9 PRACTICE PAPER

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

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

Choose the correct option in the following questions.

1. **If $\oint \vec{E}.d\vec{S} = 0$ over a surface, then**

(*a*) the electric field inside the surface and on it is zero.

(*b*) all charges must necessarily be outside the surface.

(c) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

(*d*) both (*b*) and (*c*)

2. **When a glass rod is rubbed with a dry silk cloth, the glass rod is positively charged due to the transfer of**

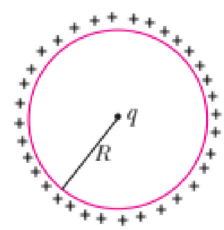
(*a*) protons from silk cloth to glass rod

(*b*) electrons from silk cloth to glass rod

(*c*) protons from glass rod to silk cloth

(*d*) electrons from glass rod to silk cloth

3. **A positive charge Q is uniformly distributed along a circular ring of radius R. A small test charge q is placed at the centre of the ring. Then**



(*i*) If $q > 0$ and is displaced away from the centre in the plane of the ring, it will be pushed back towards the centre.

(*ii*) If $q < 0$ and is displaced away from the centre in the plane of the ring, it will never return to the centre and will continue moving till it hits the ring.

(*iii*) If $q < 0$. it will perform SHM for small displacement along the axis.

(*iv*) q at the centre of the ring is in an unstable equilibrium within the plane of the ring for $q > 0$.

Choose the correct option:

(*a*) (*i*), (*ii*) and (*iii*) are correct.

(*b*) (*i*), (*iii*) and (*iv*) are correct.

(*c*) (*ii*), (*iii*) and (*iv*) are correct.

(*d*) only (*iii*) is correct.

4. **The plates of a parallel plate capacitor are 4 cm apart, the first plate is at 300 V and the second plate at – 100 V. The voltage at 3 cm from the second plate is**

(*a*) 200 V

(*b*) 400 V

(*c*) 250 V

(*d*) 500 V

5. **The electric potential V at any point x, y, z (all in metres) in space is given by $V = 4x^2$ volt. The electric field at the point (1 m, 0, 2 m) in volt/metre is**

(*a*) 8 along negative X-axis

(*b*) 8 along positive X-axis

(*c*) 16 along negative X-axis

(*d*) 16 along positive Z-axis

6. **If the potential of a capacitor having capacitance 6 μF is increased from 10 V to 20 V, the increase in energy is**

(*a*) 9×10^{-4} J

(*b*) 4.5×10^{-6} J

(*c*) 12×10^{-6} J

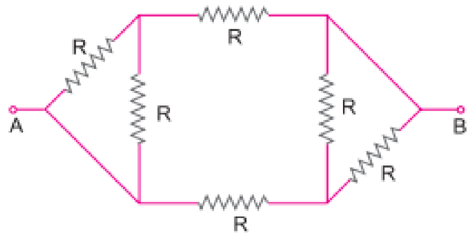
(*d*) 2.25×10^{-6} J

7. **A charge Q is kept at the centre of a circle of radius r. A test charge q_0, is carried from a point X to the point Y on this circle such that are XY subtends an angle of 60° at the centre of the circle. The amount s of work done in this process will be**

(*a*) $\frac{1}{4\pi\varepsilon_0}\frac{Qq_0}{2r}$ (*b*) $\frac{1}{4\pi\varepsilon_0}\frac{\sqrt{3}Qq_0}{2r}$

(*c*) zero (*d*) $\frac{1}{4\pi\varepsilon_0}\frac{\sqrt{3}Qq_0}{r}$

8. **The equivalent resistance of network of 6 resistances shown in figure is**

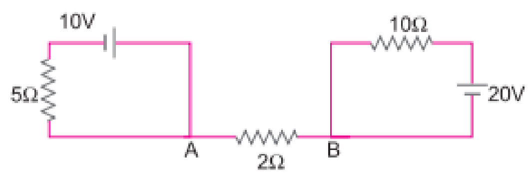


(*a*) $6R$ (*b*) $\frac{R}{3}$ (*c*) $\frac{3R}{2}$ (*d*) $\frac{3R}{4}$

9. **The resistance of series combination of two resistances is S. When they are joined in parallel, the total resistance is P. If $S = nP$ then the minimum possible value of n is**

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

10. **In fig. shown, the current through 2Ω resistor is**



(*a*) 0 A (*b*) 2 A (*c*) 4 A (*d*) 6 A

11. **n equal resistors connected in series across a source of emf together dissipate power P. What must be the power dissipated if the same resistors are connected in parallel across the same source of emf?**

(*a*) nP (*b*) $\frac{P}{n}$

(*c*) n^2P (*d*) $\frac{P}{n^2}$

12. **The kinetic energy of a proton and that of an α-particle are 4 eV and 1 eV respectively. The ratio of the de-Broglie wavelengths associated with them will be**

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

13. **Consider the following statements about the representation of the magnetic field**

Statement P: The magnetic field emerging out of the plane of the paper is denoted by a dot (⊙).

Statement Q: The magnetic field going into the plane of the paper is denoted by a cross (⊗).

Select the most appropriate option:

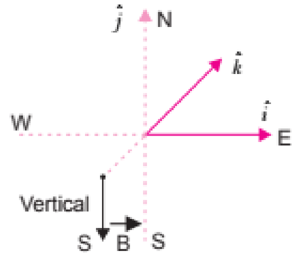
(*a*) P is true, but Q is false (*b*) P is false, but Q is true

(*c*) Both P and Q are true (*d*) Both P and Q are false

14. **In a certain region of space, electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other. An electron enters perpendicularly to both the fields and moves undeflected. The velocity of electron is**

(*a*) $\frac{\vec{B}}{\vec{E}}$ (*b*) $\vec{E} \times \vec{B}$ (*c*) $\vec{E} \cdot \vec{B}$ (*d*) $\frac{\vec{E}}{\vec{B}}$

15. **A horizontal overhead power line is at a height of 4 m from the ground and carries a current of 100 A from east to west. The magnetic field directly below it on the ground is**
($\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1})



(*a*) 5×10^{-6} T southward
(*b*) $2{\cdot}5 \times 10^{-7}$ T northward
(*c*) $2{\cdot}5 \times 10^{-7}$ T southward
(*d*) 5×10^{-6} T northward

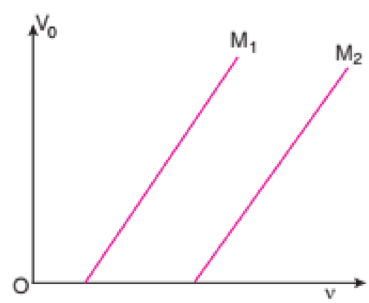
16. **A proton charge (+*e* coulomb) enters in a magnetic field of strength *B* (tesla) perpendicular to the magnetic lines of force, with speed *v*. The force on the proton is**
(*a*) evB
(*b*) zero
(*c*) ∞
(*d*) $evB/2$

17. **A stream of electrons is projected horizontally to the right. A straight conductor carrying a current is supported parallel to electron stream and above it. If the current in the conductor is from left to right, then what will be the effect on electron stream?**
(*a*) The electron stream will be speeded up towards the right.
(*b*) The electron stream will be retarded.
(*c*) The electron stream will be pulled upward.
(*d*) The electron stream will be pulled downward.

18. **The magnetic susceptibility for a diamagnetic material is**
(*a*) small and negative
(*b*) small and positive
(*c*) large and positive
(*d*) large and negative

19. **The time-period of a freely-suspended magnet is independent of**
(*a*) length of the magnet
(*b*) moment of inertia of the magnet
(*c*) horizontal component of earth's magnetic field
(*d*) length of the suspension.

20. **The variation of the stopping potential (V_o) withe the frequency (ν) of the light incident on two different photosensitive surfaces M_1 and M_2 is shown in the figure. Identify the surface which has greater value of the work function.**



(*a*) M_1
(*b*) M_2
(*c*) V_0
(*d*) $M_2 < M_1$

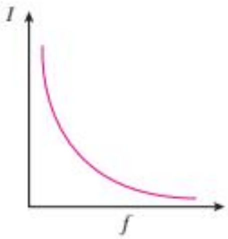
21. **Due to relative motion of a magnet with respect to a coil, an emf is induced in the coil. Identify the principle involved.**
(*a*) Gauss's law
(*b*) Biot-Savart law
(*c*) Ampere's circuital law
(*d*) Faraday's law

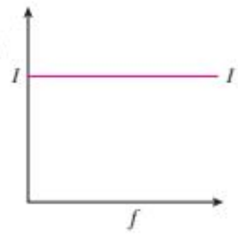
22. **An alternating voltage source of variable angular frequency 'ω' and fixed amplitude '*V*' is connected in series with a capacitance *C* and electric bulb of resistance *R* (inductance zero). When 'ω' is increased**
(*a*) the bulb glows dimmer
(*b*) the bulb glows brighter
(*c*) net impedance of the circuit remains unchanged
(*d*) total impedance of the circuit increases

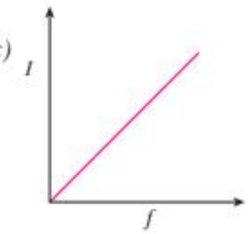
23. The instantaneous values of EMF and the current in a series AC circuit are $E = E_0 \sin \omega t$ and $I = I_0 \sin (\omega t + \pi/3)$ respectively, then it is

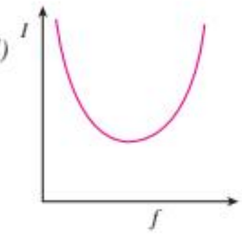
(*a*) necessarily a *RL* circuit
(*b*) necessarily a *RC* circuit
(*c*) necessarily a *LCR* circuit
(*d*) can be *RC* or *LCR* circuit

24. Which of the following graphs represent the variation of current (*I*) with frequency (*f*) in an AC circuit containing a pure capacitor?

(*a*)


(*b*)


(*c*)


(*d*)


25. Match List I (Electromagnetic wave type) with List II (Its association/application) and select the correct option from the choices given below the lists:

List-I	List-II
P. Infrared waves	(*i*) To treat muscular strain
Q. Radio waves	(*ii*) For broadcasting
R. X-rays	(*iii*) To detect fracture of bones
S. Ultraviolet rays	(*iv*) Absorbed by the ozone layer of the atmosphere

(*a*) *P*–(*iv*), *Q*–(*iii*), *R*–(*ii*), *S*–(*i*)
(*b*) *P*–(*i*), *Q*–(*ii*), *R*–(*iv*), *S*–(*iii*)
(*c*) *P*–(*iii*), *Q*–(*ii*), *R*–(*i*), *S*–(*iv*)
(*d*) *P*–(*i*), *Q*–(*ii*), *R*–(*iii*), *S*–(*iv*)

26. When light rays are incident on a prism at an angle of 45°, the minimum deviation is obtained. If refractive index of prism is $\sqrt{2}$, then the angle of prism will be

(*a*) 60°
(*b*) 40°
(*c*) 50°
(*d*) 30°

27. A thin convex lens made from crown glass $\left(\mu = \frac{3}{2}\right)$ has focal length *f*. When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal length f_1 and f_2 respectively. The correct relation between the focal lengths is

(*a*) $f_1 = f_2 < f$
(*b*) $f_1 > f$ and f_2 becomes negative
(*c*) $f_2 > f$ and f_1 becomes negative
(*d*) f_1 and f_2 both become negative

28. An astronomical telescope in normal adjustment receives light from a distant source *S*. The tube length is now increased slightly

(*a*) a virtual image of source *S* will be formed behind the eyepiece
(*b*) no image will be formed
(*c*) a real image of source *S* will be formed behind the eye piece closed to it
(*d*) a real image of source *S* will be formed behind the eye piece far away from it

29. **A hollow double concave lens is made of very thin transparent material. It can be filled with air or either of two liquids L_1 and L_2 having refractive indices n_1 and n_2 respectively ($n_1 > n_2 > 1$). The lens will diverge a parallel beam of light if it is filled with**

(*a*) air and placed in air
(*b*) air and immersed in L_1
(*c*) L_1 and immersed in L_2
(*d*) L_2 and immersed in L_1

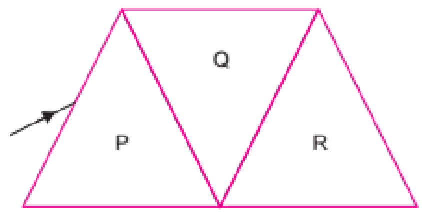
30. **The critical angle of a prism is 42°. When a ray of light is incident normally on one face of the prism, the ray just undergoes total internal reflection from the opposite face. Then the refracting angle of the prism is**

(*a*) 21°
(*b*) 42°
(*c*) 48°
(*d*) 84°

31. **Larger aperture of objective lens in an astronomical telescope**

(*a*) increases the resolving power of telescope.
(*b*) decreases the brightness of the image.
(*c*) increases the size of the image.
(*d*) decreases the length of the telescope.

32. **A given ray of light suffers minimum deviation in an equilateral prism *P*. Additional prisms *Q* and *R* of identical shape and of same material as *P* are now added as shown in fig. The ray will now suffer**



(*a*) greater deviation
(*b*) no deviation
(*c*) same deviation as before
(*d*) total internal reflection

33. **You are asked to design a shaving mirror assuming that a person keeps it 10 cm from his face and views the magnified image of the face at the closest comfortable distance of 25 cm. The radius of curvature of the mirror would then be**

(*a*) – 60 cm
(*b*) 24 cm
(*c*) 30 cm
(*d*) –24 cm

34. **To demonstrate the phenomenon of interference we require two sources which emit radiation**

(*a*) of same frequency and having a definite phase relationship
(*b*) of nearly the same frequency
(*c*) of the same frequency with arbitrary phase relationship
(*d*) of different wavelengths

35. **If Young's experiment is performed using two separate identical sources of light instead of using two slits and one bulb**

(*a*) the interference fringes will be brighter
(*b*) the interference fringes will be darker
(*c*) no fringes will be obtained
(*d*) the contrast between bright and dark fringes increases

36. **On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam**

(*a*) becomes narrower
(*b*) goes horizontally without any deflection
(*c*) bends downwards
(*d*) bends upwards

37. **Unpolarised light is incident from water (${}_an_w = \frac{4}{3}$) on a transparent medium. If the angle of incidence is 60° and the reflected light in water is plane polarised, then refractive index of medium is**

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

38. **Einstein's photoelectric equation states that:**

$$E_k = h\nu - W,$$

In this equation E_k refers to

(*a*) kinetic energy of all ejected electrons

(*b*) mean kinetic energy of emitted electrons

(*c*) minimum kinetic energy of emitted electrons

(*d*) maximum kinetic energy of emitted electrons

39. **When a monochomatic radiation of intensity 'I' falls on a metal surface, the number of photo-electrons and their maximum kinetic energy are N and T respectively. If the intensity of radiation is $2I$, the number of emitted electrons and their maximum kinetic energy are respectively.**

(*a*) $2N$ and T (*b*) $2N$ and $2T$

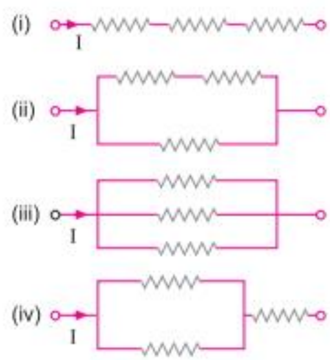
(*c*) N and T (*d*) N and $2T$

40. **X-ray are used to irradiate sodium and copper surfaces in two separate experiments and stopping potential is determined. This stopping potential is**

(*a*) equal in both cases (*b*) greater for sodium

(*c*) greater for copper (*d*) infinite in both cases

41. **Three equal resistances are arranged in different combinations as shown below. Arrange them in increasing order of power dissipation.**



(*a*) (iii) < (ii) < (iv) < (i) (*b*) (ii) < (iii) < (iv) < (i)

(*c*) (i) < (iv) < (iii) < (ii) (*d*) (i) < (iii) < (ii) < (iv)

42. **A circular coil expands radially in a region of magnetic field and no electromotive force is produced in the coil. This can be because**

(*a*) the magnetic field is constant.

(*b*) the magnetic field is in the same plane as the circular coil and it may or may not vary.

(*c*) the magnetic field has a perpendicular (to the plane of the coil) component whose magnitude is decreasing suitably.

(*d*) both (*b*) and (*c*)

43. **Consider the spectral line resulting from the transition $n = 2 \rightarrow n = 1$ in the atoms and ions given below. The shortest wavelength is produced by**

(*a*) hydrogen atom (*b*) deuterium atom

(*c*) singly ionised helium (*d*) doubly ionised lithium

44. **In a hydrogen like atom electron makes transition from an energy level with quantum number n to another with quantum number $(n - 1)$. If $n >> 1$, the frequency of radiation emitted is proportional to**

(*a*) $\frac{1}{n^3}$ (*b*) $\frac{1}{n}$

(*c*) $\frac{1}{n^2}$ (*d*) $\frac{1}{n^{3/2}}$

45. The hydrogen atom can give spectral lines in the Lyman, Balmer and Paschen series. Which of the following statements is correct?

(*a*) Lyman series is in the infrared region.
(*b*) Balmer series is in the visible region (partly).
(*c*) Paschen series is in the visible region.
(*d*) Balmer series is (solely) in the ultraviolet region.

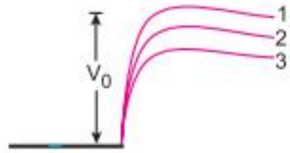
46. If $M(A, Z)$, M_P and M_n denote the masses of the nucleus ${}^{A}_{Z}X$, proton and neutron respectively in units of u ($1u = 931.5$ MeV/c^2) and BE represents its binding energy in MeV, then:

(*a*) $M(A, Z) = ZM_P + (A - Z)M_n - BE/c^2$
(*b*) $M(A, Z) = ZM_P + (A - Z)M_n + BE$
(*c*) $M(A, Z) = ZM_P + (A - Z)M_n - BE$
(*d*) $M(A, Z) = ZM_P + (A - Z)M_n + BE/c^2$

47. If n_e and n_h are the number of electrons and holes in pure germanium, then

(*a*) $n_e > n_h$
(*b*) $n_e < n_h$
(*c*) $n_e = n_h$
(*d*) n_e = finite and $n_h = 0$

48. In given figure, V_0 is the potential barrier across a *p-n* junction, when no battery is connected across the junction

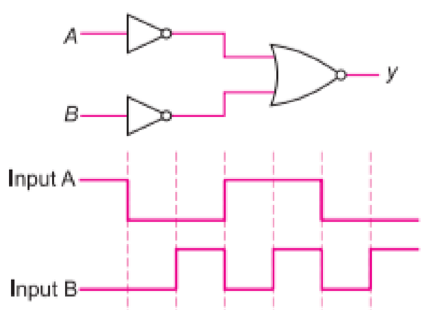


(*a*) 1 and 3 both correspond to forward bias of junction
(*b*) 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junction
(*c*) 1 corresponds to forward bias and 3 corresponds to reverse bias of junction.
(*d*) 1 and 3 both correspond to reverse bias of junction.

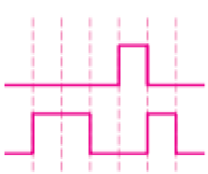
49. In case of frequency modulation, which of the following statements is correct?

(*a*) Amplitude of carrier wave varies in accordance with that of modulating signal.
(*b*) Frequency of carrier wave is equal to that of the modulating signal.
(*c*) Frequency of carrier wave is less than that of modulating signal.
(*d*) Frequency of carrier wave varies in accordance with the amplitude of the modulation signal.

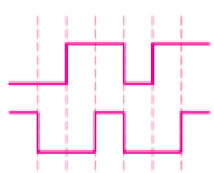
50. The logic circuit shown below has the input waveforms '*A*' and '*B*' as shown. Pick out the correct output waveform.



(*a*)
(*c*)



(*b*)
(*d*)



ANSWERS

PRACTICE PAPER – 9

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

SOLUTIONS

PRACTICE PAPER—9

2. (*d*) Electrons from glass rod to silk cloth

3. (*a*) As is known from theory, at the centre of the ring, $E = 0$ when a positive charge ($q > 0$) is displaced, away from the centre in the plane of the ring, say to the right, force of repulsion on q, due to charge on right half increases and due to charge on left half decreases. Therefore, charge q is pushed back towards the centre. Choice (*a*) is correct.

When charge q is negative ($q < 0$), force is of attraction. Therefore, charge q displaced to the right continues moving to the right till it hits the ring. Choice (*b*) is correct.

Along the axis of the ring, at a distance r from the centre,

$$E = \frac{Qr}{4\pi\varepsilon_0 (r^2 + a^2)^{3/2}}$$

If charge q is negative ($q < 0$), it will perform SHM for small displacement along the axis. Choice (*c*) is correct.

4. (*a*) $E = \dfrac{\Delta V}{d} = \dfrac{300 - (-100)}{4} = 100$ V/cm

$\therefore$ Voltage at 3 cm from second plate $= 300 - (1 \times 100) = 200$ V.

5. (*a*) $E_x = -\dfrac{dV}{dx} = -\dfrac{d}{dx}(4x^2)$

$= -8x = -8 \times 1 = -8$

$\vec{E} = -8\hat{x}$ or 8 V/m along negative x-axis

6. (*a*) $U = \frac{1}{2}CV_2^2 - \frac{1}{2}CV_1^2 = \frac{1}{2}C(V_2^2 - V_1^2)$

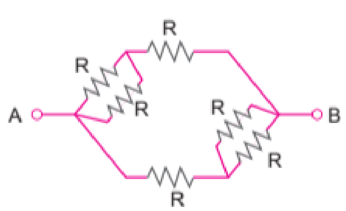
$= \frac{1}{2} \times 6 \times 10^{-6}[(20)^2 - (10)^2] = 9 \times 10^{-4}$ J

7. (*c*) Potential due to charge Q at X and Y is same

(*i.e.*, $V_x = V_Y = \dfrac{kQ}{r}$)

Hence, work done, $W = q_0 \Delta V = 0$.

8. (*d*) The given circuit deformed as



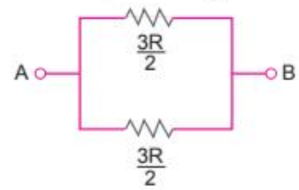
Now, $R_1 = \dfrac{R}{2}, R_2 = \dfrac{R}{2}$

Now, R_1 and R in series,

So, $R' = \dfrac{R}{2} + R = \dfrac{3R}{2}$

and, R_2 and R in series,

$R'' = \dfrac{R}{2} + R = \dfrac{3R}{2}$



Hence, $\dfrac{1}{R_{AB}} = \dfrac{1}{R'} + \dfrac{1}{R''}$

$= \dfrac{2}{3R} + \dfrac{2}{3R} = \dfrac{2+2}{3R} = \dfrac{4}{3R}$

$\therefore \quad R_{AB} = \dfrac{3R}{4}\,\Omega$

9. (*a*) Let two resistance are R_1 and R_2.

In series, $S = R_1 + R_2$ ...(*i*)

In parallel, $P = \dfrac{R_1 R_2}{R_1 + R_2}$ ...(*ii*)

Now, $S = nP$ (as given)

$R_1 + R_2 = n\left(\dfrac{R_1 R_2}{R_1 + R_2}\right)$

$\Rightarrow \quad (R_1 + R_2)^2 = nR_1R_2$

$\Rightarrow \quad R_1^2 + R_2^2 + 2R_1R_2 = nR_1R_2$

Dividing by R_2^2 both side, we get

$$\left(\frac{R_1}{R_2}\right)^2 + 1 + \frac{2R_1}{R_2} = \frac{nR_1}{R_2}$$

$K^2 + 2K + 1 = nK$ $\quad$ [Let $\dfrac{R_1}{R_2} = K$]

$\Rightarrow \quad K^2 = K(2 - n) + 1 = 0$

For Real value of K, $D \geqslant 0$

$(2 - n)^2 - 4 \geqslant 0$

For minimum value,

$(2 - n)^2 - 4 = 0$

$\Rightarrow \quad (2 - n)^2 = 4$

$\Rightarrow \quad (2 - n) = \pm 2$

Hence, $n = 0, 4$ (since, n can't be 0).

So, $n = 4$

10. (*a*) Here, $I_1 = \dfrac{10}{5} = 2$ A, $I_2 = \dfrac{20}{10} = 2$ A

Current in both circuit is 2 A, by Kirchhoff's first law, no current can flow in 2 Ω.

11. (*c*) $P = \frac{V^2}{R} \propto \frac{1}{R}$

In series, $R_1 = nR$, In parallel, $R_2 = \frac{R}{n}$

$$\frac{P_2}{P_1} = \frac{R_1}{R_2} = \frac{nR}{R/n} \Rightarrow P_2 = n^2 P_1$$

12. (*b*) $K_p = 4\text{ eV}$

$K_\alpha = 1\text{ eV}$

The de Broglie wavelength,

$$\lambda \propto \frac{1}{\sqrt{mK}}$$

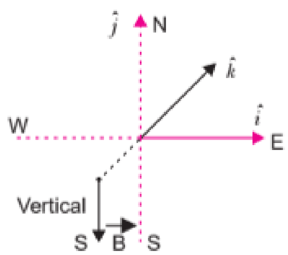
$$\frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{K_\alpha m_\alpha}{K_p m_p}}$$

$$\frac{K_p}{K_\alpha} = 4 \text{ and } \frac{m_\alpha}{m_p} = 4$$

$$\frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{K_\alpha m_\alpha}{K_p m_p}} = \sqrt{\frac{1}{4} \times \frac{4}{1}} = \frac{1}{1}$$

14. (*d*) $\vec{E} = c\vec{B}$

15. (*a*) $B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7} \times 100}{2\pi \times 4} = 5 \times 10^{-6}\text{ T}$



Direction of $\vec{B}$

As $\vec{B} = \frac{\mu_0 I}{4\pi} \frac{\vec{dl} \times \vec{r}}{r^3}$

$\Rightarrow \quad \hat{B} = (-\hat{i} \times -\hat{k}) = -\hat{j}$ (or southward)

16. (*a*) $F = q(|\vec{v} \times \vec{B}|) = qvB\sin\theta$

$= e \times vB \times \sin 90° = evB$

17. (*d*) Current due to stream of electrons will be in a direction opposite to the direction of current in the straight conductor which is held parallel above the stream of electrons. The two currents, one by straight conductor and another by stream of electrons are in opposite directions. Hence, they will repel. So, the stream of electrons will be pulled downward.

18. (*a*) The magnetic susceptibility indicates whether a material is repelled out or attract of a magnetic field.For diamagnetic material, it is small and negative.

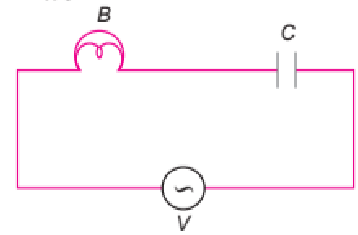
19. (*d*) Time period, $T = 2\pi\sqrt{\frac{I}{MB}}$

Hence, T is independent from length of suspension.

20. (*b*) M_2 has greater value of work function due to higher value of threshold frequency.

22. (*b*) We know that,

$$X_C = \frac{1}{\omega C}$$



If ω increases, then X_C decreases and hence, Z decreases.

Also, $I = \frac{V}{Z}$

As Z decreases, I will increase.

Hence, brightness of the bulb will increase.

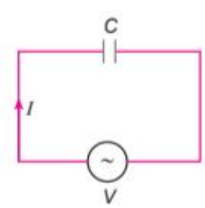
23. (*d*) From the given equation, $E = E_o \sin \omega t$

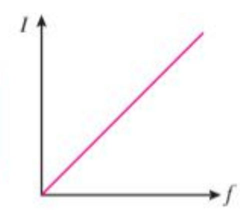
$$I = I_o \sin\left(\omega t + \frac{\pi}{3}\right)$$

Here, I can lead the voltage, which may be possible in RC or LCR circuit. So, it can be RC or LCR circuit.

24. (*c*) In a pure capacitive *ac* circuit,

$$I = \frac{V}{X_C}, \quad X_C = \frac{1}{\omega C}$$





$$\Rightarrow I = \frac{V}{\frac{1}{\omega C}} = V\omega C = 2\pi f C V$$

Hence, $I \propto f$

26. (*a*) $n = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\frac{A}{2}}$ But $\frac{A + \delta_m}{2} = i = 45°$

$$\sqrt{2} = \frac{\sin 45°}{\sin\frac{A}{2}} \Rightarrow \sin\frac{A}{2} = \frac{1}{2} \Rightarrow \frac{A}{2} = 30°$$

$$\Rightarrow A = 60°$$

27. (*b*) By using lens maker's formula,

$$\frac{1}{f_1} = \left(\frac{3/2}{4/3} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \frac{1}{8}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f_2} = \left(\frac{3/2}{5/3} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = -\frac{1}{10}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \frac{1}{2}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Clearly, $f_1 = 4f$ and $f_2 = -5f$.

28. (*a*) When distance between objective and eye lens is increased, the image formed by objective lies between principal focus and optical centre of eye lens instead of lying at focus of eye lens, so virtual image of S is formed at finite distance from the eye lens.

29. (*c*) The nature of lens will remain unchanged if the surrounding medium has refractive index less than that of lens material, so correct alternatives may be lens should be of refractive index n_2 immersed in a medium of refractive index n_1 or air or lens should be filled with a material of refractive index n_1 and immersed in air.

30. (*b*) For condition of TIR, $i \geq C$.

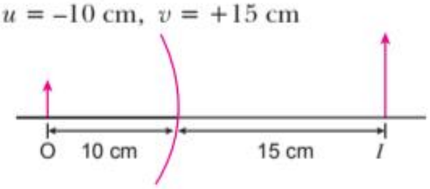
$$r_2 = C = 42°$$

Also, $A = r_1 + r_2$, (Here, $r_1 = 0$ due to light ray incident normal on one face of the prism)

$$\Rightarrow \quad A = 42° + 0° = 42°$$

32. (*c*) The deviation produced by Q and R are equal and opposite.

33. (*a*) $u = -10$ cm, $v = +15$ cm



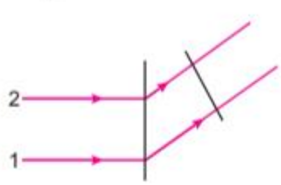
$$\frac{2}{R} = \frac{1}{u} + \frac{1}{v}$$

$$\Rightarrow \quad \frac{2}{R} = \frac{1}{-10} + \frac{1}{15} = -\frac{5}{150} = \frac{1}{30}$$

$R = -60$ cm.

35. (*c*) No fringes will be obtained because two separate however identical sources cannot be considered as coherent sources.

36. (*d*) Ray 1 travels faster than ray 2. The light beam bends upwards.



37. (*b*) Brewster's law gives, ${}_w n_m = \tan 60° = \sqrt{3}$

$$\frac{{}_a n_m}{{}_a n_w} = \sqrt{3} \quad \Rightarrow {}_a n_m = \sqrt{3} \times {}_a n_w$$

$$v = \sqrt{3} \times \frac{4}{3} = \frac{4}{\sqrt{3}} = 2.3$$

39. (*a*) The number of photoelectrons emitted is directly proportional to intensity of incident radiation while the kinetic energy is independent of the intensity.

40. (*b*) As we know,

$$eV_0 = \frac{hc}{\lambda} - \phi$$

The work function of sodium is less than that of copper and hence the stopping potential is more in case of sodium than copper.

41. (*a*) Power dissipated $= I^2R$

In (*i*) case, $P_1 = I^2\,(3r)$

In (*ii*) case, $R_2 = \dfrac{(2r)(r)}{2r + r} = \dfrac{2}{3}r$

$\therefore \quad P_2 = I^2\left(\dfrac{2}{3}r\right)$

In (*iii*) case, $R_3 = \dfrac{r}{3} \quad \therefore P_3 = I^2\left(\dfrac{r}{3}\right)$

In (*iv*) case, $R_4 = \dfrac{r}{2} + r = \dfrac{3}{2}r$

$$P_4 = I^2\left(\frac{3}{2}r\right)$$

Clearly, $P_3 < P_2 < P_4 < P_1$

42. (*d*) When circular coil expands radially in a region of magnetic field such that the magnetic field is in the same plane as the circular coil or the magnetic field has a perpendicular (to the plane of the coil) component whose magnitude is decreasing suitably in such a away that the cross product of magnetic field and surface of plane of coil remain constant at every instant.

43. (*d*) The wavelength is given by

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_2^2} - \frac{1}{n_1^2}\right) \quad \Rightarrow \quad \lambda \propto \frac{1}{Z^2}$$

As Z is maximum for lithium, the wavelength will be minimum.

44. (*a*) In a hydrogen like atom, when an electron makes a transition, from nth level to $(n-1)$th level, the frequency of the emitted radiation is

$$\nu = RcZ^2\left[\frac{1}{(n-1)^2} - \frac{1}{n}\right] = \frac{RcZ^2(2n-1)}{(n-1)^2\,n^2}$$

For $n >> 1$,

$$\nu = \frac{RcZ^2 \times 2n}{n^2 \times n^2} = \frac{2RcZ^2}{n^3}$$

$$\Rightarrow \quad \nu \propto \frac{1}{n^3}$$

45. (*b*) Balmer series lies in the visible region.

47. (*c*) In a pure semiconductor of germanium or silicon, the number density of electrons and holes are equal *i.e.*, $n_e = n_h$.

48. (*b*) When *p*-*n* junction is forward biased, the height of potential barrier decreases whereas when it is reverse biased, the height of potential barrier increases.

50. (*a*) From truth table,

A	B	$\overline{A}$	$\overline{B}$	Y
1	0	0	1	0
0	0	1	1	0
0	1	1	0	0
1	0	0	1	0
1	1	0	0	1
0	0	1	1	0
0	1	1	0	0

Output waveform: