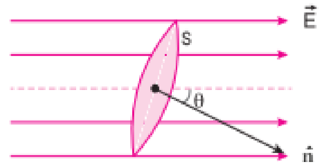
PRACTICE PAPER 6

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

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

Choose the correct option in the following questions.

1. **A plane of surface area S is placed in an electric field such that the direction of normal on surface 'S' makes an angle 'θ' with the direction of electric field $\vec{E}$. The electric flux through the surface is**



(*a*) ES (*b*) $ES \sin \theta$
(*c*) $ES \cos \theta$ (*d*) zero

2. **A small metal ball is suspended in a uniform electric field with the help of an insulated thread. If high energy X-ray beam falls on the ball, it will**

(*a*) be deflected in the direction of field (*b*) be deflected opposite to direction of field
(*c*) not deflect at all (*d*) fly to infinity

3. **An electric dipole consisting of charges $+q$ and $-q$ separated by a distance r, is kept symmetrically at the centre of an imaginary sphere of radius R ($> r$), Another point charge Q is also kept is also kept at the centre of the sphere. The net electric flux coming out of the sphere will be**

(*a*) $\frac{-(2q+Q)}{4\pi\varepsilon_0}$ (*b*) $\frac{Q}{\varepsilon_0}$ (*c*) $\frac{2q+Q}{\varepsilon_0}$ (*d*) $\frac{-Q}{\varepsilon_0}$

4. **Match the following and find the correct option.**

Column I		Column II	
(*A*)	Linear charge density	(*i*)	$\frac{\text{Charge}}{\text{Volume}}$
(*B*)	Surface charge density	(*ii*)	$\frac{\text{Charge}}{\text{Length}}$
(*C*)	Volume charge density	(*iii*)	$\frac{\text{Charge}}{\text{Area}}$

(*a*) A—(*ii*), B—(*iii*), C—(*i*) (*b*) A—(*i*), B—(*iii*), C—(*i*)
(*c*) A—(*iii*), B—(*i*), C—(*ii*) (*d*) A—(*iii*), B—(*ii*), C—(*i*)

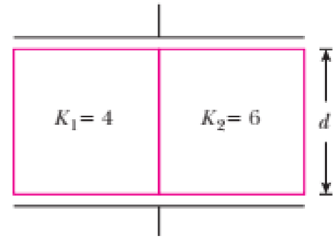
5. **An air filled parallel plate capacitor has a capacitance 1 pF. The separation of the plates is doubled and wax inserted between them, which makes the capacitance 2 pF. This implies that dielectric constant of wax is**

(*a*) 2.0 (*b*) 4/3 (*c*) 4.0 (*d*) 8.0

6. **A dipole is placed parallel to electric field. If W is the work done in rotating the dipole from 0° to 60°, then work done in rotating it from 0° to 180° is**

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

7. **A capacitor of capacitance 1 μF is filled with two dielectric of dielectric constant 4 and 6. The new capacitance would be**



(*a*) 10 μF (*b*) 7 μF
(*c*) 5 μF (*d*) 4 μF

8. **A point charge of 2 μC is placed at centre of Faraday cage in the shape of cube with surface of 9 cm edge. The number of electric field lines passing through the cube normally will be**

(*a*) 1.9×10^5 Nm^2/C entering the surface (*b*) 1.9×10^5 Nm^2/C leaving the surface
(*c*) 2.0×10^5 Nm^2/C leaving the surface (*d*) 2.0×10^5 Nm^2/C entering the surface

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

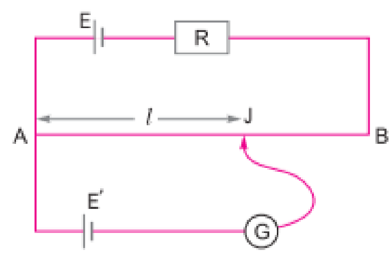
Statement P : Electrons move from a region of higher potential to a region of lower potential.

Statement Q : An electron has less potential energy at a point where potential is higher and vice-versa.

Select the most appropriate option:

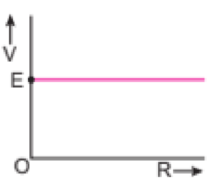
(*a*) P is true, but Q is false (*b*) P is false, but Q is true
(*c*) Both P and Q are true (*d*) Both P and Q are false

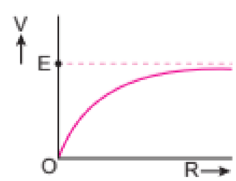
10. **AB is a potentiometer wire of a potentiometer. If the value of R is increased, in which direction will the balance point J shift?**

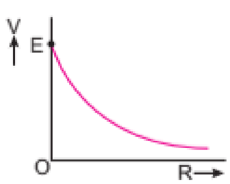


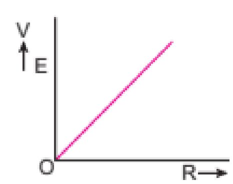
(*a*) Towards A (*b*) Towards B
(*c*) Same as initial point (*d*) None of these

11. **A cell of emf (E) and internal resistance r is connected across a variable external resistance R. The graph of terminal potential difference V as a function of R is**

(*a*)


(*b*)


(*c*)


(*d*)


12. **A current of 10 A is flowing from east to west in a long straight wire kept on a horizontal table. The magnetic field developed at a distance of 10 cm due north on the table is**

(*a*) 2×10^{-5} T, acting downwards (*b*) 2×10^{-5} T, acting upwards
(*c*) 4×10^{-5} T, acting downwards (*d*) 4×10^{-5} T, acting upwards

13. **Two thin, long and parallel wires separated by a distance '*d*' carry a current '*i*' ampere each. The magnitude of the force per unit length exerted by one wire on the other is**

(*a*) $\frac{\mu_0 i^2}{2\pi d}$ (*b*) $\frac{\mu_0 i}{2\pi d}$ (*c*) $\frac{\mu_0 i^2}{2\pi d^2}$ (*d*) $\frac{\mu_0 i}{2\pi d^2}$

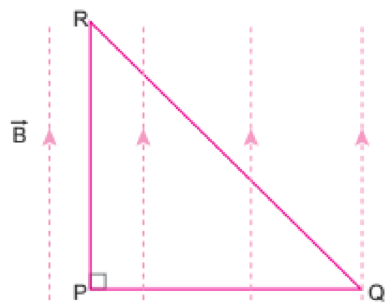
14. **For conversion of a galvanometer into an ammeter, one should use**

(*a*) a high resistance in series
(*b*) a high resistance in parallel
(*c*) a low resistance in series
(*d*) a low resistance in parallel

15. **When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that**

(*a*) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°
(*b*) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°
(*c*) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°
(*d*) angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°

16. **An isosceles right angled current carrying loop *PQR* is placed in a uniform magnetic field $\vec{B}$ pointing along *PR*. If the magnetic force acting on the arm *PQ* is *F*, then the magnetic force which acts on the arm *QR* will be**



(*a*) *F* (*b*) $\frac{F}{\sqrt{2}}$ (*c*) $\sqrt{2}F$ (*d*) $-F$

17. **The magnetic field of Earth can be modelled by that of a point dipole placed at the centre of the Earth. The dipole axis makes an angle of 11.3° with the axis of Earth. At Mumbai, declination is nearly zero. Then,**

(*a*) the declination varies between 11.3° W to 11.3° E.
(*b*) the least declination is 0°.
(*c*) the plane defined by dipole axis and Earth axis passes through Greenwich.
(*d*) declination averaged over Earth must be always negative.

18. **A bar magnet *AB* with magnetic moment *M* is cut into two equal parts perpendicular to its axis. One part is kept over the other so that end *B* is exactly over *A*. What will be the magnetic moment of the combination so formed?**

(*a*) $\frac{M}{4}$ (*b*) $\frac{3M}{4}$ (*c*) *M* (*d*) Zero

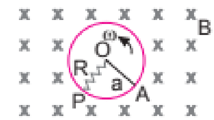
19. **In electromagnetic induction, line integral of induced field E around a closed path is ______________ and induced electric field is ______________.**

(*a*) zero, non conservative
(*b*) non zero, conservative
(*c*) zero, conservative
(*d*) non zero, non conservative

20. **A migratory Siberian bird is flying in the sky with a velocity of 10 m/s and the distance between two feathers is 2 cm. The earth's magnetic field *B* perpendicular to the feathers is 4×10^{-5} T. Then emf generated between the two feathers is**

(*a*) 4 μV
(*b*) 6 μV
(*c*) 8 μV
(*d*) 10 μV

21. **Figure shows a conducting circular loop of radius '*a*' placed in a uniform, perpendicular magnetic field *B*. A metal rod *OA* is pivoted at the centre *O* of the loop. The other end *A* of the rod touches the loop. The rod *OA* and the loop are resistanceless but a tungsten wire of resistance *R* is connected between *O* and a fixed point *P* on the loop. The rod *OA* is made to rotate anticlockwise with a uniform angular velocity ω by an external source. The current induced in the tungsten wire is:**



(*a*) zero
(*b*) $\frac{B\omega a^2}{R}$
(*c*) $\frac{B\omega a^2}{2R}$
(*d*) $\frac{B\omega a^2}{8R}$

22. **A circular loop of radius *r*, carrying a current *I* lies in *y-z* plane with its centre at the origin. The net magnetic flux through the loop is:**

(*a*) directly proportional to r
(*b*) zero
(*c*) inversely proportional to r
(*d*) directly proportional to I

23. **In a purely resistive *ac* circuit, the current**

(*a*) is in phase with the emf
(*b*) leads the emf by a phase difference of π radians
(*c*) leads the emf by a phase difference of π /2 radians
(*d*) lags behind the emf by phase difference of π /4 radians

24. **A capacitor of capacitance *C* has reactance X_C. If capacitance and frequency become double, then the capacitive reactance will be**

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

25. **An electromagnetic wave travelling along *z*-axis is given as:**

$E = E_0 \cos(kz - \omega t)$. Choose the correct options from the following:

(*a*) The associated magnetic field is given as $\vec{B} = \frac{1}{c}(\hat{k} \times \vec{E}) = \frac{1}{\omega}(\hat{k} \times \vec{E})$
(*b*) The electromagnetic field can be written in terms of the associated magnetic field as $\vec{E} = c(\vec{B} \times \hat{k})$.
(*c*) $\hat{k} . \vec{E} = 0, \hat{k} . \vec{B} = 0$
(*d*) all of the above

26. **Which of the following statements is false for the properties of electromagnetic waves?**

(*a*) The energy of electromagnetic wave is divided equally between electric and magnetic fields.
(*b*) Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave.
(*c*) These waves do not require any material medium for propagation.
(*d*) Both electric and magnetic field vectors attain the maximum and minimum at the same place and same time.

27. **Which of the following is true for rays coming from infinity**

(*a*) two images are formed
(*b*) continuous image is formed between focal points of upper and lower lens
(*c*) one image is formed
(*d*) no image is formed

28. **Two polaroids P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1. A third polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45° with that of P_1. The intensity of transmitted light through P_2 is**

(*a*) $\frac{I_0}{4}$ (*b*) $\frac{I_0}{8}$

(*c*) $\frac{I_0}{16}$ (*d*) $\frac{I_0}{2}$

29. **An electron is released from rest in a region of uniform electric and magnetic fields acting parallel to each other. The electron will**

(*a*) move in a straight line. (*b*) move in a circle.

(*c*) remain stationary. (*d*) move in a helical path.

30. **In a compound microscope, the intermediate image is**

(*a*) virtual, erect and magnified (*b*) real, erect and magnified

(*c*) real, inverted and magnified (*d*) virtual, erect and reduced

31. **A biconvex lens has a radius of curvature of magnitude 20 cm. Which one of the following options describe best the image formed of an object of height 2 cm placed 30 cm from the lens?**

(*a*) Real, inverted, height = 1 cm (*b*) Virtual, upright, height = 1 cm

(*c*) Virtual, upright, height = 0.5 cm (*d*) Real, inverted, height = 4 cm

32. **For a glass prism, the angle of minimum deviation will be smallest for the light of**

(*a*) red colour (*b*) blue colour

(*c*) yellow colour (*d*) green colour

33. **When a wave undergoes reflection at an interface from rarer to denser medium, adhoc change in its phase is:**

(*a*) $\frac{\pi}{2}$ (*b*) 0 (*c*) π (*d*) $\frac{\pi}{4}$

34. **In a single slit diffraction the distance between plane of slit and screen is 1 m. The size of the slit is 0.7 mm and second maximum is formed at the distance of 2 mm from the centre of the screen, then the wavelength of light used is**

(*a*) 5600 Å (*b*) 2800 Å

(*c*) 3000 Å (*d*) 6000 Å

35. **Unpolarised light is incident on a plane glass surface at an angle of incidence i. If angle of refraction be r, what should be the angle of incidence so that the reflected and refracted rays are perpendicular to each other?**

(*a*) $i + r = 90°$ (*b*) $i + r = 180°$

(*c*) $i + r = 0$ (*d*) $i + r = i_c$

36. **For light diverging from a point source**

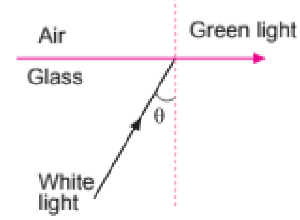
(*a*) the wavefront is spherical.

(*b*) the intensity decreases in proportion to the distance squared.

(*c*) the wavefront is parabolic.

(*d*) the intensity at the wavefront does not depend on the distance.

37. **White light is incident on the interface of glass and air as shown in figure. If green light is just totally internally reflected, then the emerging ray in air contains**



(*a*) yellow, orange, red

(*b*) violet, indigo, blue

(*c*) all colours

(*d*) all colours except green

38. **A message signal of frequency ω_m is superposed on a carrier wave of frequency ω_c to get an amplitude modulated wave (AM). The frequency of the AM wave will be**

(*a*) ω_m

(*b*) ω_c

(*c*) $\frac{\omega_c + \omega_m}{2}$

(*d*) $\frac{\omega_c - \omega_m}{2}$

39. **If ν_1 is the frequency of the series limit of Lyman series, ν_2 is the frequency of the first line of Lyman series and ν_3 is the frequency of the series limit of the Balmer series. Then**

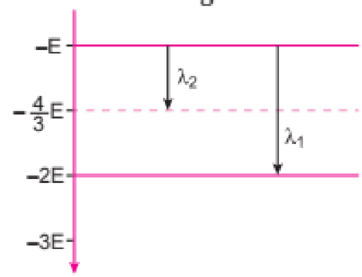
(*a*) $\nu_1 - \nu_2 = \nu_3$

(*b*) $\nu_1 + \nu_2 = \nu_3$

(*c*) $\frac{1}{\nu_2} = \frac{1}{\nu_1} + \frac{1}{\nu_3}$

(*d*) $\frac{1}{\nu_2} = \frac{1}{\nu_1} - \frac{1}{\nu_3}$

40. **Some energy levels of a molecule are shown in the figure. The ratio of the wavelengths $r = \frac{\lambda_1}{\lambda_2}$, is given by**



(*a*) $r = \frac{4}{3}$

(*b*) $r = \frac{2}{3}$

(*c*) $r = \frac{3}{4}$

(*d*) $r = \frac{1}{3}$

41. **As an electron makes a transition from an excited state to the ground state of a hydrogen-like atom/ion**

(*a*) its kinetic energy increases but potential energy and total energy decreases

(*b*) kinetic energy, potential energy and total energy decrease

(*c*) kinetic energy decreases, potential energy increases but total energy remains same

(*d*) kinetic energy and total energy decrease but potential energy increases

42. **M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in a radioactive decay. The Q-value for a β^- decay is Q_1 and that for a β^+ decay is Q_2. If m_e denotes the mass of an electron, then which of the following statements is correct?**

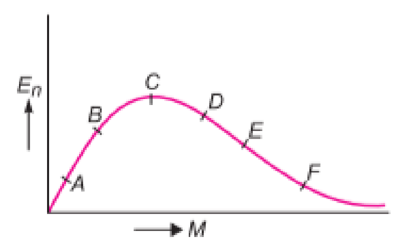
(*a*) $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y - 2m_e)c^2$

(*b*) $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y)c^2$

(*c*) $Q_1 = (M_x - M_y - 2m_e)c^2$ and $Q_2 = (M_x - M_y + 2m_e)c^2$

(*d*) $Q_1 = (M_x - M_y + 2m_e)c^2$ and $Q_2 = (M_x - M_y + 2m_e)c^2$

43. **Fig. shows a plot of binding energy per nucleon E_n against the nuclear mass M. A, B, C, D, E, F correspond to different nuclei. Consider four reactions:**



(*i*) $A + B \rightarrow C + \varepsilon$

(*ii*) $C \rightarrow A + B + \varepsilon$

(*iii*) $D + E \rightarrow F + \varepsilon$

(*iv*) $F \rightarrow D + E + \varepsilon$

where ε is the energy released. In which reaction ε is positive?

(*a*) (*i*) and (*iv*)

(*b*) (*i*) and (*iii*)

(*c*) (*ii*) and (*iv*)

(*d*) (*ii*) and (*iii*)

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

Statement P : Hydrogen atom consists of only one electron but its emission spectrum has many lines.

Statement Q : Only Lyman series is found in the absorption spectrum of hydrogen atom whereas in the emission spectrum, all the series are found.

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

45. Within depletion region of *p*-*n* junction diode

(*a*) *p*-side is positive and *n*-side is negative
(*b*) *p*-side is negative and *n*-side is positive
(*c*) both sides are positive or negative
(*d*) both sides are neutral

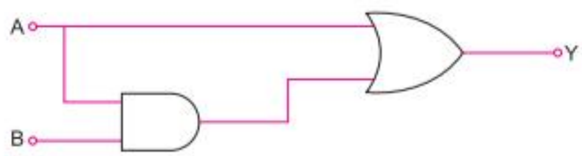
46. The minimum kinetic energy needed to separate a proton from a nucleus containing Z-proton and N neutrons is (m_p = mass of protons):

(*a*) $\left(M_Z^{A-1} + m_n - M_Z^A\right)c^2$
(*b*) $\left(M_Z^{A-1} + m_p - M_Z^A\right)c^2$
(*c*) $\left(M_Z^{A+1} - M_Z^A - m_p\right)c^2$
(*d*) 8 MeV

47. At equilibrium, in a *p*-*n* junction diode the net current is

(*a*) due to diffusion of majority charge carriers.
(*b*) due to drift of minority charge carriers.
(*c*) zero as diffusion and drift currents are equal and opposite.
(*d*) zero as no charge carriers cross the junction.

48. In given combination of two gates if $A = 0, B = 0; A = 0, B = 1$; then output Y respectively will be:



(*a*) 0, 0
(*b*) 0, 1
(*c*) 1, 0
(*d*) 1, 1

49. Which one of the following represents forward bias diode?

(*a*)


(*b*)


(*c*)


(*d*)


50. Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statements is most appropriate?

(*a*) The number of free electrons for conduction is significant only in Si and Ge but small in C.
(*b*) The number of free conduction electrons is significant in C but small in Si and Ge.
(*c*) The number of free conduction electrons in negligibly small in all the three.
(*d*) The number of free electrons for conduction is significant in all the three.

ANSWERS

PRACTICE PAPER – 6

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

SOLUTIONS

PRACTICE PAPER—6

2. (*a*) When high energy *x*-ray beam falls on the metal ball, photo-electric emission takes place and electrons are emitted from metal ball. This make metal ball positively charged and hence it is deflected in the direction of the electric field.

3. (*b*) Net charge enclosed in the imaginary sphere,

$Q_{en} = -q + q + Q = Q$

From Gauss's Law,

$$\phi = \frac{Q_{en}}{\varepsilon_0} = \frac{Q}{\varepsilon_0}$$

4. (*a*) Linear charge density, $\lambda = \frac{\text{Charge}}{\text{Length}}$

Surface charge density, $\sigma = \frac{\text{Charge}}{\text{Area}}$

Volume charge density, $\rho = \frac{\text{Charge}}{\text{Volume}}$

5. (*c*) $C = \frac{\varepsilon_0 A}{d} = 1\text{pF}$

$$C' = \frac{K\varepsilon_0 A}{d'} = \frac{K\varepsilon_0 A}{2d} = \frac{K}{2} \times \left(\frac{\varepsilon_0 A}{d}\right)$$

$$\frac{C'}{C} = \frac{2\text{ pF}}{1\text{ pF}} = \frac{K}{2} \Rightarrow K = 4$$

6. (*c*) $W = PE(\cos\theta_1 - \cos\theta_2)$

$= PE(\cos 0° - \cos 60°)$

$= PE\left(1 - \frac{1}{2}\right) = \frac{1}{2}PE$

$W' = PE(\cos 0° - \cos 180°)$

$= PE\{1 - (-1)\} = 2PE$

$$\frac{W}{W'} = \frac{\frac{1}{2}PE}{2PE} = \frac{1}{4}$$

$W' = 4\,W$

7. (*c*) The arrangement is equivalent to a parallel combination of two capacitors, each with plate area *A*/2 and separation *d*,

$$C = C_1 + C_2 = \frac{\varepsilon_0 A}{2d}(K_1 + K_2)$$

$$= \frac{1}{2}(K_1 + K_2) \qquad \left[\because C_0 = \frac{\varepsilon_0 A}{d} = 1\mu\text{F(given)}\right]$$

$$\therefore \qquad C = \frac{1}{2}(4 + 6) = 5\,\mu\text{F}$$

8. (*c*) $q = 2\,\mu\text{C} = 2 \times 10^{-6}\text{ C}$

$$\varepsilon_0 = 8.85 \times 10^{-12}\frac{\text{Nm}^2}{\text{C}^2}$$

Now, total number of electric field lines

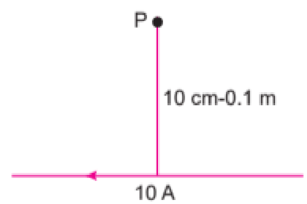
$$= \frac{q_{in}}{\varepsilon_0} = \frac{2\times10^{-6}}{8.85\times10^{-12}}$$

$= 2.2\times10^5\frac{\text{Nm}^2}{\text{C}}$ leaving the surface

10. (*b*) If *R* is increased, current in main circuit will decrease (by $V = IR$) as the potential (*E*) is constant. So, in turn potential difference across *AB* will decrease (by $V = IR$). As *R* of AB is constant so potential gradient $K = \frac{V}{AB}$ will decrease. So, to balance potential across AB equal to potential of secondary circuit (*E*′), the length *AJ*′ must be larger than earlier *AJ*. So, the point *J* shifts towards *B*.

11. (*b*) $V = IR = E - Ir$

12. (*a*) $d = 0.1$ m



Magnetic field at P is,

$$B = \frac{\mu_0 I}{2\pi d}$$

$$= 2\times10^{-7}\times\frac{10}{0.1}$$

$= 2 \times 10^{-5}$ T, acting downwards.

13. (*a*) We know that

$$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi d} = \frac{\mu_0 i^2}{2\pi d}, \qquad [I_1 = I_2 = i]$$

14. (*d*) Shunting (a low resistance in parallel)

15. (*a*) For non-zero force $\sin\theta \neq 0$ or $\theta \neq 0°$ or 180°

16. (*d*) $F_{PQ} = Il_{PQ}B$

$F_{QR} = I\,l_{QR}B\sin\theta$

$\theta = 45°$

$L_{QR} = \sqrt{2}\,l_{PQ}$

$$F_{QR} = I\sqrt{2}l_{PQ}B\frac{1}{\sqrt{2}} = Il_{PQ}B = F_{PQ}$$

Since FQR and FPQ have opposite direction FQR = –F.

17. (*a*) For the earth's magnetism, the magnetic field lines of the earth resemble that of a hypothetical magnetic dipole located at the centre of the earth. The axis of the dipole does not coincide with the axis of rotation of the earth but it is presently litted by 11.3° with respect to the later. Hence, the declination varies between 11.3° W to 11.3°E.

18. (*d*) $\vec{M} = \left(\frac{1}{2}\vec{M}\right) + \left(-\frac{1}{2}\vec{M}\right) = 0$

19. (*d*) In electromagnetic induction, line integral of induced field E around a close path is not zero, and induced electric field is non-conservative (*i.e.*, work done due to its path is not equal to zero).

20. (*c*) $\varepsilon = Blv$, taking, $B = 4 \times 10^{-5}$ T, $l = 2$ cm $= 2 \times 10^{-2}$m, $v = 10$ m/s

$\varepsilon = 4 \times 10^{-5} \times 2 \times 10^{-2} \times 10 = 8 \times 10^{-6}$ V

$\varepsilon = 8\,\mu$V

21. (*c*) EMF induced between point O and A,

$E = \frac{1}{2}B\omega l^2$

Potential difference across OP, $= \frac{1}{2}B\omega a^2$

Current in R, $I = \frac{V}{R} = \frac{B\omega a^2}{2R}$

22. (*b*) Magnetic flux $= \sum_i \vec{B_i}.\vec{A_i}$

Where B_i is the magnetic field passing through the area A_i.

Since $B = 0$

Hence net magnetic flux is zero.

24. (*c*) $X_C' = \frac{1}{2\pi(2f)(2C)} = \frac{X_C}{4}$

25. (*d*) Suppose an EM wave travels in –ve Z-direction. Its electric field is

$E = E_0 \cos(kz - \omega t)$

which is perpendicular to Z-axis. It acts along Y-direction.

The associated magnetic field $\vec{B}$ in electromagnetic wave is along X-axis *i.e.*, along $\hat{k}\times\vec{E}$

As $B_0 = \frac{E_0}{c}$

$\therefore \quad \vec{B} = \frac{1}{c}(\hat{k}\times\vec{E})$

The associated electric field can be written as

$\vec{E} = c(\vec{B} \times \hat{k})$

Angle between $\hat{k}$ and $\vec{E}$ is 90° between $\hat{k}$ and $\vec{B}$ is 90°.

Therefore, $\hat{k}.\vec{E} = 0$ and $\hat{k}.\vec{B} = 0$

26. (*b*) Both the fields are mutually perpendicular to each other and to the axis of propagation.

27. (*a*) The given lens has two focal lengths and hence, two images will be formed.

28. (*b*) The intensity of transmitted light through P_1,

$I_1 = \frac{I_0}{2}$

The intensity of transmitted light through P_3,

$I_2 = I_1\cos^2 45°$

$= \frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{2}.\frac{1}{2} = \frac{I_0}{4}$

Angle between polaroids P_3 and P_2

$= 90° - 45° = 45°$

$\therefore$ Intensity of transmitted light through P_2,

$I_3 = I_2\cos^2 45° = \frac{I_0}{4}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{8}$

29. (*a*) When electron is released from rest, it starts move along the opposite direction of electric field in straight line. Since velocity and magnetic fields are parallel, so no magnetic force acts on the particle. Hence it continuously move in straight line.

31. (*d*) Focal length is given by

$$\frac{1}{f} = (n-1)\left[\frac{1}{20} - \left(\frac{1}{-20}\right)\right] = \frac{(n-1)}{10}\text{ cm}^{-1}$$

Assuming $n = 1.5, f = 20$ cm. Therefore, image position is calculated as

$$v = \frac{uf}{u+f} = \frac{-30\times 20}{-30+20} = 60\text{ cm}$$

and the magnification is calculated as

$$m = \frac{v}{u} = \frac{60}{30} = -2$$

The image is real, inverted, and its height is calculated as

$$\frac{h_I}{h_0} = -2 \;\Rightarrow\; h_I = -2h_0 = -2\times 2\text{ cm}$$

$$= -4\text{ cm}$$

32. (*a*) For thin prism, $\delta = (n-1)A$. So, $\delta \propto n$.

For, n is minimum for red colour. Hence least to deviate.

33. (*c*) When a wave undergoes reflection at an interface from rarer to denser medium them it undergoes a phase change of π.

34. (*a*) Distance of second secondary maximum from the centre of the screen is

$x'_2 = \frac{5}{2}\frac{D\lambda}{a}$

$$\lambda = \frac{2ax_2'}{5D} = \frac{2\times 0.7\times 10^{-3}\times 2\times 10^{-3}}{5\times 1}\text{ m}$$

$= \frac{28}{5}\times 10^{-7}$ m

$= 5600$ Å

35. (*a*) According to Brewster's law, $i + r = 90°$

36. (*a*) Due to point source propagates in all directions symmetrically. So wave point will be spherical.

And intensity of light, $I = \frac{P}{A} = \frac{P}{4\pi r^2}$,

r = radius of wave frant at any time.

37. (*a*) For green colour critical angle, $C = \theta$

Critical angle increases with decrease of refractive index or increase of wavelength, so critical angles for yellow, orange, red will be more than θ, hence these rays will get refracted.

38. (*b*) Since the frequencies of both the carrier wave and the amplitude modulated wave are similar, the frequency of the *AM* wave would be ω_c.

39. (*a*) For the series limit of Lyman series,

$n_1 = 1, n_2 = \infty$.

$$\therefore \quad \nu_1 = Rc\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = Rc$$

For the first line of Lyman series,

$n_1 = 1, n_2 = 2$.

$$\therefore \quad \nu_2 = Rc\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3}{4}Rc$$

For the series limit of Balmer series,

$n_1 = 2, n_2 = \infty$.

$$\therefore \quad \nu_3 = Rc\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] = \frac{Rc}{4}$$

Clearly, $\nu_1 = \nu_2 + \nu_3 \Rightarrow \nu_1 - \nu_2 = \nu_3$

40. (*d*) As, $E_2 - E_1 = h\nu = \frac{hc}{\lambda}$

$$\therefore \quad \frac{hc}{\lambda_1} = -E - (-2E) = E \quad \text{...}(i)$$

$$\frac{hc}{\lambda_2} = -E - \left(-\frac{4}{3}E\right) = \frac{E}{3} \quad \text{...}(ii)$$

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

$$r = \frac{\lambda_1}{\lambda_2} = \frac{1}{3}$$

41. (*a*) As we know, energy of orbiting electron,

$$KE = \frac{13.6}{n^2}\text{eV}$$

$\Rightarrow$ As n decreases, *KE* increases

$$PE = -\frac{27.2}{n^2}\text{eV}$$

$\Rightarrow$ As n decreases, *PE* decreases

$$TE = KE + PE = -\frac{13.6}{n^2}\text{eV}$$

$\Rightarrow$ As n decreases, *TE* decreases

42. (*a*) β^+ decay represented as,

$${}_ZX^A \longrightarrow {}_{Z-1}Y^A + {}_1e^0 + \nu + Q_2$$

$$\therefore \quad Q_2 = \left[m_n\left({}_ZX^A\right) - m_n\left({}_{Z-1}Y^A\right) - m_e\right]c^2$$

$$= \left[m\left({}_ZX^A\right) - m\left({}_{Z-1}Y^A\right) - 2m_e\right]c^2$$

$$= [M_x - M_y - 2m_e]c^2.$$

Now, β^- decay represented as,

$${}_ZX^A \longrightarrow {}_{Z+1}Y^A + {}_{-1}e^0 + \overline{\nu} + Q_1$$

$$\therefore \quad Q_1 = \left[m_n\left({}_ZX^A\right) - m_n\left({}_{Z+1}Y^A\right) - m_e\right]c^2$$

$$= \left[m\left({}_ZX^A\right) - m\left({}_{Z-1}Y^A\right)\right]c^2$$

$$= [M_x - M_y]c^2.$$

43. (*a*) Fusion of lighter nuclei to form heavy nucleus and fission of heavier nuclei into lighter nuclei release energy.

45. (*b*) The holes from *p*-side diffuse to the *n*-side and the electrons from *n*-side diffuse to the *p*-side forming a depletion layer. Thus, the *p*-side of depletion region is negatively charged and *n*-side of depletion region is positively charged.

46. (*b*) Initial nucleus is ${}_Z^AX$ and final nucleus is ${}_{Z-1}^{A-1}X$.

Reaction is

$$Q + {}_Z^AX \longrightarrow {}_Z^{A-1}Y + p$$

$$\Rightarrow \quad Q = {}_Z^{A-1}Y + p - {}_Z^AX$$

$$\Rightarrow \quad Q = [M_Z^{A-1} + m_p - M_Z^A]c^2$$

47. (*c*) Zero as diffusion and drift current are equal and opposite.

48. (*a*) Truth table for given combination,

A	B	Y′ = A . B
0	0	0
0	1	0

again

A	Y′	Y = A + Y′
0	0	0
0	0	0

Hence, output, Y = 0, 0

49. (*a*) In forward biased diode, *p*-side is at higher potential than *n*-side.

50. (*a*) The energy band gap is maximum for carbon, less for silicon and minimum for germanium. So the number of free electrons is very small in case of carbon.