAMINATION

(2016-2017)

NAME :

APPLICATION NUMBER :

QUALIFICATION :

AREA OF RESEARCH INTEREST :

Signature of the candidate with date

ENTRANCE EXAMINATION, JUNE 2016

QUESTION PAPER BOOKLET

Ph. D. (PHYSICS)

Maximum: ***100 Marks*** Time: ***2 hrs***

INSTRUCTIONS:

- This question paper consists of 100 questions.
- All questions are compulsory.
- Each question carries one mark each.
- There is no negative marking.
- Answers are to be marked on the answer sheet provided.
- Only scientific calculators are permitted. Mobile Phone based calculators are not permitted.
- Hand over both question booklet and the answer sheet at the end of the Examination.

(2016-17)

ANSWER SHEET

Write your answer in the box against the question number

1	2	3	4	5	6	7	8	9	10
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**

Signature of the candidate with date

Name and signature of the

Examiner with date **Head of the Department**

Table of information

Speed of light in free space	$c = 3 \times 10^{8}$ m/s
Boltzmann constant	$K_B = 1.380 \times 10^{-23}$ J/K
Planck's constant	$h = 6.626 \times 10^{-34}$ Js
Electron charge	$e = 1.602 \times 10^{-19}$ C
Permittivity of free space	$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2/Nm^2
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ H/m
Mass of electron	$m_e = 9.31 \times 10^{-31}$ kg
Mass of proton	$m_p = 1.67 \times 10^{-27}$ kg
Mass of neutron	$m_n = 1.675 \times 10^{-27}$ kg
Avogadro's number	$N_0 = 6.02 \times 10^{23}$ per mole
Universal gas constant	R = 8.31 joules/(mole K)
Universal gravitational constant	$G = 6.67 \times 10^{-11}$ $m^3/(Kg\ s^2)$
1 atmosphere pressure	1 atm = 1.0×10^{5} N/m^2

Ph.D ENTRANCE EXAMINATION

QUESTION BOOKLET

1. Which one of the following is a set of dimensionless physical quantities?

   (a) strain, specific gravity, angle (b) strain, work, couple

   (c) work, angle, specific gravity (d) work, energy, frequency

2. At the turning point of an oscillation, the potential energy is equal to

   (a) Zero (b) its total energy (c) its kinetic energy (d) twice its kinetic energy

3. The superposition of two waves of the same frequency travelling in the same medium but in opposite direction gives rise to

   (a) resonance (b) beats (c) standing waves (d) harmonics

4. A small object lies on the axis of a cylindrically symmetric optical system. The image will suffer from

   (a) spherical aberration, coma and astigmatism (b) spherical aberration and coma

   (c) spherical aberration and astigmatism (d) spherical aberration

5. When applied to solar radiation, Planck's law reduces to Wien's law in the

   (a) ultraviolet region (b) infrared region (c) microwave region Visible region

6. In a porous-plug experiment, the change in temperature of the gas depends upon

   (a) its specific heat (b) its thermal conductivity

   (c) difference in pressure on either side of the plug (d) rate of flow of gas through the porous plug

7. In diffraction pattern due to single slit of width 'a' with incident light of wavelength λ with angle of diffraction θ, the condition for the first minima is

   (a) $\lambda\, sin\theta = a$ (b) $a\, cos\theta = \lambda$ (c) $a\, sin\theta = \lambda$ (d) $\lambda\, cos\theta = a$

8. With the symbols having usual meanings, the visibility of interference fringes is expressed as

   (a) $V = \frac{I_{max}}{I_{min}}$ (b) $V = \frac{I_{max} + I_{min}}{I_{max} - I_{min}}$ (c) $V = \frac{I_{min}}{I_{max}}$ (d) $V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$

9. In a Fabry-Perot interferometer, the circular fringes formed are referred to as fringes of

(a) Equal thickness (b) Equal inclination (c) Equal chromatic order (d) None of the above

10. The energy of 1.6 Joule is equal to

(a) 10^{19} MeV (b) 10^{13} MeV (c) 10^{6} MeV (d) 1.0 MeV

11. The phase difference between two interfering waves of wavelength λ is 30˚. The path difference between them is

(a) $\frac{\lambda}{3}$ (b) $\frac{\lambda}{6}$ (c) $\frac{\lambda}{9}$ (d) $\frac{\lambda}{12}$

12. The thermonuclear fusion of hydrogen inside the stars is taking place by a cycle of operations. The particular element which acts as a catalyst is

(a) nitrogen (b) oxygen (c) carbon (d) helium

13. The phase relationship between the radiation field at different points in space is called

(a) Temporal coherence (b) optical pumping (c) spatial coherence (d) none of these

14. The coating of optical strands is known as

(a) pumping (b) cladding (c) conjugating (d) none of these

15. The property of rotating the plane of polarization is known as

(a) optical activity (b) optical rotation (c) Dichroism (d) specific rotation

16. In Rayleigh scattering of light with frequency ν, the co-efficient of scattering is proportional to

(a) ν (b) ν^2 (c) ν^3 (d) ν^4

17. In order to observer Raman effect, the wavelength of the source used

(a) should be in visible region only (b) should be in infrared region only

(c) should be in ultraviolet region only (d) can be anywhere in the electromagnetic spectrum

18. An astronomical telescope of tenfold angular magnification has a length of 44 cm. The focal length of the objective is

(a) 4 cm (b) 40 cm (c) 44 cm (d) 440 cm

19. When a light wave travels from one medium to another, the characteristic parameter that remains invariant is

(a) Wavelength (b) Velocity (c) Frequency (d) Intensity

20. For image magnifications, one needs atleast

(a) Two convex lenses (b) One concave and one convex lens

(c) One concave lens (d) One convex lens

21. A lens or optical system is said to be aplanatic, if it is free from

(a) Spherical aberration (b) Coma

(c) Both Spherical aberration and coma (d) Neither Spherical aberration and coma

22. An electron microscope is superior to an optical microscope in

(a) having better resolving power (b) being easy to handle

(c) low cost (d) quickness of observation

23. Which one of the following is wrong requirement for laser production

(a) An active medium (b) A proper pumping source

(c) A cavity resonator (d) A vaccum medium

24. The temperature of sun is measured by

(a) Platinum resistance thermometer (b) Gas thermometer

(c) Pyrometer (d) Vapour pressure thermometer

25. The temperature in the Fahrenheit scale corresponding to 253 K is

(a) -4˚ F (b) 4˚ F (c) 12˚ F (d) 36˚ F

26. Thermoelectric thermometer is based on

(a) Photoelectric effect (b) Seebeck effect (c) Compton effect (d) Joule effect

27. Vander Waal's equation of state of a gas takes into account

(a) Intermolecular forces only (b) size of the molecule only

(c) both the Intermolecular forces and size of the molecule (d) the velocity of molecules only

28. Which one of the following properties of a body remains constant during a reversible adiabatic process?

(a) Enthalpy (b) Temperature (c) Specific heat (d) Entropy

29. A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to the magnetic field B. The time taken by the particle to complete one revolution

(a) $\frac{2\pi q^2 B}{m}$ (b) $\frac{2\pi mq}{B}$ (c) $\frac{2\pi m}{qB}$ (d) $\frac{2\pi qB}{m}$

30. Two thin long parallel wires separated by a distance 'b' are carrying 'i' amp each. The magnitude of the force per unit length exerted by one wire on the other is

(a) $\frac{\mu_0 i^2}{b^2}$ (b) $\frac{\mu_0 i^2}{2\pi b}$ (c) $\frac{\mu_0\, i}{2\pi b}$ (d) $\frac{\mu_0\, i}{2\pi b^2}$

31. The efficiency of a Carnot engine using an ideal gas as the working substance is (symbols have the usual meanings)

(a) $\eta = \frac{T_1 - T_2}{T_1}$ (b) $\eta = \frac{T_1}{T_1 - T_2}$ (c) $\eta = T_1(T_1 - T_2)$ (d) $\eta = T_2(T_1 - T_2)$

32. For a diatomic gas having 3 translational and 2 rotational degrees of freedom, the energy is given by

(a) $\frac{5}{2}KT$ (b) $\frac{3}{2}KT$ (c) $\frac{1}{2}KT$ (d) KT

33. Cooling is only possible when

(a) $T_i > \frac{2a}{Rb}$ (b) $T_i = \frac{2a}{Rb}$ (c) $T_i = \frac{Rb}{2a}$ (d) $T_i < \frac{2a}{Rb}$

34. Which one is the wrong example of second order phase change?

(a) Sublimation
(b) Transition of ferromagnetic to paramagnetic one at the curie point
(c) Transition of superconducting material to ordinary conducting one
(d) Transition between liquid helium I to liquid helium II

35. Which one of the following radiation takes the form of cascade shower?

(a) Cosmic radiations (b) Mesons (c) α - radiations (d) γ - radiations

36. Two sources of equal emf are connected to an external resistance R. The internal resistances of the two sources are R_1 and R_2 ($R_2 > R_1$). If the potential difference across the source having internal resistance R_2 is zero, then

(a) $R = R_2 - R_1$ (b) $R = R_2 X \frac{R_1 + R_2}{R_2 - R_1}$ (c) $R = \frac{R_1 R_2}{R_2 - R_1}$ (d) $R = \frac{R_1 R_2}{R_1 + R_2}$

37. A current I flows along the length of an infinitely long straight, thin walled pipe. Then the magnetic field

(a) at all points inside the pipe is the same, but not zero
(b) at any point inside the pipe is zero
(c) is zero only on the axis of the pipe
(d) is different at same points inside the pipe

38. The thermistors are usually made of

(a) metals with low temperature coefficient of resistivity
(b) metals with high temperature coefficient of resistivity
(c) metal oxides with high temperature coefficient of resistivity
(d) semiconductor materials having low temperature coefficient of resistivity

39. An ammeter reads upto 1 ampere. Its internal resistance is 0.81 ohm. To increase the range to 10 ampere, the value of the required shunt is

(a) 0.09 Ω (b) 0.03 Ω (c) 0.3 Ω (d) 0.9 Ω

40. A steady current flows in a metallic conductor of non-uniform cross-section. Which of the following quantity is constant along the conductor?

(a) current (b) drift speed (c) current density (d) none of these

41. A machine gun fires a bullet of mass 40 g with a velocity of 1200m/s. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can be fire per second at the most

(a) one (b) four (c) two (d) three

42. A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time t is proportional to

(a) $t^{1/2}$ (b) $t^{3/4}$ (c) $t^{3/2}$ (d) $t^{1/4}$

43. A box is lying on an incline plane. If the box starts sliding when the angle of inclination is 60°, then the coefficient of static friction of the box and the plane is

(a) 2.732 (b) 1.732 (c) 0.267 (d) 0.176

44. Average density of the earth

(a) is a complex function of g (b) does not depend on g

(c) is inversely proportional to g (d) is directly proportional to g

45. The escape velocity for a body projected vertically upwards from the surface of the earth is 11 km/s. If the body is projected at an angle of 45° with the vertical, the escape velocity will be

(a) $11/\sqrt{2}$ km/s (b) $11\sqrt{2}$ km/s (c) 2 km/s (d) 11 km/s

46. Energy required to move a body of mass m from an orbit of radius 2R to 3R is

(a) $GMm/(12R^2)$ (b) $GMm/(3R^2)$ (c) $\sqrt{(2GM/R)}$ (d) $\sqrt{(2GM^2/R)}$

47. Octal equivalent of decimal number 130_{10} is

(a) 202_8 (b) 673_8 (c) 220_8 (d) 367_8

48. Which of the following classic experiments provides unambiguous proof that the Earth is a non-inertial frame of reference with respect to the fixed stars

(a) Fizeau's rotating wheel experiment (b) Foucault's pendulum experiment

(c) Newton's coin-and-feather experiment (d) Michelson-Morley experiment

49. The product MN of two Hermitian matrices M and N is anti-Hermitian. It follows that

(a) $[M, N] = 0$ (b) $\{M, N\} = 0$ (c) $M^{\dagger} = N$ (d) $M^{\dagger} = N^{-1}$

50. A solid sample has the property that, when cooled below a certain temperature, it expels any small applied magnetic field from within the materials. Which of the following best describes this sample in the cooled state?

(a) Ferromagnet (b) Antiferromagnet (c) Diamagnet (d) Paramagnet

51. If the eigen values of a symmetric 3x3 matrix A are 0,1,3 and the corresponding eigen vectors can be written as $\begin{pmatrix}1\\1\\1\end{pmatrix}, \begin{pmatrix}1\\0\\-1\end{pmatrix}, \begin{pmatrix}1\\-2\\1\end{pmatrix}$ respectively, then the matrix A^4 is

(a)$\begin{pmatrix} 41 & -81 & 40 \\ -81 & 0 & -81 \\ 40 & -81 & 41 \end{pmatrix}$ (b) $\begin{pmatrix} -82 & -81 & 79 \\ -81 & 0 & -81 \\ 79 & -81 & 83 \end{pmatrix}$ (c) $\begin{pmatrix} 14 & -27 & 13 \\ -27 & 54 & -27 \\ 13 & -27 & 14 \end{pmatrix}$ (d) $\begin{pmatrix} 14 & -13 & 27 \\ -13 & 54 & -13 \\ 27 & -13 & 14 \end{pmatrix}$

52. In a simple cubic lattice of lattice constant 0.287 nm, the number of atoms per mm^2 along the (1 1 1) plane is

(a) 2.11×10^{13} (b) 1.73×10^{13} (c) 1.29×10^{13} (d) 1.21×10^{13}

53. Two homonuclear diatomic molecules produce different rotational spectra, eventhough the atoms are known to have identical chemical properties. This leads to the conclusion that the atoms must be

(a) isotopes (b) isobars (c) isotones (d) isomers

54. For constant uniform electric and magnetic field $\vec{E} = \overrightarrow{E_0}$ and $\vec{B} = \overrightarrow{B_0}$, it is possible to choose a gauge such that the scalar potential φ and vector potential $\vec{A}$ are given by

(a)$\varphi = 0$; $\vec{A} = \frac{1}{2}(\overrightarrow{B_0} \times \vec{r})$ (b) $\varphi = -\overrightarrow{E_0} . \vec{r}$; $\vec{A} = \frac{1}{2}(\overrightarrow{B_0} \times \vec{r})$ (c) $\varphi = -\overrightarrow{E_0} . \vec{r}; \vec{A} = 0$ (d) $\varphi = 0; \vec{A} = -\overrightarrow{E_0}$ t

55. Which of the following option is Lorentz invariant?

(a) $|\vec{E} X \vec{B}|^2$ (b) $|\vec{E}|^2 - |\vec{B}|^2$ (c) $|\vec{E}|^2 + |\vec{B}|^2$ (d) $|\vec{E}|^2 |\vec{B}|^2$

56. The energy of the first excited quantum state of a particle in the two-dimensional potential $V(x,y) = \frac{1}{2}m\omega^2(x^2 + 4y^2)$ is

(a) $2\hbar\omega$ (b) $3\hbar\omega$ (c) $\frac{3}{2}\hbar\omega$ (d) $\frac{5}{2}\hbar\omega$

57. The commentator $[x^2, p^2]$ *is*

(a) $2i\hbar xp$ (b) $2i\hbar(xp + px)$ (c) $2i\hbar px$ (d) $2i\hbar(xp - px)$

58. Let v, p and E denote the speed, the magnitude of momentum and the energy of a free particle of rest mass. Then

(a) ${dE}/{dp} = constant$ (b) $p = mv$ (c) $v = cp/\sqrt{p^2 + m^2c^2}$ (d) $E = mc^2$

59. A particle of mass m in three dimensions is in the potential $V(r) = \begin{cases} 0 & r < a \\ \infty & r > a \end{cases}$

(a) $\frac{\pi^2\hbar^2}{2ma^2}$ (b) $\frac{\pi^2\hbar^2}{ma^2}$ (c) $\frac{3\pi^2\hbar^2}{2ma^2}$ (d) $\frac{9\pi^2\hbar^2}{2ma^2}$

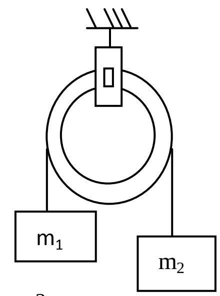
60. The ratio of the energy of the first excited state E_1 to that of the ground state E_0 to that of a particle in a three-dimensional rectangular box of side L, L and L/2 is

(a) 3:2 (b) 2:1 (c) 4:1 (d) 4:3

61. Numerical aperture of the optical fibre is a measure of

(a) its resolving power (b) its light gathering power (c) the pulse dispersion (d) attenuation of light through it

62. Two masses m_1 = 5 kg and m_2 = 4.8 kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when lift is free to move? (g= 9.8 m/s^2)



(a) 0.2 m/s^2 (b) 9.8 m/s^2 (c) 5 m/s^2 (d) 4.8 m/s^2

63. A broadcasting centre broadcasts at 300 m band. A condenser of capacitance 2.4 μF is available. The value of the inductance required for resonant circuit is

(a) 10^{-4} H (b) 10^{-8} H (c) 10^{-6} H (d) 10^{-2} H

64. L, C and R represent the physical quantities inductance, capacitance and resistance respectively. The combination which have the dimensions of frequency are

(a) $\frac{1}{RC}$ (b) $\frac{R}{L}$ (c) $\frac{1}{\sqrt{LC}}$ (d) $\frac{C}{L}$

65. A circuit has a resistance of 12 ohm and an impedance of 15 ohm. The power factor of the circuit will be

(a) 0.4 (b) 0.8 (c) 0.125 (d) 1.25

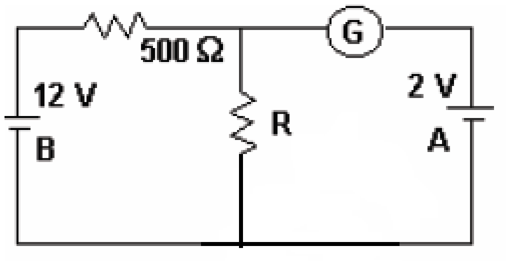
66. The core of any transformer is laminated so as to

(a) make it light weight (b) make it robust and strong

(c) increase the secondary voltage (d) reduce the energy loss due to eddy current

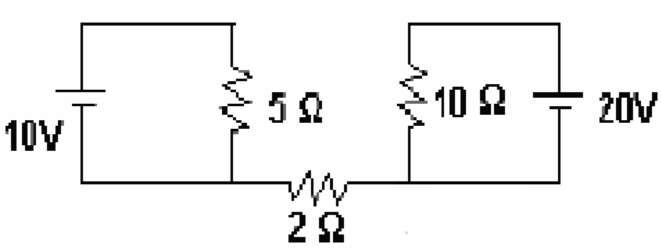
67. The magnetic flux linked with a coil is given by the equation $\Phi = 3t^2 + 4t = 9$ Wb. The magnitude of induced emf at t=2 sec is

(a) 16 V (b) 9 V (c) 4 V (d) 1 V

68. 

In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be

(a) 100 Ω (b) 200 Ω (c) 1000 Ω (d) 500 Ω

69. 

Find out the current in 2 Ω resistance.

(a) 0 (b) 2 A (c) 3 A (d) 5 A

70. The number of free electrons per unit volume in copper is n. The electrons each of charge q flowing with velocity v constitute current I. If A is the cross-sectional area of the wire, the current density in the wire is

(a) nAq/v (b) $\boldsymbol{nq/v}$ (c) $nAqv$ (d) nqv

71. The temperature coefficient of resistance of a wire is 0.00125 per ˚C. At 300 K, its resistance is 1 ohm. The resistance of the wire will be 2 ohm at

(a) 1154 K (b) 1100 K (c) 1400 K (d) 1127 K

72. A light source is at the bottom of a pool of water (the index of refraction of water is 1.33). At what minimum angle of incidence will a ray be totally reflected at the surface

(a) 0˚ (b) 25˚ (c) 50˚ (d) 75˚

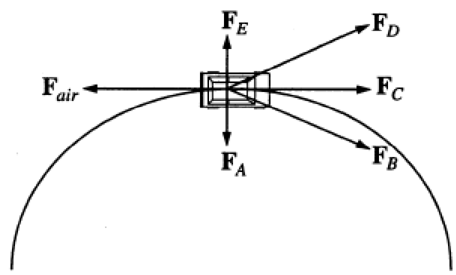
73. The approximate number of photons in a femtosecond (10^{-15} s) pulse of 600 nanometers wavelength light from a 10-kilowatt peak-power dye laser is

(a) 10^3 (b) 10^7 (c) 10^{11} (d) 10^{15}

74. According to Standard Model of elementary particles, which of the following is NOT a composite object?

(a) Muson (b) Pi-Meson (c) Neutron (d) Deuteron

75. A car travels with constant speed on a circular road on level ground. In the diagram shown below, F_{air} is the force of air resistance on the car. Which of the other forces shown best represents the horizontal force of the road on the car's tires.



(a) F_A (b) F_B (c) F_C (d) F_D

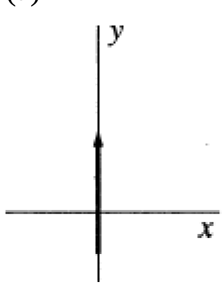
76. The wave function for identical fermions is antisymmetric under particle interchange. Which of the following is a consequence of this property?

(a) Pauli exclusion principle (b) Bohr correspondence principle

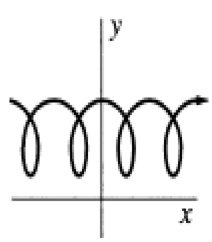
(c) Heisenberg uncertainty principle (d) Bose-Einstein condensation

77. A positively charged particle is moving in the xy plane in region where there is a non-zero uniform magnetic field B in the +z direction and non-zero uniform electric field E in the +y direction. Which of the following is a possible trajectory for the particle?

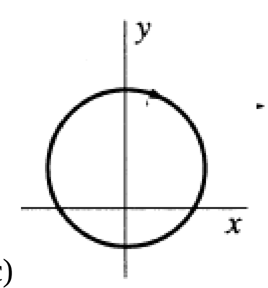
(a)



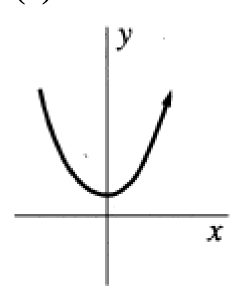
(b)



(c)



(d)



78. The specific heat of a substance at its boiling point or melting point

(a) is zero (b) is infinity (c) is negative (d) lies between 0 and 1

79. Which one of the following quantities is invariant under Lorentz transformation

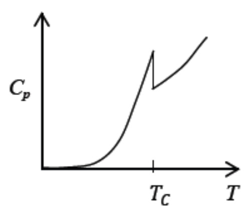
(a) Charge density (b) Charge (c) Current (d) Electric field

80. The matrix $A = \frac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is

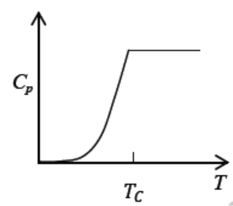
(a) orthogonal (b) symmetric (c) anti-symmetric (d) unitary

81. The plot of specific heat versus temperature across the superconducting transition temperature (T_c) is most appropriately represented by

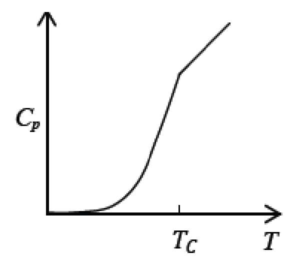
(a)



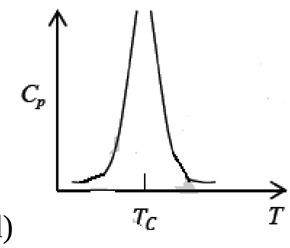
(b)



(c)



(d)



82. An unpolarized light wave is incident from air on a glass surface at the Brewster angle. The angle between the reflected and the refracted wave is

(a) 0° (b) 45° (c) 90° (d) 120°

83. The number of normal Zeeman splitting components of $^1P \rightarrow {}^1D$ transition is

(a) 3 (b) 4 (c) 8 (d) 9

84. The Hamilton's canonical equations of motion in terms of Poisson Brackets are

(a) $\dot{q} = \{q, H\}; \dot{p} = \{p, H\}$

(b) $\dot{q} = \{H, q\}; \dot{p} = \{H, p\}$

(c) $\dot{q} = \{H, p\}; \dot{p} = \{H, q\}$

(d) $\dot{q} = \{p, H\}; \dot{p} = \{q, H\}$

85. If $\vec{L}$ is the orbital angular momentum and $\vec{S}$ is the spin angular momentum, then $\vec{L}\cdot\vec{S}$ does NOT commute with

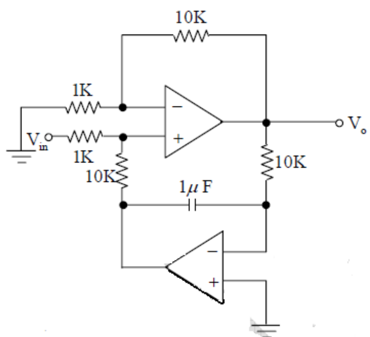
(a) S_z (b) L^2 (c) S^2 (d) $\left(\vec{L} + \vec{S}\right)^2$

86. A signal of frequency 10 kHz is being digitized by an A/D converter. A possible sampling time

which can be used is

(a)100 μs (b) 40 μs (c) 60 μs (d) 200 μs

87. A time varying V_{in} is fed to an op-amp circuit with output signal V_0 as shown in the figure below.

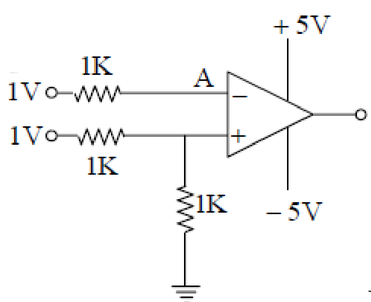


The circuit implements a

(a) high pass filter with cutoff frequency 16 Hz (b) high pass filter with cutoff frequency 100 Hz

(c) low pass filter with cutoff frequency 16 Hz (d) low pass filter with cutoff frequency 100 Hz

88.



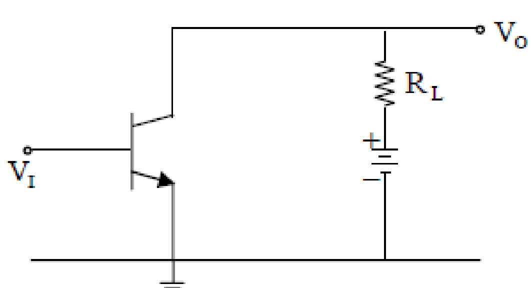
In the operational amplifier circuit below, the voltage at point A is

(a) 1.0 V (b) 0.5 V (c) 0 V (d) -5.0 V

89. An LED operates at 1.5 V and 5 mA in forward bias. Assuming an 80% external efficiency of the LED, how many photons are emitted per second?

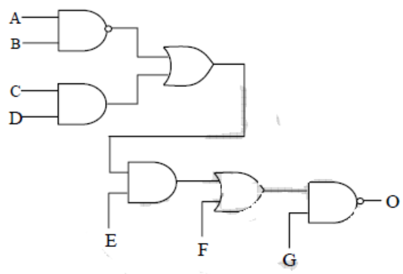
(a) 5.0 x 10^{16} (b) 1.5 x 10^{16} (c) 0.8 x 10^{16} (d) 2.5 x 10^{16}

90.



The transistor in the given circuit has h_{fe} = 35 Ω and h_{ie} = 1000 Ω. If the load resistance R_L = 1000 Ω, the voltage and current gain are respectively

(a) -35 and +35 (b) +35 and -35 (c) 35 and -0.97 (d) 0.98 and -35

91. 

The output O, of the given circuit in cases I and II where

Case I : A, B = 1; C,D = 0; E,F = 1 and G = 0

Case II: A, B = 0; C,D = 0; E,F = 0 and G = 1 are respectively

(a) 1,0 (b) 0,1 (c) 0,0 (d) 1,1

92. An op-amp based voltage follower

(a) is useful for converting a low impedance source into high impedance source
(b) is useful for converting a high impedance source into low impedance source
(c) has infinitely high closed loop output impedance
(d) has infinitely high closed loop gain

93. A narrow beam of X-rays with wavelength 1.5 Å is reflected from an ionic crystal with an fcc lattice structure with a density of 3.32 gcm^{-3}. The molecular weight is 108 AMU. The lattice constant is (given 1 AMU = 1.66 x 10^{-24} g).

(a) 6.00 Å (b) 4.56 Å (c) 4.00 Å (d)2.56 Å

94. If the energy dispersion of a two-dimensional electron system is E = uħk where u is the velocity and k is the momentum, then the density of state D(E) depends on the energy as

(a) $1/\sqrt{E}$ (b) $\sqrt{E}$ (c) E (d) constant

95. The pressure of a nonrelativistic free Fermi gas in three dimensions depends, at T=0 K, on the density of fermions n as

(a) $n^{5/3}$ (b) $n^{1/3}$ (c) $n^{2/3}$ (d) $n^{4/3}$

96. X-ray of wavelength λ = a is reflected from the (1 1 1) plane of a simple cubic lattice. If the lattice constant is a, the corresponding Bragg angle (in radian) is

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{8}$

97. The critical magnetic fields of a superconductor at temperatures 4 K and 8 K are 11 mA/m and 5.5 mA/m respectively. The transition temperature is approximately

(a) 8.4 K (b) 10.6 K (c) 12.9 K (d) 15.0 K

98. A particle of unit mass moves in a potential $V(x) = ax^2 + \frac{b}{x^2}$, where a and b are positive constants. The angular frequency of small oscillations about the minimum of the potential is

(a) $\sqrt{8b}$ (b) $\sqrt{8a}$ (c) $\sqrt{8a/b}$ (d) $\sqrt{8b/a}$

99. A constant force F is applied to a relativistic particle of rest mass m. If the particle starts from rest at t=0, its speed after a time t is

(a) Ft/m (b) $c\tanh\left(\frac{Ft}{mc}\right)$ (c) $c\left(1 - e^{-Ft/mc}\right)$ (d) $\frac{Fct}{\sqrt{F^2t^2+m^2c^2}}$

100. The magnetic field at a distance R from a long straight wire carrying a steady current I is proportional to

(a) IR (b) I/R^2 (c) I^2/R^2 (d) I/R