13 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 cylinder of radius r and length l is placed in a uniform electric field parallel to the axis of the cylinder. The total flux for the surface of the cylinder is given by**
   (*a*) zero (*b*) πr^2 (*c*) $E\pi r^2$ (*d*) $2E\pi r^2$

2. **Two parallel large thin metal sheets have equal surface densities 26.4×10^{-12} C/m^2 of opposite signs. The electric field between these sheets is**
   (*a*) 1.5 N/C (*b*) 1.5×10^{-16} N/C (*c*) 3×10^{-10} N/C (*d*) 3 N/C

3. **Consider an uncharged conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then,**
   (*a*) negative and uniformly distributed over the surface of sphere
   (*b*) positive and uniformly distributed over the surface of sphere
   (*c*) negative and appears at a point on the surface of sphere closest to point charge
   (*d*) zero

4. **Two point charges $+8q$ and $-2q$ are located at $x = 0$ and $x = L$ respectively. The point on x axis at which net electric field is zero due to these charges is**
   (*a*) $8L$ (*b*) $4L$ (*c*) $2L$ (*d*) L

5. **The figure shows the electric lines of force emerging from a charged body. If the electric fields at A and B are E_A and E_B respectively and if the distance between A and B is r, then**

   (*a*) $E_A < E_B$ (*b*) $E_A > E_B$
   (*c*) $E_A = \frac{E_B}{r}$ (*d*) $E_A = \frac{E_B}{r^2}$

6. **A capacitor plates are charged by a battery with 'V' volts. After charging, battery is disconnected and a dielectric slab with dielectric constant 'K' is inserted between its plates, the potential across the plates of a capacitor will become**
   (*a*) zero (*b*) $V/2$ (*c*) V/K (*d*) KV

7. Why does a Van de Graaff generator make your hair stand up if you touch the dome?

(*a*) The hair is attracted to the surrounding air.

(*b*) The hair is repelled by the dome of the Van de Graaff generator.

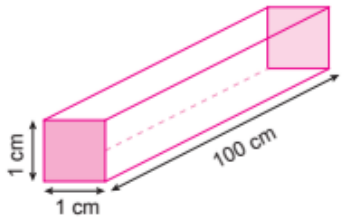
(*c*) The electrons gather on the hair ends and repel each other.

(*d*) The current is trying to flow out of the hair ends.

8. A particle *A* has charge + *q* and particle *B* has charge + 4*q* with each of them having the same mass *m*. When allowed to fall from rest through same electrical potential difference, the ratio of their speeds $v_A : v_B$ will become

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

9. Dimensions of a block are 1 cm × 1 cm × 100 cm. If specific resistance of its material is 3×10^{-7} Ω m, then the resistance between the opposite rectangular faces is



(*a*) 3×10^{-9} Ω (*b*) 3×10^{-7} Ω

(*c*) 3×10^{-5} Ω (*d*) 3×10^{-3} Ω

10. The current in electrolyte is due to

(*a*) positive ions only (*b*) negative ions only

(*c*) both positive and negative ions (*d*) holes

11. A wire of non-uniform cross-section is carrying a steady current. Along the wire

(*a*) current and current density are constant

(*b*) only current is constant

(*c*) only current density is constant

(*d*) neither current nor current density is constant

12. The image of an object formed by a device is always virtual and small. The device may be

(*a*) convex lens (*b*) concave mirror

(*c*) a glass plate (*d*) concave lens

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

Statement P : When radius of a circular loop carrying current is doubled, its magnetic moment becomes four times.

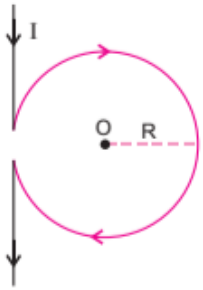
Statement Q : Magnetic moment depends on area of the loop.

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. A current *I* flows through a long straight conductor which is bent into circular loop of radius *R* in the middle as shown in the figure.



The magnitude of the net magnetic field at point O will be

(*a*) zero (*b*) $\frac{\mu_0 I}{2R}(1+\pi)$

(*c*) $\frac{\mu_0 I}{4\pi R}$ (*d*) $\frac{\mu_0 I}{2R}\left(1-\frac{1}{\pi}\right)$

15. Two thin, long parallel wires, separated by a distance (*d*) carry a current of (*i*) in the same direction. They will

(*a*) repel each other with a force of $\mu_0 i^2/(2\pi d)$

(*b*) attract each other with a force of $\mu_0 i^2/(2\pi d)$

(*c*) repel each other with a force of $\mu_0 i^2/(2\pi d^2)$

(*d*) attract each other with a force of $\mu_0 i^2/(2\pi d^2)$

16. Magnetism in substances is caused by

(*a*) orbital motion of electrons only

(*b*) spin motion of electrons only

(*c*) due to spin and orbital motions of electrons both

(*d*) hidden magnets

17. In a plane perpendicular to the magnetic meridian, the dip needle will be

(*a*) vertical

(*b*) horizontal

(*c*) inclined equal to the angle of dip at that place

(*d*) pointing in any direction

18. If the horizontal and vertical components of earth's magnetic field are equal at a certain place, the angle of dip is

(*a*) 90° (*b*) 60° (*c*) 45° (*d*) 0°

19. A carbon resistor of (47 ± 4.7) kΩ is to be marked with rings of different colours for its identification. The colour code sequence will be

(*a*) Violet—Yellow—Orange—Silver

(*b*) Yellow—Violet—Orange—Silver

(*c*) Yellow—Green—Violet—Gold

(*d*) Green—Orange—Violet—Gold

20. Match the followings in Column A having correct appropriate properties with in Column B.

Column A	Column B
(*i*) Diamagnetic Substance	(*p*) Strongly attracted by magnets
(*ii*) Paramagnetic substance	(*q*) Weakly attracted by magnets
(*iii*) Ferromagnetic substance	(*r*) Weakly repelled by magnets
	(*s*) μ_r is slightly greater than 1.

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

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

21. The magnetic flux linked with a coil at any instant t is $\phi = (6t^2 - 8t + 5)$ Wb, the emf induced in the coil at $t = 2$ second is

(*a*) +24 V (*b*) +16 V (*c*) –16 V (*d*) –24 V

22. Photoelectric effect supports:

(*a*) Newton's corpuscular nature of light

(*b*) Huygen's wave theory of light

(*c*) Maxwell's electromagnetic theory of light

(*d*) Einstein's quantum theory of light

23. Which of the following statement is true?

(*a*) Energy is created when a transformer steps up the voltage.

(*b*) A transformer is designed to convert an AC voltage to DC voltage.

(*c*) Step–up transformer increases the power for transmission.

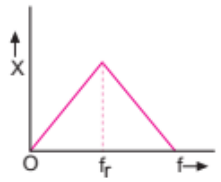
(*d*) Step–down transformer decreases the AC voltage.

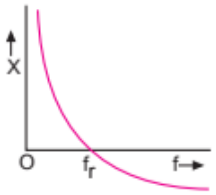
24. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which $R = 3\ \Omega$, $L = 25.48$ mH, and $C = 796\ \mu$F, then the power dissipated at the resonant condition will be

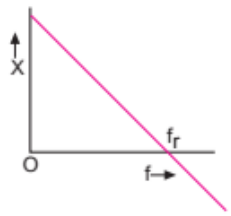
(*a*) 39.70 kW (*b*) 26.70 kW

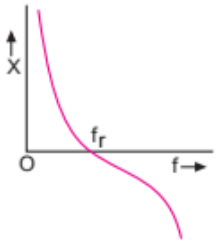
(*c*) 13.35 kW (*d*) zero

25. **Which of the following plots may represent the reactance (X) = $X_C - X_L$ of a series LC combination?**

(a)


(b)


(c)


(d)


26. **Electromagnetic waves are produced by**

(a) charge at rest only

(b) charge in uniform motion only

(c) accelerated or decelerated charge only

(d) all of above

27. **Which of the following EM waves are used in telecommunications?**

(a) Infrared (b) X-rays

(c) Microwaves (d) Ultraviolet

28. **The electric field associated with an EM wave in vacuum is given by $\vec{E} = 40\cos(KZ - 6\times10^8\, t)\hat{i}$, where E, Z and t are in volt/m, metre and second respectively. The value of vector K is**

(a) 2 m^{-1} (b) 0·5 m^{-1} (c) 6 m^{-1} (d) 3 m^{-1}

29. **The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will**

(a) act as a convex lens only for the objects that lie on its curved side.

(b) act as a concave lens for the objects that lie on its curved side.

(c) act as a convex lens irrespective of the side on which the object lies.

(d) act as a concave lens irrespective of side on which the object lies.

30. **A ray of light incident at an angle θ on a refracting face of a prism emerges from the other face normally. If the angle of the prism is 5° and the prism is made of a material of refractive index 1.5, the angle of incidence is**

(a) 7.5° (b) 5° (c) 15° (d) 2.5°

31. **If the focal length of objective lens is increased then magnifying power of**

(a) microscope will increase but that of telescope will decrease

(b) microscope and telescope both will increase

(c) microscope and telescope both will decrease

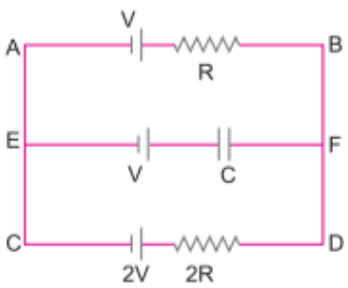
(d) microscope will decrease but that of telescope will increase

32. **It is possible to observe total internal reflection, when a ray travels from**

(a) air into water (b) air into glass

(c) water into glass (d) glass into water

33. **In the given circuit, with steady current, the potential drop across the capacitor C must be**



(a) V (b) $\frac{V}{2}$

(c) $\frac{V}{3}$ (d) $\frac{2V}{3}$

34. **For the angle of minimum deviation of prism to be equal to its refracting angle, the prism must be made of a material whose refractive index**

(*a*) lies between $\sqrt{2}$ and 1 (*b*) lies between 2 and $\sqrt{2}$

(*c*) is less than 1 (*d*) is greater than 2

35. **Resolving power of the telescope depends upon the**

(*a*) diameter of circular aperture (*b*) focal length

(*c*) magnification power (*d*) refractive index

36. **In the phenomena of diffraction of light when the violet light is used in the experiment instead of red light then,**

(*a*) fringe width increases (*b*) no change in fridge width

(*c*) fringe width decreases (*d*) colour pattern is formed

37. **The wavefront due to a source situated at the infinity is**

(*a*) spherical (*b*) plane

(*c*) cylindrical (*d*) rectangular

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

Statement P : Thin films such as soap bubble or a thin layer of oil on water show beautiful colours when illuminated by white light.

Statement Q : It is due to interference of sun's light reflected from upper and lower surfaces of the film.

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

39. **The photoelectric effect is described as the emission of electrons from the surface of a metal when:**

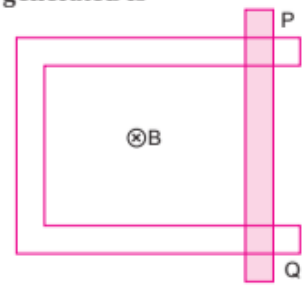
(*a*) it is heated to a high temperature

(*b*) electrons of suitable velocity impinge on it

(*c*) light of suitable wavelength falls on it

(*d*) it is placed in a strong magnetic field

40. **A 50 cm long bar *PQ* is moved with a speed of 4 m/s in a uniform magnetic field $B = 0.01$ T as shown in fig., the emf generated is**



(*a*) 0.04 V (*b*) 0.03 V (*c*) 0.02 V (*d*) 0.01 V

41. **On a particular day the maximum frequency reflected from ionosphere is 9 MHz. A radiowave of frequency 1 MHz is broadcasted in space. This wave**

(*a*) will come back to earth after reflection

(*b*) will refract through the ionosphere

(*c*) will be absorbed by ionosphere

(*d*) will surely need satellite communication

42. **In Rutherford scattering experiment when a projectile of charge Z_1 and mass m_1 approaches a target nucleus of charge Z_2 and mass m_2, the distance of closest approach is r_0. The energy of the projectile is:**

(*a*) directly proportional to $Z_1 Z_2$ (*b*) inversely proportional to Z_1

(*c*) directly proportional to mass m_1 (*d*) directly proportional to $(m_1 \times m_2)$

43. **When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge 'Ze', its distance of closest approach from the nucleus depends on m as**

(*a*) $\frac{1}{m}$ (*b*) $\frac{1}{\sqrt{m}}$

(*c*) $\frac{1}{m^2}$ (*d*) m

44. **The ratio of the frequencies of the longest wavelength limits of the Lyman series and the Balmer series of hydrogen is**

(*a*) 27 : 5 (*b*) 5 : 27 (*c*) 4 : 1 (*d*) 1 : 4

45. **Heavy stable nuclei have more neutrons than protons. This is because of the fact that**

(*a*) neutrons are heavier than protons.

(*b*) electrostatic force between protons are repulsive.

(*c*) neutrons decay into protons through beta decay.

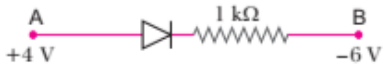
(*d*) nuclear forces between neutrons are weaker than that between protons.

46. **The nuclei of the isotopes of an element contain the same number of a certain particle. What is this particle?**

(*a*) Electron (*b*) Neutron

(*c*) Nucleon (*d*) Proton

47. **Consider the junction diode as ideal. The value of current flowing through AB is**



(*a*) 10^{-1} A (*b*) 10^{-3} A

(*c*) 0 A (*d*) 10^{-2} A

48. **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 $n_h = 0$

49. **For conduction in p-n junction, the biasing is**

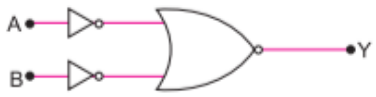
(*a*) high potential on n-side and low potential on p-side

(*b*) high potential on p-side and low potential on n-side

(*c*) same potential on both p and n-sides

(*d*) undetermined

50. **Which logic gate is represented by the following combination of logic gates?**



(*a*) OR (*b*) NAND (*c*) AND (*d*) NOR

ANSWERS

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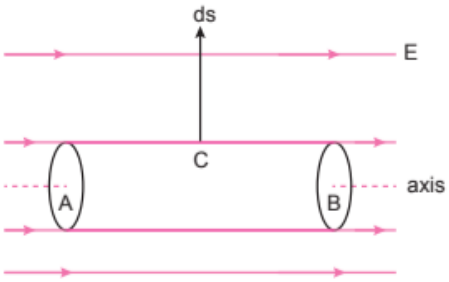
1. (*a*)	**2.** (*d*)	**3.** (*d*)	**4.** (*c*)	**5.** (*b*)	**6.** (*c*)	**7.** (*c*)
8. (*b*)	**9.** (*b*)	**10.** (*c*)	**11.** (*b*)	**12.** (*d*)	**13.** (*c*)	**14.** (*d*)
15. (*b*)	**16.** (*c*)	**17.** (*a*)	**18.** (*c*)	**19.** (*b*)	**20.** (*c*)	**21.** (*c*)
22. (*d*)	**23.** (*d*)	**24.**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

SOLUTIONS

PRACTICE PAPER–13

1. (*a*) Flux through surface *A*,



$\phi_A = E \times \pi R^2$

Flux through surface *B*,

$\phi_B = -E \times \pi R^2$

Flux through curved surface *C*,

$\phi_C = \int \vec{E}.d\vec{S} = \int E\, dS \cos 90° = 0$

$\therefore$ Total flux through cylinder $= \phi_A + \phi_B + \phi_C$

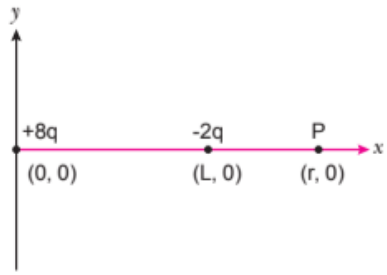
$= E.\pi R^2 - E.(\pi R^2) + 0$

$= 0$

So, $\overrightarrow{E_1} = \dfrac{K8q}{r^2}$ (at *P* due to $8q$)

$\overrightarrow{E_2} = \dfrac{-K(2q)}{(r-L)^2}$ (at *P* due to $-2q$)

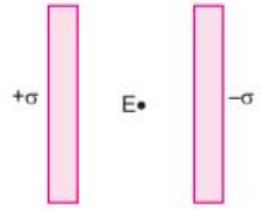
then, $\overrightarrow{E_1} + \overrightarrow{E_2} = 0$



$\Rightarrow \quad \dfrac{K(8q)}{r^2} - \dfrac{K(2q)}{(r-L)^2} = 0$

$\Rightarrow \quad \dfrac{K(8q)}{r^2} = \dfrac{K(2q)}{(r-L)^2}$

2. (*d*) Surface charge density

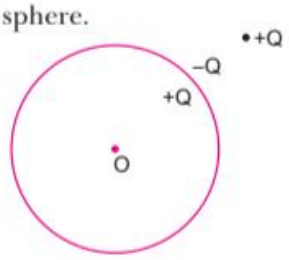


$\sigma = 26.4 \times 10^{-12}\ C/m^2$

$$E_{net} = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

$$E_{net} = \frac{26.4\times10^{-12}}{8.85\times10^{-12}} = 2.98\ NC^{-1} \simeq 3\ NC^{-1}$$

3. (*d*) Due to induction of charge, equal and opposite charge induces on the outer and inner surface of the sphere.



But the net charge on the conducting sphere is zero.

i.e., $Q_{net} = +Q - Q = 0$

4. (*c*) Let point P is at a distance r from origin where net electric field is zero.

$$\Rightarrow \quad \frac{4}{r^2} = \frac{1}{(r-L)^2}$$

$$\Rightarrow \quad 4(r-L)^2 = r^2 \quad \Rightarrow \ 2(r-L) = r$$

$$\therefore \quad r = 2L$$

5. (*b*) The number of lines of force passing per unit area is a measure of electric field. At A area is smaller and at B it is larger so $E_A > E_B$.

6. (*c*) When battery is disconnected after charging, charge stored between plates of capacitor remains constant.

When the dielectric slab of dielectric constant K is inserted,

Capacitance, $C' = KC$

and charge, $Q = C'V' \ \Rightarrow \ V' = \frac{Q}{C'}$

$$V' = \frac{CV}{KC} = \frac{V}{K}$$

Hence, the potential across the plates becomes $\frac{V}{K}$ times.

7. (*c*) Due to charging by pictures between some and hair. Hence hair becomes negatively charged.

8. (*b*) Work done = Gain in K.E.

$$\Rightarrow \quad QV = \frac{1}{2}mv^2 \ \Rightarrow \ v = \sqrt{\frac{2QV}{m}}$$

$$\therefore \quad v_A = \sqrt{\frac{2qV}{m}},\ v_B = \sqrt{\frac{2(4q)V}{m}}$$

$$\frac{v_A}{v_B} = \frac{1}{2}$$

9. (*b*) $l = 1\text{ cm} = 10^{-2}\text{ m}$, $A = (1 \times 100)\text{ cm}^2 = 10^{-2}\text{ m}^2$

$$R = \rho\frac{l}{A} = 3\times10^{-7}\times\frac{10^{-2}}{10^{-2}} = 3\times10^{-7}\Omega$$

10. (*c*) As electrolyte carry +ve as well as –ve charge.

14. (*d*) Magnetic field due to straight part of the wire is,

$B_1 = \frac{\mu_0}{2\pi}\frac{I}{R}$, normally into the plane of paper.

Magnetic field at the centre O due to the current loop of radius R is

$B_2 = \frac{\mu_0 I}{2R}$, normally into the plane of paper.

Resultant field at O is $B = B_2 - B_1 = \frac{\mu_0 I}{2R}\left(1 - \frac{1}{\pi}\right)$

16. (*c*) Magnetism in substance is caused by spin and orbital motion of electrons.

17. (*a*) The angle of dip would change of needle to placed in the geometric meridian. The vertical component would remain the same but the horizontal component would change. Hence, dip needle would remain vertical in a plane perpendicular to the magnetic meridian.

18. (*c*) Here, $B_H = B_V$

$$\tan\delta = \frac{B_V}{B_H} = 1$$

$$\therefore \quad \delta = 45°$$

19. (*b*) A carbon resistor of (47 ± 4.7) KΩ is to be marked with rings of different colours for its identification.

Digit	Multiplier	Tolerance(%)
4 7	10^3	$\frac{4.7}{47}\times100 = 10\%$

Colour:

Yellow – Violet – Orange – Silver

21. (*c*) $e = -\frac{d\phi}{dt} = -(12t - 8) = -16\text{ V}$

23. (*d*) In step down transformer,

$V_S < V_P$ and $I_S > I_P$.

So, step-down transformer decreases the *ac* voltage.

24. (*c*) Given, $V_0 = 283\text{V}$, $f = 50\text{ Hz}$,

$R = 3\,\Omega$, $L = 25.48\text{ mH}$

$C = 796\,\mu\text{F}$

At resonance condition, $Z = R$

Power dissipated, $P = I^2_{rms}R$

where,

$$I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{V_0}{R}\times\frac{1}{\sqrt{2}} = \left(\frac{283}{3}\right)\times\frac{1}{\sqrt{2}} = 66.7\text{A}$$

then, $P = I^2_{rms}R = (66.7)^2 \times 3 = 13.35\text{ kW}$

25. (*d*) Reactance $X = X_C - X_L = \frac{1}{\omega C} - \omega L$

$$X_C = \frac{1}{\omega C} \quad \text{and} \quad X_L = \omega L$$

Clearly, with increase of frequency from zero value, $\frac{1}{\omega C} - \omega L \left(= \frac{1}{2\pi fC} - 2\pi fL\right)$ decreases; becomes zero at resonant frequency (f_r) and then increases on negative side due to factor ωL and finally increases to infinity when frequency approaches infinity.

26. (*c*) An accelerated or decelerated charge produces electric and magnetic field perpendicular to each other, thus forming an EM wave.

27. (*c*) Microwaves due to short wavelength are not diffracted.

28. (*a*) Propagation constant,

$$K = \frac{\omega}{c} = \frac{6\times10^8}{3\times10^8} = 2\,\text{m}^{-1}$$

29. (*c*) According to lens maker's formula,

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

Here, $R_1 = \infty$, $R_2 = -R$

Hence, $f = \frac{R}{n-1}$

Then, $f = \frac{20}{1.5-1} = 40\text{ cm}$

As $f > 0$ means converging nature. Therefore, lens act as a convex lens irrespective of the side on which the object lies.

30. (*a*) We have, $i + e = \delta + A$

Given, $e = 0°$, $A = 5°$, $n = 1.5$

For small angle of prism,

$\delta = (n-1)A$

$\Rightarrow \quad \delta = (1.5-1)\,5° = 2.5°$

Now, $i = (\delta + A) - e$

$= 2.5° + 5° - 0° = 7.5°$

31. (*d*) Generally objective lens of microscope has short focal length so increase in its focal length will decrease its magnifying power whereas reverse is the case with telescope.

32. (*d*) Total internal reflection is observed when a ray of light travels from denser to rarer medium.

33. (*c*) There is no current in capacitor branch. Current I in circuit $ABCD$ (ignoring branch EF) is

$$I = \frac{2V - V}{R + 2R} = \frac{V}{3R}$$

p.d. across $AB = EF = V + IR$

$$= V + \frac{V}{3R}R = \frac{4}{3}V$$

$$\therefore \quad V_E + V + V_C = V_F \Rightarrow V_C = \frac{4}{3}V - V = \frac{1}{3}V$$

34. (*b*) As $A = \delta_m$

For minimum derivation,

$$n = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}} = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\frac{A}{2}}$$

$$\Rightarrow \quad n = \frac{\sin A}{\sin\frac{A}{2}} = \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}} = 2\cos\frac{A}{2}$$

For all possible values of cosine, n lies between 2 and $\sqrt{2}$.

35. (*a*) Limit of resolution,

$$d\theta = \frac{1.22\lambda}{a}, \; a = \text{diameter of circular aperture}$$

36. (*c*) $\beta = \frac{\lambda D}{d}, \quad \beta \propto \lambda$

For violet light, λ is small and fringe width decreases.

38. (*c*) When white light is incident on thin film, the film appears coloured. These colours are due to the interference between light waves reflected from the top and bottom surfaces of thin films. The colour depends on the thickness of the film and also the angle of incident light.

40. (*c*) $\varepsilon = Blv = 0.01 \times 0.50 \times 4 = 0.02$ V

42. (*a*) At the distance of closest approach, energy of projectile is entirely potential energy which is given by the formula $\frac{1}{4\pi\varepsilon_0}\frac{Z_1 Z_2}{r_0}$.

$\therefore$ The energy is directly proportional to $Z_1 Z_2$.

43. (*a*) For closest approach, kinetic energy is converted into potential energy.

$$\frac{1}{2}mv^2 = \frac{2Ze^2}{4\pi\varepsilon_0 r_0}$$

$$r_0 = \frac{4Ze^2}{4\pi\varepsilon_0 mv^2} = \frac{Ze^2}{\pi\varepsilon_0 v^2}\left(\frac{1}{m}\right)$$

$$\Rightarrow \quad r_0 \propto \frac{1}{m}$$

44. (*a*) We know that $\nu \propto \frac{1}{\lambda}$

Frequency of longest wavelength of Lyman series, $\frac{1}{\lambda_L} = R\left(\frac{1}{1} - \frac{1}{2^2}\right) = \frac{3R}{4}$

Frequency of longest wavelength of Balmer series, $\frac{1}{\lambda_B} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{5R}{36}$

$$\frac{\nu_L}{\nu_B} = \frac{3R}{4} \times \frac{36}{5R} = \frac{27}{5}$$

45. (*b*) Stable heavy nuclei have more neutrons than protons. This is because electrostatic force between protons is repulsive, which may reduce stability.

46. (*d*) Isotopes of an element have equal atomic number but different mass number. The atomic number of an element is the number of protons or electrons of a neutral atom of that element. Thus, the nuclei of isotopes of an element contains same number of protons.

47. (*d*) Here, the *p-n* junction diode is forward biased, hence it offers zero resistance.

$$\therefore \quad I_{AB} = \frac{V_A - V_B}{R_{AB}} = \frac{4-(-6)}{1\times10^3} = \frac{10}{1000}\text{A}$$

$$= 10^{-2}\text{ A}$$

48. (*c*) In a pure semiconductor, concentration of electrons is always equals to the concentration of holes.

50. (*b*) Inputs of OR gate $\overline{A}$ and $\overline{B}$

Output of OR gate $Y = \overline{A} + \overline{B} = \overline{AB}$ (NAND gate).

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