25 PRACTICE PAPER

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

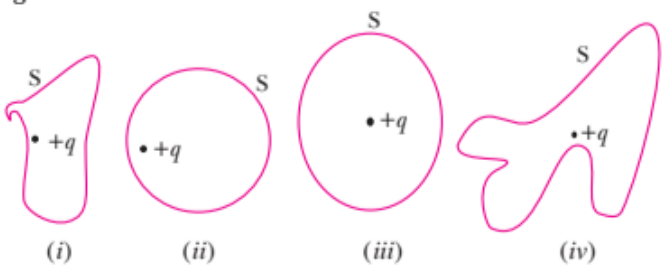
General Instructions: *Same as Practice Paper-1.*

Choose the correct option in the following questions.

1. **When air is replaced by a medium of dielectric constant K, the force of attraction between two charges separated by a distance r**

   (*a*) decreases K times (*b*) remains unchanged (*c*) increases K times (*d*) increases K^{-2} times

2. **The Electric flux through the surface**



(*i*) (*ii*) (*iii*) (*iv*)

   (*a*) in Fig. (*iv*) is the largest.
   (*b*) in Fig. (*iii*) is the least.
   (*c*) in Fig. (*ii*) is same as Fig. (*iii*) but is smaller than Fig. (*iv*)
   (*d*) is the same for all the figures.

3. **Force between two identical charges placed at a distance r in vacuum is F. Now a slab of dielectric of dielectric constant 4 is inserted between these two charges. If the thickness of the slab is $\frac{r}{2}$ then the force between the charges will become**

   (*a*) F (*b*) $\frac{F}{4}$ (*c*) $\frac{F}{2}$ (*d*) $\frac{4}{9}F$

4. **If the electric flux entering and leaving an enclosed surface respectively is f_1 and f_2. The electric charge inside the surface will be**

   (*a*) $\frac{\phi_2 - \phi_1}{\varepsilon_0}$ (*b*) $\varepsilon_0 (\phi_2 - \phi_1)$ (*c*) $\frac{\phi_1 - \phi_2}{\varepsilon_0}$ (*d*) $\varepsilon_0(\phi_1 + \phi_2)$

5. **If the net electric flux through a closed surface is zero, then we can infer**

   (*a*) no net charge is enclosed by the surface.
   (*b*) uniform electric field exists within the surface.
   (*c*) electric potential varies from point to point inside the surface.
   (*d*) charge is present inside the surface.

6. **Some charge is being given to a conductor. Then, its potential**

   (*a*) is maximum at surface. (*b*) is maximum at centre.
   (*c*) remains the same throughout the conductor. (*d*) is maximum somewhere between surface and centre.

7. ***n* identical capacitors joined in parallel are charged to a common potential *V*. The battery is disconnected. Now, the capacitors are separated and joined in series. For the new combination**

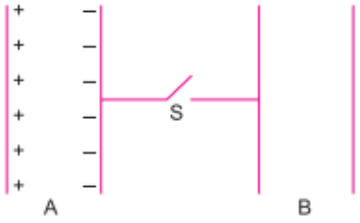
(*a*) energy and potential difference both will remain unchanged

(*b*) energy will remain same, potential difference will become nV

(*c*) energy and potential both will become n times

(*d*) energy will become n times, potential difference will remain V.

8. **Consider a situation shown in figure. The capacitor *A* has charge *q* on it whereas *B* is uncharged. The charge appearing on the capacitor *B*, a long time after the switch *S* is closed is**



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

9. **If 343 droplets each of charge *q* and radius *r* are combined to form a big drop, then the potential of big drop, as compared to small droplet will be**

(*a*) 343 times (*b*) 49 times

(*c*) 7 times (*d*) none of the above

10. **Consider the following two statements about the Oersted's experiment.**

Statement P: The magnetic field due to a straight current carrying conductor is in the form of circular loops around it.

Statement Q: The magnetic field due to a current carrying conductor is weak at near points from the conductor, compared to the far points.

(*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

11. **Electric power is transmitted over long distance through conducting wires of high voltages because**

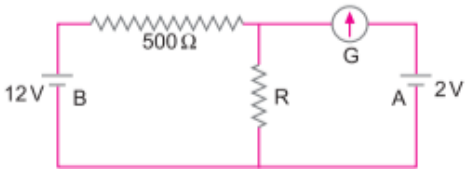
(*a*) it reduces the possibility of theft of wire

(*b*) this entails less power losses

(*c*) *ac* generators produce electric power at very high voltages

(*d*) *ac* signal of high voltage travels faster.

12. **In the circuit the galvanometer shows zero deflection. If the batteries *A* and *B* have negligible internal resistance, the value of resistance *R* will be**



(*a*) 100 Ω (*b*) 200 Ω

(*c*) 500 Ω (*d*) 1000 Ω

13. **Match the appropriate entries of Column A with Column B.**

	Column A		Column B
(*i*)	Charge carriers in electrolyte liquids	(*p*)	40 W bulbs glows maximum
(*ii*)	In series combination of 40 W and 100 W bulbs	(*q*)	$R_{ext.} = r_{int}$
(*iii*)	For getting maximum current in parallel combination of cells	(*r*)	Positive and negative ions
(*iv*)	Charge carriers in semiconductors	(*s*)	Electrons and holes

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

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

14. **A potentiometer is an accurate and versatile device to make electrical measurement of EMF because the method involves**

(*a*) potential gradients

(*b*) a condition of no current flow through the galvanometer

(*c*) a combination of cells, galvanometer and resistance

(*d*) cells

15. **A current carrying loop is placed in a uniform magnetic field. The torque acting on it does not depend upon the**

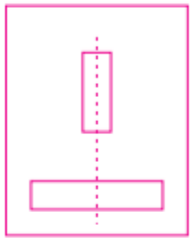
(*a*) shape of the loop (*b*) area of the loop

(*c*) value of current (*d*) magnetic field

16. **In an ammeter 4% of the mains current is passing through galvanometer. If the galvanometer is shunted with a 5 Ω resistance, then resistance of galvanometer will be**

(*a*) 116 Ω (*b*) 117 Ω (*c*) 118 Ω (*d*) 120 Ω

17. **Two short magnets are placed on a piece of cork which floats on water. The magnets are so placed that the axis of one produced bisects the axis of the other at right angles. Then the cork**



(*a*) rotates only

(*b*) moves along a straight line only

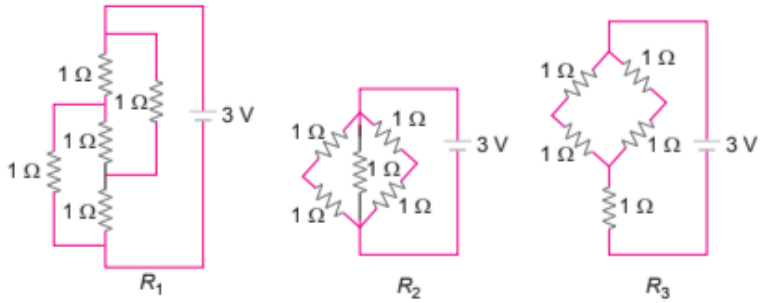
(*c*) has rotational as well as translational motion

(*d*) has neither translational nor rotational motion

18. **Two bar magnets of same geometry with magnetic moments M and $2M$ are first placed in such a way that their similar poles are on the same side, then its period of oscillation is T_1. Now the polarity of one of the magnets is reversed, then the time period of oscillations is T_2 then,**

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

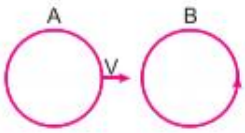
19. **Figure shows three resistor configuration R_1, R_2 and R_3 connected to 3 V battery. If the power dissipated by the configuration R_1, R_2 and R_3 is P_1, P_2 and P_3 respectively, then**



(*a*) $P_1 > P_2 > P_3$ (*b*) $P_1 > P_3 > P_2$

(*c*) $P_2 > P_1 > P_3$ (*d*) $P_3 > P_2 > P_1$

20. **There are two coils A and B as shown in the figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counter clockwise. B is kept stationary when A moves. We can infer that**



(*a*) there is a constant current in the clockwise direction in A.

(*b*) there is a varying current in A.

(*c*) there is no current in A.

(*d*) there is a constant current in the counterclockwise direction in A.

21. **The magnetic flux linked with a coil at any instant 'E' is given by**

$$\phi = 10t^2 - 50t + 250 \text{ Wb}$$

The induced emf at $t = 3$ s is

(*a*) – 190 V (*b*) – 10 V (*c*) 10 V (*d*) 190 V

22. **In an *ac* circuit the voltage and current are given by the following expressions $V = V_0 \sin \omega t$ and $I = I_0 \cos \omega t$, where the symbols have their usual meaning. Which of the following statement is correct?**

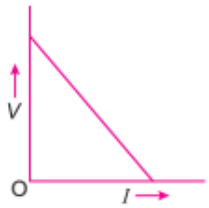
(*a*) Voltage lead the current by a phase angle of $\pi/2$.

(*b*) Voltage lags behind the current by phase angle of π.

(*c*) Voltage and current are in phase.

(*d*) Voltage lags behind the current by phase angle of $\pi/2$.

23. **A student measures the terminal potential difference (V) of a cell of emf E and internal resistance r as a function of the current (I) flowing through it. The slope and intercept, of the graph between V and I, then respectively, equal**



(*a*) $-r$ and ε (*b*) r and $-\varepsilon$

(*c*) $-\varepsilon$ and r (*d*) ε and $-r$

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

Statement P : A capacitor of suitable capacitance can be used in an AC circuit in place of the choke coil.

Statement Q : A capacitor blocks AC and allows DC only.

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

25. **For plane electromagnetic waves propagating in the Z-direction, which one of the following combinations gives the correct possible direction for $\vec{E}$ and $\vec{B}$ fields respectively?**

(*a*) $(2\hat{i} + 3\hat{j})$ and $(\hat{i} + 2\hat{j})$ (*b*) $(-2\hat{i} - 3\hat{j})$ and $(3\hat{i} - 2\hat{j})$

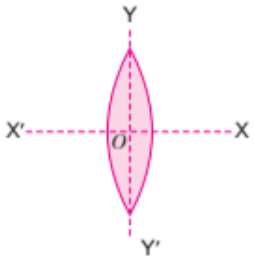
(*c*) $(3\hat{i} + 4\hat{j})$ and $(4\hat{i} - 3\hat{j})$ (*d*) $(\hat{i} + 2\hat{j})$ and $(2\hat{i} - \hat{j})$

26. **An object is placed at a distance of 40 cm from a concave mirror of focal length 15 cm. If the object is displaced through a distance of 20 cm towards the mirror, the displacement of the image will be**

(*a*) 30 cm away from the mirror (*b*) 36 cm away from the mirror

(*c*) 30 cm towards the mirror (*d*) 36 cm towards the mirror

27. **An equiconvex lens is cut into two halves along (*i*) *XOX'* and (*ii*) *YOY'* as shown in the figure. Let f, f' and f'' be the focal lengths of complete lens, of each half in case (*i*) and of each half in case (*ii*) respectively. Choose the correct statement from the following:**



(*a*) $f' = 2f$ and $f'' = f$ (*b*) $f' = f$ and $f'' = f$

(*c*) $f' = 2f$ and $f'' = 2f$ (*d*) $f' = f$ and $f'' = 2f$

28. **For relaxed eye, the magnifying power of a microscope is**

(*a*) $\frac{v_0}{u_0} \times \frac{D}{f_e}$ (*b*) $\frac{v_0}{u_0} \times \frac{f_e}{D}$ (*c*) $\frac{u_0}{v_0} \times \frac{D}{f_e}$ (*d*) $\frac{u_0}{v_0} \times \left(-\frac{D}{f_e}\right)$

29. **A real image of a object is formed in a concave mirror. The size of the image is greater than the size of the object, which of the following statements is correct?**

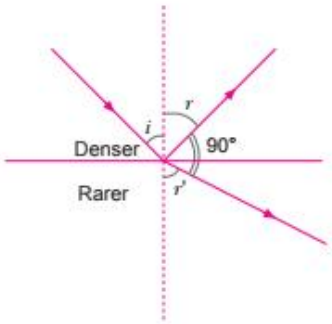
(*a*) The object is situated on the centre of curvature.

(*b*) The object is situated within the focal length.

(*c*) The object is situated between the pole and the focus.

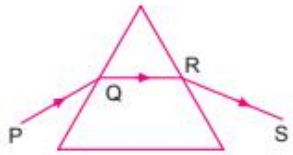
(*d*) The object is situated between centre of curvature and the focus.

30. **A ray of light from denser medium strikes a rarer medium at an angle of incidence i (fig. shown). The reflected and refracted rays make angle 90° with each other. The angles of reflection and refraction are r and r' respectively. The critical angle is**



(*a*) $\sin^{-1}(\cot r)$ (*b*) $\sin^{-1}(\tan i)$ (*c*) $\sin^{-1}(\tan r')$ (*d*) $\tan^{-1}\sin i$

31. **A ray of light is incident on an equilateral glass prism placed on a horizontal table. For minimum deviation which of the following is true?**



(*a*) PQ is horizontal (*b*) QR is horizontal

(*c*) RS is horizontal (*d*) Either PQ or RS is horizontal

32. **Two beams of red and violet colours are made to pass separately through a prism (angle of the prism is 60°). In the position of minimum deviation, the angle of refraction will be**

(*a*) 30° for both the colours (*b*) greater for the violet colour

(*c*) greater for the red colour (*d*) equal but not 30° for both the colorus

33. **Consider sunlight incident on a slit of width 10^4 Å. The image seen through the slit shall**

(*a*) be a fine sharp slit white in colour at the center.

(*b*) a bright slit white at the center diffusing to zero intensities at the edges.

(*c*) a bright slit white at the center diffusing to regions of different colours.

(*d*) only be a diffused slit white in colour.

34. **The Young's double-slit experiment is performed with blue and green lights of wavelengths 4360 Å and 5460 Å respectively. If x is the distance of 4th maxima from the central one, then**

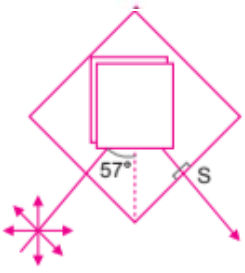
(*a*) $(x)_{blue} = (x)_{green}$ (*b*) $(x)_{blue} > (x)_{green}$ (*c*) $(x)_{blue} < (x)_{green}$ (*d*) $\dfrac{(x)_{blue}}{(x)_{green}} = \dfrac{5460}{4360}$

35. **An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of**

(*a*) small focal length and large diameter (*b*) large focal length and small diameter

(*c*) large focal length and large diameter (*d*) small focal length and small diameter

36. **The figure represents a glass plate placed vertically on a horizontal table with a beam of unpolarised light falling on its surface at the polarising angle of 57° with the normal. The electric vector in the reflected light on screen S will vibrate with respect to the plane of incidence in a**



(*a*) vertical plane

(*b*) horizontal plane

(*c*) plane making an angle of 45° with the vertical

(*d*) plane making an angle of 57° with the horizontal.

37. **A plane polarised light passes through a polaroid. The polaroid is rotated about the direction of incident light and emergent light is viewed. On rotating the polaroid through a complete rotation, it is found that**

(*a*) the intensity of light slowly reduces to zero and remains zero

(*b*) the intensity of light increases to a maximum value and remains maximum

(*c*) there is no change in intensity

(*d*) the light intensity becomes maximum two times and zero two times

38. **A particle is dropped from a height *H*. The de Broglie wavelength of the particle as a function of height is proportional to**

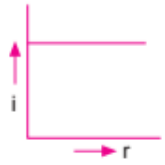
(*a*) H (*b*) $H^{1/2}$ (*c*) H^{0} (*d*) $H^{-1/2}$

39. **A photoelectric cell is illuminated by a point source of light 1 m away. The plate emits electrons having stopping potential *V*. Then**

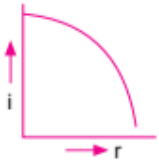
(*a*) V decreases as distance increase (*b*) V increases as distance increase

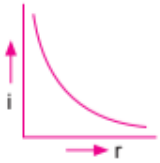
(*c*) V is independent of distance (r) (*d*) V becomes zero when distance increases or decreases

40. **A photon source causes photoelectric effect from a small metal plate. Which of the following curve best represents the saturation photocurrent (*i*) as a function of distance (*r*) between the source and the metal?**

(*a*) 

(*b*) 

(*c*) 

(*d*) 

41. **If the kinetic energy of a free electron doubles, its de Broglie wavelength changes by a factor:**

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

42. **In photoelectric effect, the work-function of a metal is 3.2 eV. The emitted electrons can be stopped by applying a potential of – 1.2 V. Which of the following is correct?**

(*a*) The energy of the incident photons is 4·7 eV.

(*b*) The energy of incident photons is 2·3 eV.

(*c*) If higher-frequency photons be used, the photoelectric current will rise.

(*d*) When the energy of photons is 3·5 eV, the photoelectric current will be maximum.

43. **In the following transitions of the hydrogen atom, the one which gives an absorption line of highest frequency is**

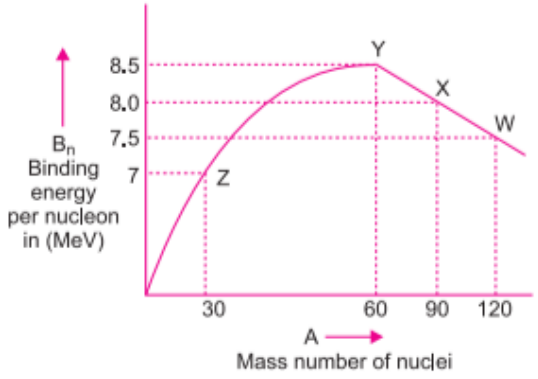
(*a*) $n = 1$ to $n = 2$ (*b*) $n = 3$ to $n = 8$ (*c*) $n = 2$ to $n = 1$ (*d*) $n = 8$ to $n = 3$

44. **Which is quantised in Bohr's atomic model?**

(*a*) Total energy of the electron (*b*) Angular momentum of the electron

(*c*) Linear velocity of the electron (*d*) Angular velocity of the electron

45. **Given figure represents a graph showing variation of binding energy per nucleon versus mass number of nuclei. Graph for nuclei, W, X, Y, Z are shown. The process in which energy is released is**



(*a*) $Y \rightarrow 2Z$ (*b*) $W \rightarrow X + Z$ (*c*) $W \rightarrow 2Y$ (*d*) $X \rightarrow Y + Z$

46. Which one of the following is a possible nuclear reaction?

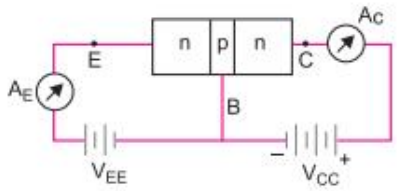
(*a*) ${}^{10}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{13}_{7}\mathrm{N} + {}^{1}_{1}\mathrm{H}$

(*b*) ${}^{23}_{11}\mathrm{Na} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{20}_{10}\mathrm{Ne} + {}^{4}_{2}\mathrm{He} + \beta$

(*c*) ${}^{239}_{93}\mathrm{Np} \rightarrow {}^{239}_{94}\mathrm{Pu} + \beta^{-} + \bar{\nu}$

(*d*) ${}^{11}_{7}\mathrm{N} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{12}_{6}\mathrm{C} + \beta^{-} + \bar{\nu}$

47. The circuit of *npn* transistor is shown in fig. The current recorded by mA is 10 mA. 90% electrons emitted reach the collector.



Which of the following statement is true ?

(*a*) Base-emitter junction and base collector junction both are forward biased.

(*b*) Base-emitter junction is forward biased while base collector junction is reverse biased.

(*c*) Base-emitter junction is reverse biased while base collector junction is forward biased.

(*d*) Base-emitter junction and base-collector junction both are reverse biased.

48. The device used as a voltage regulator is

(*a*) ordinary $p - n$ junction diode

(*b*) Zener diode

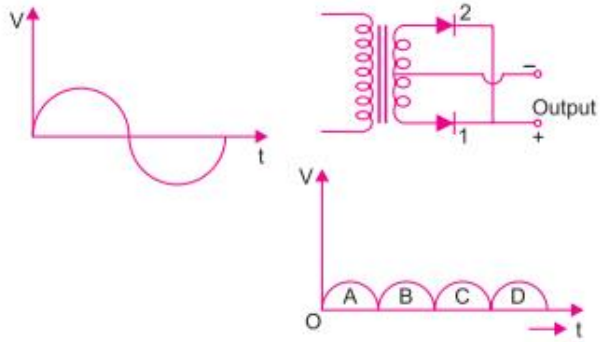
(*c*) photodiode

(*d*) light emitting diode (LED)

49. What is the bandwidth of amplitude modulation transmission if the carrier frequency is 150 kHz and the modulating frequency is 4 kHz?

(*a*) 154 kHz (*b*) 150 kHz (*c*) 146 kHz (*d*) 8 kHz

50. A full wave rectifier circuit along with the output is shown in figure. The contribution from diode '1' is:



(*a*) C (*b*) A, C (*c*) B, D (*d*) A, B, C, D

ANSWERS

PRACTICE PAPER – 5

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

SOLUTIONS

PRACTICE PAPER–5

1. (*a*) In air, the force of attraction between two charges in given by

$$F_{air} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

In dielectric medium, the force of attraction between two charges is given by

$$F_{mid} = \frac{1}{4\pi\varepsilon_0 K}\frac{q_1 q_2}{r^2}$$

$$= \frac{F_{air}}{K}$$

So, force decreases K-times.

2. (*d*) According to Gauss law, the electric flux (ϕ) through the closed surface depends only on the amount of charge enclosed inside the surface. It does not depend on size and shape of the surface.

Here, charge enclosed inside all the figures are same.

So, electric flux $\left(\phi = \frac{q}{\varepsilon_0}\right)$ will remain same.

3. (*a*) $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$

For a dielectric of dielectric constant K between the charges, the effective separation in air r_{eff} is given by

$$\frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r_{eff}^2} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{Kr^2}$$

$$\Rightarrow \quad r_{eff} = \sqrt{K}\,r$$

$$\therefore \quad F' = \frac{1}{4\pi\,\varepsilon_0}\frac{q_1 q_2}{\left(\frac{r}{2}+\frac{\sqrt{K}\,r}{2}\right)^2}$$

$$\Rightarrow \quad \frac{F'}{F} = \frac{1}{\left(\frac{1}{2}+\frac{\sqrt{4}}{2}\right)^2} = \frac{4}{9}$$

$$\Rightarrow \quad F' = \frac{4}{9}F$$

4. (*b*) Net flux diverging $\phi_2 - \phi_1 = \frac{q}{\varepsilon_0}$

$$\Rightarrow \quad q = \varepsilon_0(\phi_2 - \phi_1)$$

5. (*b*) Because earth is a good conductor.

6. (*c*) Charge are reside on the surface of conductor. So, $E = 0$ inside the conductor then, $W = q(\Delta V) = 0 \Rightarrow \Delta V = 0$, so, V = Constant.

7. (*b*) In series potential difference are additive, $V' = nV$.

$V_i = \frac{1}{2}(nC_0)V^2$, where C_0 = Capacitance of each capacitor

$$V_f = \frac{1}{2}\left(\frac{C_0}{n}\right)(nV)^2 = V_i$$

8. (*a*) The charges on the plates of the capacitor A are bound to each other, so no charge will flow to B, so there will be only equal and opposite induced charges on second plate of capacitor A are held by strong electrostatic force. Hence, charge on capacitor B is zero..

9. (*b*) Let radius of bigger drop = R.

$$i.e., \quad \frac{4}{3}\pi R^3 = 343\times\frac{4}{3}\pi r^3$$

$$\Rightarrow \quad R = 7r$$

$$\therefore \text{ Potential of big drop } = \frac{k(343q)}{10r} = \frac{49kq}{r}$$

$$\text{Potential of small drop } = \frac{kq}{r}$$

$$\therefore \quad \frac{V_{\text{big drop}}}{V_{\text{small drop}}} = 49 \Rightarrow V_{\text{big drop}} = 49V_{\text{small drop}}$$

10. (*c*) P is true and the magnetic field due to a current carrying wire is strong at near points from the conductor as compared to the far points.

11. (*b*) To reduce the power loss, the current from power house is transmitted through the wires at high voltage using step up transformer.

12. (*a*) P.d. across $R = \frac{2}{I}$

$\therefore$ P.d. across 500 Ω = 12 – 2 = 10 V

$$I = \frac{10}{500} = \frac{1}{50}\text{ A}$$

$\therefore$ This is also current in R

$$R = \frac{2}{(1/50)} = 100\ \Omega$$

14. (*b*) It is based on null deflection and measure accurate emf because the method involves a condition of no current flow through the galvanometer.

15. (*a*) $\tau = MB\sin\theta = NIAB\sin\theta$.

Hence, τ acting on it does not depend upon shape of the loop.

16. (*d*) Shunt is a low resistance connected in parallel with the galvanometer or ammeter.

$$i.e., \quad S = \frac{I_g G}{I - Ig} \Rightarrow 5 = \frac{\left(\frac{4}{100}\right)IG}{I - \left(\frac{4}{100}\right)I}$$

$$= \frac{4G}{96} \quad \left[\begin{array}{l}\text{Where } I_g = 4\% \text{ of } I \\ \qquad = \frac{4}{100} I\end{array}\right]$$

or $\quad G = \frac{96 \times 5}{4} = 120\Omega$

17. (*d*) The internal interaction can not cause external motion

18. (*a*) When polarity is same, $M_1 = 2M + M = 3M$

If, polarity is reversed, $M_2 = 2M - M = M$

$T = 2\pi\sqrt{\frac{I}{MB}}$, *i.e.*, $T \propto \frac{1}{\sqrt{M}}$ Hence, $T_1 < T_2$

19. (*c*) Equivalent resistances of the three configurations are

$R_1 = 1\ \Omega, R_2 = 1/2\ \Omega, R_3 = 2\ \Omega,$

Power, $P = V^2/R$

For same V, $P \propto 1/R$

As $R_2 < R_1 < R_3$

$\therefore\ P_2 > P_1 > P_3$

20. (*d*) When the A stops moving the current in B becomes zero, it possible only if the current in A is constant. If the current in A would be variable, these must be an induced emf in B even if the A stops moving.

21. (*b*) $\phi = 10t^2 - 50t + 250$

$$e = -\frac{d\phi}{dt} = -\frac{d}{dt}(10t^2 - 50t + 250) = -20t + 50$$

At $t = 3$ s

$e = -20(3) + 50 = -10$ V

22. (*d*) $V = V_0 \sin \omega t, I = I_0 \cos \omega t = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$

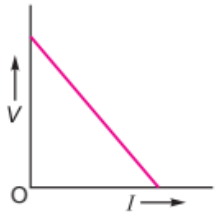
i.e., voltage lags behind the current by phase angle of $\frac{\pi}{2}$.

23. (*a*) $V = \varepsilon - Ir$

Slope $\frac{dV}{dI} = -r$

When $I = 0$, $V = \varepsilon$,

$\therefore$ Intercept $= \varepsilon$



25. (*b*) As given, $\vec{E} \cdot \vec{B} = (-2\hat{i} - 3\hat{j}) \cdot (3\hat{i} - 2\hat{j})$

$= -6 + 6 = 0$

Hence, $\vec{E} \perp \vec{B}$.

Also, $\vec{E} \times \vec{B} = (-2\hat{i} - 3\hat{j}) \times (3\hat{i} - 2\hat{j})$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -2 & -3 & 0 \\ 3 & -2 & 0 \end{vmatrix} = \hat{k}\begin{vmatrix} -2 & -3 \\ 3 & -2 \end{vmatrix} = 13\hat{k}$$

This wave propagates along +ve Z-direction.

26. (*b*) Using mirror formula,

$$\frac{1}{f} = \frac{1}{v_1} + \frac{1}{u_1} \Rightarrow -\frac{1}{15} = \frac{1}{v_1} - \frac{1}{40}$$

$$\Rightarrow \frac{1}{v_1} = \frac{1}{-15} + \frac{1}{40}$$

$v_1 = -24$ cm

When object is displaced by 20 cm towards mirror.

Now, $u_2 = -20$ cm

$$\frac{1}{f} = \frac{1}{v_2} + \frac{1}{u_2} \Rightarrow \frac{1}{-15} = \frac{1}{v_2} - \frac{1}{20}$$

$$\Rightarrow \frac{1}{v_2} = \frac{1}{20} - \frac{1}{15}$$

$v_2 = -60$ cm

So, the image will shift away from mirror by $(60 - 24)$ cm $= 36$ cm.

27. (*d*) According to lens maker's formula,

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

For equiconvex lens (complete),

$$\frac{1}{f} = (n-1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

$$\Rightarrow \quad f = \frac{R}{2(n-1)}$$

(*i*) If, lens is cut along XOX' then curvature of lens does not change,

So, $\quad f' = f = \frac{R}{2(n-1)}$

(*ii*) If lens is cut along YOY' then,

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

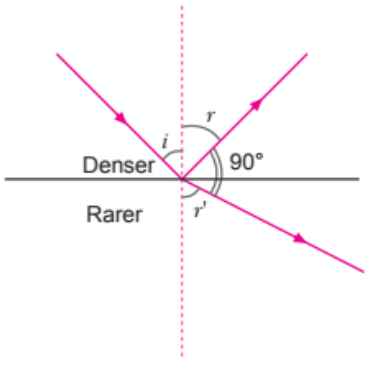
Then, $\frac{1}{f} = (n-1)\left[\frac{1}{\infty} - \left(\frac{1}{-R}\right)\right]$

$$= (n-1)\frac{1}{R}$$

$$f'' = \frac{R}{(n-1)} = 2f$$

Hence, $f' = f$ and $f'' = 2f$.

30. (*b*) From fig. $r + r' = 90° \Rightarrow r' = 90° - r$



From law of reflection, $i = r$

$\therefore \quad r' = 90 - i$

$$\sin C = \frac{n_r}{n_d} = \frac{\sin i}{\sin r'}$$

$$\Rightarrow \quad \sin C = \frac{\sin i}{\sin (90 - i)} \Rightarrow \sin C = \tan i$$

$$C = \sin^{-1} (\tan i)$$

31. (*b*) For minimum deviation, ray QR is horizontal, parallel to base.

32. (*a*) The minimum deviation condition is $r_1 = r_2 = \frac{A}{2}$.

33. (*a*) Wave length of visible light varies from 4000Å to 8000Å. As the width of slit is comparable to that of wavelength. Hence, diffraction occur at centre. So at the centre all colours appear *i.e.*, mixing of colours from white patch of centre.

34. (*c*) As $\chi_n = \frac{n\lambda D}{d}$ (n^{th} of bright fringes)

$\chi_n \propto \lambda \Rightarrow \lambda_{blue} < \lambda_{green}$ *so*, $x_{blue} < x_{grow}$

35. (*c*) For high angular resolution, an objective lens of large focal length and large aperture.

36. (*a*) When unpolarised light is incident at polarising angle, the reflected light is plane polarised in direction perpendicular to the plane of incidence. Hence, electric field vector, $\vec{E}$ in reflected light will vibrate in vertical plane with respect to the plane of incidence.

37. (*d*) In one complete rotation, the angle between polaroid and plane polarised light will be 0° and 90° two times. Hence, the intensity of light varies such that it is twice maximum and twice zero.

38. (*d*) $\lambda = \frac{h}{mv}$ and velocity of body falling from H is given by $v = \sqrt{2gH}$

Now, $\lambda = \frac{h}{m\sqrt{2gH}} = \frac{h}{m\sqrt{2g}\sqrt{H}}$ where,

$= \frac{h}{m\sqrt{2g}} =$ constant

So, $\lambda \propto H^{-1/2}$

39. (*c*) The stopping potential does not depends on the distance of source.

40. (*d*) Photocurrent $\propto \frac{1}{r^2}$ [graph (*d*) is correct]

41. (*d*) de Broglie wavelength, $\lambda = \frac{h}{\sqrt{2mE}} \propto \frac{1}{\sqrt{E}}$

when E is doubled, λ is reduced by a factor $\frac{1}{\sqrt{2}}$.

42. (*a*) From equation,

$eV_0 = E - \phi$, where E is energy of incident photon.

$1.2 \text{ eV} = E - 3.5 \text{ eV}$

$E = 3.5 \text{ eV} + 1.2 \text{ eV} = 4.7 \text{ eV}$

43. (*a*) For highest absorption frequency, the spectral lines give lowest wavelength

i.e., ($n = 1$ to $n = 2$).

44. (*b*) Angular momentum of the electron is quantised in Bohr's model, *i.e.*, it is an integral multiple of $\frac{h}{2\pi}$.

Angular momentum, $L = mvr = \frac{nh}{2\pi}$

45. (*c*) $W \rightarrow 2Y$

represents fission process, it releases energy equal to

$120 \times 8.5 - 120 \times 7.5 = 120$ MeV

46. (*c*) Nuclear reaction is a process in which two nuclei, or a nucleus and an external subatomic particle, collide to produce one or more new nuclides.

47. (*b*) Under forward bias of emitter-base junction, the electrons in emitter and holes in base are compelled to move towards the junction, thus the depletion layer of emitter-base junction is eliminated. As the base region is very thin. Hence most of electrons (about 90-98%) emitted from emitter region cross the base region and reach the collector.

48. (*b*) Zener diode is used as a voltage regulator. It operates on reversed biased.

49. (*b*) Bandwidth of AM transmission is given by

$\Delta\omega = 2\omega_m$ [ω_m = modulating frequency]

$\therefore \quad \Delta\omega = 2 \times 4 = 8$ kHz

50. (*c*) In 1st half D_2 is forward and D_1 reverse biased while in next half it is interchanged so contribution due to D_1 is B and D.