PRACTICE PAPER

17

PHYSICS

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

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

Choose the correct option in the following questions.

1. What is the value of minimum force (in N)acting between two charges placed at 1 m apart from each other?

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

2. A glass rod acquires charge by rubbing it with silk cloth. The charge on glass rod is due to

(*a*) friction (*b*) conduction (*c*) induction (*d*) radiation

3. In the process of charging, the mass of the negatively charged body

(*a*) increases (*b*) decreases

(*c*) remains constant (*d*) none of the above

4. Charge on a body is integral multiple of $\pm e$. It is given by the law of

(*a*) conservation of charge (*b*) conservation of mass

(*c*) conservation of energy (*d*) quantisation of charge

5. The Coulomb field at a point is

(*a*) always continuous

(*b*) continuous if there is no charge at that point

(*c*) discontinuous only if there is a negative charge at that point

(*d*) continuous if there is a charge at that point

6. Two point charges *A* and *B*, having charges $+q$ and $-q$ respectively, are placed at certain distance apart and force acting between them is *F*. If 25% charge of *A* is transferred to *B*, then force between the charges becomes:

(*a*) F (*b*) $\frac{9F}{16}$ (*c*) $\frac{16F}{3}$ (*d*) $\frac{4F}{3}$

7. A parallel-plate capacitor has a plate area of 2 m^2 and a plate separation of 10 cm. It carries a charge of 8.85×10^{-10} C. The electric field is

(*a*) zero between the plates

(*b*) zero outside the plates

(*c*) different at different points between the plates

(*d*) 25 NC^{-1} between the plates

8. Drift velocity v_d varies with the intensity of electric field as per the relation

(*a*) $v_d \propto E$ (*b*) $v_d \propto \frac{1}{E}$ (*c*) v_d = constant (*d*) $v_d \propto E^2$

9. **Two wires of same material have length L and $2L$ and cross-sectional areas $4A$ and A respectively. The ratio of their specific resistance would be**

(*a*) 1 : 2 (*b*) 8 : 1 (*c*) 1 : 8 (*d*) 1 : 1

10. **Two bulbs each marked 100 W, 220 V are connected in parallel across 220 V supply. The power consumed by the combination will be**

(*a*) 200 W (*b*) 100 W (*c*) 50 W (*d*) zero

11. **A metal rod of length 10 cm and a rectangular cross-section of 1cm × $\frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be**

(*a*) maximum when the battery is connected across 1 cm × $\frac{1}{2}$ cm faces.

(*b*) maximum when the battery is connected across 10 cm × 1 cm faces.

(*c*) maximum when the battery is connected across 10 cm × $\frac{1}{2}$ cm faces.

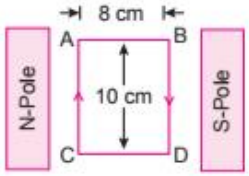
(*d*) same irrespective of the three faces.

12. **A constant voltage is applied between the two ends of a uniform metallic wire, heat 'H' is developed in it. If another wire of the same material, double the radius and twice the length as compared to original wire is used then the heat developed in it will be**

(*a*) $H/2$ (*b*) H

(*c*) $2H$ (*d*) $4H$

13. **A 100 turns coil shown in the figure carries a current of 2 A in a magnetic field of 0.2 Wb-m^{-2}. The torque acting on the coil is**



(*a*) 0.32 N-m tending to rotate the side AC out of the page

(*b*) 0.32 N-m tending to rotate the side AC into the page

(*c*) 0.64 N-m tending to rotate the side AC out of the page

(*d*) 0.64 N-m tending to rotate the side AC into the page

14. **Currents of 10 A and 2 A are flowing in opposite directions through two parallel wires A and B respectively. If the wire A is infinitely long and wire B is 2 m long, then force on wire B which is situated at 10 cm from A, is**

(*a*) 4×10^{-5} N (*b*) 8×10^{-5} N

(*c*) 6×10^{-5} N (*d*) 2×10^{-5} N

15. **An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?**

(*a*) The electron will be accelerated along the axis

(*b*) The electron path will be circular about the axis

(*c*) The electron will experience a force at 45° to the axis and hence execute a helical path

(*d*) The electron will continue to move with uniform velocity along the axis of the solenoid

16. **A sensitive magnetic instrument can be shielded very effectively from outside fields by placing it inside a box of**

(*a*) teak wood (*b*) plastic material

(*c*) soft iron of high permeability (*d*) a metal of high conductivity

17. Whenever the flux linked with a circuit changes, there is an induced emf in the circuit. This emf in the circuit lasts

(*a*) for a very short duration (*b*) for a long duration

(*c*) forever (*d*) as long as the magnetic flux in the circuit changes.

18. Self inductance of a coil delays

(*a*) the growth of current through it.

(*b*) the decay of current through it.

(*c*) both the growth and decay of current through it.

(*d*) neither the growth nor the decay of current through it.

19. Magnetic flux through a coil changes from 0.7 Wb to 0.2 Wb in 0.1 second. The induced emf developed in the coil is

(*a*) 7 V (*b*) 5 V (*c*) 20 V (*d*) 2 V

20. An alternating current generator has an internal resistance R_g and an internal reactance X_g. It is used to supply power to a passive load consisting of a resistance R_g and a reactance X_L. For maximum power to be delivered from the generator to the load, the value of X_L is equal to

(*a*) zero (*b*) X_g (*c*) $-X_g$ (*d*) R_g

21. If an *LCR* circuit contains $L = 8$ henry; $C = 0.5\ \mu F$, $R = 100\ \Omega$ in series. Then the resonant angular frequency will be

(*a*) 600 rad/s (*b*) 500 rad/s (*c*) 600 Hz (*d*) 500 Hz

22. When a voltage measuring device is connected to *ac* mains, the meter shows the steady input voltage of 220 V. This means

(*a*) input voltage cannot be *ac* voltage, but a *dc* voltage.

(*b*) maximum input voltage is 220 V.

(*c*) the meter reads not V but $<V^2>$ and is calibrated to read $\sqrt{<V^2>}$.

(*d*) the pointer of the meter is stuck by some mechanical defect.

23. In highly inductive load circuit, it is more dangerous when

(*a*) we close the switch (*b*) we open the switch

(*c*) increasing the resistance (*d*) decreasing the resistance

24. In an *ac* circuit, the emf (ε) and the current (i) at any instant are given by

$$\varepsilon = E_0 \sin \omega t,\ i = I_0 \sin(\omega t - \phi)$$

Then average power transferred to the circuit in one complete cycle of *ac* is

(*a*) $E_0 I_0$ (*b*) $\frac{1}{2} E_0 I_0$

(*c*) $\frac{1}{2} E_0 I_0 \sin\phi$ (*d*) $\frac{1}{2} E_0 I_0 \cos\phi$

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

Statement P : An alternating current of frequency 50 Hz becomes zero, 100 times in one second.

Statement Q : Alternating current changes direction and becomes zero twice in a cycle.

Select the most appropriate option:

(*a*) P is true, but Q is false (*b*) P is false, but Q is true

(*c*) Both P and Q are true (*d*) Both P and Q are false

26. A plane electromagnetic wave travelling along *X*-axis has a wavelength 10·0 mm. The electric field points along *Y*-direction and has peak value 30 V/m. Then the magnetic field in terms of x in metre and t in second may be expressed as

(*a*) $30 \sin 200\pi (ct - x)$ (*b*) $10^{-7} \sin 200\pi (ct - x)$

(*c*) $30 \sin \frac{2\pi}{10} (ct - x)$ (*d*) $10^{-7} \sin \frac{2\pi}{10} (ct - x)$

27. **An electromagnetic wave travelling in vacuum is described by**

(*a*) $E_0 k = B_0 \omega$ (*b*) $E_0 B_0 = \omega k$

(*c*) $E_0 \omega = B_0 k$ (*d*) $E_0 \omega^2 = B_0 k^2$

28. **Four lenses of focal length ± 15 cm and ± 150 cm are available for making a telescope. To produce the largest magnification, the focal length of the eyepiece should be**

(*a*) +15 cm (*b*) +150 cm (*c*) –150 cm (*d*) –15 cm

29. **The refractive index of glycerine with respect to air is 1.5 for normal light. The speed of light in glycerine is**

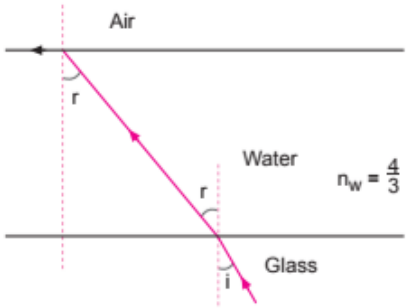
(*a*) 10^8 m/s (*b*) 2×10^8 m/s

(*c*) 3×10^8 m/s (*d*) 4.5×10^8 m/s

30. **If an object is placed unsymmetrically between two plane mirrors inclined at 70°, then the total number of images formed is**

(*a*) 5 (*b*) 4 (*c*) 3 (*d*) 1

31. **A ray of light is incident at the glass-water interface at an angle *i*, it emerges finally parallel to the surface of water, then the refractive index of glass n_g would be**



(*a*) $\frac{4}{3}\sin i$ (*b*) $\frac{1}{\sin i}$ (*c*) $\frac{4}{3}$ (*d*) 1

32. **Match the following in Column A with appropriate characteristics in Column B.**

Column A		Column B	
(*i*)	For a point charge	(*p*)	Electric field is cylindrically symmetric.
(*ii*)	For a dipole and a line charge	(*q*)	Only a torque but no net force.
(*iii*)	A dipole in a uniform electric field	(*r*)	Both a torque and a net force.
(*iv*)	A dipole in a non-uniform electric field	(*s*)	Electric field is spherically symmetric.

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

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

33. **In Young's double-slit experiment the slit separations is *d* and the wavelength of light used in λ. The maximum intensity is *I*. Then the angular position where the intensity becomes $\frac{I}{4}$ is**

(*a*) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ (*b*) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

(*c*) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$ (*d*) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

34. **A calcite crystal is placed over a dot on a piece of paper and rotated. On seeing through the calcite, one will see**

(*a*) two rotating dots (*b*) two stationary dots

(*c*) one dot only (*d*) one dot rotating about the other

35. **The angle of incidence at which reflected light is totally polarised for reflection from air to glass (refractive index n) is**

(*a*) $\sin^{-1}(n)$ (*b*) $\sin^{-1}\left(\frac{1}{n}\right)$

(*c*) $\tan^{-1}\left(\frac{1}{n}\right)$ (*d*) $\tan^{-1}(n)$

36. **A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometer from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of the light is 5000 Å, is of the order of**

(*a*) 0.5 m (*b*) 5 m

(*c*) 5 mm (*d*) 5 cm

37. **In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of**

(*a*) $\sin^{-1}\left(\frac{1}{4}\right)$ (*b*) $\sin^{-1}\left(\frac{2}{3}\right)$

(*c*) $\sin^{-1}\left(\frac{1}{4}\right)$ (*d*) $\sin^{-1}\left(\frac{3}{4}\right)$

38. **The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential is**

(*a*) 2 V (*b*) 4 V

(*c*) 6 V (*d*) 10 V

39. **A particle of mass m at rest decays into two masses m_1 and m_2 with non-zero velocities. The ratio of de Broglie wavelengths of the particles $\frac{\lambda_1}{\lambda_2}$ is**

(*a*) $\frac{m_2}{m_1}$ (*b*) $\frac{m_1}{m_2}$

(*c*) $\sqrt{\frac{m_1}{m_2}}$ (*d*) 1 : 1

40. **The energy of hydrogen atom in n^{th} orbit is E_n, then the energy in n^{th} orbit of single ionised helium atom will be**

(*a*) $4E_n$ (*b*) $\frac{E_n}{4}$

(*c*) $2E_n$ (*d*) $\frac{E_n}{2}$

41. **The ground state energy of hydrogen atom is –13.6 eV. What is the potential energy of the electron in the state?**

(*a*) 0 eV (*b*) –27.2 eV

(*c*) 1 eV (*d*) 2 eV

42. **In Bohr model of hydrogen atom, which of the following is quantised?**

(*a*) linear velocity of electron (*b*) angular velocity of electron

(*c*) linear momentum of electron (*d*) angular momentum of electron

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

Statement P : Bohr's postulate states that the stationary orbits are those for which the angular momentum is some integral multiple of $\frac{h}{2\pi}$.

Statement Q : Linear momentum of the electron in the atom is quantised.

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

44. **The equation $_{Z}X^{A} \longrightarrow {}_{Z+1}Y^{A} + {}_{-1}e^{0} + \bar{\nu}$ represents**

(*a*) β-decay (*b*) γ-decay

(*c*) fusion (*d*) fission

45. **During a mean life of a radioactive element the fraction that disintegrates is**

(*a*) e (*b*) $\frac{1}{e}$

(*c*) $\frac{e-1}{e}$ (*d*) $\frac{e}{e-1}$

46. **A nuclear reaction is given below. The masses in amu of reactant and product nuclei are given in brackets:**

$$\underset{(1.002)}{A} + \underset{(1.004)}{B} \longrightarrow \underset{(1.001)}{C} + \underset{(1.003)}{D} + Q\,(\text{MeV})$$

The value of energy Q is

(*a*) 1.234 MeV (*b*) 0.91 MeV (*c*) 0.465 MeV (*d*) 1.862 MeV

47. **The truth table shown here is for which of the following gates:**

Truth Table		
A	***B***	***Y***
1	**1**	**0**
1	**0**	**1**
0	**1**	**1**
0	**0**	**1**

(*a*) NAND (*b*) AND (*c*) XOR (*d*) NOT

48. **Which of the following is/are true?**

Digital signal

(*a*) provide a continuous set of values (*b*) represent values on discrete steps

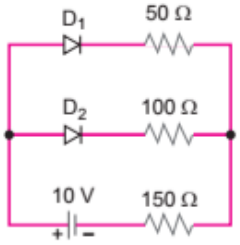
(*c*) can utilise only binary system (*d*) can utilise only decimal system

49. **When a forward bias is applied to a *p-n* junction, it**

(*a*) raises the potential barrier (*b*) reduces the majority carrier current to zero

(*c*) lowers the potential barrier (*d*) none of the above

50. **Assume that each diode shown in the figure has a forward bias resistance of 50 Ω and an infinite reverse bias resistance. The current through the 150 Ω resistance is**



(*a*) 0.66 A (*b*) 0.05 A (*c*) zero (*d*) 0.04 A

ANSWERS

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

SOLUTIONS

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1. (*a*) Smallest charge = $e = 1.6 \times 10^{-19}$

As charge is small force is minimum

$$F = \frac{k \times e \times e}{(1)^2} = ke^2$$

2. (*a*) As glass rod is rubbed with silk, so relative motion and friction comes to play.

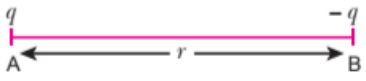
3. (*a*) A negatively charged body has more electrons than the neutral body and these excess electrons results in an increase in mass.

4. (*d*) Quantisation mean integral multiple of any smallest thing.

5. (*b*) Either positive or negative charges will interact with the lines of electric field to make the electric field discontinuous.

If there is no charge inside the electric field then the lines will not be affected. So, electric field becomes continuous.

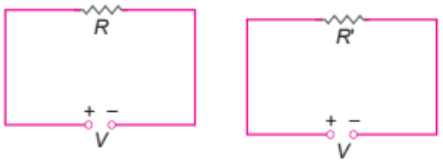
6. (*b*) $F = \dfrac{-kq^2}{r^2}$



$\because$ 25% charge from A is transferred to B, so,

$$q'_B = -q + \frac{q}{4} = \frac{-3q}{4}$$

12. (*c*)



$$R = \rho\frac{l}{A} = \rho\frac{l}{\pi r^2} \qquad R' = \rho\frac{2l}{\pi(2r)^2} = \rho\frac{2l}{4\pi r^2}$$

$$H = \frac{V^2}{R}t \qquad H' = \frac{V^2}{R'}t$$

$\because$ V = constant

$$\text{So, } \frac{H'}{H} = \frac{R}{R'} = \frac{\dfrac{\rho l}{\pi r^2}}{\rho\dfrac{2l}{4\pi r^2}} = \frac{2}{1}$$

$\therefore$ $H' = 2H$

13. (*a*) $\tau = NIAB \sin 90° = 100 \times 2 \times (80 \times 10^{-4}) \times 0.2$

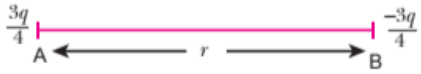
$= 0.32$ N–m

Hence, coil rotates with side AC into the page.

14. (*b*) Force on wise B is,

$$F = \frac{\mu_0 I_1 I_2 l}{2\pi r} = \frac{4\pi \times 10^{-7} \times 10 \times 2 \times 2}{2\pi \times 10 \times 10^{-2}}$$

$= 8 \times 10^{-5}$ N



So, $q'_A = \frac{3q}{4}, q'_B = \frac{-3q}{4}$

New force $(F') = \frac{k\left(\frac{3q}{4}\right)\left(\frac{-3q}{4}\right)}{r^2} = \frac{-9kq^2}{16r^2} = \frac{9F}{16}$

7. (*b*) Electric field outside the plates $= \frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} = 0$

Electric field inside the plates $= \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}$

$= \frac{\sigma}{\varepsilon_0} = \frac{q/A}{\varepsilon_0} = \frac{q}{A\varepsilon_0} = 50$ N/C

8. (*a*) $v_d = \frac{e}{m} \times \frac{V}{l}\tau$ or $v_d = \frac{e}{m} \cdot \frac{El}{l}\tau$ (Since $V = El$)

9. (*d*) Specific resistance doesn't depend upon length and area.

10. (*a*) In parallel, $P = P_1 + P_2 = 100 + 100 = 200$ W

11. (*a*) The resistance of wire depends on its geometry of wire/metallic rod. So, for greater value of R, l must be higher and A should be lower, *i.e.*, $R = \rho\frac{l}{A}$

15. (*d*) Magnetic Lorentz force, electron is projected with uniform velocity along the axis of a current carrying long solenoid $F = -eVB \sin 180° = 0$ and also $(\theta = 0°)$, as $\vec{B} \,||\, \vec{v}$. The electron will continue to move with uniform velocity along the axis of the solenoid.

17. (*d*) According to Faraday's law of EMI, emf is induced in the coil still whenever the magnetic flux is changing between coil and magnet.

19. (*b*) $e = -\frac{\Delta\phi}{\Delta t} = \frac{-(0.2 - 0.7)}{0.1} = \frac{0.5}{0.1} = 5$V

20. (*c*) According to maximum power transfer theorem, $X_L = -X_g$

21. (*b*) $\omega_r = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{8 \times 0.5 \times 10^{-6}}} = 500$ rad/s

22. (*c*) The voltmeter connected to AC mains reads mean $(< V^2 >)$ and is calibrated in such a way that it gives value of $< V^2 >$, which is multiplied by firm factor to give rms value.

23. (*b*) When just open the switch, more quickly current changes gives higher the voltage in the circuit.

24. (*d*) $P_{av} = E_{rms} I_{rms} \cos\phi = \frac{E_0}{\sqrt{2}} \times \frac{I_0}{\sqrt{2}} \cos\phi$

$$= \frac{1}{2} E_0 I_0 \cos\phi$$

26. (*b*) As we know,

$$B_0 = \frac{E_0}{c} = \frac{30}{3\times10^8} = 10^{-7}\ \text{T}$$

Also, $\frac{2\pi}{\lambda} = \frac{2\pi}{10.0\times10^{-3}} = 200\,\pi$

$\therefore \quad B = B_0 \sin 200\,\pi(ct - x)$

$= 10^{-7} \sin 200\,\pi(ct - x)$

27. (*a*) $E_x = E_0 \sin(\omega t - kx)$, $B_y = B_0 \sin(\omega t - kx)$

Also, $\frac{E_0}{B_0} = c = \frac{\omega}{k} \Rightarrow E_0 k = B_0 \omega$,

k = propagation constant.

28. (*a*) For making telescope, lenses should be convex and objective has large focal length and eyepiece has small focal length. Hence, focal length of eyepiece should be +15 cm.

29. (*b*) Absolute refractive index,

$$n = \frac{c}{v} \Rightarrow 1.5 = \frac{3\times10^8}{v}$$

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

30. (*a*) Number of images formed in inclined mirror

$$= \frac{360}{\theta} = \frac{360}{70} = 5\ \text{(whole number)}$$

31. (*b*) From Snell's law, $n \sin i$ = constant

For glass and air media,

$$n_1 \sin i_1 = n_2 \sin i_2$$

$$\Rightarrow \quad n_g \sin i = 1 \times \sin 90° \Rightarrow \quad n_g = \frac{1}{\sin i}$$

33. (*c*) Maximum intensity = I

Intensity due to one slit = $\frac{I}{4}$

$$\frac{I}{4} = I\cos^2\frac{\phi}{2}$$

34. (*d*) Calcite crystal is doubly refracting; the light transmitted through calcite crystal consists of two rays. The image of dot due to ordinary ray remains stationary while that due to extraordinary ray rotates about stationary dot.

35. (*d*) Polarising angle, $i = \tan^{-1}(n)$, (Brewster's law)

36. (*c*) We know,

Resolving power = $\theta = \frac{d}{D}$, also, $\theta = \frac{\lambda}{a}$

Then,

$$d = \theta D = \frac{\lambda}{a} D = \frac{5\times10^{-7}\times10^3}{0\cdot1}$$

$$= 5 \times 10^{-3}\ \text{m} = 5\ \text{mm}$$

37. (*d*) The condition for first minimum is

$$a \sin\theta = \lambda$$

$$\Rightarrow \quad a \sin 30° = \lambda$$

$$\Rightarrow \quad a = 2\lambda$$

The condition for first secondary maximum is

$$a \sin\theta_1 = \frac{3\lambda}{2}$$

$$\Rightarrow \quad \sin\theta_1 = \frac{3\lambda}{2a} = \frac{3\lambda}{2\times2\lambda} = \frac{3}{4}$$

$$\therefore \quad \theta_1 = \sin^{-1}\left(\frac{3}{4}\right)$$

38. (*b*) As we know, $\text{K.E}_{max} = eV_0$

$$\therefore \quad V_0 = \frac{K.E_{max}}{e} = \frac{4\,eV}{e} = 4\text{V}.$$

39. (*d*) Two emitted particles will have equal and opposite momentum, so $\lambda = \frac{h}{p}$ = same

40. (*a*) For hydrogen like atom/ions,

$$E_n' = Z^2 E_n \qquad \left[\because\ E_n \propto \frac{Z^2}{n^2}\right]$$

For helium, $Z = 2$

$$E_n' = 4E_n$$

41. (*b*) $PE = 2 \times$ Total energy

$= 2 \times (-13.6)$

PHYSICS

$$= \frac{1}{2} E_0 I_0 \cos\phi$$

26. (*b*) As we know,

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Also, $\frac{2\pi}{\lambda} = \frac{2\pi}{10.0\times10^{-3}} = 200\,\pi$

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28. (*a*) For making telescope, lenses should be convex and objective has large focal length and eyepiece has small focal length. Hence, focal length of eyepiece should be +15 cm.

29. (*b*) Absolute refractive index,

$$n = \frac{c}{v} \Rightarrow 1.5 = \frac{3\times10^8}{v}$$

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

30. (*a*) Number of images formed in inclined mirror

$$= \frac{360}{\theta} = \frac{360}{70} = 5\ \text{(whole number)}$$

31. (*b*) From Snell's law, $n \sin i$ = constant

For glass and air media,

$$n_1 \sin i_1 = n_2 \sin i_2$$

$$\Rightarrow \quad n_g \sin i = 1 \times \sin 90° \Rightarrow \quad n_g = \frac{1}{\sin i}$$

33. (*c*) Maximum intensity = I

Intensity due to one slit = $\frac{I}{4}$

$$\frac{I}{4} = I\cos^2\frac{\phi}{2}$$

$$\phi = \frac{2\pi}{3}$$

Path difference = $\frac{\lambda}{2\pi}\times\frac{2\pi}{3} = \frac{\lambda}{3}$

Angular position is given by

$$d\sin\theta = \frac{\lambda}{3}$$

$$\Rightarrow \quad \sin\theta = \left(\frac{\lambda}{3d}\right)$$

$$\Rightarrow \quad \theta = \sin^{-1}\left(\frac{\lambda}{3d}\right)$$

34. (*d*) Calcite crystal is doubly refracting; the light transmitted through calcite crystal consists of two rays. The image of dot due to ordinary ray remains stationary while that due to extraordinary ray rotates about stationary dot.

35. (*d*) Polarising angle, $i = \tan^{-1}(n)$, (Brewster's law)

36. (*c*) We know,

Resolving power = $\theta = \frac{d}{D}$, also, $\theta = \frac{\lambda}{a}$

Then,

$$d = \theta D = \frac{\lambda}{a} D = \frac{5\times10^{-7}\times10^3}{0\cdot1}$$

$$= 5 \times 10^{-3}\ \text{m} = 5\ \text{mm}$$

37. (*d*) The condition for first minimum is

$$a\sin\theta = \lambda$$

$$\Rightarrow \quad a\sin 30° = \lambda$$

$$\Rightarrow \quad a = 2\lambda$$

The condition for first secondary maximum is

$$a\sin\theta_1 = \frac{3\lambda}{2}$$

$$\Rightarrow \quad \sin\theta_1 = \frac{3\lambda}{2a} = \frac{3\lambda}{2\times2\lambda} = \frac{3}{4}$$

$$\therefore \quad \theta_1 = \sin^{-1}\left(\frac{3}{4}\right)$$

38. (*b*) As we know, $\text{K.E}_{max} = eV_0$

$$\therefore \quad V_0 = \frac{K.E_{max}}{e} = \frac{4\,eV}{e} = 4\text{V}.$$

39. (*d*) Two emitted particles will have equal and opposite momentum, so $\lambda = \frac{h}{p}$ = same

40. (*a*) For hydrogen like atom/ions,

$$E_n' = Z^2 E_n \qquad \left[\because\ E_n \propto \frac{Z^2}{n^2}\right]$$

For helium, $Z = 2$

$$E_n' = 4E_n$$

41. (*b*) $PE = 2 \times$ Total energy

$= 2 \times (-13.6)$

$= -27.2$ eV

42. (*d*) In Bohr model of hydrogen atom, angular momentum of electron is quantised.

43. (*a*) According to Bohr's postulate, the stationary orbits are those orbits in which angular momentum of electron is an integral multiple of $\frac{h}{2\pi}$.

i.e., $L = mvr = \frac{nh}{2\pi}$, $n = 1, 2, 3, \ldots$.

44. (*a*) Antinuetrino released, so it's nuclear reaction belong to β^-– decay process.

45. (*c*) $N = N_0 e^{-\lambda t}, \tau = \frac{1}{\lambda}$

Then, $N = N_0 e^{-\lambda \times \frac{1}{\lambda}} = N_0 e^{-1}$

So, fraction disintegrated;

$$1 - \frac{N}{N_0} = 1 - e^{-1} = \frac{e-1}{e}$$

46. (*d*) $Q = [m_A + m_B - (m_C + m_D)] \times c^2$

$= (2.006 - 2.004) \times 931$ MeV

$= 1.862$ MeV.

47. (*a*) From given truth table,

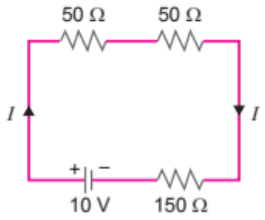
$Y = \overline{A.B}$

It behave like a NAND gate.

48. (*c*) In full wave rectifier, the fundamental frequency in ripple is twice that of input frequency.

49. (*c*) Lowers the potential barrier due to narrowing of depletion layer.

50. (*d*) Diode D_1 is forward biased and offers 50 Ω resistance. Diode D_2 is reverse biased and offers infinite resistance. The equivalent circuit is



Current through the 150 Ω resistance,

$$I = \frac{10}{50 + 50 + 150} = \frac{10}{250} = 0.04 \text{ A}$$