8 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. **A method for charging a conductor without bringing a charged object in contact with it is called**
   (*a*) electrification (*b*) magnetisation
   (*c*) electromagnetic induction (*d*) electrostatic induction

2. **Three charges $+4q$, Q and q are placed in a straight line of length l at points at distance 0, $l/2$, and l respectively. What should be Q in order to make the net force on q to be zero?**
   (*a*) $-q$ (*b*) $-2q$ (*c*) $-\frac{q}{2}$ (*d*) $4q$

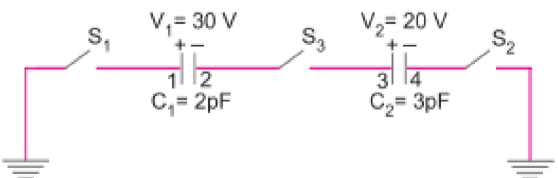
3. **What will be the value of electric field at the centre of the electric dipole?**
   (*a*) Zero
   (*b*) Equal to the electric field due to one charge at centre
   (*c*) Twice the electric field due to one charge at centre
   (*d*) Half the value of electric field due to one charge at centre

4. **A charge q is placed at the centre of a cube, what is the electric flux passing through one of its faces?**
   (*a*) $\frac{q}{6\varepsilon_0}$ (*b*) $\frac{q}{\varepsilon_0}$ (*c*) $\frac{6q}{\varepsilon_0}$ (*d*) $\frac{q}{3\varepsilon_0}$

5. **The capacitance of a capacitor becomes $\frac{7}{6}$ times its original value if a dielectric slab of thickness $t = \frac{2}{3}d$ is introduced in between the plates, where d is the separation between the plates. The dielectric constant of the slab is**
   (*a*) $\frac{14}{11}$ (*b*) $\frac{11}{14}$ (*c*) $\frac{7}{11}$ (*d*) $\frac{11}{7}$

6. **Two identical capacitors joined in parallel are charged to a common potential $V/2$. The battery is disconnected. Now, the capacitors are separated and joined in series. For the new combination:**
   (*a*) Energy and p.d. both will remain unchanged. (*b*) Energy will remain same, p.d. will become V.
   (*c*) Energy and potential both will become 2 times. (*d*) Energy will become 2 times, p.d. will remain V.

7. **Which one of the following statements is true for the given circuit?**



   (*a*) With S_1 closed, $V_1 = 15$ V, $V_2 = 20$ V. (*b*) With S_3 closed, $V_1 = V_2 = 25$ V.
   (*c*) With S_1 and S_2 closed, $V_1 = V_2 = 0$. (*d*) With S_1 and S_3 closed, $V_1 = 30$ V, $V_2 = 20$ V.

8. **Which of the following statements is not correct according to Rutherford model?**

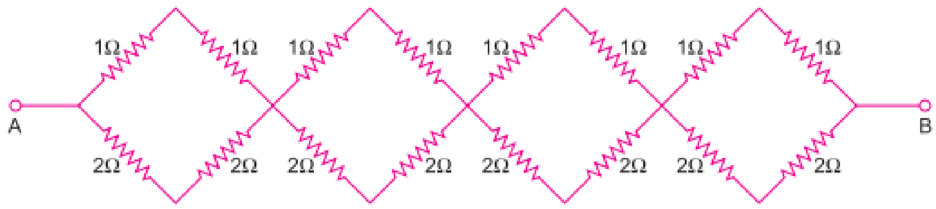
(*a*) Most of the space inside an atom is empty.

(*b*) The electrons revolve around the nucleus under the influence of coulomb force acting on them.

(*c*) Most part of the mass of the atom and its positive charge are concentrated at its centre.

(*d*) The stability of atom was established by the model.

9. **Determine the equivalent resistance of the following network.**



(*a*) $\frac{16}{3}\ \Omega$ (*b*) $\frac{1}{2}\Omega$

(*c*) $\frac{2}{3}\Omega$ (*d*) $4\ \Omega$

10. **Fuse wire must have**

(*a*) low resistivity, high melting point (*b*) high resistivity, high melting point

(*c*) high resistivity, low melting point (*d*) low resistivity, low melting point.

11. **When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ the stopping potential is $\frac{V}{4}$. The threshold wavelength for the metallic surface is**

(*a*) 4λ (*b*) 5λ (*c*) $\frac{5}{2}\lambda$ (*d*) 3λ

12. **Match the corresponding entries of Column A with Column B.**

	Column A		Column B
(*i*)	A closed loop in a uniform magnetic field	(*p*)	$\tau = 0, F \neq 0$
(*ii*)	A closed loop in a non-uniform magnetic field	(*q*)	$F = 0, \tau \neq 0$
(*iii*)	Inside a long thick wire carrying current	(*r*)	$F \neq 0, \tau \neq 0$
		(*s*)	$B \propto r$

(*a*) (*i*)–(*q*) (*ii*)–(*r*), (*iii*)–(*s*) (*b*) (*i*)–(*s*), (*ii*)–(*r*), (*iii*)–(*q*)

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

13. **A current loop in a magnetic field**

(*a*) can be in equilibrium in two orientations, both the equilibrium states are unstable.

(*b*) can be in equilibrium in two orientations, one stable while the other is unstable.

(*c*) experiences a torque whether the field is uniform or non uniform in all orientations.

(*d*) can be in equilibrium in one orientation.

14. **A galvanometer has a coil of resistance 100 Ω and gives a full scale deflection for a current of 30 mA. If it is to work as a voltmeter of 30 V range, the resistance required to be added will be**

(*a*) 500 Ω (*b*) 900 Ω (*c*) 1000 Ω (*d*) 1800 Ω

15. **Two particles having masses in the ratio 1: 1 and charge 1: 2 are projected into a uniform magnetic field perpendicular to field with speeds in the ratio 2: 3. The ratio of the radii of circular path along which the two particles move is**

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

16. **Two particles each of mass m and charge q are attached to the two ends of a light rod of length $2R$. The rod is rotated at a constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitude of the magnetic moment of the system and its angular momentum about the centre of the rod is**

(*a*) $\frac{q}{2m}$ (*b*) $\frac{q}{m}$ (*c*) $\frac{2q}{m}$ (*d*) $\frac{q}{\pi m}$

17. **Curie temperature is the temperature above which**

(*a*) ferromagnetic material becomes paramagnetic
(*b*) paramagnetic material becomes diamagnetic
(*c*) paramagnetic material becomes ferromagnetic
(*d*) ferromagnetic material becomes diamagnetic

18. **Electro-magnets are made of soft iron because soft iron has**

(*a*) small susceptibility and small retentivity
(*b*) large susceptibility and large retentivity
(*c*) large permeability and small retentivity
(*d*) small permeability and large retentivity.

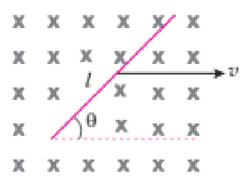
19. **Two coils of self inductances 2 mH and 8 mH are placed to close to each other that the flux linkage is complete between the coils. The mutual inductance between these coils is**

(*a*) 4 mH (*b*) 6 mH (*c*) 10 mH (*d*) 16 mH

20. **The magnitude of induced emf in a coil depend on**

(*a*) the amount of magnetic flux linked by the coil.
(*b*) the amount of electric flux linked by the coil.
(*c*) the rate of change of magnetic flux linked by the coil.
(*d*) the rate of change of electric flux linked by the coil.

21. **A circular loop of radius R carrying current I lies in x-y plane with the centre at origin. The total magnetic flux through xy plane is:**



(*a*) directly proportional to I
(*b*) directly proportional to R
(*c*) directly proportional to R^2
(*d*) zero

22. **In electric sub-station in township, large capacitor banks are used**

(*a*) to reduce power factor
(*b*) to improve power factor
(*c*) to decrease current
(*d*) to increase current in the circuit

23. **R, L and C represent the physical quantities resistance, inductance and capacitance respectively. Which one of the following combinations has dimension of frequency?**

(*a*) $\frac{1}{\sqrt{RC}}$ (*b*) $\frac{R}{L}$ (*c*) $\frac{1}{LC}$ (*d*) $\frac{C}{L}$

24. **An alternating current circuit consists of an inductor and a resistor in series. In this circuit**

(*a*) The potential difference across and current in resistor leads the potential difference across inductor.
(*b*) The potential difference across and current in resistor lags behind the potential difference across inductor by an angle $\pi/2$.
(*c*) The potential difference across and current in resistor lags behind the potential difference across inductor by an angle π
(*d*) The potential difference across resistor lags behind the potential difference across inductor by an angle $\pi/2$, while the current in resistor leads the potential difference across inductor by an angle $\pi/2$.

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

Statement P : Microwaves are better carriers of signals than optical waves.

Statement Q : Microwaves move faster than optical 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

26. **A swimmer is swimming inside a tank of water. He looks up at the sky through the water surface. The surface is calm. Sky is brighter due to daylight. He can see**

(*a*) a small illuminated patch directly above his head whose angular size is independent of the depth of the swimmer inside the tank.

(*b*) a small illuminated patch directly above his head whose angular size depends on the depth of the swimmer.

(*c*) nothing but darkness outside the tank.

(*d*) the entire top surface of water illuminated.

27. **A diver in a swimming pool wants to signal his distress to a person lying on the edge of the pool by flashing his waterproof flash light**

(*a*) he must direct the beam vertically upward

(*b*) he has to direct the beam horizontally

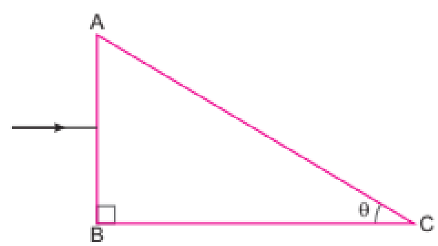
(*c*) he has to direct the beam at an angle to the vertical which is slightly less than the critical angle of incidence for total internal reflection

(*d*) he has to direct the beam at an angle to the vertical which is slightly more than the critical angle of incidence for total internal reflection.

28. **A thin concave lens is in contact with a thin convex lens. The ratio of their magnitude of powers is 2/3 and the focal length of the combined lens is 30 cm. The focal lengths of the individual lenses are**

(*a*) –15 cm and +10 cm
(*b*) –75 cm and +50 cm
(*c*) –21 cm and +14 cm
(*d*) –30 cm and +20 cm

29. **In the figure, a ray of light is perpendicular to the face *AB* of a glass prism (μ = 1.52).**



Find the value of θ so that the ray is totally reflected at face *AC*, if the prism is immersed in water (μ = 1.33).

(*a*) 45°
(*b*) 30°
(*c*) 15°
(*d*) None of these

30. **A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be**

(*a*) concave, – 0.2 diopter
(*b*) convex, + 0.15 diopter
(*c*) convex, + 2.25 diopter
(*d*) concave, – 0.25 diopter

31. **An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is**

(*a*) 12
(*b*) 16
(*c*) 8
(*d*) 10

32. **A green light is incident from the water to the air-water interface at the critical angle (θ). Select the correct statement:**

(*a*) The entire spectrum of visible light will come out of the water at an angle of 90° to the normal.

(*b*) The spectrum of visible light whose frequency is less than that of green light will come out to the air medium.

(*c*) The spectrum of visible light whose frequency is more than that of green light will come out to the air medium.

(*d*) The entire spectrum of visible light will come out of the water at various angle to the normal.

33. **In Young's double-slit experiment, the intensity at the central maximum is I_0. If one of the slit is covered, then the intensity at the central maximum will become**

(*a*) $\frac{I_0}{2}$
(*b*) $\frac{I_0}{\sqrt{2}}$
(*c*) $\frac{I_0}{4}$
(*d*) I_0

34. **The maximum number of possible interference maxima for slit separation equal to twice the wavelength in Young's double-slit experiment is**

(*a*) infinite (*b*) five (*c*) three (*d*) zero

35. **A Young's double-slit experiment uses a monchromatic light source. The shape of interference fringes formed on the screen is**

(*a*) circle (*b*) hyperbola (*c*) parabola (*d*) straight line

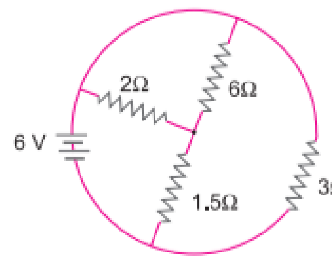
36. **If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be the intensity when the slit width is doubled?**

(*a*) $4I_0$ (*b*) $2I_0$ (*c*) $\frac{I_0}{2}$ (*d*) I_0

37. **In Young's double-slit experiment the two slits act as coherent sources of equal amplitude A and of wavelength λ. In another experiment, with the same set-up the two slits are sources of equal amplitude A and wavelength λ, but are incoherent. The ratio of intensity of light at the mid-point of the screen in the first case to that in the second case is**

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

38. **The total current supplied to circuit shown in fig. by the battery is**



(*a*) 1 A (*b*) 2 A (*c*) 4 A (*d*) 6 A

39. **The work-function of a surface of a photosensitive material is 6.2 eV. The wavelength of incident radiation for which the stopping potential is 5 V lies in**

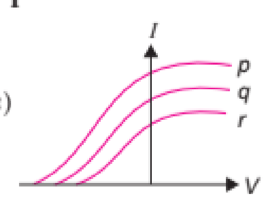
(*a*) ultraviolet region (*b*) visible region (*c*) infrared region (*d*) X-ray region

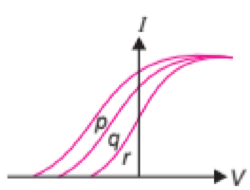
40. **The number of photoelectrons emitted for light of frequency ν (higher than the threshold frequency ν_0) is proportional to**

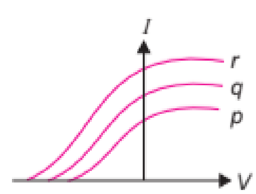
(*a*) threshold frequency (*b*) intensity of light

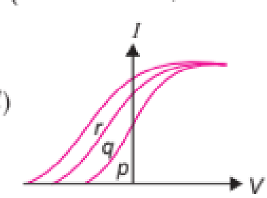
(*c*) frequency of light (*d*) $\nu - \nu_0$

41. **Photoelectric effect experiments are performed using three different metal plates p, q and r having work functions ϕ_p = 2.0 eV, ϕ_q = 2.5 eV and ϕ_r = 3.0 eV respectively. A light beam containing wavelengths of 550 nm, 450 nm and 350 nm with equal intensities illuminates each of the plates. The correct *I-V* graph for the experiment is:** **(Take hc = 1240 eV nm)**

(*a*)


(*b*)


(*c*)


(*d*)


42. **When a monochromatic point-source of light is at a distance of 0.2 m from a photo-electric cell, the cut-off voltage and the saturation current are respectively 0.6 volt and 18.0 mA. If the same source is placed 0.6 m away from the photo-electric cell, then**

(*a*) the stopping potential will be 0·2 volt (*b*) the stopping potential will be 0·6 volt

(*c*) the saturation current will be 6·0 mA (*d*) the saturation current will be 4·0 mA

43. **The transition from state n = 8 to n = 3 in a hydrogen-like atom results in ultraviolet radiation. Infra-red radiation will be obtained in the transition from**

(*a*) $2 \to 1$ (*b*) $3 \to 2$ (*c*) $4 \to 2$ (*d*) $5 \to 4$

44. **The radius of the third Bohr orbit for hydrogen is 4.5 Å. The radius of its fourth Bohr orbit is**

(*a*) 7.2 Å (*b*) 8.0 Å (*c*) 9.6 Å (*d*) 11.3 Å

45. **A fully charged capacitor has a capacitance *C*. It is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity '*s*' and mass '*m*'. If the temperature of the block is raised by ΔT the potential difference *V* across the capacitance is**

(*a*) $\frac{mC\,\Delta T}{s}$ (*b*) $\sqrt{\frac{2mC\,\Delta T}{s}}$ (*c*) $\sqrt{\frac{2ms\,\Delta T}{C}}$ (*d*) $\frac{ms\,\Delta T}{C}$

46. **Fusion reactions take place at a high temperature because**

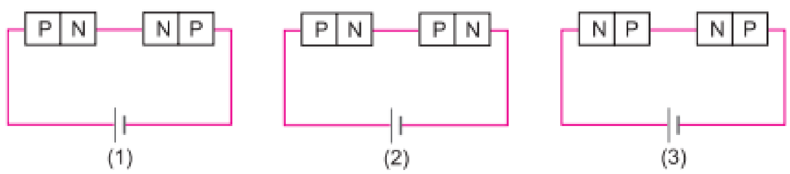
(*a*) atoms are ionised at high temperature

(*b*) molecules break up at high temperature

(*c*) nuclei break up at high temperature

(*d*) kinetic energy is high enough to overcome repulsion between nuclei

47. **Two identical junctions may be connected in series with a battery in three ways. The potential drops across the two junctions are equal in**



(*a*) circuits (1) and (2) (*b*) circuits (2) and (3)

(*c*) circuits (1) and (3) (*d*) circuit (1) only

48. **Solar energy is mainly caused due to**

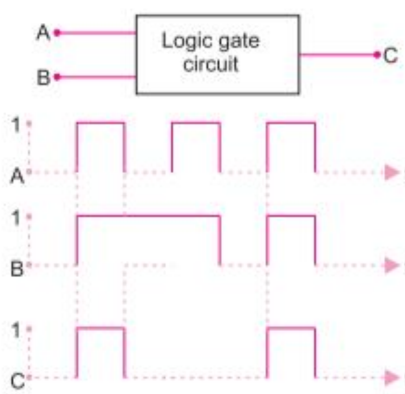
(*a*) gravitational contraction

(*b*) fusion of proton during synthesis of heavier elements

(*c*) fission of uranium present in the sun

(*d*) burning of hydrogen in the oxygen

49. **The following figure shows a logic gate circuit with two inputs *A* and *B* and the output *C*. The voltage waveforms of *A*, *B* and *C* are shown below:**



(*a*) AND gate (*b*) NAND gate

(*c*) NOR gate (*d*) OR gate

50. **A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is:**

(*a*) 1000 (*b*) 1250

(*c*) 50 (*d*) 500

ANSWERS

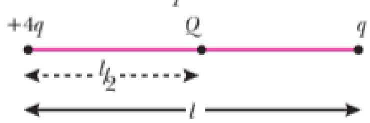
PRACTICE PAPER – 8

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

SOLUTIONS

PRACTICE PAPER–8

2. (*a*) For net force on q to be zero

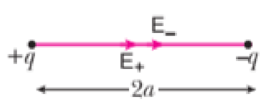


$$\frac{k(4q)(q)}{l^2} + \frac{k(Q)(q)}{(l/2)^2} = 0$$

$$\Rightarrow \quad \frac{4kq^2}{l^2} + \frac{4kQq}{l^2} = 0$$

$$\Rightarrow \quad Q = -q$$

3. (*c*) As we know that



$$E_+ = E_- = \frac{k \times q}{a^2} = \frac{kq}{a^2}$$

$$E_{net} = \sqrt{E_+^2 + E_-^2 + 2E_+ . E_- \cos 0} = E_+ + E_-$$

$$= \frac{2\,kq}{a^2}$$

As due to point charge $E = kq/a^2$. Hence electric field at the centre of the electric dipole is twice the electric field due to one charge at centre.

4. (*a*) Electric flux through whole cube $= \dfrac{q}{\varepsilon_0}$

Electric flux through one surface $= \dfrac{q}{6\varepsilon_0}$

5. (*a*) $C' = \dfrac{\varepsilon_0 A}{d - t\left(1 - \dfrac{1}{K}\right)}, \quad C = \dfrac{\varepsilon_0 A}{d}$

$$\Rightarrow \frac{C'}{C} = \frac{d}{d - t\left(1 - \dfrac{1}{K}\right)} = \frac{d}{d - \dfrac{2}{3}d\left[1 - \dfrac{1}{K}\right]} = \frac{3K}{K+2}$$

$$\Rightarrow \frac{7}{6} = \frac{3K}{K+2} \quad \Rightarrow \quad K = \frac{14}{11}$$

6. (*b*) In series potential differences are additive, $V' = \dfrac{2V}{2} = V$

Initial energy $U_i = \frac{1}{2}(2C_0)\left(\frac{V}{2}\right)^2$, where C_0 is capacitance of each capacitor

Final energy, $U_f = \frac{1}{2}\left(\frac{C_0}{2}\right)(V)^2 = U_i$

7. (*d*) Initial charge on $C_1 = 30 \times 2 = 60$ pC

Initial charge on $C_2 = 20 \times 3 = 60$ pC

Clearly initial charges on C_1 and C_2 are same; so when S_1 and S_3 are closed; the capacitors are connected in series, so charges do not redistribute and potential differences across C_1 and C_2 remain as before $V_1 = 30$ V, $V_2 = 20$ V.

9. (*a*) The given network consists of series combination of 4 equivalent units.

Resistance of Each Unit: Each unit has 2 rows, upper row contains two resistance 1 Ω, 1 Ω in series and lower row contains two resistances 2 Ω, 2 Ω in series. These two are mutually connected in parallel.

Resistance of upper row, $R_1 = 1 + 1 = 2\,\Omega$

Resistance of lower row, $R_2 = 2 + 2 = 4\,\Omega$

∴ Resistance of each unit R' is given by

$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R' = \frac{R_1R_2}{R_1 + R_2}$$

$$= \frac{2\times4}{2+4} = \frac{4}{3}\Omega$$

∴ Equivalent resistance between A and B

$$R_{AB} = R' + R' + R' + R' = 4R' = 4 \times \frac{4}{3} = \frac{16}{3}\Omega$$

11. (*d*) From Einstein photoelectric equation,

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \quad ...(i)$$

$$\frac{eV}{4} = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0} \quad ...(ii)$$

Dividing (*i*) by (*ii*), we get

$$4 = \frac{\frac{1}{\lambda} - \frac{1}{\lambda_0}}{\frac{1}{2\lambda} - \frac{1}{\lambda_0}}$$

$$\Rightarrow \quad \frac{2}{\lambda} - \frac{1}{\lambda} = \frac{4}{\lambda_0} - \frac{1}{\lambda_0} \Rightarrow \frac{1}{\lambda} = \frac{3}{\lambda_0}$$

∴ $\lambda_0 = 3\lambda$

13. (*b*) $\theta = 0°$ (Unstable) & $180°$ (Stable)

14. (*b*) $I_g = \frac{V}{R+G}$

$$30 \times 10^{-3} = \frac{30}{R + 100}$$

$R + 100 = 1000$

$\Rightarrow \quad R = 900\,\Omega$

15. (*a*) $r = \frac{mv}{qB} \Rightarrow \frac{r_1}{r_2} = \frac{m_1}{m_2}\cdot\frac{v_1}{v_2}\cdot\frac{q_2}{q_1}$

$$= 1\times\left(\frac{2}{3}\right)\times\left(\frac{2}{1}\right) = \frac{4}{3}$$

16. (*a*) Magnetic moment of system

$$M = IA = \left(\frac{q}{T} + \frac{q}{T}\right)\pi R^2 = \frac{2\pi}{T}qR^2 = \omega qR^2$$

Angular momentum about axis of rotation

$$L = I\omega = (mR^2 + mR^2)\,\omega = 2mR^2\omega$$

$$\frac{M}{L} = \frac{\omega qR^2}{2mR^2\omega} = \frac{q}{2m}$$

18. (*c*) The soft iron gets easily magnetised due to its high susceptibility and loses its magnetism due to low retentivity. It has also high permeability. The hysteresis loop of soft iron has a small area which suggests that there is a minimum loss of electromagnetic field energy in the form of thermal energy. That's why soft iron is preferably used as electromagnets.

19. (*a*) $M = \sqrt{L_1L_2} = \sqrt{2\times8} = 4$ mH

21. (*d*) Magnetic flux through the coil,

$$\phi = \vec{B}\cdot\vec{A} = B\,\hat{k}\cdot(A_x\,\hat{i} + A_y\,\hat{j}) = 0$$

22. (*b*) In electric sub-station in the township, large capacitor banks are used to improve power factor, not to decrease current.

23. (*b*) Time constant for RC circuit is given by $\tau = RC$

$\Rightarrow \frac{1}{RC}$ will have the dimension of frequency.

Similarly, time constant for a LR circuit is given by

$\tau = \frac{L}{R} \Rightarrow \frac{R}{L}$ will have dimension of frequency.

26. (*a*) Angular size of small illuminated patch depends upon the refractive index and not on the depth of the swimmer inside the tank.

27. (*c*) If $i < C$, only then light can reach from water in air.

28. (*a*) The ratio of power of the lens is given as 2/3. Therefore,

$$\left|\frac{P_{\text{concave}}}{P_{\text{convex}}}\right| = \frac{2}{3}$$

$$\left|\frac{f_{\text{convex}}}{f_{\text{concave}}}\right| = \frac{2}{3} \quad ...(i)$$

The effective focal length is calculated as

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$$\frac{1}{f_{\text{convex}}} + \frac{1}{f_{\text{concave}}} = 30 \text{ cm}$$

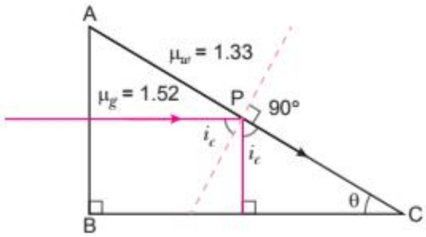
Using equation (*i*), we get

$$\frac{1}{f_{\text{convex}}} + \frac{1}{f_{\text{concave}}} = 30 \text{ cm}$$

$\Rightarrow \quad f_{\text{convex}} = 10$ cm.

Therefore, $f_{\text{concave}} = -15$ cm.

29. (*b*) Using Snell's law at point P,



$$\frac{\sin i_c}{\sin 90°} = n_{wg}$$

$$\sin i_c = \frac{n_w}{n_g} = \frac{1.33}{1.52} = 0.875$$

$\Rightarrow \quad i_c = 61°$

But $\quad i_c + \theta = 90°$

$$\theta = 90° - 61° = 29° \approx 30°$$

30. (*d*) For shift of the far point of the eye to infinity,

$$u = -\infty, v = -4 \text{ m}$$

By using lens formula,

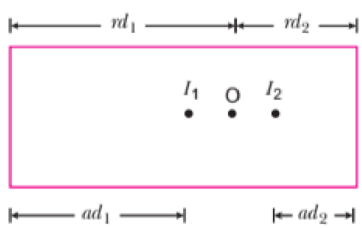
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-4} - \frac{1}{-\infty} = -\frac{1}{4}$$

$\Rightarrow \quad f = -4$ cm

Then, $P = \frac{1}{f} = -\frac{1}{4} = -0.25$ D

Negative sign implies concave lens.

31. (*a*) According to question,



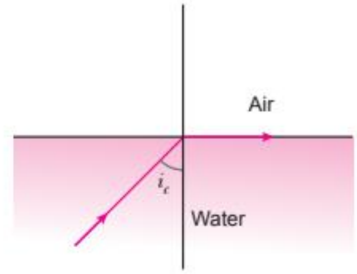
Thickness of the slab $= rd_1 + rd_2$

$$= n_g(ad_1 + ad_2) \quad \left[\because \; n = \frac{rd}{ad}\right]$$

$$= 1.5(5 + 3) \text{ cm} = 1.5 \times 8 \text{ cm} = 12 \text{ cm}$$

32. (*b*) From critical angle,

$$\sin i_c = \frac{1}{\mu_w}, \; \mu_w = a + \frac{b}{\lambda^2}$$



For light of frequency smaller than that of green light, λ will be large, μ_w small and hence i_c will be large. The spectrum will not become internally reflected and will come out to the air medium.

33. (*c*) $I_0 = I_1 + I_2 + 2\sqrt{I_1 I_2}$

If $I_1 = I_2 = I$ (let),

then, $I_0 = 4I$

When one slit is covered, then $I_2 = 0$

$$\therefore \quad I_0' = \frac{I_0}{4}$$

34. (*b*) Condition for constructive interference,

$$d \sin\theta = n\lambda \;\Rightarrow\; \sin\theta = \frac{n\lambda}{d} = \frac{n\lambda}{2\lambda} = \frac{n}{2}$$

As θ can not exceed 1, so when $n = 0, \pm 1, \pm 2$, $\sin\theta = 0, \pm\frac{1}{2}, \pm 1$; thus 5 maxima are allowed.

35. (*d*) The actual shape of fringes is hyperbolic, but their intersection on the screen is a straight line, so they appear as a straight line.

36. (*a*) In single slit diffraction pattern $I \propto a^2$;

If slit width a is doubled, intensity will become 4-times.

37. (*c*) When sources are coherent,

$$(I_{\max})_{coherent} = a^2 + a^2 + 2a^2 = 4a^2$$

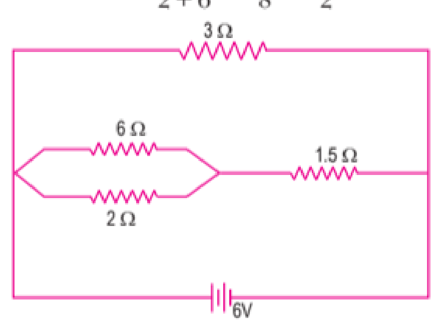
$$(I_{\max})_{incoherent} = a^2 + a^2 = 2a^2$$

Ratio = 2 : 1

38. (*c*) From circuit shown,

Here, 2 Ω R 6 Ω are in parallel,

$$R' = \frac{2 \times 6}{2 + 6} = \frac{12}{8} = \frac{3}{2}\Omega$$



Now, $R'' = (1.5 + 1.5)\Omega = 3\Omega$.

Then, $R_{eq} = \dfrac{R' \times R''}{R' + R''} = \dfrac{3 \times 3}{3+3} = 1.5\,\Omega$

$\therefore \quad I = \dfrac{V}{R_{eq}} = \dfrac{6}{1.5} = 4\text{ A}$

39. (*a*) $K.E_{max} = eV_0 = 5$ eV

Now, $E = K.E_{max} + \phi_0 = (5 + 6.2)$ eV

$= 11.2 \text{ eV} = 17.92 \times 10^{-19}$ J

$$\nu = \frac{E}{h} = \frac{17.92 \times 10^{-19}}{6.63 \times 10^{-34}} = 2.7 \times 10^{15}\text{ Hz}$$

$\Rightarrow$ *i.e.*, ν lies in ultraviolet region.

40. (*b*) Intensity of light means the energy incident per unit area per second. With increase in intensity, number of photo-electrons increases and vice-versa.

41. (*a*) Energy of each photon for wavelength λ_1 = 500 nm, λ_2 = 450 nm and λ_3 = 350 nm is:

$E_1 = \dfrac{1240}{550}\text{ eV} = 2.25\text{ eV}$,

$E_2 = \dfrac{1240}{450}\text{ eV} = 2.75\text{ eV}$

and $E_3 = \dfrac{1240}{350}\text{ eV} = 3.5\text{ eV}$

Given $\phi_p = 2.0\text{ eV}$, $\phi_q = 2.5\text{ eV}$ and $\phi_r = 3.0\text{ eV}$

Clearly, $E_1 < \phi_q$ and $E_1 < \phi_r$ so photons of wavelength λ_1 will not be able to eject electrons from q and r, and $E_2 < \lambda_r$, so wavelength l_2 will not eject electrons from r. So photoelectrons will be maximum for λ_r other conditions are also satisfied in graph (*c*).

42. (*b*) By increasing distance from 0.2 m to 0.6 m, intensity $\left(\propto \dfrac{1}{r^2}\right)$ becomes $\dfrac{1}{9}$ times; stopping potential is independent of intensity while the saturation current is proportional to intensity, so stopping potential remains same 0.6 V, while current becomes $\dfrac{1}{9}$ times *i.e.*, 2.0 mA.

43. (*d*) Energy difference between successive levels in H-like atom decreases with increase of order. If transition $4 \rightarrow 3$ represents ultraviolet radiation then transition $5 \rightarrow 4$ will represent radiation of lesser energy, *i.e.*, infra-red radiation.

44. (*b*) For Bohr's radius of n^{th} orbit,

$r \propto n^2$

$\dfrac{r_3}{r_4} = \dfrac{9}{16} \quad \Rightarrow \quad r_4 = \dfrac{16}{9} r_3$

$r_4 = \dfrac{16}{9}(4.5) = 8\,\text{Å}$

45. (*c*) Electrostatic energy = Thermal energy

$$\frac{1}{2}CV^2 = ms\,\Delta T$$

$$\Rightarrow \qquad V = \sqrt{\frac{2ms\,\Delta T}{C}}$$

47. (*b*) In circuit (2) both the diodes are forward biased and in circuit (3) both the diodes are reversed biased. Therefore, circuit (2) and (3) have equal potential drop.

48. (*b*) Solar energy is mainly caused due to the fusion of protons during the synthesis of heavier elements.

49. (*a*) From truth table

A	B	C
0	0	0
1	1	1
0	1	0
1	1	0
0	0	0
1	1	1

Hence this logic gate circuit behave like a AND gate.

50. (*b*) $A_v = \beta.\dfrac{R_L}{R_i} \Rightarrow 50 = \beta.\dfrac{200}{100} \Rightarrow \beta = 25$

$\therefore$ Power gain $= A_v.\beta = 50 \times 25 = 1250$