PRACTICE PAPER 2

PHYSICS

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

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

Choose the correct option in the following questions.

1. A slab of dielectric is introduced between two equal positive charges with a fixed separation. As a result

(*a*) the force between the two charges decreases

(*b*) the two charges start attracting each other

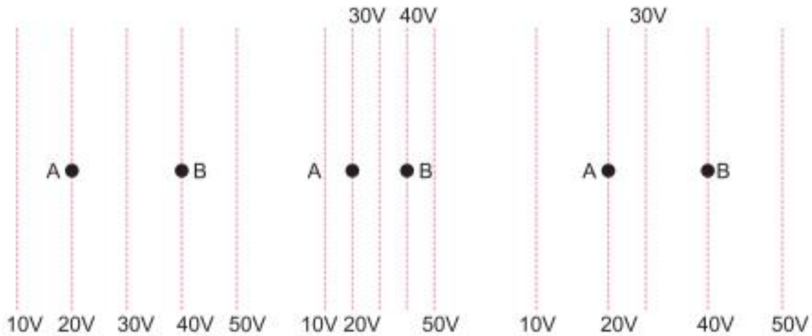
(*c*) the slab starts moving

(*d*) an electric current passes from one charge to the other

2. A charge q μC is placed at the centre of a cube of side 0.1 m. Then the electric flux diverging from each face of this cube is

(*a*) $\frac{q\times10^{-6}}{\varepsilon_0}$ (*b*) $\frac{q}{\varepsilon_0}\times10^{-4}$ (*c*) $\frac{q\times10^{-6}}{6\varepsilon_0}$ (*d*) $\frac{q\times10^{-4}}{6\varepsilon_0}$

3. Figure shows some equipotential lines distributed in space. A charged object is moved from point A to point B.



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

(*a*) The work done in Fig. (*i*) is the greatest.

(*b*) The work done in Fig. (*ii*) is least.

(*c*) The work done is the same in Fig. (*i*), Fig. (*ii*) and Fig. (*iii*).

(*d*) The work done in Fig. (*iii*) is greater than Fig. (*ii*) but equal to that in Fig. (*i*).

4. If a positive charge in displaced against the electric field in which it was situated, then

(*a*) work will be done by the electric field on the charge.

(*b*) the intensity of the electric field decreases.

(*c*) energy of the system will decrease.

(*d*) energy will be provided by external source displacing the charge.

5. **A capacitor's dielectric material has dielectric strength U_d which sets the capacitor's breakdown voltage at $V = U_d d$. The maximum energy stored in the capacitor is**

(*a*) $\frac{1}{2}\varepsilon A d U_d$ (*b*) $\varepsilon A d U_d$

(*c*) $\frac{1}{2}\varepsilon A d U_d^2$ (*d*) $\varepsilon A d U_d^2$

6. **A positively charged particle is released from rest in an uniform electric field. The electric potential energy of the charge**

(*a*) remains a constant because the electric field is uniform.

(*b*) increases because the charge moves along the electric field.

(*c*) decreases because the charge moves along the electric field.

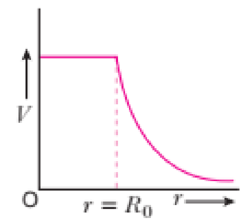
(*d*) decreases because the charge moves opposite to the electric field.

7. **A spherically symmetric charge system is centred at origin. Given that**

Electric potential,

$$V = \frac{Q}{4\pi\varepsilon_0 R_0}, r \leq R_0$$

$$V = \frac{Q}{4\pi\varepsilon_0 R_0}, r > R_0$$



Which of the following statements are true?

I. Within $r = 2R_0$, total enclosed net charge is Q.

II. Electric field is discontinuous at $g = R_0$.

III. Charge is only present ar $r = R_0$

IV Electrostatic energy is zero for $r < R_0$.

(*a*) I and II only (*b*) II and III only

(*c*) III and IV only (*d*) I, II and IV

8. **A potentiometer can measure emf of a cell because**

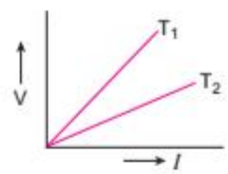
(*a*) the sensitivity of potentiometer is large.

(*b*) no current is drawn from the cell at balance.

(*c*) no current flows in the wire of potentiometer at balance.

(*d*) internal resistance of cell is neglected.

9. **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*) $T_1 < T_2$

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

Statement P : The resistance of a given mass of copper wire is inversely proportional to the square of length.

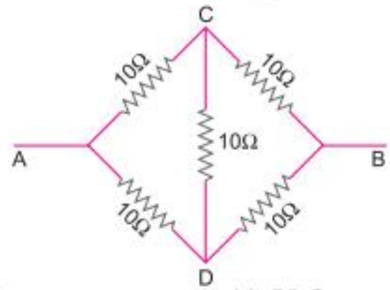
Statement Q : When a copper wire of given mass is stretched to increase its length, its cross-sectional area also increases.

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

11. **The effective resistance between terminals *A* and *B* of figure is**



(*a*) 5 Ω (*b*) 10 Ω (*c*) 20 Ω (*d*) 40 Ω

12. **The sources of light are said to be coherent if**

(*a*) they produce waves of same wavelength
(*b*) they produce waves of same amplitude
(*c*) they produce waves of same wavelength having a constant initial phase difference
(*d*) they produce waves of same amplitude and same frequency

13. **A horizontal wire 0.1 m long carries a current of 5 A. Find the magnitude and direction of the magnetic field, which can balance the weight of wire. Given the mass of the wire is 3×10^{-3} kg/m and $g = 10$ m/s^2.**

(*a*) 6×10^{-3} T, acting horizontally perpendicular to wire
(*b*) 6×10^{-3} T, acting vertically upwards
(*c*) 6×10^{-2} T, acting vertically downwards
(*d*) 6×10^{-2} T, acting horizontally perpendicular to wire

14. **An electron is travelling along the X-direction. It encounters a magnetic field in the Y-direction. Its subsequent motion will be**

(*a*) a circle in the XY-plane
(*b*) a circle in the YZ-plane
(*c*) a circle in the XZ-plane
(*d*) straight line along the X-direction

15. **A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Weber/m^2. The coil carries a current of 2 A. If the plane of the coil is inclined at an angle of 30° with the direction of the field, the torque required to keep the coil in stable equilibrium will be**

(*a*) 0.24 Nm (*b*) 0.12 Nm
(*c*) 0.15 Nm (*d*) 0.20 Nm

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

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.

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

17. **A solenoid has 1000 turns per metre length. If a current of 5 A is flowing through it, then magnetic field inside the solenoid is**

(*a*) $2\pi \times 10^{-3}$ T (*b*) $4\pi \times 10^{-5}$ T
(*c*) $2\pi \times 10^{-5}$ T (*d*) $4\pi \times 10^{-3}$ T

18. **The horizontal component of earth's magnetic field at a place is $\sqrt{3}$ times the vertical component. The angle of dip at that place is**

(*a*) π/6 (*b*) π/3 (*c*) π/4 (*d*) 0

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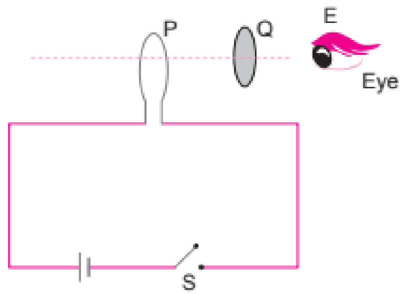
19. **The small angle between magnetic axis and geographic axis at a place is**

(*a*) magnetic meridian
(*b*) geographic meridian
(*c*) magnetic inclination
(*d*) magnetic declination

20. **As shown in figure, *P* and *Q* are two co-axial conducting loops separated by some distance. When switch *S* is closed, a clockwise current I_P flows in *P* (as seen by eye *E*) and an induced current I_{Q_1} flows in *Q*. The switch *S* remains closed for a long time. When *S* is opened, a current I_{Q_2} flows in *Q*. Then the directions of (as seen by eye *E*) are:**

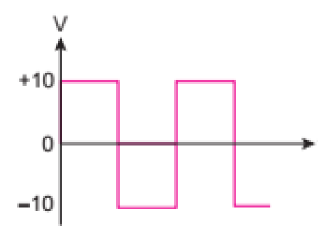


(*a*) respectively clockwise and anticlockwise
(*b*) both clockwise
(*c*) both anticlockwise
(*d*) respectively anticlockwise and clockwise

21. **A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in a time interval *t*. The emf induced in the coil will be**

(*a*) $\frac{3A_0B_0}{t}$
(*b*) $\frac{4A_0B_0}{t}$
(*c*) $\frac{3B_0}{A_0t}$
(*d*) $\frac{4B_0}{A_0t}$

22. **The r.m.s. voltage of the wave form shown is**



(*a*) 6.37 V
(*b*) 12 V
(*c*) 10 V
(*d*) 7 V

23. **Which among the following is not a cause for power loss in a transformer?**

(*a*) Eddy currents are produced in the soft iron core of a transformer.
(*b*) Electric flux sharing is not properly done in primary and secondary coils.
(*c*) Humming sound produced in the transformers due to magnetostriction.
(*d*) Primary coil is made up of a very thick copper wire.

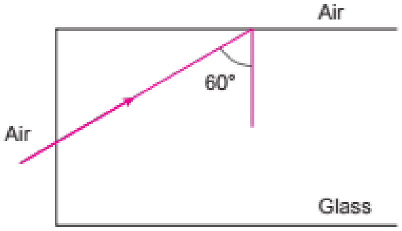
24. **We need to step-up the voltage for power transmission, so that**

(*a*) the current is reduced and consequently, the I^2R loss is cut down
(*b*) the voltage is increased , the power losses are also increased
(*c*) the power is increased before transmission is done
(*d*) the voltage is decreased so V^2/R losses are reduced

25. **The phenomenon of dispersion arises because of**

(*a*) the decomposition of white light beam by a prism
(*b*) the refraction of light
(*c*) the refractive index of the prism material
(*d*) the corpuscular nature of light

26. **A light ray from air is incident at one end of a glass fiber $\left(n = \frac{3}{2}\right)$ making an incidence angle of 60° on the lateral surface, so that it undergoes a total internal reflection. How much time would it take to transverse the straight fibre of length 1 km?**



(*a*) 6.67 μs (*b*) 5.77 μs (*c*) 3.85 μs (*d*) 3.33 μs

27. **The refractive index of glass is 1·520 for red light and 1·525 for blue light. Let D_1 and D_2 be angles of minimum deviation for red and blue light respectively in a prism of this glass, then**

(*a*) $D_1 < D_2$
(*b*) $D_1 = D_2$
(*c*) $D_1 > D_2$
(*d*) D_1 can be less or greater than D_2 depending on angle of prism.

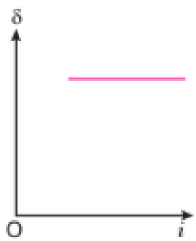
28. **A thin prism P_1 with angle 4° and made from a glass of refractive index 1·54 is combined with another prism P_2 made from a glass of refractive index 1·72 to produce dispersion without deviation. The angle of prism P_2 is**

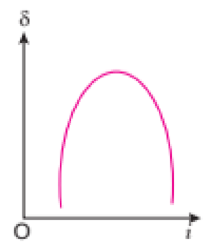
(*a*) 5.3° (*b*) 40° (*c*) 3° (*d*) 2.6°

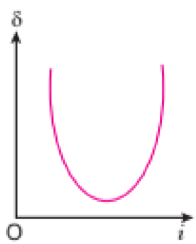
29. **A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The number of turns in the secondary in order to get output power at 230 V are**

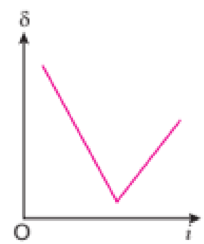
(*a*) 4 (*b*) 40 (*c*) 400 (*d*) 4000

30. **The graph between angle of deviation (δ) and angle of incidence (*i*) for a triangular prism is represented by**

(*a*)


(*b*)


(*c*)


(*d*)


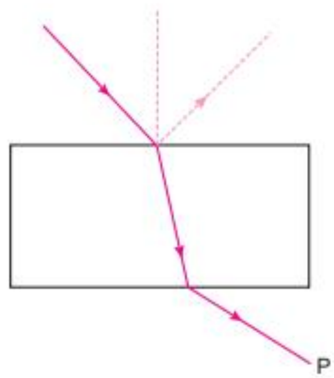
31. **A diverging lens with magnitude of focal length 25 cm is placed at a distance of 15 cm from a converging lens of magnitude of focal length 20 cm. A beam of parallel light falls on the diverging lens. The final image formed is**

(*a*) real and at a distance of 40 cm from convergent lens
(*b*) virtual and at a distance of 40 cm from convergent lens
(*c*) real and at a distance of 40 cm from the divergent lens
(*d*) real and at a distance of 6 cm from the convergent lens

32. **In a simple microscope of focal length 5 cm, final image is formed at the least distance of distinct vision, then its magnification will be**
(*a*) 6 (*b*) 5 (*c*) 2 (*d*) 1

33. **A cyclist is moving perpendicular to the principal axis at a distance of 10 m with a speed of 5 m/s in front of a convex lens of focal length 10 cm. The time of exposure of the lens if the image is displaced by 1 mm on the photo plate is**
(*a*) $\frac{1}{200}$ s (*b*) $\frac{1}{100}$ s (*c*) $\frac{1}{50}$ s (*d*) $\frac{1}{20}$ s

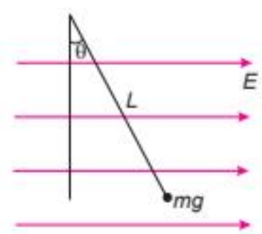
34. **Consider a light beam incident from air to a glass slab at Brewster's angle as shown in figure. A polaroid is placed in the path of the emergent ray at point P and rotated about an axis passing through the centre and perpendicular to the plane of the polaroid.**



(*a*) For a particular orientation there shall be darkness as observed through the polaroid.
(*b*) The intensity of light as seen through the polaroid shall be independent of the rotation.
(*c*) The intensity of light as seen through the polaroid shall go through a minimum but not zero for two orientations of the polaroid.
(*d*) The intensity of light as seen through the polaroid shall go through a minimum for four orientations of the polaroid.

35. **In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case**
(*a*) there shall be alternate interference patterns of red and blue.
(*b*) there shall be an interference pattern for red distinct from that for blue.
(*c*) there shall be no interference fringes.
(*d*) there shall be an interference pattern for red mixing with one for blue.

36. **A small object with charge q and weight mg is attached to one end of a string of length 'L' attached to a stationary support. The system is placed in a uniform horizontal electric field 'E', as shown in the accompanying figure. In the presence of the field, the string makes a constant angle θ with the vertical. The sign and magnitude of q is**



(*a*) positive with magnitude mg/E
(*b*) positive with magnitude $(mg/E)\tan\theta$
(*c*) negative with magnitude $mg/E \tan\theta$
(*d*) positive with magnitude $E\tan\theta/mg$

37. **Yellow light is used in a single slit diffraction experiment with slit width of 0·6 mm. If yellow light is replaced by *X*-rays, then the observed pattern will reveal**
(*a*) that the central maximum is narrower (*b*) more number of fringes
(*c*) less number of fringes (*d*) no diffraction pattern

38. **The theory, which can be explained on the basis of photoelectric effect is:**
(*a*) corpuscular theory (*b*) wave theory
(*c*) electromagnetic theory (*d*) quantum theory

39. If the kinetic energy of a moving particle of mass m is E, then the de-broglie wavelength is

(*a*) $h\sqrt{2mE}$

(*b*) $\frac{hE}{\sqrt{2m}}$

(*c*) $\frac{\sqrt{2mE}}{h}$

(*d*) $\frac{h}{\sqrt{2mE}}$

40. The de Broglie wavelength of an electron moving with a constant velocity is 0.367 nm. The mass of proton is 1835 times that of an electron. The de Broglie wavelength of a proton moving with the same velocity will be

(*a*) 0.2×10^{-12} m

(*b*) 0.3×10^{-12} m

(*c*) 0.4×10^{-12} m

(*d*) 0.5×10^{-12} m

41. Match the corresponding entries of Column A with Column B.

Column A		Column B	
(*i*)	Thermic emission.	(*p*)	Nature of metal and conditions of its surface.
(*ii*)	Photo electric effect	(*q*)	Quantum nature of radiation.
(*iii*)	Interference	(*r*)	Wave nature of radiation.
(*iv*)	Work functions	(*s*)	Removal of electrons when a metal surface is heated

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

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

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

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

42. A source S_1 is producing 10^{15} photons/second of wavelength 5000 Å. Another source S_2 is producing 1.02×10^{15} photons/second of wavelength 5100 Å. Then the ratio $\left(\frac{\text{Power of } S_2}{\text{Power of } S_1}\right)$ is

(*a*) 1.02 (*b*) 1.04 (*c*) 0.98 (*d*) 1.00

43. Paschen series of atomic spectrum of hydrogen gas lies in

(*a*) Infrared region

(*b*) Ultraviolet region

(*c*) Visible region

(*d*) Partly in ultraviolet and partly in visible region

44. A male voice after modulation-transmission sounds like that of a female to the receiver. The problem is due to

(*a*) poor selection of modulation index (selected $0 < m < 1$)

(*b*) poor bandwidth selection of amplifiers.

(*c*) poor selection of carrier frequency

(*d*) loss of energy in transmission

45. Activity of a radioactive sample decrease to $\left(\frac{1}{3}\right)$ of its original value in 3 days, then in 9 days its activity will become

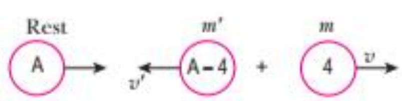
(*a*) $\frac{1}{18}$ of the original value

(*b*) $\frac{1}{9}$ of the original value

(*c*) $\frac{1}{27}$ of the original value

(*d*) $\frac{1}{3}$ of the original value

46. A nucleus of mass number A, originally at rest emits an α-particle with speed v. The daughter nucleus recoils with a speed:



(*a*) $\frac{2v}{A+4}$

(*b*) $\frac{4v}{A+4}$

(*c*) $\frac{2v}{A-4}$

(*d*) $\frac{4v}{A-4}$

47. In a semiconductor at room temperature

(*a*) the valence band is partially empty and the conduction band is partially filled

(*b*) the valence band is completely filled and the conduction band is partially filled

(*c*) the valence band is completely filled

(*d*) the conduction band is completely empty

48. Electrical conductivity of a semiconductor

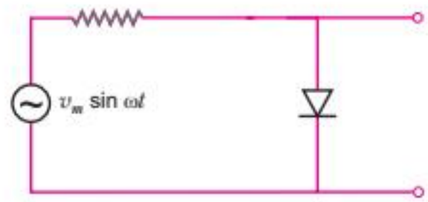
(*a*) decreases with the rise in its temperature

(*b*) increases with the rise in its temperature

(*c*) does not change with the rise in its temperature

(*d*) first increases and then decreases with the rise in its temperature

49. The output of the given circuit shown in figure.



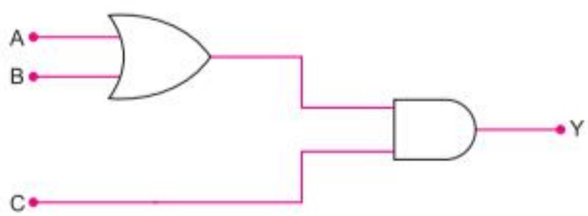
(*a*) would be zero at all times

(*b*) would be like a half wave rectifier with positive cycles in output

(*c*) would be like a half wave rectifier with negative cycles in output

(*d*) would be like that of a full wave rectifier

50. To get an output $Y=1$ from the circuit shown below, the input must be



	A	B	C
(*a*)	0	0	1
(*b*)	1	0	1
(*c*)	1	0	0
(*d*)	0	1	0

ANSWERS

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

SOLUTIONS

PRACTICE PAPER–2

1. (*a*) Force between two charges, $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$

When dielectric slab is introduced

$F' = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{r^2}$, Here $\varepsilon > \varepsilon_0$

$\Rightarrow \quad F' < F$

2. (*c*) Flux through whole cube $= \frac{q}{\varepsilon_0}$

through one surface $= \frac{q}{6\varepsilon_0} = \frac{q \times 10^{-6}}{6\varepsilon_0}$

3. (*c*) The work done by an electrostatic force is given by $W = q(\Delta V)$. Here initial and final potentials are same in all three cases and same charge is moved, so work done is same in all three cases.

4. (*d*) Since the positive charge is displaced against the electric field so the energy will be provided by external source in displacing the charge.

5. (*c*) A parallel plate capacitor can only store a finite amount of energy before dielectric breakdown occurs. The maximum energy that the capacitor can store is therefore,

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

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

11. (*b*) At balanced *WSB*,

$\frac{P}{Q} = \frac{R}{S} \Rightarrow \frac{10}{10} = \frac{10}{10}$

so, *I* across *CD* is zero.

Now, $\frac{1}{R_{AB}} = \frac{1}{R_{ACB}} + \frac{1}{R_{ADB}}$

$\frac{1}{20} + \frac{1}{20} = \frac{2}{20} = \frac{1}{10}$

$\therefore \quad R_{AB} = 10\ \Omega$

13. (*a*) Here, mass of wire, $m = 0.1 \times (3 \times 10^{-3})$ kg

In equilibrium position, $F = IlB = mg$

$\Rightarrow \quad B = \frac{mg}{Il} = \frac{(0.1 \times 3 \times 10^{-3}) \times 10}{5 \times 0.1} = 6 \times 10^{-3}\ \text{T}$

The weight is wire be supported by force F if it acts vertically upwards. It will be so if the direction of $\vec{B}$ is horizontal and perpendicular to wire carrying current.

$$E = \frac{1}{2}CV^2$$

$$E = \frac{1}{2}\frac{\varepsilon A}{d}(U_d d)^2 = \frac{1}{2}\varepsilon A d U_d^2 \quad \left[\because C = \frac{\varepsilon A}{d}\right]$$

6. (*c*) The positively charged particle experience electrostatic force along the direction of electric field, *i.e.*, from high electrostatic potential to low electrostatic potential. Thus, the work done by the electric field on the positive charge, hence potential energy of positive charge decreases.

7. (*d*) Statement-I is correct because the entire charge Q lies within a sphere of radius $r = 2R_0$.

II. For $r < R_0$, $|E| = \left|\frac{dV}{dr}\right| = 0$,

For $r < R_0$, $|E| = \left|\frac{dV}{dr}\right| = \frac{Q}{4\pi\varepsilon_0 r}$

Electric field is discontinuous at $r = R_0$.

The Statement-II is correct.

III. As V changes continuously for $r > R_0$, the Statement-III is wrong.

IV. For $r < R_0$, $E = 0$. Hence there is no electrostatic energy for $r < R_0$. the Statement-IV is correct.

8. (*c*) no current flows in the potentiometer wire at balance condition.

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

Also, $R \propto T$ (Temperature)

14. (*c*) As $\vec{F} = q(\vec{v}\times\vec{B})$

$$= -i(v\hat{i}\times B\hat{j}) = -ivB\,\hat{i}\times\hat{j}\,t = -ivB\hat{k}$$

Hence, electron travelling along X-direction experiences a force along negative Z-direction. So, its subsequent motion will be a circle in the XZ-plane.

15. (*d*) $|\vec{\tau}| = |\vec{m}\times\vec{B}| = mB\sin\theta = NI\times B\sin 60°$

[Angle between normal and the plane of lorp, $\theta = 60°$]

$$= 50\times 2\times(0.12\times 0.1)\times\frac{\sqrt{3}}{2} = 0.2\text{ Nm}$$

17. (*a*) $B = \mu_0 nI = 4\pi\times 10^{-7}\times 5\times 1000 = 2\pi\times 10^{-3}$ T

18. (*a*) Angle of dip,

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

where, $B_H = \sqrt{3}B_V$

So, $\tan\delta = \frac{B_V}{\sqrt{3}B_V} = \frac{1}{\sqrt{3}}$

$\therefore\ \delta = 30° = \frac{\pi}{6}$

19. (*d*) The small angle between magnetic axis and geographic axis at a place is called magnetic declination or angle of declination.

20. (*d*) According to Lenz's law,

When switch close, I_P increases then magnetic field lines increases,

$I_{Q_1} \rightarrow$ anticlock wise

When switch open, I_P decreases then magnetic field lines decreases,

$I_{Q_2} \rightarrow$ clock wise

22. (*c*) $V_{rms} = \sqrt{\frac{1}{T}\int_0^T V^2 dt}$

$$= \sqrt{\frac{1}{T}\int_0^{T/2} 10^2 dt + \int_{T/2}^{T}(-10)^2 dt}$$

$$= \sqrt{\frac{1}{T}\times 10^2\left(\int_0^{T/2} dt + \int_{T/2}^{T} dt\right)}$$

$$= \sqrt{\frac{1}{T}\times 10^2\left(\left(\frac{T}{2}-0\right)+\left(T-\frac{T}{2}\right)\right)}$$

$$= \sqrt{\frac{1}{T}\times 10^2\times T} = 10\text{ V}$$

23. (*d*) The primary coil is made up of a very thick copper wire to offer very less resistance,

$$\Rightarrow \quad A_2 = \frac{n_1 - 1}{n_2 - 1}A_1 = \frac{(1\cdot 54 - 1)}{(1\cdot 72 - 1)}\times 4° = 3°$$

29. (*c*) Given, $E_P = 2300$ V

$E_S = 230$ V

$N_P = 4000$

then, $\frac{E_P}{E_S} = \frac{N_P}{N_S}$

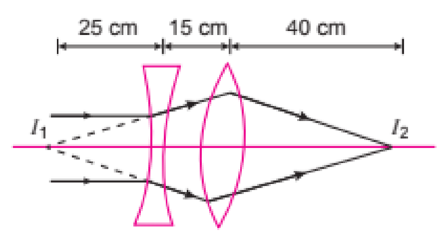
$\Rightarrow \frac{2300}{230} = \frac{4000}{N_S}$

$\Rightarrow N_S = 400$

So, number of turns in secondary are 400.

31. (*a*) As we know,

$f = -25$ cm, $f = 20$ cm



therefore negligible power loss due to primary coil as power, $P = i^2R$, since the resistance is very low, so the power loss is also very less.

24. (*a*) Current is reduced if voltage is stepped up so consequently I^2R (copper losses) are cut down.

25. (*c*) Dispersion takes place because the refractive index of refracting medium is different for different wavelengths.

26. (*b*) Speed of light in fiber,

$$v = \frac{c}{n} = \frac{3\times10^8}{1.5} = 2\times10^8 \text{ m/s}$$

Length of straight fiber = 1 km = 1000 m

Actual distance covered by light,

$$s = \frac{1000}{\sin 60°} = \frac{1000 \text{ m}}{\frac{\sqrt{3}}{2}} = \frac{2000}{\sqrt{3}} \text{ m}$$

or, time taken

$$t = \frac{s}{v} = \frac{2000}{\sqrt{3}\times2\times10^8} = 5.77\times10^{-6}\text{s} = 5.77\,\mu\text{s}$$

27. (*a*) Angle of minimum deviation for this prism,

$D = (n - 1)A$

As $n_b > n_r \Rightarrow D_b > D_r$

As $D_b = D_2$ and $D_r = D_1$

$\therefore D_1 < D_2$

28. (*c*) Condition fop dispersion without deviation by prism,

$$(n_1 - 1) A_1 = (n_2 - 1) A_2$$

For the parallel beam, the diverging lens forms a virtual image I_1 at 25 cm to its left (Concave lens)

For converging lens,

$$u = 25 + 15 = 40 \text{ cm} = 2f$$

So it forms a real image I_2 at 40 cm to its right (Convex lens).

32. (*a*) For simple microscope,

$$m = 1 + \frac{D}{f} = 1 + \frac{25}{5} = 6$$

33. (*c*) For a distant object, image is formed at second focus

For $u = -10$ m, $v = f = 0{\cdot}1$ m

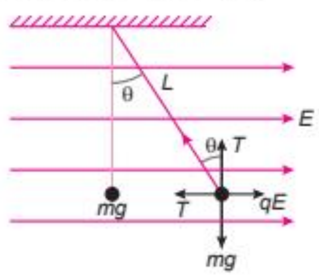
$$\frac{I}{O} = \frac{v}{u} \quad \Rightarrow \quad \frac{1\times10^{-3}}{5t} = \frac{0\cdot1}{10}$$

$$\Rightarrow \quad t = \frac{1\times10^{-3}\times10}{5\times0\cdot1} = \frac{1}{50}\text{s}$$

34. (*c*) When the light beam incident at Brewster's angle, the transmitted beam is unpolarised and reflected beam is polarised.

35. (*c*) For interference, source should be coherent and emits lights of same frequency and wavelength. In YDSE, when one of holes in covered by a red filter and another by blue. In this case, due to filtration only red and blue lights and present. Hence, there shall be no interference fringes.

36. (*b*) We know that, $T \cos\theta = mg$



$$T = \frac{mg}{\cos\theta} \qquad \ldots(i)$$

and $T \sin\theta = F_e$ $\qquad [F_e = qE]$

$T \sin\theta = qE$

$\Rightarrow mg \tan\theta = qE$

$$\therefore q = \left(\frac{mg}{E}\right)\tan\theta$$

Since q is displaced in the direction of $\vec{E}$, so, q must be positive.

44. (*b*) The frequency of male voice is less than that of a female voice. In the given problem, the frequency of modulated signal received becomes more which is possible with the poor band width selection of amplifiers. It is so because band width in amplitude modulation is equal to twice the frequency modulating signal.

45. (*c*) By radioactive decay law,

$N = N_0 e^{-\lambda t}$

when $t = 3$; $N = \frac{N_0}{3}$

$$\frac{N_0}{3} = N_0 e^{-3\lambda}$$

$$\Rightarrow e^{-3\lambda} = \frac{1}{3} \qquad \ldots(i)$$

Now when $t = 9$

$N = N_0 e^{-9\lambda}$

$N = N_0(e^{-3\lambda})^3$

37. (*d*) *X*-rays are invisible of very small wavelength $\lambda = 1$ Å, so that $\lambda << a$; and consequently no diffraction pattern results.

39. (*d*) Kinetic energy of moving electron,

$$E = \frac{1}{2}mv^2 \quad ...(i)$$

According to de Broglie wavelength,

$$\lambda = \frac{h}{mv} \quad ...(ii)$$

By equation (*i*) and (*ii*), we get,

$$\lambda = \frac{h}{\sqrt{2mE}}$$

40. (*a*) Using equation of de Broglie wavelength,

$$\lambda = \frac{h}{mv}$$

$$\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e} \Rightarrow \lambda_p = \frac{\lambda_e m_e}{m_p}$$

$$\therefore \lambda_p = \frac{0.367\, m_e}{1835\, m_e} = 0.2 \times 10^{-3} \text{ nm}$$

$$= 0.2 \times 10^{-12} \text{ m}$$

42. (*d*) As we know,

$$P = n\frac{hc}{\lambda} \propto \frac{n}{\lambda}$$

$$\frac{P_1}{P_2} = \frac{n_1}{n_2} \times \frac{\lambda_2}{\lambda_1} = \left(\frac{10^{15}}{1.02 \times 10^{15}}\right) \times \left(\frac{5,100}{5,000}\right) = 1$$

$$\Rightarrow \frac{P_2}{P_1} = 1$$

$$= N_0 \times \left(\frac{1}{3}\right)^3 \quad \text{[From (i)]}$$

$$\Rightarrow \frac{N}{N_0} = \frac{1}{27}$$

46. (*d*) According to law of conservation of linear momentum

$$4v = (A-4)v' \quad \Rightarrow \quad v' = \frac{4v}{A-4}$$

48. (*b*) As temperature increases energy band gap decreases which in turn increases the electrical conductivity of semiconductor.

49. (*c*) When diode is forward biased during positive half cycle of input *ac* voltage, the resistance of *p-n* junction is low. The current in the circuit is maximum. In this situation, a maximum potential difference will appear across resistance connected in series of circuit. This result into zero output voltage across *p-n* junction.

50. (*b*) Logic gate OR is used for addition of the input signals and logic gate AND is used for multiplication of the input signals. Hence, here inputs $A = 1, B = 0$ and $C = 1$ will get the output $Y = 1$.