PRACTICE PAPER 23

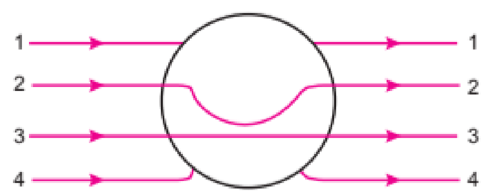
PHYSICS

Time allowed: 45 minutes **Maximum Marks: 200**

General Instructions: *Same as Practice Paper-1.*

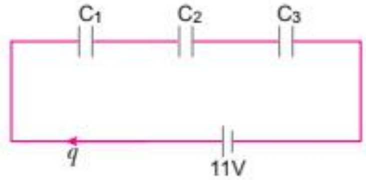
Choose the correct option in the following questions.

1. **A hemisphere is uniformly charged positively. The electric field at a point on a diameter away from the centre is directed**
   (*a*) perpendicular to the diameter (*b*) parallel to the diameter
   (*c*) at an angle tilted towards the diameter (*d*) at an angle tilted away from the diameter
2. **The unit of permittivity of free space (ε_0) is**
   (*a*) $CN^{-1}m^{-1}$ (*b*) Nm^2C^{-2}
   (*c*) $C^2 N^{-1}m^{-2}$ (*d*) $C^2 N^{-2}m^{-2}$
3. **Two point charges q_1 and q_2 are at separation r. The force acting between them is given by $F = K\dfrac{q_1 q_2}{r^2}$. The constant K depends upon**
   (*a*) only on the system of units (*b*) only on medium between charges
   (*c*) both on (*a*) and (*b*) (*d*) neither on (*a*) nor on (*b*)
4. **A metallic solid is placed in a uniform electric field.**



   The lines of force follow the path(s) shown in figure as:
   (*a*) 1 (*b*) 2
   (*c*) 3 (*d*) 4
5. **A charge Q is supplied to a metallic conductor. Which of the following statements is correct?**
   (*a*) Electric field inside it is same as on the surface.
   (*b*) Electric potential inside is zero.
   (*c*) Electric potential on the surface is zero.
   (*d*) Electric potential inside it is constant.
6. **Equipotential surfaces**
   (*a*) are closer in regions of large electric fields compared to regions of lower electric fields.
   (*b*) will be more crowded near sharp edges of a conductor.
   (*c*) will be more crowded near regions of large charge densities.
   (*d*) all of the above

7. **Three capacitors of capacitances 1 μF, 2 μF & 3 μF are connected in series and a potential difference of 11V is applied across the combination then the potential difference across the plates of 1 μF capacitor is**



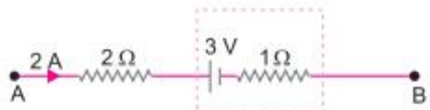
(*a*) 2 V (*b*) 3 V (*c*) 4 V (*d*) 6 V

8. **The electric potential at a point (*x*, *y*, *z*) is given by $V = -x^2y - xz^3 + 4$. The electric field $\vec{E}$ at that point is**

(*a*) $\vec{E} = 2xy\,\hat{i} + (x^2 + y^2)\,\hat{j} + (3xz - y^2)\,\hat{k}$ (*b*) $\vec{E} = z^3\,\hat{i} + xyz\,\hat{j} + z^2\,\hat{k}$

(*c*) $\vec{E} = (2xy - z^3)\,\hat{i} + xy^2\,\hat{j} + 3z^2x\,\hat{k}$ (*d*) $\vec{E} = (2xy + z^3)\,\hat{i} + x^2\,\hat{j} + 3xz^2\,\hat{k}$

9. **Figure represents a part of a closed circuit. The potential difference between points *A* and *B* ($V_A - V_B$) is**



(*a*) +9 *V* (*b*) – 9 *V* (*c*) +3 *V* (*d*) + 6 *V*

10. **Which of the following phenomenon cannot take place with longitudinal waves (*e.g.*, sound waves)?**

(*a*) Reflection (*b*) Interference

(*c*) Diffraction (*d*) Polarisation

11. **In a Wheatstone bridge, three resistances *P*, *Q* and *R* are connected in the three arms and the fourth arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balanced will be**

(*a*) $\frac{P}{Q} = \frac{2S}{S_1 + S_2}$ (*b*) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{S_1 S_2}$ (*c*) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{2S_1 S_2}$ (*d*) $\frac{P}{Q} = \frac{R}{S_1 S_2}$

12. **For a fixed potential difference applied across a conductor, the drift speed of free electrons does not depend upon**

(*a*) free electron density in the conductor. (*b*) mass of the electrons.

(*c*) length of the conductor (*d*) temperature of the conductor.

13. **Current sensitivity of a galvanometer can be increased by decreasing**

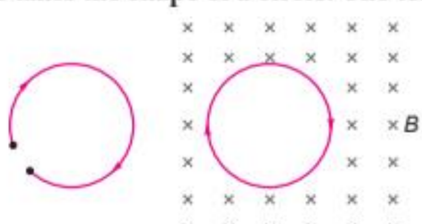
(*a*) torsional constant K (*b*) area A

(*c*) magnetic field B (*d*) number of turns N

14. **The expression for magnetic force per unit charge $\vec{F}_m$, when a charge *q* moves with a velocity $\vec{v}$ in a magnetic field $\vec{B}$ is given by**

(*a*) $\vec{F}_m = (\vec{v}.\vec{B})$ (*b*) $\vec{F}_m = (\vec{v} \times \vec{B})$ (*c*) $\vec{F}_m = \frac{1}{q}(\vec{v} \times \vec{B})$ (*d*) $\vec{F}_m = q(\vec{v} \times \vec{B})$

15. **A thin flexible wire of length *L* is connected to two adjacent fixed points and carries a current *I* in the clockwise direction as shown in Fig. When the system is put in a uniform magnetic field of strength *B* going into the plane of the paper, the wire takes the shape of a circle. The tension in the wire is**



(*a*) *IBL* (*b*) *IBL*/π (*c*) $\frac{IBL}{2\pi}$ (*d*) $\frac{IBL}{4\pi}$

16. **A charged particle with charge q enters a region of constant uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$ and comes out without any change in magnitude or direction of $\vec{v}$. Then**

(*a*) $\vec{v} = \frac{\vec{B} \times \vec{E}}{E^2}$ (*b*) $\vec{v} = \frac{\vec{E} \times \vec{B}}{E^2}$ (*c*) $\vec{v} = \frac{\vec{B} \times \vec{E}}{E^2}$ (*d*) $\vec{v} = \frac{\vec{E} \times \vec{B}}{B^2}$

17. **Given below are two statements labelled as Statement P and Statement Q:**

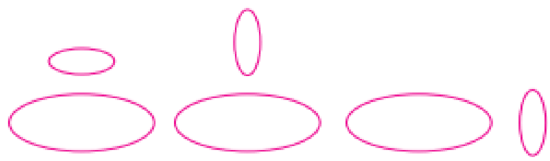
Statement P : In an electromagnetic wave electric and magnetic field vectors are mutually perpendicular and have a phase of $\frac{\pi}{2}$.

Statement Q : Phase difference refers to time difference. There is a time difference between the peaks of electric and magnetic oscillations in EM waves.

Select the most appropriate option:

(*a*) P is true, but Q is false (*b*) P is false, but Q is true
(*c*) Both P and Q are true (*d*) Both P and Q are false

18. **Two circular coils can be arranged in any of the three situations as shown in fig. Their mutual inductance will be:**



(*i*) (*ii*) (*iii*)

(*a*) maximum in situation (*i*) (*b*) maximum in situation (*ii*)
(*c*) maximum in situation (*iii*) (*d*) same in all situations

19. **The strength of a photoelectric current depends upon**

(*a*) frequency of incident radiation (*b*) intensity of incident radiation
(*c*) angle of incident radiation (*d*) distance between anode and cathode

20. **The equivalent inductance of two inductors is 2.4 H when connected in parallel and 10 H when connected in series. What is the value of inductances of the individual inductors?**

(*a*) 2 H, 8 H (*b*) 4 H, 6 H
(*c*) 3 H, 7 H (*d*) 5 H, 5 H

21. **In a circuit current I is given by $I = I_0 \sin(\omega t - \pi/2)$ when *ac* potential of $E = E_0 \sin \omega t$ has been applied. Then the power consumption P in the circuit would be:**

(*a*) $\frac{E_0 I_0}{\sqrt{2}}$ (*b*) $\frac{E_0 I_0}{2}$ (*c*) $\frac{EI}{\sqrt{2}}$ (*d*) zero

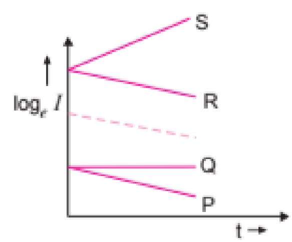
22. **An *ac* source is connected in series to an inductance L and a capacitance C, such that the frequency of the *ac* source is**

(*a*) $L^{-1}C^{-1}$ (*b*) $L^{-1/2}C^{-1/2}$ (*c*) $\left(\frac{1}{2\pi}\right)L^{-1}C^{-1}$ (*d*) $\left(\frac{1}{2\pi}\right)L^{-1/2}C^{-1/2}$

23. **In a transformer, the number of turns of primary and secondary coil are 500 and 400 respectively. If 220 V is supplied to the primary coil, then ratio of currents in primary and secondary coils is**

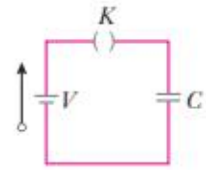
(*a*) 5 : 9 (*b*) 5 : 4 (*c*) 9 : 5 (*d*) 4 : 5

24. **In an *RC* circuit while charging, the graph of $\log_e I$ versus time (t) is shown by the dotted line in the diagram where I is the current. When the value of the resistance is doubled, which of the solid curves best represents the variation of $\log_e I$ versus time (t)?**



(*a*) *P* (*b*) *Q*
(*c*) *R* (*d*) *S*

25. **A parallel plate capacitor is connected to a battery as shown in figure.**
Consider two situations:



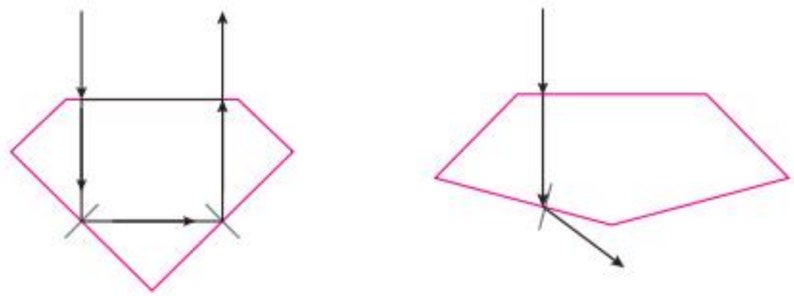
(*i*) Key *K* is kept closed and plates of capacitors are moved apart using insulating handle.

(*ii*) Key *K* is opened and plates of capacitors are moved apart using insulating handle.

Choose the correct option:

(*a*) In (*i*), *Q* remains same but *C* changes.
(*b*) In (*ii*), *V* remains same but *C* changes.
(*c*) In (*i*), *V* remains same and hence *C* changes.
(*d*) In (*ii*) both *Q* and *V* changes.

26. **The following diagram shows same diamond cut in two different shapes.**



The brilliance of diamond in the second diamond will be:

(*a*) less than the first
(*b*) greater than first
(*c*) same as first
(*d*) will depend on the intensity of light

27. **Light cannot easily escape a diamond without multiple internal reflections. This is because**

(*a*) its critical angle with reference to air is too large.
(*b*) its critical angle with reference to air is too small.
(*c*) the diamond is transparent.
(*d*) rays always enter at angle greater than critical angle.

28. **The phenomenon by which an underwater hemispherical field of view is compressed into a conical field is known as**

(*a*) Snell's law
(*b*) Snell's window
(*c*) mirage
(*d*) looming

29. **The necessary conditions for total internal reflection is**

(*a*) the angle of incidence in denser medium must be smaller than the critical angle for two media
(*b*) the angle of refraction in denser medium must be greater than the critical angle for two media
(*c*) the angle of incidence in denser medium must be greater than the critical angle for two media
(*d*) none of these

30. **An optical fiber ($n = \sqrt{3}$) is surrounded by a glass coating $\left(n = \frac{3}{2}\right)$, the critical angle for total internal reflection at the fiber-glass interface is**

(*a*) 30°
(*b*) 45°
(*c*) 60°
(*d*) 90°

31. **In the fiber optic link, power transfer from one fiber to another and from fiber to detector must take place with**

(*a*) minimum coupling efficiency
(*b*) maximum coupling efficiency
(*c*) unpredictable
(*d*) none of these

32. **The height through which an object appears to be raised in a denser medium is called normal shift. Let the normal shift to be (*d*) and real depth be (*t*) then expression for the normal shift is**

(*a*) $d = t\,(1 - n)$
(*b*) $d = t(1 + n)$
(*c*) $d = t\left(1 + \frac{1}{n}\right)$
(*d*) $d = t\left(1 - \frac{1}{n}\right)$

33. Match the corresponding entries of Column A with Column B.

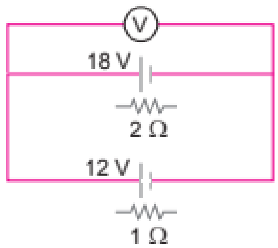
	Column A		Column B
(*i*)	Permanent magnets	(*p*)	High permeability and low retentivity
(*ii*)	Electromagnets	(*q*)	Field lines get highly concentrated
(*iii*)	Inside a ferromagnetic substance	(*r*)	Field lines get slightly reduced
(*iv*)	Inside a diamagnetic substance	(*s*)	High retentivity and high coercivity

(*a*) (*i*)–(*r*), (*ii*)–(*q*), (*iii*)–(*p*), (*iv*)–(*s*)
(*b*) (*i*)–(*s*), (*ii*)–(*r*), (*iii*)–(*q*), (*iv*)–(*p*)
(*c*) (*i*)–(*r*), (*ii*)–(*q*) (*iii*)–(*s*), (*iv*)–(*p*)
(*d*) (*i*)–(*s*), (*ii*)–(*p*), (*iii*)–(*q*), (*iv*)–(*r*)

34. In a Young's double-slit experiment the fringe width is found to be 0.4 mm. If the whole apparatus is dipped in water of refractive index 4/3, without disturbing the arrangement, the new fringe width will be

(*a*) 0.30 mm (*b*) 0.40 mm (*c*) 0.53 mm (*d*) 0.2 mm

35. Two batteries, one of emf 18 V and internal resistance 2 Ω and the other of emf 12 V and internal resistance 1 Ω, are connected as shown. The voltmeter *V* will record a reading of



(*a*) 30 V (*b*) 18 V (*c*) 15 V (*d*) 14 V

36. A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewsters angle ϕ. If *n* represents the refractive index of glass with respect to air, then the angle between the reflected and refracted rays is

(*a*) $90 + \phi$
(*b*) $\sin^{-1}(n \cos\phi)$
(*c*) $90°$
(*d*) $90° - \sin^{-1}\left(\frac{\sin\phi}{n}\right)$

37. Consider the diffraction pattern for a small pinhole. As the size of the hole is increased

(*a*) the size of central maxima decreases
(*b*) the intensity of central maxima increases
(*c*) the size of central maxima increases
(*d*) the intensity of central maxima decreases

38. Photoelectric effect supports quantum nature of light because

(*a*) there is minimum frequency of light below which no photoelectrons are emitted
(*b*) the maximum energy of photoelectron depends only on the frequency of light and not on its intensity
(*c*) photoelectric effect is an instantaneous process
(*d*) all the above

39. A deutron has an energy of 4 MeV when accelerated through a potential difference *V*. What will be the energy of an α-particle accelerated by the same potential difference *V*?

(*a*) 4 MeV (*b*) 8 MeV (*c*) 12 MeV (*d*) 20 MeV

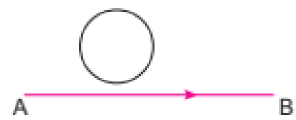
40. If photons of frequency ν are incident on the surfaces of two metals, *A* and *B* of threshold frequencies $\nu/2$ and $\nu/3$ respectively, the ratio of maximum kinetic energy of electrons emitted from *A* to that from *B* is

(*a*) 2 : 3 *b*) 3 : 4 (*c*) 1 : 3 (*d*) $\sqrt{3} : \sqrt{2}$

41. An electron is accelerated from rest through a potential difference of *V* volt. If the de Broglie wavelength of the electron is 1.227×10^{-2} nm, the potential difference is:

(*a*) 10^4 V (*b*) 10 V (*c*) 10^2 V (*d*) 10^3 V

42. **The current in a wire AB is increasing in magnitude. The direction of induced current in the loop (if any) will be:**



(*a*) clockwise
(*b*) anticlockwise
(*c*) arbitrary
(*d*) no current is induced

43. **To explain his theory, Bohr used**

(*a*) conservation of linear momentum
(*b*) quantisation of angular momentum
(*c*) conservation of quantum
(*d*) none of these

44. **The ratio of the speed of the electrons in the ground state of hydrogen to the speed of light in vacuum is**

(*a*) 1/2
(*b*) 2/237
(*c*) 1/137
(*d*) 1/237

45. **If E_n and J_n denote the magnitudes of total energy and of angular momentum of electron in the n^{th} allowed orbit of Bohr's orbit. Then:**

(*a*) $E_n \propto J_n$
(*b*) $E_n \propto \frac{1}{J_n}$
(*c*) $E_n \propto J_n^2$
(*d*) $E_n \propto \frac{1}{J_n^2}$

46. **The half life of ^{215}At is 100 μs. The time taken for the activity of the sample of ^{215}At to decay to $\frac{1}{16}$ th of its initial value is**

(*a*) 400 μs
(*b*) 300 μs
(*c*) 40 μs
(*d*) 6.3 μs

47. **Given below are two statements labelled as Statement P and Statement Q:**

Statement P : Microwave communication is preferred over optical communication.

Statement Q : Microwaves provide a large number of channels and bandwidth compared to optical signals.

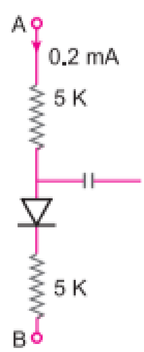
Select the most appropriate option:

(*a*) P is true, but Q is false
(*b*) P is false, but Q is true
(*c*) Both P and Q are true
(*d*) Both P and Q are false

48. **In an oscillator the feedback used is:**

(*a*) positive
(*b*) negative
(*c*) neither positive nor negative
(*d*) positive in some oscillators and negative in others

49. **In the circuit shown in figure, if the diode forward voltage drop is 0.3 V, the voltage difference between A and B is**



(*a*) 1.3 V
(*b*) 2.3 V
(*c*) 0
(*d*) 0.5 V

50. **In a *p-n* junction diode, change in temperature due to heating**

(*a*) affects only reverse resistance
(*b*) affects the overall *V-I* characteristics of *p-n* junction
(*c*) does not affect resistance of *p-n* junction
(*d*) affects only forward resistance

ANSWERS

PRACTICE PAPER – 3

1. (*a*)	**2.** (*c*)	**3.** (*c*)	**4.** (*d*)	**5.** (*d*)	**6.** (*d*)	**7.** (*d*)
8. (*d*)	**9.** (*a*)	**10.** (*d*)	**11.** (*b*)	**12.** (*a*)	**13.** (*a*)	**14.** (*b*)
15. (*c*)	**16.** (*d*)	**17.** (*d*)	**18.** (*a*)	**19.** (*b*)	**20.** (*b*)	**21.** (*d*)
22. (*d*)	**23.** (*d*)	**24.** (*a*)	**25.** (*c*)	**26.** (*a*)	**27.** (*b*)	**28.** (*b*)
29. (*c*)	**30.** (*c*)	**31.** (*b*)	**32.** (*d*)	**33.** (*d*)	**34.** (*a*)	**35.** (*d*)
36. (*c*)	**37.** (*a*)	**38.** (*d*)	**39.** (*b*)	**40.** (*b*)	**41.** (*a*)	**42.** (*a*)
43. (*b*)	**44.** (*c*)	**45.** (*d*)	**46.** (*a*)	**47.** (*c*)	**48.** (*a*)	**49.** (*b*)
50. (*b*)						

SOLUTIONS

PRACTICE PAPER–3

1. (*a*) As the diameter of hemisphere is plane surface, and whole hemisphere is uniformally charged positively, so the electric field lines emerging outward will be perpendicular to the surface.

2. (*c*) According to Coulomb's law,

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

$$\varepsilon_0 = \frac{q_1 q_2}{4\pi F r^2}$$

$$\text{SI unit of } \varepsilon_0 = \frac{\text{C.C}}{\text{Nm}^2} = \text{C}^2\text{N}^{-1}\text{m}^{-2}$$

4. (*d*) No lines of force can exist inside a conductor because $E = 0$. Also lines of force enter and emerge normally from a conductor.

5. (*d*) The electrostatic property of metallic conductor, charge reside on the surface of conductor. Hence electric field inside the conductor is zero and potential is constant.

6. (*d*) $E = \frac{-dv}{dr}$, since the electric field (E) is inversely

10. (*d*) In polarisation waves are propagates perpendicular to the electric field vector (*i.e.*, transverse or electromagnetic wave).

11. (*b*) Resistance of fourth arm S = S_1 and S_2 connected in parallel $= \frac{S_1 S_2}{S_1 + S_2}$

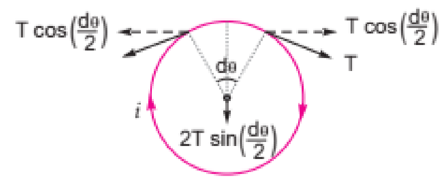
$$\therefore \quad \frac{P}{Q} = \frac{R}{S} \Rightarrow \frac{P}{Q} = \frac{R(S_1 + S_2)}{S_1 S_2}$$

13. (*a*) Current sensitivity of a galvanometer,

$$S = \frac{\theta}{I} = \frac{NAB}{K}.$$

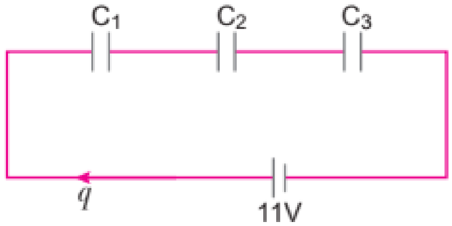
Hence if torsional constant (K) is decreases then current sensitivity increases.

15. (*c*)



proportional to the separation between equipotential surface. So, equipotential surface are closer in regions of large E.

7. (*d*)



$$\frac{1}{C_{eq}} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$$

$$= \frac{11}{6} \Rightarrow C_{eq} = \frac{6}{11}\,\mu F$$

$$q = C_{eq} V = \frac{6}{11} \times 11 = 6\,\mu C$$

Also, $q = C_1V_1 \Rightarrow 6 = 1 \times V_1$

$V_1 = 6$ V

8. (*d*) $E = -\left(\hat{i}\frac{\partial V}{\partial x} + \hat{j}\frac{\partial V}{\partial y} + \hat{k}\frac{\partial V}{\partial z}\right)$

Here $V = -x^2y - xz^2 + 4$

$\therefore\ \vec{E} = -[\hat{i}(-2xy - z^3) + \hat{j}(-x^2) + \hat{k}(-3xz^2)]$

$= (2xy + z^3)\,\hat{i} + x^2\,\hat{j} + 3xz^2\hat{k}$

9. (*a*) According to Kirchoff's loop rule,

$V_A - (2 \times 2) - 3 - (2 \times 1) - V_B = 0$

$\Rightarrow \quad V_A - V_B = 4 + 3 + 2 = 9$ V.

$$2T\sin\left(\frac{d\theta}{2}\right) = BI(Rd\theta)$$

For small $d\theta$; $2T\left(\frac{d\theta}{2}\right) = BIRd\theta$

$\Rightarrow \quad T = BIR$

But $\quad R = \frac{L}{2\pi}$

$\therefore \quad T = \frac{BIL}{2\pi}$

16. (*d*) $q\vec{E} + q\vec{v} \times \vec{B} = 0 \Rightarrow \vec{v} \times \vec{B} = -\vec{E}$

$\vec{B} \times (\vec{v} \times \vec{B}) = -\vec{B} \times \vec{E}$

or $\quad (\vec{B}\cdot\vec{B})\vec{v} - (\vec{B}\cdot\vec{v})\vec{B} = \vec{E} \times \vec{B}$

$\Rightarrow \quad$ As $\vec{B}$ is perpendicular to $\vec{v}$; $\vec{B}\cdot\vec{v} = 0$

$\therefore \quad \vec{v} = \frac{\vec{E} \times \vec{B}}{B^2}$

18. (*a*) The magnetic field is along the axis of a circular coil. The maximum flux linkage between the coils is in situation (*i*).

19. (*b*) Intensity of light means energy incident per unit area per second. For a given frequency, if intensity of light is increased, the photoelectric current increases and vice-versa.

20. (*b*) $\frac{L_1 L_2}{L_1 + L_2} = 2.4, \qquad L_1 + L_2 = 10$

$$\frac{L_1L_2}{10}=2.4 \Rightarrow L_1L_2=24 \Rightarrow L_1=\frac{24}{L_2}$$

$$\frac{24}{L_2}+L_2=10 \Rightarrow L_2=4\text{ H}, L_1=6\text{ H}$$

21. (*d*) $P = E_{rms} I_{rms} \cos\phi = E_{rms} I_{rms} \cos\left(-\frac{\pi}{2}\right) = 0$

23. (*d*) $\frac{I_P}{I_S} = \frac{N_S}{N_P} = \frac{400}{500} = 4:5$

24. (*a*) Charging current $I = I_0 e^{-t/RC}$

$$\Rightarrow \quad \log_e I = \log_e I_0 - \frac{t}{RC} \quad \text{where } I_0 = \frac{E}{R}$$

Clearly, the graph of $\log_e I$ versus t is a straight line of slope $-\frac{1}{RC}$ shown by dotted line. When R increases to $2R$, I_0 decreases so value of $\log_e I_0$ decreases and slope becomes half. This is shown in P.

25. (*c*) When key K is kept closed, condenser C is charged to potential V. When plates of capacitor are moved apart, its capacitance, $C = \frac{\varepsilon_0 A}{d}$ decreases.

As potential of condenser remains same, charge $Q = CV$ decreases. So option (*c*) is correct.

Once key K is closed, condenser gets charged $Q = CV$. Now, if key K is opened, battery is disconnected, no more charging can occur, *i.e.*, Q remains same.

As plates of capacitor are moved apart, its capacity $C = \frac{\varepsilon_0 A}{d}$ decreases.

Therefore, its potential, $V = q/C$ increases.

26. (*a*) The brilliance of second diamond will be less than that of first because critical angle for first diamond w.r.t. air is very small as compared to second diamond. So, more TIR takes place in first diamond as compared to the second.

27. (*b*) Its critical angle of light with reference to air is too small.

28. (*b*) Snell's window: The phenomenon by which an underwater viewer sees above the surface through a cone of light.

29. (*c*) For TIR, $i > i_c$

30. (*c*) According to the condition of TIR,

$${}_g n_f = \frac{{}_a n_f}{{}_a n_g} \qquad \left[\begin{array}{l}\because f = \text{optical fiber}\\ g = \text{glass}\end{array}\right]$$

$$\sin i_c = \frac{1}{{}_g n_f}$$

$$\Rightarrow \qquad \sin i_c = \frac{{}_a n_g}{{}_a n_f} = \frac{\frac{3}{2}}{\sqrt{3}}$$

$$\Rightarrow \qquad \sin i_c = \frac{3}{2\sqrt{3}} = \frac{\sqrt{3}}{2} \Rightarrow i_c = 60°$$

31. (*b*) Because optical fiber transmits the light signal without loss of energy, so it takes place with maximum coupling efficiency.

32. (*d*) Normal shift = Real depth – Apparent depth

$$d = \text{Real depth}\left(1 - \frac{\text{Apparent depth}}{\text{Real depth}}\right)$$

$$\therefore \; d = t\left[1 - \frac{1}{n}\right]$$

34. (*a*) $\lambda_w = \frac{\lambda_{air}}{n} = \frac{3}{4}\lambda_{air}$

Fringe width, $\beta \propto \lambda \Rightarrow \frac{\beta_w}{\beta_{air}} = \frac{\lambda_w}{\lambda_{air}} = \frac{3}{4}$

$$\Rightarrow \beta_w = \frac{3}{4} \times 0.4 = 0.3 \text{ mm}$$

35. (*d*) $V_{eff} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2}$

$$= \frac{18\times 1 + 12 \times 2}{2+1} = \frac{42}{3} = 14 \text{ V}$$

36. (*c*) When the incidence angle of ray is equal to Brewster's angle then angle between reflected and refracted ray is 90°.

37. (*a*) Increasing the width of pinhole, d decreases. So, size of central maxima decreases. As the energy passing through hole (*i.e.*, size of the hole increasing). So area of hole decreasing, $\left(I \propto \frac{1}{\text{Area}}\right)$. So I (intensity) increases.

39. (*b*) As we know,

Energy of moving charge particle, particles $E = qV$

$$\frac{E_\alpha}{E_d} = \frac{q_\alpha V}{q_d V} = \frac{2e}{e}$$

$$E_\alpha = 2E_d = 2 \times 4 \text{ MeV} = 8 \text{ MeV}$$

40. (*b*) As from equation of photoelectric emission, $h\nu = (KE)_{\max} + h\nu_0$

$$(KE)_A = h\nu - h(\nu_0)_A, \; (\nu_0)_A = \frac{\nu}{2} \quad \text{(given)}$$

$$(KE)_A = h\nu - \frac{h\nu}{2} = \frac{h\nu}{2}$$

And, $\quad (KE)_B = h\nu - h(\nu_0)_B = h\nu - \frac{h\nu}{3} = \frac{2h\nu}{3}$

$$\frac{(KE)_A}{(KE)_B} = \frac{\frac{h\nu}{2}}{\frac{2h\nu}{3}} = \frac{3}{4}$$

41. (*a*) de Broglie wavelengths,

$$\lambda = \frac{12.27}{\sqrt{V}} \mathring{A}$$

$$\Rightarrow \quad \sqrt{V} = \frac{12.27 \times 10^{-10}}{1.227 \times 10^{-11}} = 10^2$$

$\therefore$ $V = 10^4$ volts

42. (*a*) According to Lenz's law, the current induced in coil will oppose the increased magnetic field due to increase of current, so current induced will be clockwise.

43. (*b*) According to Bohr's model, angular momentum of electron is quantised and is an integral multiple of $\frac{h}{2\pi}$.

44. (*c*) $v_n = \frac{e^2}{2nh\varepsilon_0}$, for $n = 1$, $v = 0.0219 \times 10^8$ ms^{-1}.

Then, $\frac{v}{c} = \frac{0.0219 \times 10^8}{3 \times 10^8} \approx \frac{1}{137}$

45. (*d*) $E_n = \frac{-13.6}{n^2} \Rightarrow E_n \propto \frac{1}{n^2}$ ...(*i*)

Also, $J_n = \frac{nh}{2\pi} \Rightarrow J_n \propto n$ ...(*ii*)

From (*i*) and (*ii*)

$$E_n \propto \frac{1}{J_n^2}$$

46. (*a*) $\frac{N}{N_0} = \left(\frac{1}{2}\right)^n \Rightarrow \frac{1}{16} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^n$

$\therefore$ $n = 4$, $t = nT = 4 \times 100$ μs $= 400$ μs.

48. (*a*) The oscillator which acts as an amplifier makes uses of positive feedback to generate an output frequency.

49. (*b*) The capacitor will behave as an open circuit for the steady current flow through it in the circuit, so current will flow from A to B only. Let potential across A and B is V, so by Kirchhoff's loop law

$$V = (5000 \times 0.2 \times 10^{-3}) + 0.3 + (5000 \times 0.2 \times 10^{-3})$$

$$= 1 + 0.3 + 1 = 2.3 \text{ V}$$

50. (*b*) Due to increase in temperature, number of electron-hole pairs increases. This changes both the forward and reverse resistance. Hence the overall *V-I* characteristic is affected.