PRACTICE PAPER

12

PHYSICS

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

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

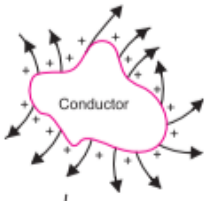
Choose the correct option in the following questions.

1. **Two point charges placed in a medium of dielectric constant 5 are at a distance r between them, experience an electrostatic force 'F'. The electrostatic force between them in vacuum at the same distance r will be**
   (*a*) $5F$ (*b*) F (*c*) $F/2$ (*d*) $F/5$

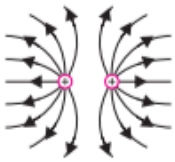
2. **Which statement is true for Gauss law?**
   (*a*) All the charges whether inside or outside the Gaussian surface contribute to the electric flux.
   (*b*) Electric flux depends upon the geometry of the Gaussian surface.
   (*c*) Gauss theorem can be applied to non-uniform electric field.
   (*d*) The electric field over the Gaussian surface remains continuous and uniform at every point.

3. **Which among the curves shown in figure possibly represent electrostatic field lines?**

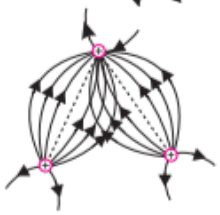
(*a*)



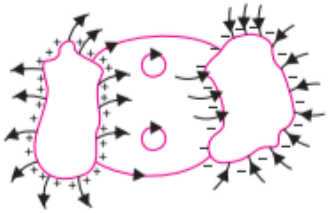
(*b*)



(*c*)



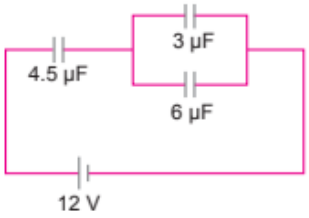
(*d*)



4. **Three charges $2q$, $-q$ and $-q$ lie at the vertices of a triangle. The value of E and V at centroid of triangle will be**
   (*a*) $E \neq 0$ and $V \neq 0$ (*b*) $E = 0$ and $V = 0$
   (*c*) $E \neq 0$ and $V = 0$ (*d*) $E = 0$ and $V \neq 0$

5. **Two parallel plate capacitors X and Y, have the same area of plates and same separation between plates. X has air and Y with dielectric of constant 2 , between its plates. They are connected in series to a battery of 12 V. The ratio of electrostatic energy stored in X and Y is**
   (*a*) 4:1 (*b*) 1:4
   (*c*) 2:1 (*d*) 1:2

6. In the circuit shown in the figure, the potential difference across the 4.5 μF capacitor is



(*a*) 8 V (*b*) 6 V (*c*) $\frac{48}{13}$ V (*d*) 8/3 V

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

Statement P : Change never flows from a condenser of higher capacity to the condenser of lower capacity.

Statement Q : Flow of charge between two bodies connected by a thin wire is determined by the charges on them.

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

8. The shape of equipotential surface for an infinite line charge is

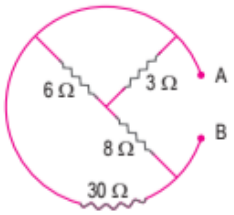
(*a*) parallel plane surface

(*b*) parallel plane surface perpendicular to lines of force

(*c*) coaxial cylindrical surface

(*d*) none of these

9. The equivalent resistance between *A* and *B* is



(*a*) 3 ohms (*b*) 5.5 ohms (*c*) 7.5 ohms (*d*) 9.5 ohms

10. The best instrument for accurate measurement of EMF of a cell is

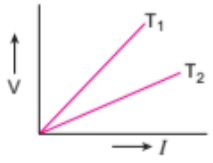
(*a*) potentiometer (*b*) metre bridge

(*c*) voltmeter (*d*) ammeter and voltmeter

11. Three resistors having values R_1, R_2, and R_3 are connected in series to a battery. Suppose R_1 carries a current of 2.0 A, R_2 has a resistance of 3.0 ohms, and R_3 dissipates 6.0 watts of power. Then the voltage across R_3 is

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

12. The voltage *V* and current *I* graph for a conductor at two different temperatures T_1 and T_2 are shown in the figure. The relation between T_1 and T_2 is



(*a*) $T_1 > T_2$ (*b*) $T_1 \approx T_2$ (*c*) $T_1 = T_2$ (*d*) $T_1 < T_2$

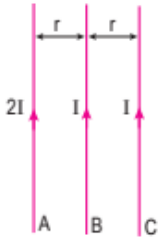
13. The SI unit of magnetic field intensity is

(*a*) AmN^{-1} (*b*) $NA^{-1}m^{-1}$ (*c*) $NA^{-2}m^{-2}$ (*d*) $NA^{-1}m^{-2}$

14. **The current sensitivity of a galvanometer increases by 20%. If its resistance also increases by 25%, the voltage sensitivity will**

(*a*) decrease by 1%
(*b*) increase by 5%
(*c*) increase by 10%
(*d*) decrease by 4%

15. **Three infinitely long parallel straight current carrying wires *A*, *B* and *C* are kept at equal distance from each other as shown in the figure . The wire *C* experiences net force *F* .The net force on wire *C*, when the current in wire *A* is reversed will be**



(*a*) zero
(*b*) *F*/2
(*c*) *F*
(*d*) 2*F*

16. **The magnetic induction at the centre of a circular loop of area π square metre is 0.1 T. The magnetic moment of the loop is (μ_0 is permeability of air)**

(*a*) $\frac{0 \cdot 1\pi}{\mu_0}$
(*b*) $\frac{0 \cdot 2\pi}{\mu_0}$
(*c*) $\frac{0 \cdot 3\pi}{\mu_0}$
(*d*) $\frac{0 \cdot 4\pi}{\mu_0}$

17. **A magnet is dropped with its north pole towards a closed circular coil placed on a table then**

(*a*) looking from above, the induced current in the coil will be anti-clockwise
(*b*) the magnet will fall with uniform acceleration
(*c*) as the magnet falls, its acceleration will be reduced
(*d*) no current will be induced in the coil

18. **A bar magnet of magnetic moment *m* is cut into two parts of equal length. The magnetic moment of either part is**

(*a*) *m*
(*b*) 2*m*
(*c*) *m* / 2
(*d*) zero

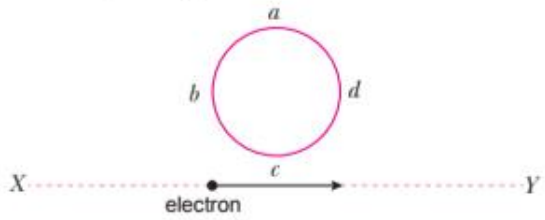
19. **The bar magnet is replaced by a solenoid of cross sectional area 2×10^{-4} m^2 and 1000 turns, but same magnetic moment (0.4 Am^2) then current through the solenoid is**

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

20. **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**

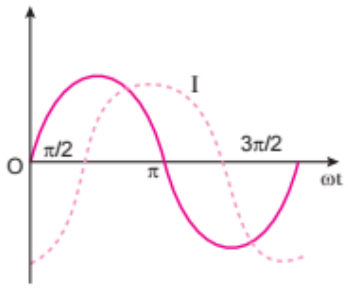
(*a*) 4 mH
(*b*) 6 mH
(*c*) 10 mH
(*d*) 16 mH

21. **An electron moves on a straight line path *XY* as shown. The *abcd* is a coil adjacent to the path of electron. What will be the direction of current, if any, induced in the coil?**



(*a*) The current will reverse its direction as the electron goes past the coil.
(*b*) No current induced
(*c*) *abcd*
(*d*) *adcb*

22. The variation of the instantaneous current $I(t)$ and the instantaneous emf $E(t)$ in a circuit is as shown in the following fig. Which of the following statements is correct?



(a) The voltage lags behind the current by $\pi/2$.
(b) The voltage leads the current by $\pi/2$.
(c) The voltage and the current are in phase.
(d) The voltage leads the current by π.

23. When an *ac* voltage of 220 V is applied to the capacitor C
(a) the maximum voltage between plates is 220 V.
(b) power delivered to the capacitor is zero.
(c) the charge on the plates is in phase with the applied voltage.
(d) both (b) and (c)

24. The core used in transformers and other electromagnetic devices are laminated
(a) to increase the magnetic field
(b) to increase the level of magnetic saturation of the core
(c) to reduce the magnetism in the core
(d) to reduce eddy current losses in the core

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

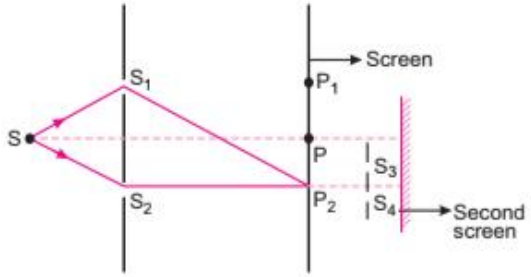
Statement P : The speed of electromagnetic waves in free space is maximum for gamma rays and minimum for radiowaves.

Statement Q : For waves with same wavelengths this just means that the speed will be equal to c.

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. Figure shows a standard two slit arrangement with slits S_1, S_2. P_1, P_2 are the two minima points on either side of P.



At P_2 on the screen, there is a hole and behind P_2 is a second 2- slit arrangement with slits S_3, S_4 and a second screen behind them.

(a) There would be no interference pattern on the second screen but it would be lighted.
(b) The second screen would be totally dark.
(c) There would be a single bright point on the second screen.
(d) There would be a regular two slit pattern on the second screen.

27. An object approaches a convergent lens from the left of the lens with a uniform speed 5 m/s and stops at the focus. The image

(*a*) moves away from the lens with a uniform speed 5 m/s

(*b*) moves away from the lens with a uniform acceleration

(*c*) moves away from the lens with a non-uniform acceleration

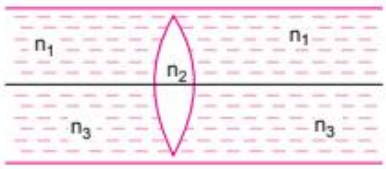
(*d*) moves towards the lens with a non-uniform acceleration

28. The reddish appearance of rising and setting sun is due to

(*a*) reflection of light (*b*) diffraction of light

(*c*) scattering of light (*d*) interference of light

29. A double convex lens; made of a material of refractive index n_2 is placed inside two liquids of refractive indices n_1 and n_3 such that $n_1 > n_2 > n_3$ as shown in fig. A wide parallel beam of light is incident on the lens from the left. The lens will give rise to



(*a*) a single convergent beam (*b*) a single divergent beam

(*c*) a convergent and a divergent beam (*d*) a single beam parallel to incident beam

30. A setting sun appears to be at an altitude higher than it really is. This is because of

(*a*) absorption of light (*b*) reflection of light

(*c*) refraction of light (*d*) dispersion of light

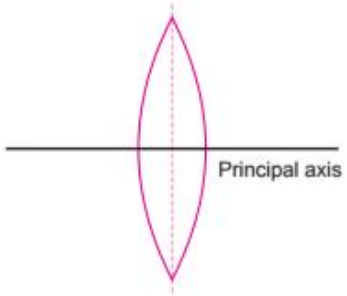
31. A man moves towards a mirror with a velocity 4 m/s. With what velocity his image moves towards mirror?

(*a*) 2 m/s (*b*) 4 m/s (*c*) 8 m/s (*d*) 16 m/s

32. An equilateral triangular prism is made of glass n = 1.5. A ray of light is incident normally on one of the faces. The angle between the incident and emergent ray is

(*a*) 60° (*b*) 90° (*c*) 120° (*d*) 180°

33. An equiconvex lens of focal length 15 cm is cut into two halves as shown in figure. Find the focal length of each part.



(*a*) 0.30 cm (*b*) –20 cm

(*c*) 30 cm (*d*) –15 cm

34. An electromagnetic wave of frequency 3 MHz passes from vacuum into a dielectric medium with permittivity ε = 4. Then,

(*a*) wavelength and frequency both remain unchanged

(*b*) wavelength is doubled and the frequency remains unchanged

(*c*) wavelength is doubled and the frequency becomes half

(*d*) wavelength is halved and the frequency remains unchanged

35. **The intensities of two waves A and B are respectively 9 units and 4 units. If they interfere, the ratio of $I_{max} : I_{min}$ will be**

(*a*) 25:1 (*b*) 81:16 (*c*) 9:4 (*d*) 3:2

36. **For light wave, λ is the wavelength, δ is the phase difference between two points on the wave separated by a distance of Δ. The relationship between λ, δ and Δ is**

(*a*) $\Delta = \frac{2\pi}{\lambda}\delta$ (*b*) $\Delta = \frac{\lambda}{2\pi}\delta$

(*c*) $\delta = \frac{\Delta}{\lambda}$ (*d*) $\delta = \frac{\Delta\pi}{\lambda}$

37. **The phenomenon of interference is based on**

(*a*) conservation of momentum (*b*) conservation of energy

(*c*) conservation of momentum and energy (*d*) quantum nature of light

38. **Match each situation given in Column A with the statement(s) in Column B vaid for that situation.**

Column A	Column B
(*i*) Plane wave front incident on a convex lens	(*p*) Plane wave front emerges
(*ii*) Plane wave front incident on a concave lens	(*q*) Converging spherical wave front emerges
(*iii*) One slit is closed in YDSE	(*r*) Diverging spherical wave front emerges
(*iv*) In YDSE, if width of source slit is increased	(*s*) Interference pattern disappears
	(*t*) Interference pattern becomes less sharp

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

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

39. **The threshold wavelength for photoelectric emission from a material is 5200 Å. Photoelectrons will be emitted when this material is illuminated with monochromatic radiation from a:**

(*a*) 50 watt infrared lamp (*b*) 1000 watt infrared lamp

(*c*) 1 watt ultraviolet lamp (*d*) 1 watt infrared lamp

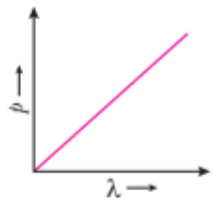
40. **Electrons used in an electron microscope are accelerated by a voltage of 25 kV. If the voltage is increased to 100 kV then the de-Broglie wavelength associated with the electrons would**

(*a*) increase by 2 times (*b*) decrease by 2 times

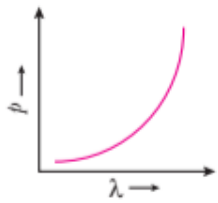
(*c*) decrease by 4 times (*d*) increase by 4 times

41. **Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength?**

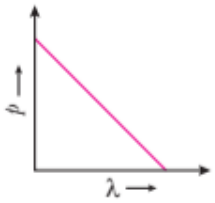
(*a*)



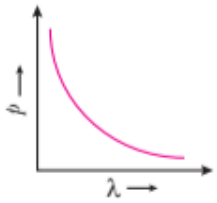
(*b*)



(*c*)



(*d*)



42. **An electron is moving with an initial velocity $v = v_0\hat{i}$ and is in a magnetic field $B = B_0\hat{j}$. Then its de Broglie wavelength.**

(*a*) remains constant
(*b*) increases with time
(*c*) decreases with time
(*d*) increase and decreases periodically

43. **In Geiger-Marsden experiment, the expression of distance of closest approach to the nucleus of an alpha particle before it comes to momentarily at rest and reverse its direction is**

(*a*) $\frac{Ze^2}{4\pi\varepsilon_0 K}$
(*b*) $\frac{Ze^2}{2\varepsilon_0 K}$
(*c*) $\frac{Ze^2}{2\pi\varepsilon_0 K}$
(*d*) $\frac{Ze^2}{4\varepsilon_0 K}$

44. **According to Bohr's postulates, an electron revolve around the nucleus in _____ orbits.**

(*a*) dynamic
(*b*) stationary
(*c*) lower
(*d*) first

45. **Two spherical nuclei have mass numbers 216 and 64 with their radii R_1 and R_2 respectively. The ratio, $\frac{R_1}{R_2}$ is equal to**

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

46. **At a specific instant, emission of radioactive compound is deflected in a magnetic field. The compound cannot emit.**

(*a*) electrons
(*b*) protons
(*c*) He^{2+}
(*d*) neutrons

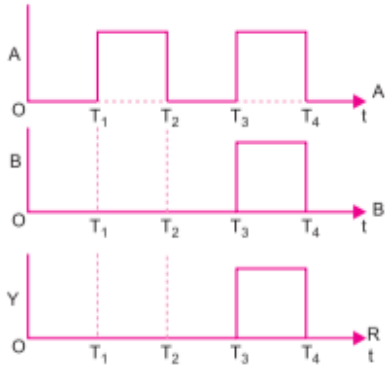
47. **In a *p*-*n*-junction diode, change in temperature due to heating**

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

48. **In a *p*-*n* junction diode, *p* is connected with positive terminal and *n* is connected with negative terminal of a battery, then the width of depletion layer**

(*a*) increases
(*b*) decreases
(*c*) remains unchanged
(*d*) first increases and then decreases

49. **Figure represents waveforms of two inputs *A* and *B* and that for output *Y* of a logic gate. The gate must be**



(*a*) OR gate
(*b*) AND gate
(*c*) NAND gate
(*d*) XOR gate

50. **Frequencies in the UHF range normally propagate by means of**

(*a*) ground waves
(*b*) surface waves
(*c*) sky waves
(*d*) space waves

ANSWERS

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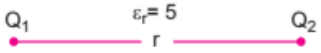
1. (*a*)	**2.** (*d*)	**3.** (*a*)	**4.** (*c*)	**5.** (*c*)	**6.** (*a*)	**7.** (*d*)
8. (*c*)	**9.** (*c*)	**10.** (*a*)	**11.** (*c*)	**12.** (*a*)	**13.** (*b*)	**14.** (*d*)
15. (*a*)	**16.** (*b*)	**17.** (*a*)	**18.** (*c*)	**19.** (*b*)	**20.** (*a*)	**21.** (*a*)
22. (*b*)	**23.** (*d*)	**24.**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

SOLUTIONS

PRACTICE PAPER–12

1. (*a*) Let charges Q_1 and Q_2 are placed in medium of dielectric constant ε_r at a distance r between them,

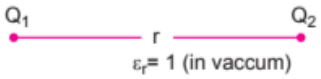


then,

$$F = \frac{1}{4\pi\varepsilon_0\varepsilon_r}\cdot\frac{Q_1Q_2}{r^2} = \frac{1}{4\pi\varepsilon_0(5)}\cdot\frac{Q_1Q_2}{r^2} \quad ...(i)$$

and when the charges are placed in vacuum,

$$F' = \frac{1}{4\pi\varepsilon_0}\cdot\frac{Q_1Q_2}{r^2} \quad ...(ii)$$



by dividing equation (*i*) and (*ii*)

$$\frac{F}{F'} = \frac{1}{5} \quad \Rightarrow \quad F' = 5F$$

2. (*d*) The electric field over the Gaussian surface remains continuous and uniform at every point.

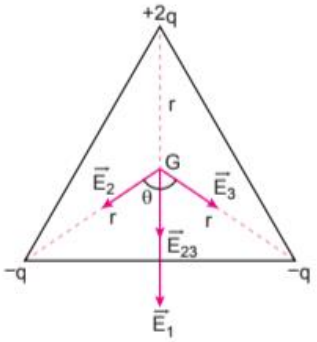
3. (*b*) Fig, (*a*) is wrong because the field lines must be normal to a conductor.

Fig, (*b*) is right because it satisfies all the properties of electric field lines.

Fig, (*c*) is wrong because field lines cannot intersect each other.

Fig, (*d*) is wrong because field lines cannot form closed loops.

4. (*c*) Let, G is centroid of equilateral triangle which is at a distance r from each vertices.



So, electric field due to $+2q$, $-q$, and $-q$ at G are,

$$|\vec{E}_1| = \frac{K(2q)}{r^2}, |\vec{E}_2| = \frac{Kq}{r^2}$$

$$|\vec{E}_3| = \frac{Kq}{r^2}$$

$$|\vec{E}_{23}| = |\vec{E}_2 + \vec{E}_3| = 2\frac{Kq}{r^2}\cos\left(\frac{\theta}{2}\right) = \frac{2Kq}{r^2}\cos 60°$$

$[\because \theta = 120°]$

$$= 2\frac{Kq}{r^2}\times\frac{1}{2} = \frac{Kq}{r^2}$$

$$|\vec{E}_{net}| = |\vec{E}_1| + |\vec{E}_{23}| = \frac{2Kq}{r^2} + \frac{Kq}{r^2} = \frac{3Kq}{r^2}$$

So, E at $G \neq 0$

Now,

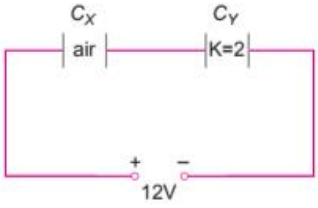
$$V \text{ at } G = V_1 + V_2 + V_3 = \frac{K.2q}{r} - \frac{Kq}{r} - \frac{Kq}{r} = 0$$

Hence, $E \neq 0$ and $V = 0$

5. (*c*) Given, A = same

d = same

Q = same (in series)



$$C_X = \frac{\varepsilon_o A}{d}, \quad C_Y = \frac{2\varepsilon_o A}{d}$$

$$U_X = \frac{Q^2}{2C_X}, \quad U_Y = \frac{Q^2}{2C_Y}$$

$$\therefore \quad \frac{U_X}{U_Y} = \frac{C_Y}{C_X} = \frac{2C_X}{C_X} = \frac{2}{1}$$

6. (*a*) $\frac{1}{C_{eq}} = \frac{1}{(3+6)} + \frac{1}{4.5}$ $C_{eq} = \frac{4.5\times 9}{4.5+9} = 3\,\mu F$

$Q = C_{eq}V = 3 \times 12 = 36\,\mu C$

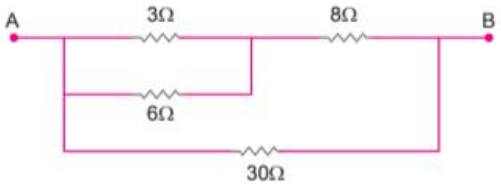
Now potential across 4.5 μF

$$V = \frac{q}{C} = \frac{3.6}{4.5} = 8\text{ V}$$

8. (*c*) The shape of equipotential surface for infinite line charge is coaxial cylindrical surface.

9. (*c*) Here, 3 Ω and 6 Ω are in parallel,

$$\therefore \quad R_1 = \frac{3\times 6}{3+6} = \frac{18}{9} = 2\,\Omega$$



Now, R_1 and 8 Ω are in series

$R_2 = R_1 + 8 = 2 + 8 = 10\ \Omega$

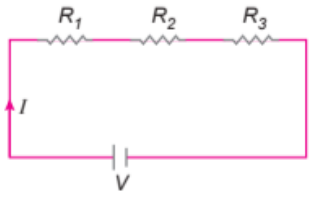
Now, R_2 and 30 Ω are in parallel

$$R_{eq} = \frac{R_2 \times 30}{R_2 + 30} = \frac{10 \times 30}{10 + 30} = \frac{300}{40} = \frac{30}{4} = \frac{15}{2}$$

$\therefore \quad R_{eq} = 7.5\ \Omega$

10. (*a*) Potentiometer measures accurate value of emf because it does not draw any current from the cell in balance condition. So, the cell remains in open circuit.

11. (*c*) Since, R_1, R_2, R_3 are connected in series, I remains same across the circuit.



Given, current across R_1, $I = 2$ A

$R_2 = 3\ \Omega$, $P_3 = 6$ W

Power across R_3, $P_3 = V_3 I$

$$\Rightarrow \quad 6 = V_3(2)$$

$$\therefore \quad V_3 = \frac{6}{2} = 3\ \text{V}$$

12. (*a*) Slope of *V*-*I* gives resistance of conductor.

Also, $R \propto T$ (Temperature)

Here, $(V/I)_{T_1} > (V/I)_{T_2}$

So, $\quad R_1 > R_2 \Rightarrow T_1 > T_2$

13. (*b*) We know that, $F = IBl \sin\theta$

$$\therefore \quad B = \frac{F}{Il \sin\theta}$$

SI unit of $B = \dfrac{\text{N}}{\text{Am}} = \text{NA}^{-1}\text{m}^{-1}$

[$\because \sin\theta$ is unitless]

14. (*d*) Given, $I'_g = I_g + \dfrac{20}{100} I_g = \dfrac{120}{100} I_g = 1.2 I_g$

and $\quad R' = R + \dfrac{25}{100} R = \dfrac{125}{100} R = 1.25\, R$

Now, new voltage sensitivity,

$$V'_g = \frac{I'_g}{R'} = \frac{1.2 I_g}{1.25 R} = \frac{120}{125} V_g = \frac{24}{25} V_g$$

where V_g = initial voltage sensitivity

and $\quad V_g = \dfrac{I_g}{R}$

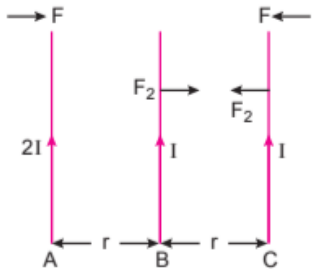
Now, % change in

$$V_g = \frac{V'_g - V_g}{V_g} \times 100 = \frac{\frac{24}{25} V_g - V_g}{V_g} \times 100$$

$$= \frac{-1}{25} \times 100 = -4\%$$

So, it decreases by 4%.

15. (*a*) Let, F_1 is force per unit length between A and C



i.e., $\quad F_1 = \dfrac{\mu_0}{4\pi} \dfrac{2I \times I}{2r}$

and, F_2 is force per unit length between B and C

$$F_2 = \frac{\mu_0 I \times I}{4\pi r}$$

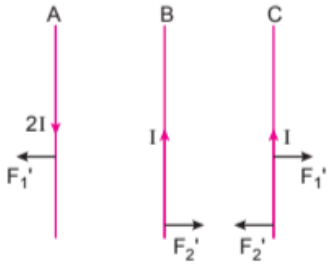
Now, F_{net} on 'C' wire,

$$F_{net} = F_1 + F_2 = \frac{2\mu_0 I^2}{4\pi r} = F \qquad \text{(given)}$$

Now, according to question

F_1' = Repulsive force per unit length between A and C

$$= \frac{\mu_0 2I.I}{4\pi 2r} = \frac{\mu_0 I^2}{4\pi r}$$



F_2' = Attractive force per unit length between B and C

$$= \frac{\mu_0 I.I}{4\pi r} = \frac{\mu_0 I^2}{4\pi r}$$

$\therefore \quad$ Net force on 'C' is $F_1' - F_2' = 0$

$$\left[\because \quad F_1' = F_2' = \frac{\mu_0 I^2}{4\pi r}\right]$$

$\therefore \quad$ Net force on 'C' is zero.

PHYSICS

16. (*b*) Area of ring $A = \pi R^2 = \pi \Rightarrow R = 1$ m

Magnetic field at the centre of ring

$$B = \frac{\mu_0 I}{2R}, \quad \Rightarrow \quad I = \frac{B.2R}{\mu_0} = \frac{2B}{\mu_0}$$

Magnetic moment, $M = IA = \frac{2B}{\mu_0} \times \pi = \frac{0.2\pi}{\mu_0}$

17. (*a*) According to Lenz's law, magnetic field lines increases in the coil due to opposes it change, induced current in coil is anticlockwise.

18. (*b*) When the magnet is cut into two equal halves, the magnetic moment is also halved *i.e.* it becomes $m/2$.

19. (*b*) Here, $A = 2 \times 10^{-4}$ m^2, $N = 1000$, $M = 0.4$ Am^2

$$M = NIA$$

$$0.4 = 1000 \times I \times 2 \times 10^{-4}$$

$$\therefore \qquad I = \frac{0.4}{1000 \times 2 \times 10^{-4}} = 2 \text{ A}$$

20. (*a*) $\mathrm{M} = \sqrt{\mathrm{L_1 L_2}} = \sqrt{2 \times 8} = 4$ mH

21. (*a*) According to Lenz's law, the current induced in coil will opposes the increasing magnetic field when electron pass the coil from X to Y.

23. (*d*) The plate with positive charge will be at higher potential and the plate with negative charge will be at lower potential. So, we can say that the charge is in phase with applied voltage.

26. (*d*) According to Huygen's principle, wave will propagates from the soures S_1 and S_2. Each point on the screen will acts as secondary source of wavelets. The hole will acts as a source of fresh light for slits S_3 and S_4.

Therefore, there will be regular two slit pattern on the second screen.

27. (*c*) Here, the object moves towards convergent lens from left of lens with a uniform speed of 5 m/s, hence the image will move away from the lens with a non-uniform acceleration, the image slower in the beginning and faster later on will more from F to $2F$ and when the object moves from $2F$ to F, the image will move from $2F$ to infinity. At $2F$, the speed of the object and image will be equal.

28. (*c*) The reddish appearance of the rising and the setting sun is due to scattering of light.

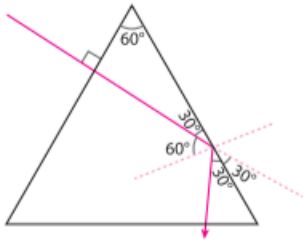
29. (*c*) As $n_2 < n_1$, the upper half of lens acts as a divergent lens. As $n_2 > n_3$, the lower half of the lens acts as a convergent lens. Hence lens gives two refracted rays: one convergent and the other divergent.

30. (*c*) When light rays pass through the atmospheric layers of different refractive index, then refraction takes place but our eyes unable to trace the bent rays, follow the incident rays backwards until we see an apparent image of the sun at height more than its actual height.

31. (*b*) In plane mirror speed of object = Speed of image

32. (*a*) When ray of light incident normally on one face of prism then,

$$i_1 = 0, r_1 = 0, A = 60° \quad \text{(Given)}$$



By geometry, $\quad i_2 = 60°$

Now, $\quad \sin i_c = \frac{1}{n}$

$$i_c = \sin^{-1}\left(\frac{1}{1.5}\right) = 41.81° \approx 42°$$

Hence, $i_c < i_2$, then TIR will takes place.

Then according to geometry.

Angle between incident and emergent ray is $30° + 30° = 60°$

33. (*c*) When equiconvex lens cut into two equal half along vertical axis, then $f' = 2f$

34. (*d*) The frequency of the EM wave remains constant when it passes from one medium to another.

Speed of wave in medium,

$$v = \frac{1}{\sqrt{\mu_0 \varepsilon_0 \mu_r \varepsilon_r}} = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

For dielectric medium, $\mu_r \simeq 1, \varepsilon_r = 4$ (given)

Hence, $\qquad v = \frac{c}{\sqrt{\varepsilon_r}} = \frac{c}{\sqrt{4}} = \frac{c}{2}$

Now, from relation,

$$v = \lambda \nu$$

$$\Rightarrow \qquad \frac{\lambda_{\text{medium}}}{\lambda_{\text{air}}} = \frac{v_{\text{medium}}}{v_{\text{air}}} = \frac{v}{c} = \frac{1}{2}$$

$$\therefore \qquad \lambda_{\text{medium}} = \frac{\lambda_{\text{air}}}{2}$$

35. (*a*) As we know,

$$\frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{I_1} + \sqrt{I_2}\right)^2}{\left(\sqrt{I_1} - \sqrt{I_2}\right)^2} = \frac{\left(\sqrt{9} + \sqrt{4}\right)^2}{\left(\sqrt{9} - \sqrt{4}\right)^2}$$

$$= \frac{(5)^2}{1^2} = \frac{25}{1}$$

36. (*b*) The relation between path difference (Δ), phase difference (δ) and time difference (t) *i.e.*, $\frac{\Delta}{\lambda} = \frac{\delta}{2\pi} = \frac{t}{T}$ where, λ and T are wave length and time period of wave propagation.

39. (*c*) For photo emission takes place, $\lambda_{incident} < \lambda_0$. Here, wavelength of UV light, $\lambda < 5200$ Å while for infrared radiation, $\lambda > 5200$ Å. So photoelectrons will be emitted when the material is illuminated with 1 W of ultraviolet radiation.

40. (*b*) de-broglie wavelength,

$$\lambda = \frac{12.27}{\sqrt{V}}\text{Å} \Rightarrow \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{V_2}{V_1}} = \sqrt{\frac{100}{25}} = 2$$

$\therefore \quad \lambda_2 = \frac{\lambda}{2}$ *i.e.*, decreases by 2 times.

41. (*d*) de-Broglie wavelength,

$$\lambda = \frac{h}{p} \; i.e., \lambda \propto \frac{1}{p} \text{ or } p \propto \frac{1}{\lambda}$$

42. (*a*) Given $\vec{v} = v_o\hat{i}$ and $\vec{B} = B_o\hat{j}$

Force on moving electron in magnetic field B is given as

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

$$\vec{F} = -e\,[v_o\hat{i} \times B_o\hat{j}]$$

$$\vec{F} = -e\; v_0 B_0 \hat{k}$$

So the force is perpendicular to both v and B. As the force is perpendicular to the velocity, the value of mv does not change and the de

43. (*c*) The smallest distance of approach of α-particle near heavy neutrons is a measure of the size of nucleus.

Distance of nearest approach $\simeq$ Size of nucleus

$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{2Ze^2}{K}.$$

45. (*a*) From radius of nuclei, $R = R_0 A^{1/3}$

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{216}{64}\right)^{1/3} = \frac{6}{4} = 3:2.$$

46. (*d*) Neutrons, are being neutral particles are not deflected by magnetic field.

47. (*d*) Due to heating, number of electron-hole pairs will increase, so overall resistance of diode will change, due to which forward biasing and reversed biasing both are changed.

48. (*b*) The p-side is connected to positive and n-side is connected to negative terminal which makes the diode forward biased and the width of depletion layer decreases.

49. (*b*) Output exists only when $A = 1$, $B = 1$; then it is possible only in AND gate.