# PRACTICE PAPER 19

PHYSICS

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

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

***Choose the correct option in the following questions.***

1. **When the distance between two charged particles is halved, the Coulomb force between them becomes**
(*a*) one-half (*b*) one-fourth (*c*) double (*d*) four times.

2. **Two charges are at distance $d$ apart in air. Coulomb force between them is $F$. If a dielectric material of dielectric constant $K$ is placed between them, the Coulomb force now becomes**
(*a*) $F/K$ (*b*) $FK$ (*c*) $F/K^2$ (*d*) $K^2F$

3. **Which physical quantity have unit newton /coulomb?**
(*a*) Electric charge (*b*) Electric field
(*c*) Electric force (*d*) Electric potential

4. **Electric field lines contracts lengthwise, It shows**
(*a*) repulsion between same charges
(*b*) attraction between opposite charges
(*c*) no relation between force & contraction
(*d*) electric field lines does not move in straight path

5. **The electric flux emerging out from 1C charge is**
(*a*) $\frac{1}{\varepsilon_0}$ (*b*) $4\pi$ (*c*) $\frac{4\pi}{\varepsilon_0}$ (*d*) $\varepsilon_0$

6. **A charge $Q$ is supplied to a metallic conductor. Which of the following is correct?**
(*a*) More in case of sphere (*b*) More in case of cube
(*c*) Same in both cases (*d*) Information incomplete

7. **The capacitors of capacitances $C_1$ and $C_2$ are connected in parallel. If a charge $Q$ is given to the combination, the ratio of the charge on the capacitor $C_1$ to the charge on $C_2$ will be**
(*a*) $\frac{C_1}{C_2}$ (*b*) $\sqrt{\frac{C_1}{C_2}}$
(*c*) $\sqrt{\frac{C_2}{C_1}}$ (*d*) $\frac{C_2}{C_1}$

8. **Drift velocity of electrons in a conductor is of the order of**
(*a*) a few millimeters per second (*b*) a few meters per second
(*c*) a few kilometers per second (*d*) $3 \times 10^{10}$ cms$^{-1}$

9. **Two bulbs one of 50 watts and another of 25 watts are connected in series to the mains. The ratio of the current through them is**
(*a*) 1 : 1 (*b*) 1 : 2 (*c*) 2 : 2 (*d*) 1 : 4

**10.** **The electric current in a conductor varies with time $t$ as $I = 2t + 3t^2$, where $I$ is in ampere and $t$ in seconds. Electric charge flowing through a section of the conductor during $t = 2$ s to $t = 3$ s is**

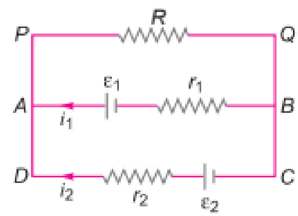
(*a*) 10 C (*b*) 24 C (*c*) 33 C (*d*) 44 C

**11.** **According to Joule's law, if potential difference across a conductor of material of resistivity ρ remains constant, then heat produced in the conductor is directly proportional to**

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

(*c*) $\rho^{-1}$ (*d*) $\rho^2$

**12.** **See the electrical circuit shown in fig. Which one of the following is the correct equation for it?**

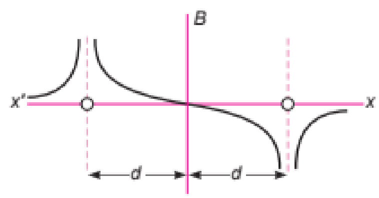



(*a*) $\varepsilon_2 - i_2r_2 - \varepsilon_1 - i_1r_1 = 0$ (*b*) $-\varepsilon_2 - (i_1 + i_2) R + i_2r_2 = 0$

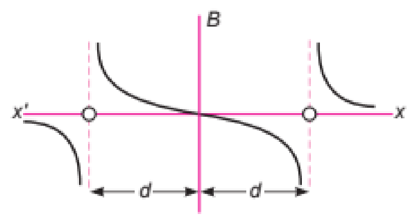
(*c*) $\varepsilon_1 - (i_1 + i_2) R + i_1r_1 = 0$ (*d*) $\varepsilon_1 - (i_1 + i_2) R - i_1r_1 = 0$

**13.** **Two long parallel wires are at a distance $2d$ apart. They carry steady currents flowing out of the plane of paper as shown. The variation of the magnetic field B along the line X'X is given by**

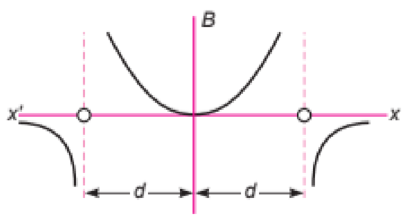
(*a*)



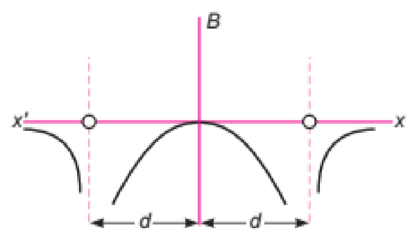

(*b*)




(*c*)




(*d*)




**14.** **A charged particle moves through a magnetic field perpendicular to its direction. Then**

(*a*) both momentum and kinetic energy of the particles are not constant
(*b*) both momentum and kinetic energy of the particles are constant
(*c*) kinetic energy changes but momentum remains constant
(*d*) momentum changes but kinetic energy remains constant

**15.** **When a straight conductor is carrying an electric current**

(*a*) there are circular magnetic lines of force around it.
(*b*) there are no magnetic lines of force near it.
(*c*) there are magnetic lines of force parallel to conductor along the direction of current.
(*d*) there are magnetic lines of force parallel to conductor opposite to the direction of current.

**16.** **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

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

**Statement P** : Susceptibility is defined as the ratio of intensity of magnetisation $I$ to magnetic intensity $H$.

**Statement Q** : Greater the value of susceptibility, smaller the value of intensity of magnetisation $I$.

**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

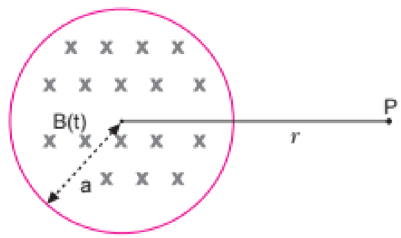
**18. Which of the following units denotes the dimensions $\frac{ML^2}{Q^2}$, where $Q$ denotes the electric charge?**

(*a*) $Wb/m^2$
(*b*) henry (H)
(*c*) $H/m^2$
(*d*) weber (Wb)

**19. Two co-axial solenoids are made by winding insulated wire over a pipe of cross-sectional area $A = 10\ cm^2$ and length $l = 10$ cm. If one solenoid has 300 turns and the other 400 turns, their mutual inductance is :**

(*a*) $4{\cdot}8\ \pi \times 10^{-5}$ H
(*b*) $2{\cdot}4\ \pi \times 10^{-4}$ H
(*c*) $2{\cdot}4\ \pi \times 10^{-5}$ H
(*d*) $4{\cdot}8\ \pi \times 10^{-4}$ H

**20. A uniform but time varying magnetic field $B(t)$ exists in a circular region of radius '$a$' and is directed into the plane of paper as shown. The magnitude of the induced electric field at point $P$ at a distance $r$ from the centre of the circular region:**




(*a*) is zero
(*b*) decreases as $1/r$
(*c*) increases as $r$
(*d*) decreases as $1/r^2$

**21. A 20 volt AC is applied to a circuit consisting of a resistance and a coil with negligible resistance. If the voltage across the resistance is 12 volt, the voltage across the coil is**

(*a*) 16 V
(*b*) 10 V
(*c*) 8 V
(*d*) 6 V

**22. Match the following in Column A with Column B.**

| | Column A | | Column B |
|---|---|---|---|
| (*i*) | Reactance of a series RLC-circuit at resonance | (*p*) | Voltages across L and C are 180° out of phase |
| (*ii*) | For a series LC-circuit | (*q*) | Currents in L and C are 180° out of phase |
| (*iii*) | For a parallel LC-circuit | (*r*) | minimum |
| (*iv*) | Reactance of a capacitor in a DC circuit | (*s*) | infinite |

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

**23. Reactance of a capacitor of capacitance $C$ for an alternating current of frequency $\frac{400}{\pi}$ Hz is 25 Ω. The value of $C$ is**

(*a*) 25 μF
(*b*) 50 μF
(*c*) 75 μF
(*d*) 100 μF

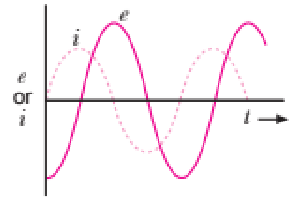
**24. In an *ac* circuit, voltage $V$ and current $i$ are given by**

$$V = 100 \sin 100\,t \text{ volt}$$
$$i = 100 \sin (100t + \pi/3) \text{ mA}$$

**The power dissipated in the circuit is**

(*a*) $10^4$ W
(*b*) 10 W
(*c*) 2.5 W
(*d*) 5 W

**25.** **When an ac source of emf, $e = E_0 \sin 100t$ is connected across a circuit, the phase difference between emf and the current in the circuit is observed to be $\pi/4$ as shown in figure. If the circuit consists possibly $RC$ or $RL$ or $LC$ in series, the relationship between the two elements is.**




(a) $R = 1\ k\Omega$, $C = 10\ \mu F$
(b) $R = 1\ k\Omega$, $C = 1\ \mu F$
(c) $R = 1\ k\Omega$, $L = 10$ H
(d) $R = 1\ k\Omega$, $L = 1$ H

**26.** **Which of the following electromagnetic wave in order of increasing frequency.**

(a) Microwave < Infrared < Ultraviolet < $\gamma$-rays
(b) $\gamma$-rays < Ultraviolet < Infrared < Microwave
(c) Ultraviolet < Infrared < Microwave < $\gamma$-rays
(d) $\gamma$-rays < Microwave < Infrared < Ultraviolet

**27.** **The ratio of velocity of the two light waves of wavelengths 4000 Å and 8000 Å travelling in vacuum will be**

(a) 1 : 2 (b) 2 : 1 (c) 1 : 1 (d) None

**28.** **Electromagnetic wave of wavelength 1500 nm lies in which region of the spectrum?**

(a) Radiowave (b) Microwave (c) Infrared (d) Ultraviolet

**29.** **When an object is placed in front of a convex lens of focal length $f$, a virtual image with magnification 2 is formed. Then the object distance is**

(a) $2f/3$ (b) $f/2$ (c) $f/3$ (d) $f/4$

**30.** **The critical angle of a transparent slab is 30°. The refractive index of the material of the slab is :**

(a) 2 (b) 0.5 (c) 1.6 (d) 0.866

**31.** **The angle of a prism is 60°. The angle of refraction for a ray passing through it in minimum deviation position is**

(a) 30° (b) 45° (c) 60° (d) 75°

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

**Statement P** : A ray of light is incident from outside on a glass sphere surrounded by air. This ray may suffer total internal reflection at second interface.

**Statement Q** : If a ray of light goes from denser to rarer medium, it bends away from the normal.

**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

**33.** **Unpolarized light is incident on a plane glass surface having refractive index $\sqrt{3}$. The angle of incidence at which reflected and refracted rays would become perpendicular to each other is**

(a) 15° (b) 30° (c) 45° (d) 60°

**34.** **An unpolarised beam of intensity $I_0$ is incident on a pair of nicol prism making an angle of 60° with each other. The intensity of light emerging from the pair is**

(a) $I_0$ (b) $I_0/2$ (c) $I_0/4$ (d) $I_0/8$

**35.** **In Young's double slit experiment, the separation of the two slits is doubled. To keep the same spacing of fringes, the distance $D$ of the screen from the slits should be made**

(a) $\frac{D}{2}$ (b) $\frac{D}{\sqrt{2}}$ (c) $2D$ (d) $4D$

**36.** **The phenomenon of polarization is exhibited by**

(a) longitudinal wave (b) matter wave (c) transverse wave (d) mechanical wave

**37.** **The phase difference between two waves at the place of constructive interference is given as a**

(a) multiple of $\pi$ (b) multiple of $(2n - 1)\pi$ (c) even multiple of $\pi$ (d) odd multiple of $\pi$

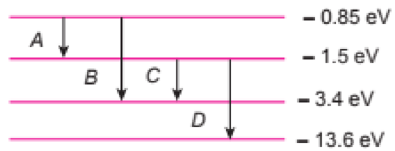
38. **The path difference between two waves at the place of destructive interference is given by**
(*a*) multiple of $\lambda$ (*b*) multiple of $\lambda/2$ (*c*) even multiple of $\lambda/2$ (*d*) odd multiple of $\lambda/2$

39. **The photoelectric effect occurs only when the incident light has more than a certain minimum**
(*a*) frequency (*b*) wavelength (*c*) velocity (*d*) charge

40. **The threshold wavelength for a metal having work function $\phi_0$ is $\lambda_0$, what is the threshold wavelength for a metal whose work function is $\frac{\phi_0}{2}$?**
(*a*) $4\lambda_0$ (*b*) $2\lambda_0$ (*c*) $\lambda_0/2$ (*d*) $\lambda_0/4$

41. **The electric potential between a proton and an electron is given by $V = V_0 \log_e \frac{r}{r_0}$ where $r_0$ is a constant. Assuming Bohr's model to be applicable, the variation of $r_n$ with principal quantum number $n$ is represented as:**
(*a*) $r_n \propto n$ (*b*) $r_n \propto \frac{1}{n}$ (*c*) $r_n \propto n^2$ (*d*) $r_n \propto \frac{1}{n^2}$

42. **The energy level diagram of an element is given below. The transition that corresponds to the emission of a spectral line of wavelength 102.7 nm is**




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

43. **Kinetic energy of electron in hydrogen atom is**
(*a*) $\frac{e^2}{4\pi\varepsilon_0 r}$ (*b*) $\frac{e^2}{3\pi\varepsilon_0 r}$ (*c*) $\frac{e^3}{8\pi\varepsilon_0 r}$ (*d*) $\frac{e^2}{8\pi\varepsilon_0 r}$

44. **A triply ionized beryllium ($Be^{3+}$) has the same orbital radius as the ground state of hydrogen. Then the quantum state $n$ of $Be^{3+}$ is**
(*a*) $n = 1$ (*b*) $n = 2$ (*c*) $n = 3$ (*d*) $n = 4$

45. **In case of frequency modulation, which of the following statement is correct?**
(*a*) Amplitude of carrier wave varies in accordance with that of modulating signal.
(*b*) Frequency of carrier wave is less than that of modulating signal.
(*c*) Frequency of carrier wave is equal to that of modulating signal.
(*d*) Frequency of carrier wave varies in accordance with the amplitude of the modulating signal

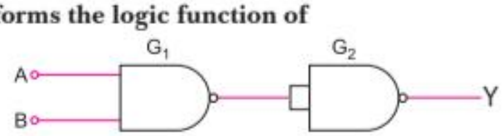
46. **When a radioactive nucleus emits a $\beta$-particle, the mass number of the atom**
(*a*) increases by one (*b*) remains the same (*c*) decreases by one (*d*) decreases by four

47. **$\beta$-rays emitted by a radioactive material are**
(*a*) electro-magnetic radiations (*b*) the electrons orbiting around the nucleus
(*c*) charged particles emitted by nucleus (*d*) neutral particles

48. **The energy gap between the valence and conduction bands of a substance is 1 eV. The substance is a**
(*a*) conductor (*b*) semiconductor (*c*) insulator (*d*) superconductor

49. **A *p-n* photodiode is made of a material with a band gap of 2.0 eV. The minimum frequency of the radiation that can be absorbed by the material is nearly**
(*a*) $10 \times 10^{14}$ Hz (*b*) $5 \times 10^{14}$ Hz (*c*) $1 \times 10^{14}$ Hz (*d*) $20 \times 10^{14}$ Hz

50. **The following diagram performs the logic function of**




(*a*) XOR gate (*b*) AND gate (*c*) NAND gate (*d*) OR gate

PHYSICS

# ANSWERS

## PRACTICE PAPER – 19

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

# SOLUTIONS

## PRACTICE PAPER—19

1. (*d*) By Coulomb's law, $F \propto \frac{1}{d^2}$

$$\therefore \quad \frac{F}{F'} = \left(\frac{d/2}{d}\right)^2 \quad \Rightarrow \quad F' = 4F$$

2. (*a*) In air, $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{d^2}$ ...(1)

In material, $F' = \frac{1}{4\pi\varepsilon_0 K}\frac{q_1 q_2}{d^2}$ ...(2)

Dividing equation (1) and (2)

$$\frac{F'}{F} = \frac{1}{K} \Rightarrow F' = \frac{F}{K}$$

3. (*b*) As $E = \frac{F}{q}$; unit = N/C

4. (*b*) Electric field lines initiate from positive charge and terminate on negative charge, hence they got contracted length wise, this is the indication of force of attraction of force between unlike charges.

5. (*a*) Electric flux = $\frac{Q_{enclosed}}{\varepsilon_0}$

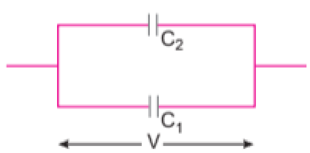
$Q_{enclosed} = 1$ C

$$\therefore \quad \phi = \frac{1}{\varepsilon_0}$$

6. (*c*) In all conductors charge is same.

7. (*a*) Potential difference across $C_1$ = V

Potential difference across $C_2$ = V




$$V = \frac{Q}{C}$$

$$\frac{Q_1}{C_1} = \frac{Q_2}{C_2} \Rightarrow \frac{Q_1}{Q_2} = \frac{C_1}{C_2}$$

9. (*a*) In series current is same.

10. (*b*) $I = \frac{dq}{dt} \Rightarrow q = \int_2^3 I\,dt = \int_2^3 (2t + 3t^2)\,dt$

$$= \left[\frac{2t^2}{2} + \frac{3t^3}{3}\right]_2^3 = [t^2 + t^3]_2^3$$

$$= [(3)^2 + (3)^3] - [(2)^2 + (2)^3] = 24 \text{ C}$$

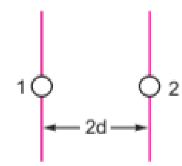
11. (*c*) $Q = \frac{V^2}{R}t = \frac{V^2}{(\rho l / A)}t \propto \frac{1}{\rho}$

12. (*d*) Applying Kirchhoff's law in mesh *ABQPA*

$-\varepsilon_1 + i_1 r_1 + (i_1 + i_2) R = 0$

$\Rightarrow \quad \varepsilon_1 - (i_1 + i_2) R - i_1 r_1 = 0$

13. (*b*) By Maxwell right hand rule the magnetic field to the loop of wire '1' will be downward and to the right of wire '2' it is upward $\left(B \propto \frac{1}{r}\right)$. On the right of wire '1' it is upward and on the left of wire '2' it is downward. The field between the two wires at the centre is zero




14. (*d*) Magnetic force changes the direction of particle, so momentum of particle changes.

15. (*a*) According to right hand thumb rule, there are concentric circular magnetic field lines around it.

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

19. (*d*) Mutual inductance of two solenoid system,

$$M = \mu_0\left(\frac{N_1}{l}\right)N_2 A$$

$$= 4\pi \times 10^{-7}\left(\frac{300}{0 \cdot 10}\right) \times 400 \times 10 \times 10^{-4} \text{ H}$$

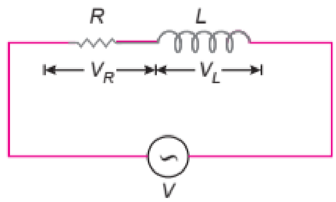
$= 4.8\,\pi \times 10^{-4}$ H

**20.** (*b*) If $E$ is electric field induced at distance $r$, then

$$E\,2\pi r = \frac{d}{dt}\{AB\,(t)\} = \pi a^2 \frac{dB}{dt}(t)$$

$$\Rightarrow \quad E = \frac{a^2}{2r}\frac{dB}{dt}(t) \propto \frac{1}{r}$$

**21.** (*a*) $V$ = Effective voltage supply = 20 V




$V_R$ = Effective voltage across $R$ = 12 V

$V_L$ = Effective voltage across $L$

Now, $\quad V = \sqrt{V_R^2 + V_L^2}$

$$\Rightarrow \quad 20 = \sqrt{(12)^2 + V_L^2}$$

$$\Rightarrow \quad (20)^2 = 144 + V_L^2$$

$$\therefore \quad V_L = \sqrt{400-144} = \sqrt{256} = 16 \text{ V}$$

**23.** (*b*) $X_C = \dfrac{1}{2\pi f C} = \dfrac{1}{2\pi\left(\dfrac{400}{\pi}\right)C} \Rightarrow C = \dfrac{1}{2\times 400\times 25}$

$= 50\,\mu$F

**24.** (*c*) $P_{av} = \dfrac{1}{2}V_0 I_0 \cos\phi$

$$= \frac{1}{2}\times 100\times 100\times 10^{-3}\times \cos\frac{\pi}{3} = 2.5 \text{ W}$$

**25.** (*c*) In given figure current is leading applied voltage by $\dfrac{\pi}{4}$, so circuit may be *RL* or *RLC* circuit. Out of given circuits the possible circuit is *RL* circuit.

Also $\tan\phi = \dfrac{\omega L}{R}$

$$\tan 45° = \frac{100\,L}{R} \quad \Rightarrow \quad R = 100\,L$$

**26.** (*a*) Microwave < Infrared < Ultraviolet < $\gamma$-rays

**27.** (*c*) In vacuum, the light waves travel with a constant velocity *i.e.*, $3 \times 10^8$ m/s, irrespective of the wavelengths and frequency. So, the ratio of the two velocities of the wavelengths is 1 : 1.

**28.** (*c*) For infrared wavelength range is approximately $7.8 \times 10^{-7}$ m to $1.1 \times 10^{-3}$ m.

**29.** (*b*) For magnification, $m = +2$ (Virtual image)

$$m = \frac{v}{u} \;\Rightarrow\; 2 = \frac{v}{u} \;\Rightarrow\; v = 2u$$

Using lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \;\Rightarrow\; \frac{1}{f} = \frac{1}{2u} - \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{f} = \frac{1-2}{2u} = \frac{-1}{2u}$$

$$u = \frac{-f}{2} \;\Rightarrow\; |u| = \frac{f}{2}$$

**30.** (*a*) We know that, $n = \dfrac{1}{\sin i_c}$

$$n = \frac{1}{\sin 30°} \quad \Rightarrow \quad n = 2$$

**31.** (*a*) For minimum deviation, $r = \dfrac{A}{2} \;\Rightarrow\; r = 30°$

**32.** (*c*) They ray will suffer total internal reflection at second interface only if its angle of incidence is greater than the critical angle.

**33.** (*d*) By Brewster's law,

$n = \tan i_p$

$\sqrt{3} = \tan i_p \;\Rightarrow\; \tan 60° = \tan i_p$

$\Rightarrow\; i_p = 60°$

**34.** (*d*) $I = \dfrac{I_0}{2}\cos^2\theta = \dfrac{I_0}{2}\cos^2 60° = \dfrac{I_0}{2}\times\dfrac{1}{4} = \dfrac{I_0}{8}$

**35.** (*c*) Fringe width, $\beta = \dfrac{\lambda D}{d}$

when $d$ is doubled $D$ should also doubled, for same value of $\beta$.

**37.** (*c*) For constructive interference,

$\phi = 2n\pi$ ; $n = 0, 1, 2, 3, \ldots\ldots$

**38.** (*d*) For destructive interference,

$x = (2n-1)\dfrac{\lambda}{2}$ ; $n = 1, 2, 3, \ldots\ldots$

**39.** (*a*) The minimum required frequency to eject an electron from metal surface is called threshold frequency.

**40.** (*b*) Work function, $\phi_0 = \dfrac{hc}{\lambda_0}$

$$\frac{\phi_0}{\phi_0'} = \frac{\dfrac{hc}{\lambda_0}}{\dfrac{hc}{\lambda_0'}} \Rightarrow 2 = \frac{\lambda_0'}{\lambda_0} \Rightarrow \lambda_0' = 2\lambda_0$$

**41.** (*a*) Potential energy,

$$U = eV = eV_0 \log_e \frac{r}{r_0}$$

$$F_e = -\frac{dU}{dr} = -\frac{d}{dr}\left[eV_0 \log_e \frac{r}{r_0}\right] = -\frac{eV_0}{r}$$

$|F_e| = \dfrac{eV_0}{r}$ (Attractive)

For circular orbit

$$\frac{mv^2}{r} = \frac{eV_0}{r} \qquad \ldots(i)$$

$$v = \sqrt{\frac{eV_0}{m}}$$

From Bohr's quantum condition

$$mvr = \frac{nh}{2\pi} \quad \ldots(ii)$$

Eliminating $v$ we get

$$r_n \propto n$$

**42.** (*b*) As we known,

$$\Delta E = \frac{hc}{\lambda} = \frac{12.42\times10^{-7}\,\text{eV m}}{1.027\times10^{-7}\,\text{m}}$$

$= 12.1\,\text{eV}$, same for transition $D$, $\Delta E = 12.1\,\text{eV}$

**43.** (*d*) The electrostatic attractive force between nucleus and electron is responsible for revolving electron round the nucleus with centripetal force.

Then, $F_e = F_c$

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

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

Now, kinetic energy of electron in orbit, $n = 1$, $Z = 1$ for H-atom

$$\text{KE} = \frac{1}{2}mv^2 = \frac{1}{2}\cdot\frac{e^2}{4\pi\varepsilon_0 r}$$

$$= \frac{e^2}{8\pi\varepsilon_0 r}$$

**44.** (*b*) As we know, $r_n = r_0\dfrac{n^2}{Z}$

For $n = 1$, $r_1 = r_0$

For $Be^{3+}$ atom, $r_n = r_0$ (Given)

$$r_0\frac{n^2}{Z} = r_0$$

$$\Rightarrow \quad \frac{n^2}{4} = 1 \quad \Rightarrow \quad n = 2.$$

**46.** (*b*) In basic β-decay, a neutron is transformed into a proton and an electron. The electron is then emitted as a β-particle which increases the atomic number by 1 and the molar mass is unchanged.

**47.** (*c*) β-particles are high energy electrons which are emitted by the radioactive decay of atomic nucleus.

**48.** (*b*) The energy gap is smaller than 3 eV but greater than 0, thus, the substance is a semiconductor.

**49.** (*b*) Here, $E = h\nu$

So, $\nu = \dfrac{E}{h}$

$$= \frac{2\times1.6\times10^{-19}}{6.6\times10^{-34}}$$

$= 4.84 \times 10^{14}$ Hz $\simeq 5 \times 10^{14}$ Hz (approx)

**50.** (*b*) Output of $G_1 = \overline{AB}$

Output of $G_2 = \overline{\overline{AB}} = AB$ (AND gate)