

Government of Puducherry
Directorate of School Education
Competitive Examination for Empanelment of Guest Lecturers-2019

11

QUESTION BOOKLET

ROLL NO:

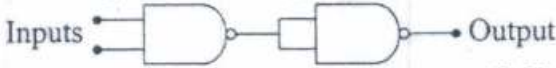
SUBJECT: PHYSICS

Time: 2:00 Hours

Total Marks: 90

INSTRUCTIONS TO CANDIDATES

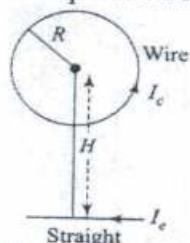
- 1) Write Roll Number in the space provided in this Question Booklet above.
- 2) The Candidate should check the question paper that question paper consists of all the pages and that it is not torn.
- 3) Please write the Roll No. etc., on the OMR sheet using Black Ball point pen only.
- 4) The candidate shall use only "**BLACK BALL POINT PEN**" for marking the answers.
- 5) There are **90 questions**. For every correct answer 1 (One) mark will be awarded and for each wrong answer 0.25 mark will be deducted.
- 6) Use of eraser/ whitener/ correction fluid is prohibited on OMR answer sheets.
- 7) Use of calculators, cell phones, logarithmic table, electronic gadgets etc., is strictly prohibited.
- 8) For any rough work, use the rough page given at the end of the Question Booklet.
- 9) The candidate has to deposit the original copy of OMR sheet along with the Hall Ticket after the completion of examination and may carry the duplicate OMR (impression) sheet for reference.
- 10) No candidate is allowed to leave the examination centre premises till the completion of the entire examination process.
- 11) Please avoid marking of answers on Question Booklet.
- 12) The questions in English version alone will be taken as authentic though questions are given in other languages for the convenience of the candidates.

1. The moment of inertia of a rod about an axis through its centre and perpendicular to it is $\frac{1}{12}ML^2$ (where M is the mass and L the length of the rod). The rod is bent in the middle so that the two halves make an angle of 60° . The moment of inertia of the bent rod about the same axis would be.
 (a) $\frac{1}{48}ML^2$ (b) $\frac{1}{12}ML^2$ (c) $\frac{1}{24}ML^2$ (d) $\frac{ML^2}{8\sqrt{3}}$
2. A boat at anchor is rocked by waves whose crests are 100 m apart and velocity is 25 m/s. The boat bounces up one in every.
 (a) 2500 s (b) 75 s (c) 4 s (d) 0.25 s
3. By sucking through a straw, a student can reduce the pressure in his lungs to 750 mm of Hg (density = 13.6 g/cm^3). Using the straw, he can drink water from a glass up to maximum depth of.
 (a) 10 cm (b) 75 cm (c) 13.6 cm (d) 1.36 cm
4. Two parallel large thin metal sheets have equal surface charge densities ($\sigma = 26.4 \times 10^{-12} \text{ C/m}^2$) of opposite signs. The electric field between these sheets is.
 (a) 1.5 N/C (b) $1.5 \times 10^{-10} \frac{\text{N}}{\text{C}}$ (c) 3 N/C (d) $3 \times 10^{-10} \text{ N/C}$
5. A wire mesh consisting of very small squares is viewed at a distance of 8 cm through a magnifying converging lens of focal length 10 cm, kept close to the eye. The magnification produced by the lens is.
 (a) 5 (b) 8 (c) 10 (d) 20
6. Hard X-rays for the study of fractures in bones should have a minimum wavelength of 10^{-11} m . The accelerating voltage for electrons in X-ray machine should be.
 (a) $< 124 \text{ kV}$ (b) $> 124 \text{ kV}$ (c) between 60 kV and 70 kV (d) = 100 kV
7. A lens is made of flint glass (refractive index = 1.5). When the lens is immersed in a liquid of refractive index 1.25, the focal length.
 (a) increases by a factor of 1.25
 (b) increases by a factor of 2.5
 (c) increases by a factor of 1.2
 (d) decreases by a factor of 1.2
8. The voltage of clouds is $4 \times 10^6 \text{ V}$ with respect to ground. In a lightning strike lasting 100 ms, a charge of 4 C is delivered to the ground. The power of lightning strike is.
 (a) 160 MW (b) 80 MW (c) 20 MW (d) 500 kW
9. A point source emits sound equally in all directions in a non-absorbing medium. Two points P and Q are at distance of 2m and 3m respectively from the source. The ratio of the intensities of the waves at P and Q is.
 (a) 9 : 4 (b) 2 : 3 (c) 3 : 2 (d) 4 : 9
10. What a p-n junction diode is reverse biased, then.
 (a) no current flows
 (b) the depletion region is increased
 (c) the depletion region is reduced
 (d) the height of the potential barrier is reduced
11. The circuit given below represents which of the logic operations?
 Inputs  Output
 (a) AND (b) NOT (c) OR (d) NOR
12. The spatial distribution of the electric field due to charges (A, B) is shown in the figure. Which one of the following statements is correct?



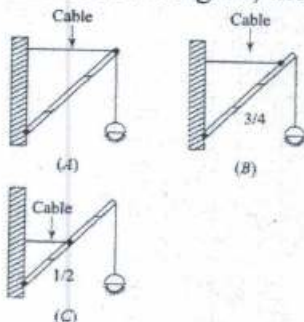
- (a) A is +ve and B -ve and $|A| > |B|$
- (b) A is -ve and B +ve ; $|A| = |B|$
- (c) Both are +ve but $A > B$
- (d) Both are -ve but $A > B$

13. Circular loop of a wire and a long straight wire carry currents I_c and I_e , respectively as shown in the figure. Assuming that these are placed in the same plane. The magnetic field will be zero at the centre of the loop when the separation H is.



- (a) $\frac{I_e R}{I_c \pi}$
- (b) $\frac{I_c R}{I_e \pi}$
- (c) $\frac{\pi I_c}{I_e R}$
- (d) $\frac{I_e \pi}{I_c R}$

14. If a street light of mass M is suspended from the end of uniform rod of length L in different possible patterns as shown in the figure, then.



- (a) pattern A is more sturdy
- (b) pattern B is more sturdy
- (c) pattern C is more sturdy
- (d) all will have the same sturdiness

15. ${}_{92}^{238}\text{U}$ has 92 protons and 238 nucleons. It decays by emitting an alpha particle and becomes.

- (a) ${}_{92}^{234}\text{U}$
- (b) ${}_{90}^{234}\text{Th}$
- (c) ${}_{92}^{235}\text{U}$
- (d) ${}_{93}^{237}\text{Np}$

16. The fossil bone has a ${}^{14}\text{C} : {}^{12}\text{C}$ ratio, which is $\left[\frac{1}{16}\right]$ of that in a living animal bone. If the half-life of ${}^{14}\text{C}$ is 5730 years, then the age of the fossil bone is.

- (a) 11460 years
- (b) 17190 years
- (c) 22920 years
- (d) 45840 years

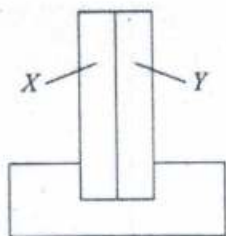
17. Which one of the following is a possible nuclear reaction?

- (a) ${}_{5}^{10}\text{B} + {}_{2}^{4}\text{He} \rightarrow {}_{7}^{13}\text{N} + {}_{1}^{1}\text{H}$
- (b) ${}_{11}^{23}\text{Na} + {}_{1}^{1}\text{H} \rightarrow {}_{10}^{20}\text{Ne} + {}_{2}^{4}\text{He}$
- (c) ${}_{93}^{239}\text{Np} \rightarrow {}_{94}^{239}\text{Pu} + \beta^{-} + \bar{\nu}$
- (d) ${}_{7}^{11}\text{N} + {}_{1}^{1}\text{H} \rightarrow {}_{6}^{12}\text{C} + \beta^{-} + \nu$

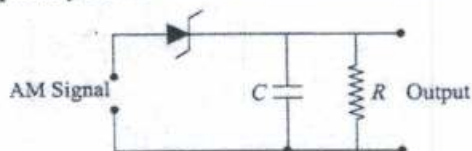
18. Two tuning forks P and Q when set vibrating, give 4 beats/sec. If a prong of the fork P is filed, the beats are reduced to 2/s. What is frequency of P, if that of Q is 250 Hz?

- (a) 246 Hz
- (b) 250 Hz
- (c) 254 Hz
- (d) 252 Hz

19. A bimetallic strip consists of metals X and Y. It is mounted rigidly at the base as shown. The metal X has a higher coefficient of expansion compared to that for metal Y. When bimetallic strip is placed in a cold bath.

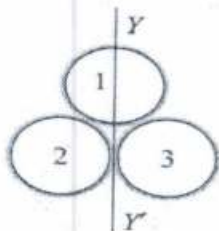


- (a) it will bend towards the right
 (b) it will bend towards the left
 (c) it will not bend but shrink
 (d) it will neither bend nor shrink
20. A light emitting diode (LED) has a voltage drop of 2 V across it and passes a current of 10mA. When it operates with a 6 V battery through a limiting resistor R. The value of R is.
 (a) 40 k Ω (b) 4 k Ω (c) 200 Ω (d) 400 Ω
21. The minimum potential difference between the base emitter required to switch a silicon transistor 'ON' is approximately.
 (a) 1 V (b) 3 V (c) 5 V (d) 4.2 V
22. Given below is a circuit diagram of an AM demodulator for good demodulation of AM signal of carrier frequency f, the value of RC should be.



- (a) $RC = \frac{1}{f}$ (b) $RC < \frac{1}{f}$
 (c) $RC \geq \frac{1}{f}$ (d) $RC \gg \frac{1}{f}$
23. In CGS system the magnitude of the force is 100 dynes. In another system where the fundamental physical quantities are kilogram, metre and minute, the magnitude of the force is.
 (a) 0.036 (b) 0.36 (c) 3.6 (d) 36
24. A particle (A) is dropped from a height and another particle (B) is thrown in horizontal direction with speed of 5m/sec from the same height. The correct statement is.
 (a) Both particles will reach at ground simultaneously
 (b) Both particles will reach at ground with the same speed
 (c) Particle(A) will reach at ground first with respect to particle (B)
 (d) Particle (B) will reach at ground first with respect to particle (A)
25. An aircraft executes a horizontal loop with a speed of 150 m/s with its wings banked at an angle of 12°. the radius of the loop is ($g = 10 \text{ m/s}^2$).
 (a) 10.6 km (b) 9.6 km (c) 7.4 km (d) 5.8 km
26. A block of metal weighing 2 kg is resting on a frictionless plane. It is struck by a jet releasing water at a rate of 1 kg/sec and at a speed of 5 m/sec. The initial acceleration of the block will be.
 (a) 2.5 m/sec² (b) 5.0 m/sec²
 (c) 10 m/sec² (d) None of the above
27. A car is moving along a straight horizontal road with a speed v_0 . If the coefficient of friction between the tyres and the road is μ , the shortest distance in which the car can be stopped is.
 (a) $\frac{v_0^2}{2\mu g}$ (b) $\frac{v_0}{\mu g}$ (c) $\left(\frac{v_0}{\mu g}\right)^2$ (d) $\frac{v_0}{\mu}$
28. A spring of force constant 10 N/m has an initial stretch 0.20 m. In changing the stretch to 0.25 m, the increase in potential energy is about.
 (a) 0.1 joule (b) 0.2 joule
 (c) 0.3 joule (d) 0.5 joule
29. Mass M is divided into two parts xM and (1 - x)M. For a given separation, the value of x for which the gravitational attraction between the two pieces becomes maximum is.

- (a) $\frac{1}{2}$ (b) $\frac{3}{5}$ (c) 1 (d) 2
30. Steel and copper wires of the same length are stretched by the same weight one after the other. Young's modulus of steel and copper are $2 \times 10^{11} \text{ N/m}^2$ and $1.2 \times 10^{11} \text{ N/m}^2$. The ratio of increase in length.
- (a) $\frac{2}{5}$ (b) $\frac{3}{5}$ (c) $\frac{5}{4}$ (d) $\frac{5}{2}$
31. The force required to separate two glass plates of area 10^{-2} m^2 with a film of water 0.05 mm thick between them is (surface tension of water is $70 \times 10^{-3} \text{ N/m}$).
- (a) 28 N (b) 14 N (c) 50 N (d) 38 N
32. A body of density d_1 is counterpoised by Mg of weights of density d_2 in air of density d . Then the true mass of the body is.
- (a) M (b) $M \left(1 - \frac{d}{d_2}\right)$
(c) $M \left(1 - \frac{d}{d_1}\right)$ (d) $\frac{M(1-d/d_2)}{(1-d/d_1)}$
33. A uniform metal rod is used as a bar pendulum. If the room temperature rises by 10°C , and the coefficient of linear expansion of the metal of the rod is 2×10^{-6} per $^\circ\text{C}$, the period of the pendulum will have percentage increase of.
- (a) -2×10^{-3} (b) -1×10^{-3}
(c) 2×10^{-3} (d) 1×10^{-3}
34. Suppose ideal gas equation follows $VP^3 = \text{constant}$. Initial temperature and volume of the gas are T and V respectively. If gas expand to $27V$, then its temperature will become.
- (a) T (b) $9T$ (c) $27T$ (d) $T/9$
35. If ΔQ and ΔW represents the heat supplied to the system and the work done on the system respectively, then the first law of thermodynamics can be written as.
- (a) $\Delta Q = \Delta U + \Delta W$
(b) $\Delta Q = \Delta U - \Delta W$
(c) $\Delta Q = \Delta W - \Delta U$
(d) $\Delta Q = -\Delta W - \Delta U$
- Where ΔU is the internal energy.
36. The thermal conductivity of a material in CGS system is 0.4. In steady state, the rate of flow of heat 10 cal/sec-cm^2 , then the thermal gradient will be.
- (a) 10°C/cm (b) 12°C/cm
(c) 25°C/cm (d) 20°C/cm
37. The amplitude and the time period in a SHM is 0.5 cm and 0.4 sec respectively. If the initial phase is $\pi/2$ radian, then the equation of SHM will be.
- (a) $y = 0.5 \sin 5\pi t$ (b) $y = 0.5 \sin 4\pi t$
(c) $y = 0.5 \sin 2.5\pi t$ (d) $y = 0.5 \cos 5\pi t$
38. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.170 second. The frequency of the wave is.
- (a) 1.47 Hz (b) 0.36 Hz (c) 0.73 Hz (d) 2.94 Hz
39. Three rings each of mass M and radius R are arranged as shown in the figure. The moment of inertia of the system about YY' will be.



- (a) $3MR^2$ (b) $\frac{3}{2}MR^2$ (c) $5MR^2$ (d) $\frac{7}{2}MR^2$
40. The capacity and the energy stored in a parallel plate condenser with air between its plates are respectively C_o and W_o . If the air is replaced by glass (dielectric constant = 5) between the plates, the capacity of the plates and the energy stored in it will respectively be.
- (a) $5C_o, 5W_o$ (b) $5C_o, \frac{W_o}{5}$
(c) $\frac{C_o}{5}, 5W_o$ (d) $\frac{C_o}{5}, \frac{W_o}{5}$
41. A body of mass 5 gm is executing SHM about a point with amplitude 10 cm. Its maximum velocity is 100 cm/sec. Its velocity will be 50 cm/sec at a distance.
- (a) 5 (b) $5\sqrt{2}$ (c) $5\sqrt{3}$ (d) $10\sqrt{2}$
42. At which temperature the speed of sound in hydrogen will be the same as that of speed of sound in oxygen at 100°C .
- (a) -148°C (b) -212.5°C (c) -317.5°C (d) -249.7°C
43. If the initial velocity of a projectile be doubled, keeping the angle of projection same, the maximum height reached by it will.
- (a) Remain the same (b) Be doubled
(c) Be quadrupled (d) Be halved
44. Force acting upon a charged particle kept between the plates of a charged condenser is F. If one plate of the condenser is removed, then the force acting on the same particle will become.
- (a) 0 (b) $F/2$ (c) F (d) $2F$
45. Masses of three wires of copper are in the ratio of 1: 3: 5 and their lengths are in the ratio of 5: 3: 1. The ratio of their electrical resistances are.
- (a) 1: 3: 5 (b) 5: 3: 1
(c) 1: 15: 125 (d) 125: 15: 1
46. Stern-Gerlach experiment is important because it gives experimental verification of
- (a) quantization of energy (b) orbital motion of electron
(c) electron spin (d) sommerfeld model of atom
47. Larmor frequency is the frequency of precession of
- (a) orbital angular momentum L about the external magnetic field, B
(b) spin angular momentum, S about the external magnetic field, B
(c) total angular momentum J about the external magnetic field, B
(d) orbital angular momentum, L about the total angular momentum J
48. The half-width of gain profile of a He-Ne laser is 2×10^{-3} nm. If the length of the cavity is 30 cm, how many longitudinal modes can be excited? The emission wavelength is 6328\AA .
- (a) 1 (b) 2 (c) 3 (d) 4
49. The ratio between most probable speed and root mean square speed of a gas molecule is
- (a) $\sqrt{\frac{3}{2}}$ (b) $\sqrt{\frac{3}{8\pi}}$ (c) $\sqrt{\frac{2}{3}}$ (d) $\sqrt{\frac{8}{3\pi}}$
50. Which one of the following is correct?
- (a) $\frac{E_\lambda}{T^4} = \text{constant}$ (b) $\frac{E_\lambda}{T^5} = \text{constant}$ (c) $\frac{E_\lambda}{T^2} = \text{constant}$ (d) $\frac{E_\lambda}{T} = \text{constant}$
51. A mass m of water at $T_1\text{K}$ is isobarically and adiabatically mixed with an equal mass of water at $T_2\text{K}$ the entropy change of the universe is
- (a) $2mC_p \ln \frac{(T_1+T_2)/2}{\sqrt{T_1T_2}}$ (b) $2m \ln \frac{(T_1+T_2)/2}{\sqrt{T_1T_2}}$ (c) $2C_p \ln \frac{(T_1+T_2)/2}{\sqrt{T_1T_2}}$ (d) $2mC_p$
52. If in an elastic collision, a massive particle collides against a lighter one at rest
- (a) it can never bounce back along its original path
(b) it may bounce back along its original path

- (c) the two particles move at right angles to each other after collision
 (d) none of the above
53. From the nozzle of rocket 100 kg of gases are exhausted per sec with a velocity of 1000 m/sec. what force (thrust) does the gas exert on the rocket?
 (a) 100 kg/sec (b) 10^5 N (c) 10^3 N (d) 100 N
54. The length of a rod, of length 5m in a frame of reference which is moving with 0.6 c velocity in a direction making 30° angle with the rod is nearly
 (a) 4.3 m (b) 3.4 m (c) 2.43 m (d) 2.34 m
55. Which of the following relations is correct for modulus of rigidity η bulk modulus K and poisson's ratio σ ?
 (a) $\sigma = \frac{K-2\eta}{6K+2\eta}$ (b) $\sigma = \frac{3K-2\eta}{K+2\eta}$ (c) $\sigma = \frac{3K-2\eta}{6K+2\eta}$ (d) $\sigma = \frac{K-2\eta}{K+2\eta}$
56. The depletion region is created by
 (a) ionization (b) diffusion (c) recombination (d) a, b and c
57. Where will be the position of the Fermi level of the n-type material when $N_D = N_A$
 (a) E_C (b) E_V (c) $\frac{E_C+E_V}{2}$ (d) none of these
58. Wien-bridge oscillators are based on
 (a) positive feedback (b) negative feedback (c) piezoelectric effect (d) high gain
59. For an ideal dielectric, polarization \vec{P} is given by
 (a) $\vec{P} = \epsilon_0 \vec{E}$ (b) $\vec{P} = (K-1)\epsilon_0 \vec{E}$ (c) $\vec{P} = (K+1)\epsilon_0 \vec{E}$ (d) $\vec{P} = \frac{\epsilon_0}{K-1} \vec{E}$
60. The dipole moment of water molecule is 6.2×10^{-30} C-m at 20°C . The polarizability α is
 (a) 3.17×10^{-39} C-m²/V (b) 3.17×10^{-37} C-m²/V
 (c) 3.17×10^{-35} C-m²/V (d) 3.17×10^{-33} C-m²/V
61. A circuit containing resistor R_1 inductor L_1 and capacitor C_1 connected in series gives resonance at the same frequency f as the second similar combination R_2L_2 and C_2 . If the two circuits are connected in series, the whole circuit will resonate at the frequency
 (a) $2f$ (b) $f/2$ (c) f (d) $f/4$
62. For dispersive medium, group velocity (v_g) and phase velocity (v_p) are related as
 (a) $v_g = v_p + \lambda \frac{dv_p}{d\lambda}$ (b) $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$ (c) $v_g = v_p + \frac{1}{\lambda} \frac{dv_p}{d\lambda}$ (d) $v_g = v_p - \frac{1}{\lambda} \frac{dv_p}{d\lambda}$
63. In Newton's ring experiment, the diameters of the bright rings are proportional to the
 (a) natural number (b) square root of natural numbers
 (c) square root of odd number (d) odd numbers
64. Interference pattern is produced by two point sources S_1 and S_2 on a plane perpendicular to the line joining S_1 and S_2 . What will be the shape of interference fringes?
 (a) straight line (b) circular (c) parabolic (d) hyperbolic
65. When the distance between two mirrors in Michelson interferometer decreased is
 (a) the fringe pattern appears to collapse at the centre
 (b) the fringe pattern expands
 (c) the fringe pattern remains stable
 (d) the shape of the fringe changes
66. An unpolarized light is incident on a glass plate placed in air at polarizing angle. The reflected light is
 (a) plane polarized with electric vector perpendicular to the plane of incidence
 (b) plane polarized with electric vector parallel to the plane of incidence
 (c) partially polarized having more electric field vectors perpendicular to the plane of incidence

- (d) partially polarized having more electric field vectors parallel to the plane of incidence
67. Number of generalized coordinates required to describe the motion of a solid cylinder rolling without slipping on a inclined plane is
 (a) 5 (b) 2 (c) 3 (d) 4
68. Which one of the following represents the equation of motion for the system described by the Hamiltonian $H(q,p)$?
 (a) $\dot{q} = \frac{\partial H}{\partial p}, \dot{p} = \frac{\partial H}{\partial q}$ (b) $-\dot{q} = \frac{\partial H}{\partial p}, \dot{p} = \frac{\partial H}{\partial q}$ (c) $\dot{q} = \frac{\partial H}{\partial p}, \dot{p} = -\frac{\partial H}{\partial q}$ (d) $\dot{q} = \frac{\partial H}{\partial p}, -\dot{p} = \frac{\partial H}{\partial q}$
69. A system is described by the Lagrangian $L(r, \theta, \dot{r}, \dot{\theta}) = \frac{1}{2}m\dot{r}^2 + \frac{1}{2}mr^2\dot{\theta}^2 + \frac{1}{r}$
 Which one of the following is not true?
 (a) total energy of the system is conserved (b) angular momentum of the system is conserved
 (c) θ is cyclic coordinate (d) linear momentum of system is conserved
70. Lagrangian for simple harmonic oscillator with frequency ω , mass m in one dimension is given by
 (a) $\frac{1}{2}m(\dot{x}^2 - \omega^2x^2)$ (b) $\frac{1}{2}m(\dot{x}^2 + \omega^2x^2)$ (c) $\frac{1}{2}m(\ddot{x} + \omega^2x^2)$ (d) $\frac{p^2}{2m} + \frac{1}{2}m\omega^2x^2$
71. The statistical systems in which both energy and number of particles change are best described by
 (a) micro-canonical ensemble theory (b) canonical ensemble theory
 (c) grand-canonical ensemble theory (d) both canonical as well as grand-canonical ensemble theory
72. Given three isobars, namely ${}_{11}^{25}\text{Na}$, ${}_{12}^{25}\text{Mg}$ and ${}_{13}^{25}\text{Al}$
 (a) ${}_{11}^{25}\text{Na}$ is stable and the other two are beta emitters
 (b) ${}_{12}^{25}\text{Mg}$ is stable and the other two are beta emitters
 (c) ${}_{13}^{25}\text{Al}$ is stable and the other two are beta emitters
 (d) all nuclei are stable
73. The rate of electron emission from 4 mg of ${}_{80}^{210}\text{Pb}$ with half-life 5 days is
 (a) 1.84×10^{16} (b) 1.84×10^{13} (c) 9.2×10^{11} (d) 9.2×10^{16}
74. The average velocity of nucleons inside the nucleus is of the order of
 (a) 3×10^8 m/s (b) 6×10^7 m/s (c) 3×10^6 m/s (d) 6×10^6 m/s
75. In a crystal a lattice plane cuts intercepts of $2a$, $3b$ and $6c$ along the axes where a , b , c are primitive vectors of the unit cell. The Miller indices the given plane are
 (a) (321) (b) (231) (c) (123) (d) (213)
76. Origin of characteristic X-ray is
 (a) photoelectric effect (b) inverse photoelectric effect
 (c) electronic transitions within atoms (d) Compton effect
77. The relation of the reciprocal basis vector \vec{A} to the direct basis vector \vec{a} is given by
 (a) $\vec{A} \cdot \vec{a} = 0$ (b) $\vec{A} \cdot \vec{a} = 2\pi$ (c) $\vec{A} \cdot \vec{a} = \pi$ (d) $\vec{A} \cdot \vec{a} = \frac{\pi}{2}$
78. The electron velocity v_F , at the Fermi surface is
 (a) $\hbar \left(\frac{3\pi^2 N}{V} \right)^{1/3}$ (b) $\frac{\hbar}{m} \left(\frac{3\pi^2 N}{V} \right)^{1/3}$ (c) $\frac{\hbar}{m} \left(\frac{3\pi N}{V} \right)^{1/3}$ (d) $\frac{\hbar}{m} \left(\frac{\pi^2 N}{V} \right)^{1/3}$
79. The direction of propagation of electromagnetic wave is given by
 (a) $\vec{E} \cdot \vec{B}$ (b) \vec{E} (c) $\vec{E} \times \vec{B}$ (d) \vec{B}
80. The divergence of the curl of a vector field is
 (a) a scalar (b) a vector (c) zero (d) infinity
81. In conductors, which condition will be true?
 (a) $\sigma\omega\epsilon > 1$ (b) $\frac{\sigma}{\omega\epsilon} > 1$ (c) $\frac{\sigma}{\omega\epsilon} < 1$ (d) $\sigma\omega\epsilon < 1$

82. The phenomenon employed in the waveguide operation is
 (a) reflection (b) refraction (c) total internal reflection (d) absorption
83. Given the matrix $\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$ with one of the eigenvalues equal to -3, the other two eigenvalues are
 (a) 0, 1 (b) 0, -1 (c) 0, 2 (d) -3, 5
84. The raising and lowering of angular momentum operators are defined as $L_{\pm} = L_x \pm iL_y$. The commutator $[L_-, L_{\pm}]$ is equal to
 (a) $-2\hbar L_-$ (b) $\hbar L_-$ (c) $\hbar L_+$ (d) $-\hbar L_-$
85. The bound state energy for the state $\psi_{5,4,2}(r, \theta, \phi)$ in a H-atom problem is given by
 (a) $-\frac{13.6}{5} eV$ (b) $-\frac{13.6}{25} eV$ (c) $-13.6 \times 5 eV$ (d) $-13.6 \times 25 eV$
86. In any Bohr orbit of hydrogen atom, the ratio of the kinetic energy to the potential energy of the electron is
 (a) 1/2 (b) 2 (c) -1/2 (d) -2
87. Considering the nuclear mass finite, the Rydberg constant is maximum for
 (a) hydrogen atom (b) deuterium atom
 (c) singly ionized helium atom (d) doubly ionized lithium atom
88. The loss of energy per hour in the iron core of a transformer, the hysteresis loop of which is equivalent in area to 2500 ergs/cm² is (given frequency = 50 Hz, density of iron = 7.5 g/cm³ weight of the iron core = 10 kg)
 (a) $5.985 \times 10^2 J$ (b) $5.985 \times 10^3 J$ (c) $5.985 \times 10^4 J$ (d) $5.985 \times 10^5 J$
89. Given the transformation $u = x + y$, $v = x - y$ and $du dv = k dx dy$, the value of k is
 (a) 1 (b) -1 (c) 2 (d) 1/2
90. If a^+ and a are creation and annihilation operators for SHO, then which of the following is not Hermitian operator
 (a) $aa^+ + a^+a$ (b) $aa^+ + a^+a$ (c) $i(a^+ - a)$ (d) $i(a^+ + a)$

