PHYSICS

1. The force which is always directed away or towards a fixed centre and magnitude of which is a function of distance only from the fixed centre is known as :

   (A) Coriolis force

   (B) Central force

   (C) Centrifugal force

   (D) Centripetal force

2. If the kinetic energy of a body becomes four times of its initial value, then new momentum will be :

   (A) three times its initial value

   (B) four times its initial value

   (C) two times its initial value

   (D) unchanged

3. The polar coordinates of a particle at any instant t are $r = 8e^{2t}$, $\theta = 4t$. Then radial component of acceleration is :

   (A) $16\ e^{2t}$

   (B) $12\ e^{2t}$

   (C) 12

   (D) 0

4. The potential energy of a harmonic oscillator in its resting position is 12 joules and average kinetic energy is 5 joules. Then the total energy at any instant is :

   (A) 17 joules

   (B) 22 joules

   (C) 5 joules

   (D) 12 joules

5. Moment of inertia of a uniform circular disc about a diameter is I. Its moment of inertia about an axis perpendicular to its plane and passing through a point on its rim will be :

(A) 4 I

(B) 6 I

(C) 3 I

(D) 5 I

6. Two simple harmonic waves having same frequency and each of amplitude A, superimpose. The resultant energy when two waves have phase difference of $\frac{\pi}{2}$ is given by (k being a constant) :

(A) $3\ kA^2$

(B) $4\ kA^2$

(C) 0

(D) $2\ kA^2$

7. Consider a beam of electrons moving parallel to two separate cylinders C_1 and C_2 kept at potential φ_1 and φ_2 respectively. The beam converges if :

(A) $\varphi_1 < \varphi_2$

(B) $\varphi_2 > \varphi_1$

(C) $\varphi_1 = \varphi_2$

(D) All the above conditions from (A) to (C) are satisfied

8. A particle of mass m and charge e moves with speed V in the plane perpendicular to a uniform magnetic field B. Its period of revolution will :

(A) be independent of B

(B) be independent of speed

(C) be inversely proportional to m

(D) depend on the radius of orbit

9. In streamline flow of liquid, the total energy of liquid is constant at :

(A) inner points

(B) outer points

(C) the centre

(D) all points

10. The Bernoulli's theorem is applicable if the flow of the liquid is :

(A) irrotational and liquid should be compressible

(B) rotational and liquid should be compressible

(C) irrotational and liquid should be incompressible

(D) rotational and liquid should be incompressible

11. If $\vec{A} = 3\hat{i}x$, $\vec{B} = 5\hat{j}y$, then $\nabla(\vec{A} \cdot \vec{B})$ is equal to :

(A) $5\hat{i}y + 3\hat{j}x$

(B) $\frac{3}{2}yx^2\hat{i} + \frac{5}{2}xy^2\hat{j}$

(C) 2

(D) 0

12. Let $\vec{r}$ be the position vector of any point on the surface of a cube of side L, then surface integral $\iint_S \vec{r} \cdot d\vec{S}$ is :

(A) $3L^3$

(B) $3L^2$

(C) $2L^2$

(D) 0

13. Polarization of a dieleetrical material occurs due to :

(A) electrons

(B) bound charges

(C) free charges

(D) none of the above

14. The electric potential at a point due to an electric dipole is perpendicular to the dipole axis, if the angle between dipole axis and the line joining the point with centre of dipole is :

(A) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$

(B) $\tan^{-1}(1)$

(C) $\tan^{-1}(\sqrt{2})$

(D) $\tan^{-1}(\sqrt{3})$

15. The electric field intensity $\vec{E}$ due to an infinite uniformly charge plane sheet at a point of distance r from the sheet is related as :

(A) $E \propto r$

(B) $E \propto \frac{1}{r}$

(C) $E \propto r^2$

(D) E is independent of r

16. Consider a boundary between two dielectric and dielectric field makes an angle θ_1 and θ_2 with the media of permittivity ϵ_1 and ϵ_2 respectively, then we have :

(A) $\frac{\tan\theta_1}{\tan\theta_2} = \frac{\epsilon_1}{\epsilon_2}$

(B) $\frac{\tan\theta_1}{\tan\theta_2} = \frac{\epsilon_2}{\epsilon_1}$

(C) $\frac{\tan\theta_1 + \tan\theta_2}{\tan\theta_2} = \frac{\epsilon_1}{\epsilon_2}$

(D) $\frac{\tan\theta_1 + \tan\theta_2}{\tan\theta_1} = \frac{\epsilon_2}{\epsilon_1}$

17. If u_E and u_M are respectively, the electric and magnetic energy derivatives of a plane electromagnetic wave propagation in free space, then :

(A) $u_E = 2u_M$

(B) $u_E = u_M$

(C) $u_E = \frac{1}{2}u_M$

(D) $u_E = \frac{3}{2}u_M$

18. When a pure inductance L and pure capacitance C are connected in parallel and a.c. voltage V is applied across the system, then at resonance the current from the source is :

(A) $\frac{V}{\omega L}$

(B) $-V\omega C$

(C) 0

(D) Very large

19. The magnetic induction $\vec{B}$ and magnetic vector potential $\vec{A}$ are related by :

(A) $\vec{A} = \vec{\nabla} \times \vec{B}$

(B) $\vec{\nabla} \times (\vec{A} \times \vec{B}) = 0$

(C) $\vec{B} = -\vec{\nabla} \times \vec{A}$

(D) $\vec{B} = \nabla \times \vec{A}$

20. If magnetic monopole existed, then which of the following Maxwell's equation will be modified :

(A) $\vec{\nabla} \cdot \vec{D} = \rho$

(B) $\vec{\nabla} \cdot \vec{B} = 0$

(C) $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

(D) $\vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$

21. In kinetic theory of gases, it is assumed that collision between the molecules is :

(A) perfectly elastic

(B) perfectly inelastic

(C) partly elastic

(D) partly inelastic

22. If the degree of freedom of a gas is 'n', then the ratio of specific heat at constant pressure C_p to specific heat at constant volume C_v is :

(A) $1 + \frac{1}{n}$

(B) $1 + \frac{2}{n}$

(C) $1 + \frac{1}{2n}$

(D) $\frac{2n}{1 + 2n}$

23. Which of the following Maxwell's relation leads to Clausius-Clapeyron equation ?

(A) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial V}\right)_V$

(B) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(C) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(D) $\left(\frac{\partial V}{\partial T}\right)_P = \left(\frac{\partial S}{\partial P}\right)_T$

24. The permissible microstates corresponding to a given macrostate satisfy the constraint/constraints :

(A) $\delta N \neq 0,\ \delta E \neq 0$

(B) $\delta N = 0,\ \delta E \neq 0$

(C) $\delta N = 0,\ \delta E = 0$

(D) $\delta N \neq 0,\ \delta E = 0$

25. For a perfect gas $\left(\frac{\partial U}{\partial V}\right)_T = 0$, while for a gas obeying van der Waals' equation $\left(\frac{\partial U}{\partial V}\right)_T$ is equal to :

(A) aV^2

(B) $(V - b)$

(C) $\frac{1}{V - b}$

(D) $\frac{a}{V^2}$

26. For cooling to take place in a Joule-Thomson experiment, the initial temperature of gas should be :

(A) equal to the inversion temperature

(B) less than the inversion temperature

(C) more than inversion temperature

(D) more than or equal to the inversion temperature

27. If a system A is in thermal equilibrium separately with B and C, then B and C are also in thermal equilibrium with each other. This is the statement of :

(A) Zeroth law of thermodynamics

(B) First law of themodynamics

(C) Second law of thermodynamics

(D) Third law of thermodynamics

28. The quantum statistics reduces to classical statistics under the following condition (ρ is the number density of particles and λ is the thermal de-Broglie wavelengths) :

(A) $\rho\lambda^3 = 1$

(B) $\rho\lambda^3 >> 1$

(C) $\rho\lambda^3 << 1$

(D) $\rho = 0$

29. In statistical physics, the absolute temperature T of a system is related to the total number of accessible state Ω by :

(A) $kT = \frac{\partial\Omega}{\partial E}$

(B) $\frac{1}{kT} = \frac{\partial\Omega}{\partial E}$

(C) $kT = \frac{\partial \log\Omega}{\partial E}$

(D) $\frac{1}{kT} = \frac{\partial \log\Omega}{\partial E}$

30. In a gas the relative magnitude of the most probable speed (V_p), the average speed ($\bar{V}$) and root mean speed (V_{rms}) of the molecule are :

(A) $V_{rms} > \bar{V} > V_p$

(B) $\bar{V} > V_{rms} > V_p$

(C) $V_p > \bar{V} > V_{rms}$

(D) $V_p > V_{rms} > \bar{V}$

31. The reverberation time is the time which energy density of sound wave falls to 10^{-6} of its :

(A) maximum steady value

(B) half maximum steady value

(C) minimum steady value

(D) mean value

32. If the intensity of sound is doubled, then intensity level difference increases by :

(A) 50 dB

(B) 30 dB

(C) 10 dB

(D) 3 dB

33. An ultrasonic sound pulse is sent vertically down the ocean waters and the echo is received 3 seconds later. The depth of the ocean at that place is approximately :

(A) 4.40 km

(B) 3.30 km

(C) 2.20 km

(D) 1.10 km

34. If the equation of motion of a longitudinal wave is $y = 0.15 \sin (4\pi t - 2\pi x)m$, and let the displacement of a particle due to this wave is 0.15 m, its kinetic energy is :

(A) 4.8 J

(B) 2.4 J

(C) 1.14 J

(D) zero

35. The minimum number of lines in a grating which will just resolve the spectral lines of wavelength 5890 Å and 5896 Å in second order is :

(A) 491

(B) 981

(C) 2940

(D) 2943

36. The resolving power of a telescope is the highest for :

(A) red light

(B) yellow light

(C) green light

(D) blue light

37. The power of Huygen's eye-piece is :

(A) zero

(B) positive

(C) negative

(D) none of the above

38. In Michelson's interferometer sodium light is used for circular fringes. The distances of separation of two mirrors for two consecutive positions of least contrast are equal to d_1 and d_2. If λ_1 and λ_2 are wavelengths of two lines of sodium light, then their difference $(\lambda_1 - \lambda_2)$ is equal to :

(A) $\dfrac{\lambda_1\lambda_2}{2(d_2 - d_1)}$

(B) $\dfrac{\lambda_1\lambda_2}{2(d_2 + d_1)}$

(C) $\dfrac{3\lambda_1\lambda_2}{2(d_2 - d_1)}$

(D) $\lambda_1\lambda_2(d_2 + d_2)$

39. Chromatic aberration can be eliminated by using two convex lenses of focal lengths, f_1 and f_2 respectively. Which are separated by a distance equal to :

(A) $d = (f_1 - f_2)$

(B) $d = (f_1 + f_2)$

(C) $d = \dfrac{(f_1 + f_2)}{2}$

(D) $\dfrac{1}{d} = \dfrac{1}{f_1} + \dfrac{1}{f_2}$

40. For a system of atoms and photons in equilibrium at a temperature T, the ratio of transition rate of stimulated to spontaneous emission is given by :

(A) $e^{h\nu / kT}$

(B) $e^{-h\nu / kT}$

(C) $\dfrac{1}{e^{h\nu / kT} - 1}$

(D) $1 - e^{h\nu} / kT$

41. A light beam moves in positive x-direction with speed of light c. Another light beam moves in the negative x-direction with same speed. To an observer sitting on the first beam, the second beam appears to move with speed :

(A) $2c$

(B) c

(C) 0

(D) $\frac{c}{2}$

42. Let rest mass of a body be m_0 and if it is moving with the velocity of $0.8\,c$, then its relativistic kinetic energy is :

(A) $\frac{1}{2}m_0(0.8c)^2$

(B) $m_0c^2 - \frac{1}{2}m_0(.8c)^2$

(C) $\frac{3}{2}m_0c^2$

(D) $\frac{2}{3}m_0c^2$

43. The uncertainty in the location of a particle is equal to de-Broglie wavelength, then the uncertainty in its velocity is :

(A) $\frac{3}{2}$V

(B) 2 V

(C) V

(D) $\frac{V}{2}$

44. For an electron orbit with orbital quantum number $l = 2$, the possible values of components of total angular momentum along specified direction (z-axis) are :

(A) $\pm\frac{1}{2}\left(\frac{h}{2\pi}\right), \pm\frac{3}{2}\left(\frac{h}{2\pi}\right)$

(B) $\pm\frac{3}{2}\left(\frac{h}{2\pi}\right), \pm\frac{5}{2}\left(\frac{h}{2\pi}\right)$

(C) $\pm\frac{1}{2}\left(\frac{h}{2\pi}\right), \pm\frac{5}{2}\left(\frac{h}{2\pi}\right)$

(D) $\pm\frac{1}{2}\left(\frac{h}{2\pi}\right), \pm\frac{3}{2}\left(\frac{h}{2\pi}\right), \pm\frac{5}{2}\left(\frac{h}{2\pi}\right)$

45. The lowest energy for a particle in a box of length L is (m is mass of the particle) :

(A) $\frac{\hbar^2\pi^2x^2}{2mL^2}$

(B) $\frac{\hbar^2\pi^2}{2mL^2}$

(C) $\sqrt{\frac{2}{L}}\sin\frac{n\pi x}{L}$

(D) $\frac{n\hbar}{2\pi}$

46. If the frequency of k_α X-ray emitted from the element with atomic number 31 is f, then frequency of k_α X-ray emitted from the element with atomic number 51 is :

(A) $\frac{25}{9}f$

(B) $\frac{5}{3}f$

(C) $\frac{51}{31}f$

(D) $\frac{9}{25}f$

47. The vibrational-rotational molecular spectra arises as energy involved in such a transition is of the order of :

(A) 0.001 eV

(B) 0.01 eV

(C) 0.1 eV

(D) 10 eV

48. A Raman frequency shift of 3000 cm^{-1} is observed for a substance. The substance will show infrared absorption at :

(A) 0.3 μm

(B) 3 μm

(C) 30 μm

(D) 300 Å

49. The source of energy of the sun is due to :

(A) fusion of heavy nuclei

(B) fusion of light nuclei

(C) fusion of very heavy nuclei

(D) fusion and fission process

50. The tunnel effect makes possible :

(A) α-decay

(B) positive β-decay

(C) negative β-decay

(D) gamma decay

51. The basic structure of NaCl is :

(A) simple cubic

(B) fcc

(C) bcc

(D) hexagonal closed packed

52. According to Kronig-Penny model the energy spectrum of electron :

(A) is continuous

(B) consists of alternate regions of allowed and forbidden energy of equal width

(C) consists of alternate regions of allowed and forbidden energy such that width of energy bands increases with the increase of energy

(D) consists of alternate regions of allowed and forbidden energy such that width of allowed energy bands with the increase of energy

53. According to Debye's model for the lattice specific heat at low temperature, its value is proportional to :

(A) T^3

(B) T^2

(C) T

(D) $e^{-h\nu/kT}$

54. The first Brillouin zone of the lattice in the k-space is between :

(A) 0 to $\frac{\pi}{a}$

(B) $-\frac{\pi}{a}$ to $+\frac{\pi}{a}$

(C) $-\frac{\pi}{a}$ to $-\frac{2\pi}{a}$

(D) $+\frac{\pi}{a}$ to $+\frac{2\pi}{a}$

55. When electrons leave the N-material to fill holes in the P-material, the process is called :

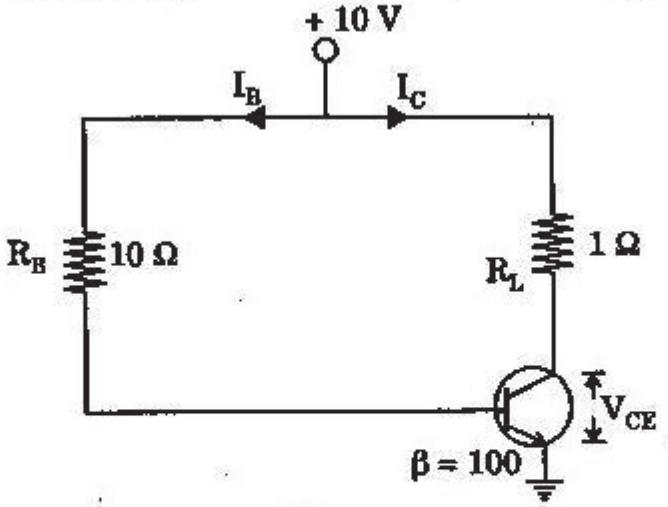
(A) doping

(B) mixing

(C) depletion

(D) diffusion

56. For the C.E. circuit of figure below, the value of V_{CE} is (take $\beta = 100$) :



(A) 5 V
(B) –5 V
(C) 0
(D) 20 V

57. Leakage current of a junction diode :
(A) is in the range of mA to μA
(B) is due to majority carriers
(C) depends on the method of its fabrication
(D) decreases with temperature

58. The most desirable feature of transformer coupled amplifiers is its :
(A) ability to provide impedance matching between stages
(B) higher voltage gain
(C) wide frequency range
(D) ability to eliminate hum from the output

59. In a JFET drain current is maximum when V_{GS} is :
(A) zero
(B) negative
(C) positive
(D) equal to V_P

60. The *h*-parameters are called hybrid because they :
(A) are obtained from different characteristics
(B) are mixed with other paramters
(C) apply to circuits contained in a black box
(D) are defined by using both open and short circuit terminations