PRACTICE PAPER

21

PHYSICS

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

General Instructions:

(*i*) The examination will consist of **Objective type with Multiple Choice Questions (MCQs)**.

(*ii*) There are **50** questions in total in this paper, out of which **40** questions are to be attempted.

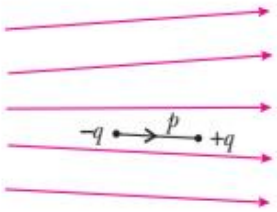
(*iii*) Each question carries **five** marks.

(*iv*) There is **negative** marking of **one** mark for every **incorrect answer**.

(*v*) Use of calculator and log tables is **NOT** permitted.

Choose the correct option in the following questions.

1. **Figure shows electric field lines in which an electric dipole *p* is placed as shown. Which of the following statements is correct?**



(*a*) The dipole will not experience any force.

(*b*) The dipole will experience a force towards right.

(*c*) The dipole will experience a force towards left.

(*d*) The dipole will experience a force upwards.

2. **During the propagation of electromagnetic waves in a medium**

(*a*) electric energy density is double of the magnetic energy density

(*b*) electric energy density is half of the magnetic energy density

(*c*) electric energy density is equal to the magnetic energy density

(*d*) both electric and magnetic energy densities are zero

3. **The electric flux through a closed Gaussian surface depends upon**

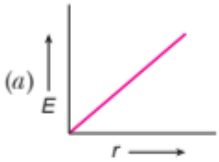
(*a*) net charge enclosed and permittivity of the medium

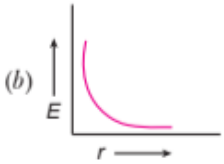
(*b*) net charge enclosed, permittivity of the medium and the size of the Gaussian surface

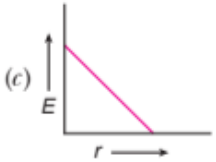
(*c*) net charge enclosed only

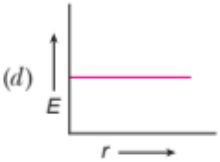
(*d*) permittivity of the medium only

4. **For a point charge, the graph between electric field versus distance is given by**

(*a*) 

(*b*) 

(*c*) 

(*d*) 

5. The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by

$$V(x) = \frac{20}{x^2 - 4} \text{ volts.}$$

The electric field E at $x = 4$ μm is given by

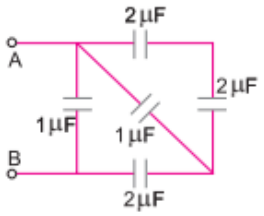
(*a*) $\frac{5}{3}$ V/μm and is in positive x-direction

(*b*) $\frac{10}{9}$ V/μm and is in negative x-direction

(*c*) $\frac{10}{9}$ V/μm and is in positive x-direction

(*d*) $\frac{5}{3}$ V/μm and is in negative x-direction

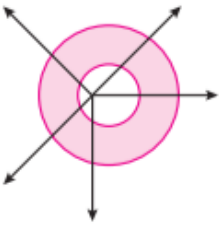
6. Five capacitors are connected as shown in the figure. The equivalent capacitance between A and B is



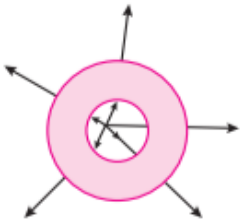
(*a*) 1 μF (*b*) 2 μF (*c*) 3 μF (*d*) 4 μF

7. A metallic shell has a point charge q kept inside a cavity. Which one of the following diagrams correctly represents the electric lines of force?

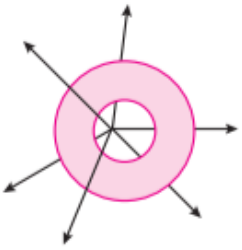
(*a*)



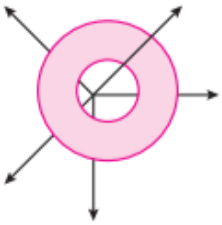
(*b*)



(*c*)



(*d*)



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

Statement P : The capacitance of a parallel plate capacitor increases when a dielectric constant of medium between the plates.

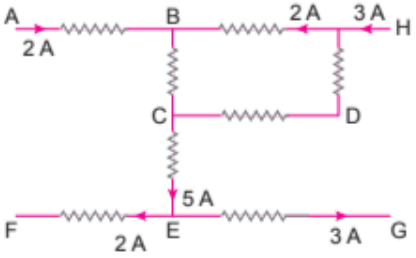
Statement Q : Capacitance of a parallel plate capacitor is directly proportional to dielectric constant of medium between the plates.

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

9. In the circuit diagram the electric current through branch BC is



(*a*) 1 A (*b*) 2 A (*c*) 4 A (*d*) 5 A

10. A compass needle is placed above a straight conducting wire. If current passes through the conducting wire from South to North. Then the deflection of the compass _____.

(*a*) is towards West
(*b*) is towards East
(*c*) keeps oscillating in East-West direction
(*d*) no deflection

11. Newton's rings is a natural phenomenon that involves

(*a*) an interference pattern due to reflection of light between two surfaces
(*b*) an interference pattern due to refraction of light between two surfaces
(*c*) a diffraction pattern due to reflection of light between two surfaces
(*d*) a diffraction pattern due to refraction of light between two surfaces

12. Column A represents characteristics of a charged particle moving in a field while column B represent the path.

	Column A		Column B
(*i*)	A charged particle moving parallel to electric field.	(*p*)	straight line
(*ii*)	A charged particle moving parallel to magnetic field.	(*q*)	circle
(*iii*)	A charged particle moving perpendicular electric field.	(*r*)	helix
(*iv*)	A charged particle moving perpendicular magnetic field.	(*s*)	parabola

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

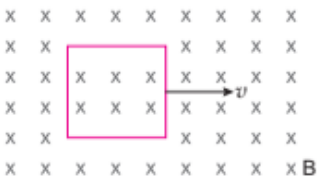
13. An atom is a current loop. It is assumed that the magnetism of atom is caused by revolving electron due to its

(*a*) orbital motion
(*b*) spin motion
(*c*) both (*a*) and (*b*)
(*d*) none of these

14. The angle between the magnetic meridian and the geographical meridian is known as

(*a*) magnetic dip
(*b*) magnetic declination
(*c*) magnetic moment
(*d*) magnetic field strength

15. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere as in given figure. The current induced in the loop is

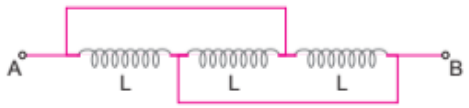


(*a*) Blv/R clockwise
(*b*) Blv/R anticlockwise
(*c*) $2Blv/R$ anticlockwise
(*d*) zero.

16. The Lorentz force experienced by a charged particle of charge q, moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$ is given by

(*a*) $\vec{F} = q(\vec{v} \cdot \vec{B})$
(*b*) $\vec{F} = q(\vec{v} \times \vec{B})$
(*c*) $\vec{F} = q(\vec{B} \times \vec{v})$
(*d*) $\vec{F} = \vec{v} \times \vec{B}/q$

17. The effective inductance between A and B in the fig. shown if L = 3 H is



(*a*) 1 H
(*b*) 9 H
(*c*) 0·67 H
(*d*) 1·5H

18. The dimension of magnetic flux is

(*a*) $M^1L^2T^{-2}A^{-1}$
(*b*) $M^2L^3T^{-3}A^1$
(*c*) $M^1L^2T^{-3}A^{-1}$
(*d*) $M^1L^3T^{-3}A^1$

19. **The voltage and current in *ac* circuit are given by**

$$V = 5\sin\left(100\pi t - \frac{\pi}{6}\right), i = 4\sin\left(100\pi t + \frac{\pi}{6}\right)$$

We can conclude

(*a*) voltage leads the current by 30°
(*b*) current leads the voltage by 30°
(*c*) current leads the voltage by 60°
(*d*) current and voltage are in phase

20. **The power dissipated in an *LCR* series circuit connected to an *ac* source of emf ε is**

(*a*) $\dfrac{\varepsilon^2\sqrt{R^2+\left(\omega L-\dfrac{1}{\omega C}\right)^2}}{R}$

(*b*) $\dfrac{\varepsilon^2\sqrt{R^2+\left(\omega L-\dfrac{1}{\omega C}\right)^2}}{R}$

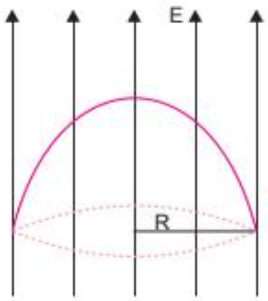
(*c*) $\dfrac{\varepsilon^2 R}{\sqrt{R^2+\left(\omega L-\dfrac{1}{\omega C}\right)^2}}$

(*d*) $\dfrac{\varepsilon^2 R}{R^2+\left(\omega L-\dfrac{1}{\omega C}\right)^2}$

21. **In an *ac* generator, a coil with *N* turns, all of the same area *A* and total resistance *R*, rotates with frequency ω in a magnetic field *B*. The maximum value of emf generated in the coil is**

(*a*) *NABR*ω
(*b*) *NAB*
(*c*) *NABR*
(*d*) *NAB*ω

22. **A hemispherical surface of radius *R* is placed with its cross-section perpendicular to a uniform electric field as shown in figure. The electric flux through the surface is**



(*a*) πR^2E
(*b*) $2\pi R^2E$
(*c*) $4\pi R^2E$
(*d*) zero

23. **The electric field of an electromagnetic wave in free space is given by $\vec{E} = 10\cos(10^7t + kx)\,\hat{j}$ V/m where *x* is in meters and *t* in seconds. It can inferred that**

(*i*) the wavelength λ is 188.4 m
(*ii*) the number *k* is 0.33 rad/m
(*iii*) the wave amplitude is 10 V/m
(*iv*) the wave is propagating along (+) *X*–direction.

Which one of the following pair of statements is correct?

(*a*) (*i*) and (*ii*)
(*b*) (*ii*) and (*iii*)
(*c*) (*i*) and (*iii*)
(*d*) (*iii*) and (*iv*)

24. **Why is refractive index in a transparent medium greater than one?**

(*a*) Because the speed of light in vacuum is always less than speed in a transparent medium.
(*b*) Because the speed of light in vacuum is always greater than the speed in a transparent medium.
(*c*) Frequency of wave changes when it crosses medium.
(*d*) None of the above

25. **A boy stands straight in front of a mirror at a distance of 30 cm away from it. He sees his erect image whose height is $\frac{1}{5}$ th of his real height. The mirror he is using is**

(*a*) plane mirror
(*b*) convex mirror
(*c*) concave mirror
(*d*) plane-concave mirror

26. **Loss of ability of eye to focus on near and far object with advancing age is called**

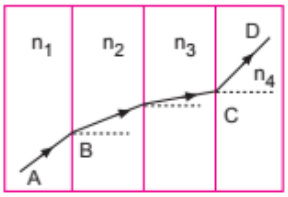
(*a*) presbyopia
(*b*) astigmatism
(*c*) hypermetropia
(*d*) myopia

27. **A small linear object of length b is placed along the axis of a convex lens of focal length f. The size of the image is**

(a) $b\left(\frac{u-f}{f}\right)^{1/2}$ (b) $b\left(\frac{u-f}{f}\right)$

(c) $b\left(\frac{f}{u-f}\right)^{1/2}$ (d) $b\left(\frac{f}{u-f}\right)^{2}$

28. **A ray of light passes through four media of refractive indices n_1, n_2, n_3 and n_4 as shown in figure. The surface of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have**



(a) $n_1 = n_2$ (b) $n_2 = n_3$ (c) $n_3 = n_4$ (d) $n_4 = n_1$

29. **Two thin lenses when in contact produce a combination of power + 10 D. When they are 0·25 m apart, the power reduces to + 6 D. The focal length of lenses are**

(a) 0·5 m, 0·125 m (b) 0·75 m, 0·5 m

(c) 1·0 m, 0·5 m (d) 0·75 m, 0·125 m

30. **Which of the following is correct for "Malus Law"?**

(a) $I = I_0^2 \cos^2\theta$ (b) $I = I_0 \cos^2\theta$

(c) $I = I_0^2 \sin^2\theta$ (d) $I = I_0 \tan^{-1}\theta$

31. **Two coherent monochromatic light beams of intensities I and $4I$ are superposed. The maximum and minimum possible intensities in the resulting beam are**

(a) $5I$, I (b) $5I$, $3I$

(c) $9I$, I (d) $9I$, $3I$

32. **A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved further apart by means of insulating handles.**
Which of the following statements is true?

I. The charge on the capacitor increases

II. The voltage across the plates increases

III. The capacitance increases

IV. The electrostatic energy stored in the capacitor increases

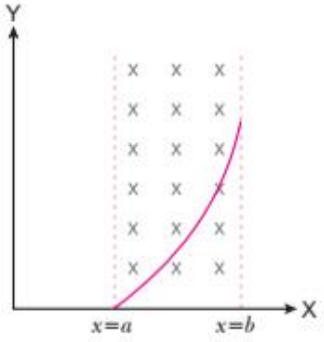
(a) I only (b) II and III only

(c) IV only (d) II and IV only

33. **A particle of mass m and charge q moves with a constant velocity v along positive X-axis. It enters a region containing a uniform magnetic field B directed along the negative Z-axis, extending from $x = a$ to $x = b$. The minimum value of v required so that the particle can just enter the region $x > b$ is**

(a) $\frac{qbB}{M}$ (b) $\frac{q(b-a)B}{m}$

(c) $\frac{qaB}{m}$ (d) $\frac{q(b+a)B}{2m}$



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

Statement P : An electrical bulb starts glowing instantly as it is switched on.

Statement Q : Drift speed of electrons in a metallic wire is very large.

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

35. **An electromagnetic radiation of frequency *n* wavelength λ, travelling with velocity *v* in air enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively**

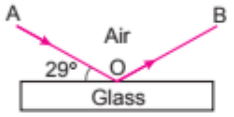
(*a*) $n, 2\lambda$ and $\frac{v}{\mu}$

(*b*) $\frac{2n}{\mu}, \frac{\lambda}{\mu}$ and v

(*c*) $\frac{n}{\mu}, \frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

(*d*) $n, \frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

36. **A beam of light *AO* is incident on a glass slab ($n = 1{\cdot}54$) as shown in figure. The reflected light *OB* is passed through a Nicol prism. On viewing through the Nicol prism, we find on rotating the Nicol prism that**



(*a*) the intensity is reduced down to zero and remains zero

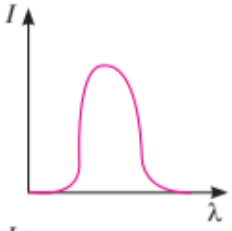
(*b*) the intensity reduces down somewhat and rises again

(*c*) there is no change in intensity

(*d*) the intensity gradually reduces to zero and again increases

37. **The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current *I* of the photocell varies as follows:**

(*a*)



(*b*)

(*c*)

(*d*)

38. **A photocell connected in an electrical circuit is placed at a distance '*d*' from a source of light. As a result, current *I* flows in the circuit. What will be the current in the circuit when the distance is reduced to '*d*/2'?**

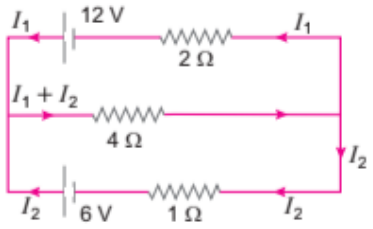
(*a*) *I*

(*b*) 2*I*

(*c*) 4*I*

(*d*) *I*/2

39. **Electric current through resistance 4 Ω, in the given circuit is**



(*a*) 0 A

(*b*) 0.5 A

(*c*) 12/7 A

(*d*) 2/7 A

40. **A particle A of mass m and initial velocity v collides with a particle B of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de-Broglie wavelengths λ_A to λ_B after the collision is**

(*a*) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$ (*b*) $\frac{\lambda_A}{\lambda_B} = 2$

(*c*) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$ (*d*) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$

41. **Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6 eV are incident on C, no photoelectrons will reach the anode A. If the stopping potential of A relative to C is**

(*a*) –1 V (*b*) –3 V

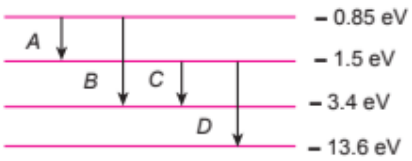
(*c*) +3 V (*d*) +4 V

42. **Hydrogen H, deuterium D, singly-ionised helium He^+ and doubly-ionised lithium Li^{++} all have one electron around the nucleus. Consider $n = 2$ to $n = 1$ transition. The wavelengths of the emitted radiations are $\lambda_1, \lambda_2, \lambda_3$, and λ_4 respectively. Then approximately**

(*a*) $\lambda_1 = 2\lambda_2 = 2\sqrt{2}\lambda_3 = 3\sqrt{2}\lambda_4$ (*b*) $\lambda_1 = \lambda_2 = 2\lambda_3 = 3\lambda_4$

(*c*) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$ (*d*) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

43. **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

44. **When an electron in an atom goes from a lower to a higher orbit, its**

(*a*) kinetic energy (*KE*) increases, potential energy (*PE*) decreases

(*b*) *KE* increases, *PE* increases

(*c*) *KE* decreases, *PE* increases

(*d*) *KE* decreases, *PE* decreases

45. **The activity of a radioactive sample is measured as N_0 counts per minute at $t = 0$ and $\frac{N_0}{e}$ counts per minute at $t = 5$ minutes. The time (in minutes) at which the activity reduces to half of its value is**

(*a*) $\frac{5}{\log_e 2}$ (*b*) $\log_{10} 2$

(*c*) $5 \log_e 2$ (*d*) $\log_e\left(\frac{2}{5}\right)$

46. **In the reaction: $_{92}U^{234} \longrightarrow {}_{90}Th^{230} + X + Q$; 'X' is**

(*a*) $_1H^2$ (*b*) $_2He^4$ (*c*) $_3Li^6$ (*d*) $_4He^2$

47. **Three waves A, B and C of frequencies 1600 kHz, 5 MHz and 60 MHz, respectively are to be transmitted from one place to another. Which of the following is the most appropriate mode of communication?**

(*a*) A is transmitted via space wave while B and C are transmitted via sky wave.

(*b*) A is transmitted via ground wave, B via sky wave and C via space wave.

(*c*) B and C are transmitted via ground wave while A is transmitted via sky wave.

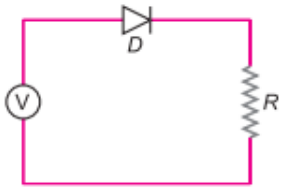
(*d*) B is transmitted via ground wave while A and C are transmitted via space wave

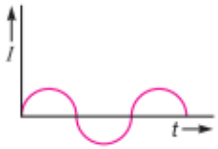
48. **A transistor is operated in CE configuration at $V_C = 2$ V such that a change in the base current from 100 μA to 200 μA produces a change in the collector current from 5 mA to 10 mA. The current gain is**

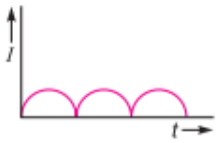
(*a*) 100 (*b*) 150

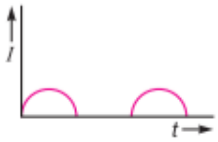
(*c*) 50 (*d*) 75

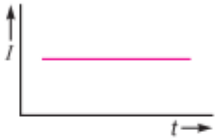
49. **A *p-n* junction (*D*) shown in the fig. can act as a rectifier. An alternating current source (*V*) is connected in the circuit. The output current in the circuit is represented by**



(*a*) 

(*b*) 

(*c*) 

(*d*) 

50. **If μ_e and μ_h are electron and hole mobility, *E* be the applied electric field, the current density *j* for intrinsic semiconductor is equal to**

(*a*) $n_i e(\mu_e + \mu_h)E$

(*b*) $n_i e(\mu_e + \mu_h)E$

(*c*) $\dfrac{n_i e(\mu_e + \mu_h)}{E}$

(*d*) $\dfrac{E}{n_i e(\mu_e + \mu_h)}$

ANSWERS

PRACTICE PAPER – 1

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

SOLUTIONS

PRACTICE PAPER–1

1. (*c*) The density of electric field lines decreases from left to right, so electric field (E) on $+q$ charge will be smaller than $-q$ charge.

Since, $\vec{F} = q\vec{E}$, therefore force on $+q$ will be smaller than $-q$.

The direction of force $+q$ charge is along the direction of electric field, so the force on $-q$ will be towards left. Hence net force on dipole will be towards left.

2. (*c*) Energy is equally distributed between electric and magnetic fields of an electromagnetic wave.

3. (*a*) $Flux = \dfrac{Q_{enc}}{\varepsilon_0}$

Net charge enclosed and permittivity of medium.

4. (*b*) As we know that electric field due to point change

$$E = \frac{KQ}{r^2} \; i.e., \; E \propto \frac{1}{r^2}$$

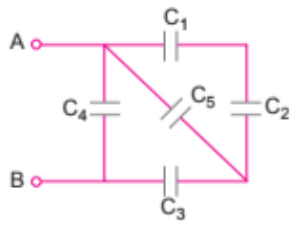
5. (*c*) $V = \dfrac{20}{x^2 - 4}$

$$E = -\frac{dV}{dx} = -\frac{d}{dx}\left(\frac{20}{x^2-4}\right) = \frac{40x}{(x^2-4)^2}$$

At $x = 4$ μm

$$E = \frac{40 \times 4}{(16-4)^2} = \frac{10}{9} \text{ V/μm along positive } x\text{-axis}$$

6. (*b*) C_1 and C_2 are connected in series, their equivalent capacitance is



$$C_{12} = \frac{C_1 C_2}{C_1 + C_2}$$

$$= \frac{2 \times 2}{2+2} = 1\,\mu F$$

Similarly, capacitance of C_3 and C_4

$C_{34} = 1\ \mu F$

The circuit represents Wheatstone's bridge and capacitor C_5 is neglected.

Equivalent capacitance of circuit

$C_{eq} = C_{12} + C_{34} = 1 + 1 = 2\ \mu F.$

7. (*b*) Electric field is zero within the metal, so there should be no line of force within metal and lines are always normal to equipotential surface.

9. (*c*) $i = 2\text{ A} + 2\text{ A} = 4\text{ A}$

10. (*b*) According to right hand thumb rule, magnetic field produced along West to East.

11. (*a*) Newton's rings is a phenomenon in which an interference pattern is created by the reflection of light between two surfaces; a spherical surface and an adjacent touching flat surface.

13. (*c*) When electron revolve around the nucleus, the magnetism is caused by both angular momentum due to spin motion and linear momentum due to orbital motion.

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

15. (*d*) No flux change is taking place because magnetic field exists everywhere and is constant in time and space.

17. (*a*) Given three inductors are connected in parallel, so

$$\frac{1}{L_{eff}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1,$$

$L_{eff} = 1$ H

19. (*c*) Phase lead of current over voltage

$$\phi = 100\,\pi t + \frac{\pi}{6} - \left(100\pi t - \frac{\pi}{6}\right) = \frac{\pi}{3} = 60°$$

21. (*d*) As we know,

$$e = -\frac{d\phi}{dt} \quad [\because \phi = \vec{B}.\vec{A} = BA\cos\theta, \theta = \omega t$$

$$e = -\frac{d}{dt}(BA\cos\omega t) = +NBA\omega\sin\omega t$$

For maximum value of emf generated in a coil,

$$e_{max} = e_0 = \text{Peak value} = NBA\omega$$

22. (*c*) $\phi = E \times$ (Normal surface area)

$$= E \times \pi R^2 = \pi R^2 E$$

23. (*c*) $\vec{E} = E_0\cos(\omega t + kx)$

E_0= wave amplitude = 10 V/m

$\omega = 10^7$ rad/s

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{10^7} = 2\pi\times10^{-7}\text{ s}$$

and , $\lambda = v \times t$

$= 3 \times 10^8 \times 2\pi \times 10^{-7}$

$= 3 \times 2 \times 3{\cdot}14 \times 10$

$= 188{\cdot}4$ m

24. (*b*) We know that, $n = \frac{c}{v}$

if, $c > v$ then $n > 1$.

25. (*b*) Out of given option only convex mirror can form a virtual and diminished image.

27. (*d*) As we know, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ for a lens.

$\Rightarrow$ Differentiating, $0 = -\frac{1}{v^2}dv + \frac{1}{u^2}du$

$$\Rightarrow \frac{dv}{v^2} = \frac{du}{u^2} \Rightarrow dv = \left(\frac{v}{u}\right)^2 du$$

Let $du = dx_1$, $dv = dx_2$

$\Rightarrow$ Axial magnification,

$$m_x = \frac{dx_2}{dx_1} = \left(\frac{dv}{du}\right) = \left(\frac{v}{u}\right)^2$$

Given

$$dx_1 = b, \Rightarrow dx_2 = \left(\frac{v}{u}\right)^2 b = \left(\frac{f}{u-f}\right)^2 b.$$

28. (*d*) From Snell's law,

$n_1 \sin i_1 = n_4 \sin i_4$ ...(*i*)

As CD is parallel to AB

$i_4 = i_1$

Then equation (*i*) implies, $n_1 = n_4$.

29. (*a*) Given, $P_1 + P_2 = +10$ ...(*i*)

$P_1 + P_2 - dP_1P_2 = +6$ ...(*ii*)

On subtracting,

$$dP_1P_2 = 4 \quad \Rightarrow \quad P_1P_2 = \frac{4}{0{\cdot}25} = 16 \quad ...(iii)$$

$$(P_1 - P_2) = \sqrt{(P_1+P_2)^2 - 4P_1P_2}$$

$$= \sqrt{(10)^2 - 4\times16} = 6 \quad ...(iv)$$

Solving (*i*) and (*iv*), we get $P_1 = 8$ D, $P_2 = 2$ D

$$\therefore \quad f_1 = \frac{1}{P_1} = \frac{1}{8} = 0{\cdot}125\text{ m},$$

$$f_2 = \frac{1}{P_2} = \frac{1}{2} = 0.5\text{ m}$$

31. (*c*) $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = \left(\sqrt{I} + \sqrt{4I}\right)^2$

$$I_{max} = \left(3\sqrt{I}\right)^2 = 9I$$

$$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2 = \left(\sqrt{I} - \sqrt{4I}\right)^2$$

$$I_{min} = \left(-\sqrt{I}\right)^2 = I$$

32. (*d*) When capacitor is charged and then disconnected, the charge across the capacitor remains constant but plates moves apart then distance in between plates are increases hence capacitance decreases. Hence from $Q = CV$, the voltage across the capacitor increases to keep the charge constant as well as energy stored in the capacitor also be increases (i.e., $E = \frac{1}{2}QV$).

33. (*b*) For entering the particle in the region $x > b$, the radius of circular path $x \geq b - a$

or $\frac{mv}{qB} \geq (b-a) \Rightarrow v_{min} = \frac{qB(b-a)}{m}$

35. (*d*) Frequency n remains same

$$\mu = \frac{\lambda}{\lambda_{med}} \text{ or } \lambda_{med} = \frac{\lambda}{\mu}$$

$$\mu = \frac{v}{v_{med}} \text{ or } v_{med} = \frac{v}{\mu}$$

36. (*b*) If $i_p = \tan^{-1}(1{\cdot}54) = 57°$

The angle of incidence is $(90 - 29) = 61°$; the reflected light is partially polarised; so intensity of reflected light passing through Nicol changes but is not zero.

37. (*d*) According to Einstein photoelectric equation,

$$K_{max} = h\nu - W_0 = \frac{hc}{\lambda} - W_0$$

As the value of λ increases, the value of K_{max} decreases and a smaller number of electrons reach the anode. There are no photoelectrons are emitted when λ is greater than threshold wavelength λ_0.

38. (*c*) As we know, $I \propto \frac{1}{d^2}$

$$\frac{I_2}{I_1} = \frac{d_1^2}{d_2^2}$$

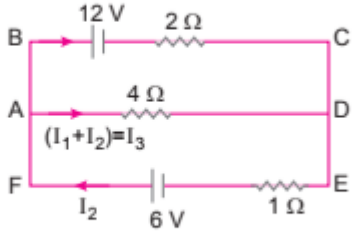
Given,

$$d_2 = \frac{d_1}{2}, d_1 = d$$

$$I_1 = I$$

$$I_2 = \frac{d^2}{(d/2)^2} = 4I$$

39. (*c*) In loop *ABCDA*



$$-12 + 2I_1 + 4(I_1 + I_2) = 0$$
$$6I_1 + 4I_2 = 12$$
$$3I_1 + 2I_2 = 6 \quad \ldots(i)$$

In loop *FADEF*

$$-4(I_1 + I_2) - I_2 + 6 = 0$$
$$4I_1 + 5I_2 = 6 \quad \ldots(ii)$$

Solving (*i*) and (*ii*)

$$I_1 = \frac{18}{7}A, I_2 = \frac{-6}{7}A$$

So, $I_3 = I_1 + I_2$

$$= \frac{18}{7} - \frac{6}{7} = \frac{12}{7}\text{A}$$

41. (*b*) Using photoelectric emission equation,

$K_{max} = h\nu - W_0$

$2\text{eV} = 5\text{eV} - W_0 \Rightarrow W_0 = 3\text{eV}$

$\therefore \quad V_s = V_{cathode} - V_{anode} = 3\text{V}$

$\Rightarrow \quad V_{anode} - V_{cathode} = -3\text{V}$

42. (*c*) From Rydberg's formula,

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{3RZ^2}{4}$$

$$\lambda = \frac{4}{3RZ^2}$$

Nor, Z for H = 1, D = 1, $He^+ = 2$, $Li^{++} = 3$.

So, $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$

43. (*b*) As we known,

$$\Delta E = \frac{hc}{\lambda} = \frac{12.42 \times 10^{-7}\text{ eV m}}{1.027 \times 10^{-7}\text{ m}}$$

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

44. (*c*) When electron goes from a lower to higher orbit, energy is absorbed by the electron. So, *KE* decreases and *PE* increases.

45. (*c*) As we know, $N = N_0 e^{-\lambda t}$

$$N = \frac{N_0}{e} \text{ at } t = 5\text{ min}$$

$$\frac{N_0}{e} = N_0 e^{-\lambda(5)}$$

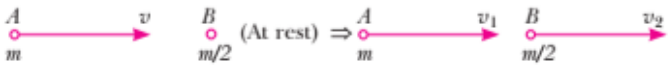
$$\lambda = \frac{1}{5}$$

$$T_{1/2} = \frac{\log_e 2}{\lambda} = 5\log_e 2$$

46. (*b*) Let x and y be the mass number and atomic number of X respectively.

Mass of LHS = Mass of RHS

40. (*b*) According to Law of Conservation of momentum,



Before collision = After collision

$$m_1u_1 + m_2u_2 = m_2v_1 + m_2v_2 \quad \left[\because \begin{matrix} u_1 = v \\ u_2 = 0 \end{matrix}\right]$$

$$v_1 = \frac{m_1 - m_2}{m_1 + m_2}.u_1 + 0 = \frac{m - \frac{m}{2}}{m + \frac{m}{2}}.v = \frac{v}{3}$$

$$v_2 = \frac{2m_1}{m_1 + m_2}.u_1 + 0 = \frac{2m}{m + \frac{m}{2}}.v = \frac{4v}{3}$$

Ratio of the de Broglie wavelengths,

$$\frac{\lambda_A}{\lambda_B} = \frac{p_B}{p_A} = \frac{\frac{m}{2}.\frac{4v}{3}}{m\frac{v}{3}} = 2$$

$234 = 230 + x \Rightarrow x = 4$

Also, $92 = 90 + y \Rightarrow y = 2$

$\therefore$ X is $^{4}_{2}\text{He}$

48. (*c*) Current gain,

$$\beta = \frac{dI_C}{dI_B} = \frac{10 - 5}{200 - 10} = \frac{5 \times 10^{-3}}{100 \times 10^{-6}} = 50$$

49. (*c*) The given circuit represents a half wave rectifier and for every half cycle of *ac*, the diode is reverse biased and does not conduct.

50. (*a*) As we know,

$$I = I_e + I_h$$
$$= en_eAv_e + en_hAv_h$$
$$= eA(n_e\mu_e + n_h\mu_h)E$$

Here, Current density,

$$J = \frac{I}{A} = en_i(\mu_e + \mu_h)E$$