PHYSICS

1. If the Cartesian coordinates of a point are (1, 0, 0), then the spherical polar coordinates of the same point are :

   (A)   (0, 90°, 0)

   (B)   (0, 90°, 180°)

   (C)   (1, 90°, 0)

   (D)   (0, 180°, 90°)

2. Coriolis force is experienced :

   (A)   in inertial frame of reference only

   (B)   in non-inertial frame of reference only

   (C)   both in inertial and non-inertial frames

   (D)   neither in inertial nor in non-inertial frames

3. A mass m is moving with a constant velocity along a line parallel to the x-axis from the origin. Its angular momentum w.r.t. the origin :

   (A)   is zero

   (B)   goes on increasing

   (C)   goes on decreasing

   (D)   is constant

4. The moment of inertia of a solid sphere and a spherical shell of equal masses about their diameters are equal. The ratio of their radii is :

   (A) $3 : 5$

   (B) $5 : 3$

   (C) $\sqrt{3} : \sqrt{5}$

   (D) $\sqrt{5} : \sqrt{3}$

5. A body executes S.H.M. with an amplitude A. At what displacement from the mean position is the potential energy of the body one-fourth of its total energy ?

(A) A/4

(B) A/2

(C) 3A/4

(D) $\dfrac{A}{\sqrt{2}}$

6. The amplitude of the transient state :

(A) increases exponentially with time

(B) decreases exponentially with time

(C) falls suddenly to zero

(D) becomes infinite after some time

7. An electric charge in a uniform motion produces :

(A) an electric field only

(B) a magnetic field only

(C) both electric and magnetic field

(D) no such field at all

8. The limitation of a cyclotron is that it can't be used to accelerate neutral particles like neutrons because they :

(A) experience force in electric fields only

(B) experience force in magnetic fields only

(C) experience force both in electric and magnetic fields

(D) do not experience force in electric and magnetic fields

9. A wire is stretched by a force such that its length becomes double. Then Young's modulus of rigidity Y of the wire will :

   (A) have no change

   (B) become double of its original value

   (C) become half of its original value

   (D) become four times of its original value

10. When terminal velocity is reached, the acceleration of the body moving through viscous medium is :

    (A) Positive

    (B) Negative

    (C) Zero

    (D) Equal to acceleration due to gravity

11. A vector field $\vec{A}$ is said to be irrotational if :

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

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

    (C) $\vec{\nabla} \times \vec{A} = 1$

    (D) $\vec{\nabla} . \vec{A} = 1$

12. If

$$\vec{A} = \frac{x}{r}\hat{i} + \frac{y}{r}\hat{j} + \frac{z}{r}\hat{k},$$

    where $\vec{r}$ is the positive vector, then $\nabla . \vec{A}$ is given by :

    (A) $\dfrac{2}{r^2}$

    (B) $\dfrac{2}{r}$

    (C) Zero

    (D) 3

13. The electric field intensities due to a dipole on its axial line and equitorial line are represented by E_{axial} and $E_{equ.}$ respectively, then relation between them is given by :

(A) $E_{axial} = E_{equ.}$

(B) $E_{axial} = 4E_{equ.}$

(C) $E_{axial} = 2E_{equ.}$

(D) $E_{axial} = \frac{1}{2}E_{equ.}$

14. A surface of a charged conductor is always under a electrostatic pressure acting :

(A) randomly

(B) inward

(C) outward

(D) none of the above

15. A parallel plate capacitor with oil between the plates (dielectric constant of oil $k = 2$) has a capacitance C. If the oil is removed, then capacitance of capacitor becomes :

(A) $\frac{C}{2}$

(B) $\frac{C}{\sqrt{2}}$

(C) $2C$

(D) $\sqrt{2}C$

16. An LCR series circuit is connected to a source of alternating current. At resonance, the applied voltage and the current flowing through the circuit will have a phase difference of :

(A) π

(B) $\pi/2$

(C) $\pi/4$

(D) 0

17. A magnetic material is non-uniformly magnetised. If the magnetisation at any point in a material is given by $xz^2\hat{i} + xy\hat{j}$, then equivalent current density $\vec{J}$ is :

(A) $2xz\hat{j} + y\hat{k}$

(B) $2xz\hat{j} + x\hat{k}$

(C) $xz^2\hat{i} + y\hat{k}$

(D) $xz^2\hat{i} + x\hat{k}$

18. If k is dielectric constant and χ_e is electric susceptibility, then relation between them is given by :

(A) $k = \dfrac{1 - \chi_e}{1 + \chi_e}$

(B) $k = \dfrac{1 + \chi_e}{1 - \chi_e}$

(C) $k = 1 + \chi_e$

(D) $k = 1 - \chi_e$

19. If ϵ_0 and μ_0 represent the permittivity and permeability of vacuum, ϵ and μ represent the permittivity and permeability of medium, then refractive index of the medium is given by :

(A) $\sqrt{\dfrac{\epsilon_0 \mu_0}{\epsilon \mu}}$

(B) $\sqrt{\dfrac{\epsilon \mu}{\epsilon_0 \mu_0}}$

(C) $\sqrt{\dfrac{\epsilon}{\mu_0 \epsilon_0}}$

(D) $\sqrt{\dfrac{\mu_0 \epsilon_0}{\epsilon}}$

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20. In an electromagnetic wave the rate of flow of energy per unit area along the direction of propagation of the wave is given by :

    (A) $(\vec{E} \times \vec{B})/\mu$

    (B) $(\vec{E} \times \vec{B})/\epsilon$

    (C) $(\vec{E} \times \vec{B})/\mu\epsilon$

    (D) $(\vec{E} \times \vec{B})$

21. For an ideal gas in an adiabatic process at a constant pressure P, the rate of change of internal energy U with temperature T is :

    (A) a negative constant

    (B) directly proportional to T

    (C) a positive constant

    (D) zero

22. Mean free path of gas molecules is inversely proportional to :

    (A) Temperature

    (B) Volume

    (C) Pressure

    (D) None of the above

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

    (A) aV^2

    (B) $(V - b)$

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

    (D) a/V^2

24. At temperature above the temperature of inversion, the gases show :

    (A) heating effect

    (B) cooling effect

    (C) neither cooling nor heating effect

    (D) both cooling and heating effects

25. Which of the following is *not* one of Maxwell's four thermodynamic relations ?

    (A) $\left(\dfrac{\partial T}{\partial P}\right)_N = -\left(\dfrac{\partial P}{\partial S}\right)_V$

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

    (C) $\left(\dfrac{\partial T}{\partial V}\right)_S = -\left(\dfrac{\partial P}{\partial S}\right)_V$

    (D) $\left(\dfrac{\partial U}{\partial V}\right)_S = -\left(\dfrac{\partial U}{\partial S}\right)_V$

26. If the initial and final temperatures are T_1 and T_2 absolute, then efficiency of Carnot engine is given by :

    (A) $\eta = 1 - \dfrac{T_1}{T_2}$

    (B) $\eta = 1 - \dfrac{T_2}{T_1}$

    (C) $\eta = \dfrac{T_1}{T_2}$

    (D) $\eta = \dfrac{T_2}{T_1}$

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27. All accessible microstates corresponding to possible macrostates are equally probable. This is the most fundamental postulate of Statistical Mechanics and is called :

(A) Postulate of additive law of probability

(B) Postulate of multiplicative law of probability

(C) Postulate of equal a priori probability

(D) Postulate of independent law of probability

28. According to Boltzmann's canonical distribution law, the low energy cells will contain :

(A) less particles than high energy cells

(B) more particles than high energy cells

(C) infinite particles than high energy cells

(D) equal number of particles in high energy cells

29. In Maxwell-Boltzmann distribution, the most probable speed is defined as when :

(A) Probability distribution is zero

(B) Probability distribution is one

(C) Probability distribution is maximum

(D) Probability distribution is minimum

30. Bose-Einstein statistics is based on quantum statistics given by indistinguishable particles of :

(A) Integral spin

(B) Half spin

(C) Pauli's exclusion principle

(D) Electron spins

31. Which of the following does *not* affect the reverberation time of a room ?

    (A) Area of the walls

    (B) Volume

    (C) Frequency

    (D) Absorption coefficient

32. Sound waves having which frequency are audible by human being ?

    (A) 5 cycles/sec

    (B) 27,000 cycles/sec

    (C) 5,000 cycles/sec

    (D) 50,000 cycles/sec

33. When two sound waves of same frequency and amplitude are 100 degrees out of phase, the result is :

    (A) beats

    (B) increased loudness

    (C) resonance

    (D) silence

34. One of the practical applications of reflection of sound is :

    (A) speaking tube

    (B) ear trumpet

    (C) the sound board

    (D) all the examples above are practical application of reflection of sound

35. According to Fermat's principle of all the paths connecting two points, the path actually followed by light is :

(A) maximum only

(B) minimum only

(C) either maximum or minimum

(D) none of the above

36. For an achromatic combination of two lenses in contact the lenses should have :

(A) equal dispersive powers

(B) same focal length

(C) unequal dispersive powers and should be either both convex or both concave

(D) unequal dispersive powers and one should be convex and the other concave

37. In an interference pattern minima has zero intensity when the disturbances superimposed have :

(A) unequal amplitudes

(B) equal amplitudes

(C) unequal phases

(D) none of the above

38. In case of a grating the ratio of the wavelength of a line in the spectrum to the least difference in the wavelength of the next line that can just be seen as separate is known as :

(A) dispersive power

(B) magnifying power

(C) resolving power

(D) luminosity power

39. In elliptically polarised light :

(A) the amplitude of the vibrations changes in direction as well as in magnitude

(B) the amplitude of the vibrations changes in magnitude only

(C) the magnitude of the vibrations changes in direction only

(D) none of the above statements is correct

40. A laser is a coherent source because it contains :

(A) many frequencies

(B) uncoordinated waves of a particular frequency

(C) coordinated waves of many wavelengths

(D) coordinated waves of a particular frequency

41. At what fraction of the velocity of light must a body move in order that its rest mass increases three times ?

    (A) $\dfrac{2\sqrt{2}}{3}$

    (B) $\dfrac{\sqrt{2}}{3}$

    (C) $\dfrac{\sqrt{3}}{2}$

    (D) $\sqrt{\dfrac{2}{3}}$

42. Lengths of objects in motion :

    (A) appear increased in the direction of motion

    (B) appear decreased in the direction of motion

    (C) are the same as for stationary objects

    (D) appear decreased perpendicular to the direction of motion

43. A photon and electron have got same de-Broglie wavelength. If E_1 and E_2 are total energies of photon and electron respectively, then :

    (A) $E_2 = E_1$

    (B) $E_2 < E_1$

    (C) $E_2 > E_1$

    (D) $E_2 = E_1 = 0$

44. The physical significance of principal quantum number n in hydrogen atom governs :

    (A) total energy of electron

    (B) magnitude of angular momentum of electron

    (C) direction of angular momentum of electron

    (D) total angular momentum of electron

45. The Lande's 'g' factor for s electron is equal to :

   (A) 1

   (B) 2

   (C) 1/2

   (D) 3/2

46. K_B-line in an X-ray spectra will arise when an electron from :

   (A) the K-shell goes to L-shell

   (B) the M-shell goes to K-shell

   (C) the M-shell goes to L-shell

   (D) the N-shell goes to K-shell

47. If the angular frequencies of the incident and the scattered photons in Raman scattering are ω and ω' respectively, then :

   (A) $\omega' > \omega$ for the anti-stokes lines

   (B) $\omega' > \omega$ for the stokes lines

   (C) $\omega' > \omega$ for the stokes as well as anti-stokes lines

   (D) $\omega' < \omega$ for the stokes as well as anti-stokes lines

48. A rigid diatomic molecule is free to rotate in a fixed plane. The rotational energy eigen values are given by :

   (A) $\dfrac{ml}{2\hbar^2}$

   (B) $\dfrac{2ml}{\hbar^2}$

   (C) $\dfrac{\hbar^2 l}{2m}$

   (D) $\dfrac{\hbar m^2}{2l}$

49. The nucleus $_{48}Cd^{115}$, after two successive β-decays will give :

(A) $_{46}Pa^{113}$

(B) $_{48}Cd^{114}$

(C) $_{50}Sn^{113}$

(D) $_{50}Sn^{115}$

50. According to liquid drop model, when a nucleus is bombarded by neutrons, the compound nucleus attains the given shapes in the sequence :

(A) ellipsoidal, spherical, dumb-bell

(B) spherical, ellipsoidal, dumb-bell

(C) spherical, dumb-bell, ellipsoidal

(D) dumb-bell, ellipsoidal, spherical

51. The number of atoms per unit bcc cell is :

(A) 4

(B) 3

(C) 2

(D) 1

52. If $\vec{K}$ represents wave vector space and $\vec{G}$ represents reciprocal lattice, then Bragg's diffraction condition is given by :

(A) $\vec{K}.\vec{G} + G^2 = 0$

(B) $\vec{K}.\vec{G} - G^2 = 0$

(C) $\vec{K}.\vec{G} + 2G^2 = 0$

(D) $2\vec{K}.\vec{G} + G^2 = 0$

53. According to Langevin's classical theory of diamagnetism, the susceptibility of diamagnetism substance is :

(A) proportional to number of electrons Z

(B) inverversely proportional to number of electrons Z

(C) independent of number of electrons Z

(D) None of the above statements

54. The Fermi energy in a metal is given by (m^* is effective mass of electron) :

(A) $E_f = \dfrac{\hbar^2}{m^*}\left(\dfrac{3N}{8\pi V}\right)^{\frac{2}{3}}$

(B) $E_f = \dfrac{\hbar^2}{2m^*}\left(\dfrac{3N}{8\pi V}\right)^{\frac{1}{3}}$

(C) $E_f = \dfrac{\hbar^2}{2m^*}\left(\dfrac{3N}{8\pi V}\right)^{\frac{2}{3}}$

(D) $E_f = \dfrac{\hbar^2}{m^*}\left(\dfrac{3N}{8\pi V}\right)^{\frac{1}{3}}$

55. In an N-type semiconductor, there are :

(A) no majority carriers

(B) immobile negative ions

(C) immobile positive ions

(D) holes as majority carriers

56. When a P-N junction of a diode is forward-biased, diffusion current causes :

(A) covalent bonding

(B) forward bonding

(C) reverse-biasing

(D) establishment of barrier potential

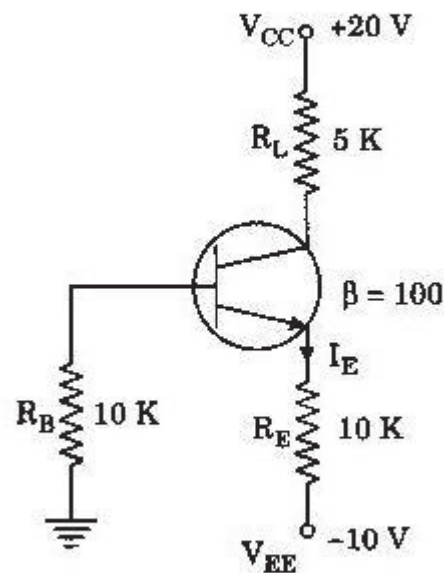57. The value of I_E in the circuit shown in the below given Fig. is (taking $\beta = 100$) :

Fig.

(A) 9.9 mA
(B) 0.99 mA
(C) 9.9 A
(D) 0.099 mA

58. For small values of drain-to-source voltage, JFET behaves like a :

(A) resistor
(B) constant-current source
(C) constant-voltage source
(D) negative resistance

59. The most desirable feature of transformer coupling is its :

(A) higher voltage gain
(B) wide frequency range
(C) ability to provide impedance matching between stages
(D) ability to eliminate hum from the output

60. The smallest of the four h-parameters of a transistor is :

(A) h_i
(B) h_o
(C) h_r
(D) h_f