CBSE EXAMINATION PAPER-2025

PHYSICS

(Solved)

Time allowed : 3 hours | Maximum Marks : 82

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **38 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 2** are case based questions

iv. **Section B** – questions number **3 to 18** are multiple choice questions

v. **Section C** – questions number **19 to 24** are very short answer

vi. **Section D** – questions number **25 to 32** are short answer

vii. **Section E** – questions number **33 to 38** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

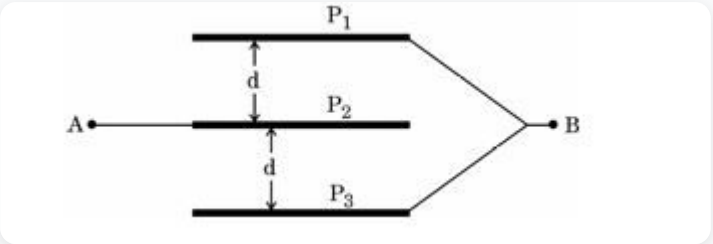
ix. Use of calculator is NOT allowed.

Section A

Question 1.

A parallel plate capacitor consists of two conducting plates kept generally parallel from each other at a distance. When the capacitor is charged, the charge resides on the inner surfaces of the plates and an electric field is set up between them. Thus, electrostatic energy is stored in the capacitor. The figure shows three large square metallic plates, each of side 'L' held parallel and equivalent from each other. The space between P_1 and P_2 and P_2 and P_3 is completely filled with mica sheets of dielectric constant 'K'. The plate P_2 is connected to point A and other plates P_1 and P_3 are connected to point B.

Point A is maintained at a positive potential with respect to point B and the potential difference between A and B is V.



(1) The capacitance of the system between A and B will be:

[1 Marks]

(2)

The charge on plate P_1 is:

[1 Marks]

(3)

The electric field in the region between P_1 and P_2 is:

(a) V/d (b)2V/d

(c) V/2d (d) d/V

[1 Marks]

(4)

The separation between the plates of same area (L^2) of a parallel plate air capacitor having capacitance equal to that of this system, will be :

(a) d/K (b) 2d/K

(c) d/2K (d) d/4K

[1 Marks]

(5)

If the source of potential difference applied between A and B is removed, and then A and B are connected by a conducting wire, the net charge on the system will be :

[1 Marks]

Question 2.

A hydrogen atom consists of an electron revolving in a circular orbit of radius r with certain velocity v around a proton located at the nucleus of the atom. The electrostatic force of attraction between the revolving electron and the proton provides the requisite centripetal force to keep it in the orbit. According to Bohr's model, an electron can revolve only in certain stable orbits. The angular momentum of the electron in these orbits is some integral multiple of $h/2\pi$, where h is the Planck's constant. Further, when an electron makes a transition from one orbit of higher energy to that of lower energy, a photon is emitted having energy equal to the difference between energies of the initial and final states. Assuming the mass and charge of an electron as m and e respectively, answer the following questions.

(1)

The expression for the speed of electron v in terms of radius of the orbit (r) and physical constant ($K=1/4\pi\varepsilon_o$) is:

[1 Marks]

(2) The total energy of the atom in terms of r and physical constant K is:

[1 Marks]

(3)

A photon of wavelength 500 nm is emitted when an electron makes a transition from one state to the other state in an atom. The change in the total energy of the electron and change in its kinetic energy in eV as per Bohr's model, respectively will be:

(A) 2·48, -2·48 (B) -1·24, 1·24

(C) -2·48, 2·48 (D) 1·24, -1·24

[1 Marks]

(4)

In Bohr's model of hydrogen atom, the frequency of revolution of electron in its n^{th} orbit is proportional to:

(A) n (B)1/n

(C) $1/n^2$ (D) $1/n^3$

[1 Marks]

(5)

An electron makes a transition from -3·4 eV state to the ground state in hydrogen atom. Its radius of orbit changes by : (radius of orbit of electron in ground state = 0·53 Å)

(A) 0·53 Å (B) 1·06 Å

(C) 1·59 Å (D) 2·12 Å

[1 Marks]

Section B

Question 3.

A body acquires charge $8{\cdot}0 \times 10^{-12}$ C. The mass of the body:

[1 Marks]

(A) increases by $9{\cdot}1 \times 10^{-23}$ kg

(B) decreases by $4{\cdot}55 \times 10^{-23}$ kg

(C) increases by $4{\cdot}5 \times 10^{-7}$ kg

(D) decreases by $1{\cdot}0 \times 10^{-6}$ kg

Question 4.

A current flows through a cylindrical conductor of radius R. The current density at a point in the conductor is j = αr (along its axis), here α is a constant and r is distance from the axis of the conductor. The current flowing through the portion of the conductor from r = 0 to r = R/2 is proportional to:

[1 Marks]

(A) R^4

(B) R

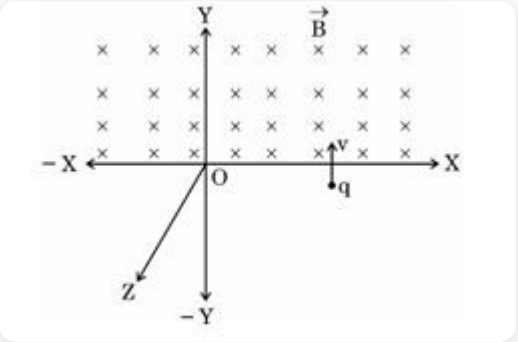
(C) R^2

(D) R^3

Question 5.

A particle having charge +q enters a uniform magnetic field B as shown in the figure. The particle will describe:

[1 Marks]



(A) a circular path in XZ plane

(B) a helical path with its axis parallel to Y-axis

(C) a semicircular path in YZ plane

(D) a semicircular path in XY plane

Question 6.

A bar magnet is initially at right angles to a uniform magnetic field. The magnet is rotated till the torque acting on it becomes one-half of its initial value. The angle through which the bar magnet is rotated is:

[1 Marks]

(A) 30

(B) 45

(C) 60

(D) 75

Question 7. Which one out of the following materials is not paramagnetic?

[1 Marks]

(A) Aluminium

(B) Sodium Chloride

(C) Calcium

(D) Copper Chloride

Question 8.

An ammeter connected in series in an ac circuit reads 10 A. The maximum value of current at any instant in the circuit is:

[1 Marks]

(A) $10\sqrt{2}$ A

(B) $10/\sqrt{2}$ A

(C) $10/\sqrt{2\pi}$ A

(D) $10/\pi$ A

Question 9.

The amplitude of electric field in an electromagnetic wave in free space is 1000 Vm^{-1}. The amplitude of the magnetic field in this electromagnetic wave is:

[1 Marks]

(A) $3{\cdot}33 \times 10^{-8}$ T

(B) $3{\cdot}0 \times 10^{-11}$ T

(C) $3{\cdot}0 \times 10^{-3}$ T

(D) $3{\cdot}33 \times 10^{-6}$ T

Question 10.

The magnification produced by a spherical mirror is 2·0. The mirror used and the nature of the image formed will be:

[1 Marks]

(A) Convex and virtual

(B) Concave and real

(C) Convex and real

(D) Concave and virtual

Question 11. Choose the correct statement:

[1 Marks]

(A) Photons of light show diffraction whereas electrons do not show diffraction.

(B) Electrons have momentum whereas photons do not have momentum.

(C) All electromagnetic radiations do not have photons.

(D) Photons of light and electrons both exhibit dual nature.

Question 12.

A beam of red light and a beam of blue light have equal intensities. Which of the following statements is true?

[1 Marks]

(A) The red beam has more number of photons than the blue beam.

(B) The blue beam has more number of photons than the red beam.

(C) Wavelength of red light is lesser than wavelength of blue light.

(D) The blue light beam has lesser energy per photon than that in the red light beam.

Question 13. Which of the following is an electrical conductor at room temperature?

[1 Marks]

(A) Mica

(B) Sn

(C) Si

(D) C

Question 14. A long straight wire is held vertically and carries a steady current in upward direction. The shape of magnetic field lines produced by the current-carrying wire are:

[1 Marks]

(A) horizontal straight lines directed radially out from the wire.

(B) straight lines parallel to the current-carrying wire.

(C) concentric horizontal circles around the wire.

(D) coaxial helixes around the wire.

Question 15.

Assertion (A): n-type semiconductor is not negatively charged.

Reason (R): Neutral pentavalent impurity atom doped in intrinsic semiconductor (neutral) donates its fifth unpaired electron to the crystal lattice and becomes a positive donor.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are false.

(C) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(D) Assertion (A) is true, but Reason (R) is false.

Question 16.

Assertion (A): A series LCR circuit behaves as a pure resistive circuit at resonance.

Reason (R): At resonance, $X_L = X_C$ gives $\omega = 1/\sqrt{LC}$

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false.

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(C) Both Assertion (A) and Reason (R) are false.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

Question 17.

Assertion (A): In double slit experiment if one slit is closed, diffraction pattern due to the other slit will appear on the screen.

Reason (R): For interference, at least two waves are required.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are false.

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(D) Assertion (A) is true, but Reason (R) is false.

Question 18.

Assertion (A): For monochromatic incident radiation, the emitted photoelectrons from a given metal have speed ranging from zero to a certain maximum value.

Reason (R): Each metal has a definite work function.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(C) Both Assertion (A) and Reason (R) are false.

(D) Assertion (A) is true, but Reason (R) is false.

Section C

Question 19.

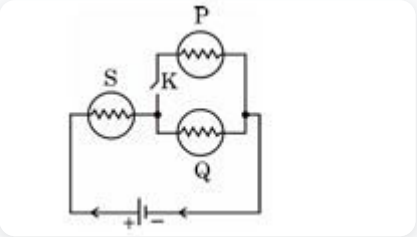
In the given figure, three identical bulbs P, Q and S are connected to a battery.

(i) Compare the brightness of bulbs P and Q with that of bulb S when key K is closed.

(ii) Compare the brightness of the bulbs S and Q when the key K is opened.

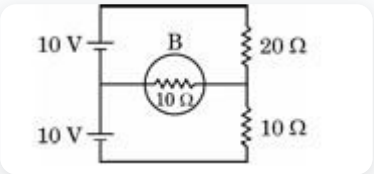
Justify your answer in both cases.

[2 Marks]



Question 20. Two cells of emf 10 V each, two resistors of 20 Ω and 10 Ω and a bulb B of 10 Ω resistance are connected together as shown in the figure. Find the current that flows through the bulb.

[2 Marks]



Question 21. Find the angle of diffraction (in degrees) for first secondary maximum of the pattern due to diffraction at a single slit. The width of the slit and wavelength of light used are 0.55 mm and 550 nm, respectively.

[2 Marks]

Question 22. An equiconvex lens is made of glass of refractive index 1.55. If the focal length of the lens is 15.0 cm, calculate the radius of curvature of its surfaces.

[2 Marks]

Question 23.

Calculate the mass of an α-particle in atomic mass unit (u). Given, Mass of a normal helium atom = 4.002603 u.

Mass of carbon atom = $1{\cdot}9926 \times 10^{-26}$ kg

[2 Marks]

Question 24.

In an intrinsic semiconductor, carrier's concentration is $5*10^{8}$ m^{-3}. On doping with impurity atoms, the hole concentration becomes 8×10^{12} m^{-3}.

(a) Identify (i) the type of dopant and (ii) the extrinsic semiconductor so formed.

(b) Calculate the electron concentration in the extrinsic semiconductor.

[2 Marks]

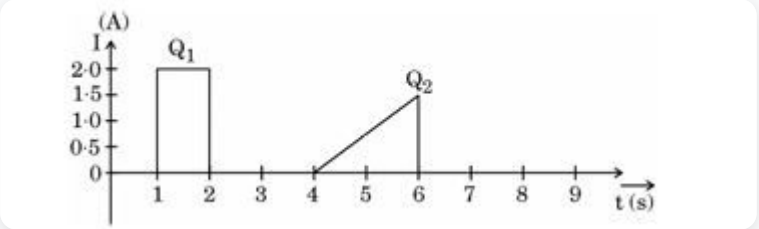
Section D

Question 25.

(i) Derive an expression for the resistivity of a conductor in terms of number density of free electrons and relaxation time.

(ii) The figure shows the plot of current through a cross-section of wire over two different time intervals. Compare the charges (Q_1 and Q_2) that pass through the cross-section during these time intervals.

[3 Marks]

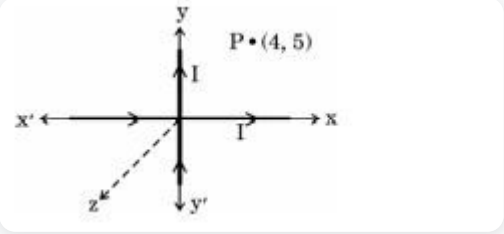


Question 26.

(a) Write vector form of Biot-Savart law.

(b) Two insulated long straight wires, each carrying 2·0 A current are kept along xx' and yy' axis as shown in the figure. Find the magnitude and direction of resultant magnetic field at point P (4m, 5m).

[3 Marks]



Question 27.

(a) State any three characteristics of electromagnetic waves.

(b) Briefly explain how and where the displacement current exists during the charging of a capacitor.

[3 Marks]

Question 28.

A double slit set-up was initially placed in a tank filled with water and the interference pattern was obtained using a laser light. When water is replaced by a transparent liquid of refractive index n > n_water, what will be the effect on the following ?

(a) Speed, frequency and wavelength of the light of laser beam.

(b) The fringe width, shape of interference fringes and shift in the position of central maximum.

[3 Marks]

Question 29.

Explain the following observations using Einstein's photoelectric equation:

(a) Photoelectric emission does not occur from a surface when the frequency of the light incident on it is less than a certain minimum value.

(b) It is the frequency, and not the intensity of the incident light which affects the maximum kinetic energy of the photoelectrons.

(c) The cut-off voltage (V_0) versus frequency (v) of the incident light curve is a straight line with a slope h/e.

[3 Marks]

Question 30.

(a) Explain briefly the formation of diffusion current and drift current in a p-n junction diode.

(b) What are majority and minority charge carriers of p-type and n-type semiconductors?

[3 Marks]

Question 31.

(i) A battery of emf E and internal resistance r is connected to a variable external resistance R.

(I) Obtain the expression for current I in the circuit and the value of maximum current the battery can supply.

(II) Obtain the terminal voltage V across the battery and its maximum possible value.

(ii) The above battery sends a current I_1 when $R = R_1$ and a current I_2 when $R = R_2$. Obtain the internal resistance of the battery in terms of I_1, I_2, R_1 and R_2.

[3 Marks]

Question 32.

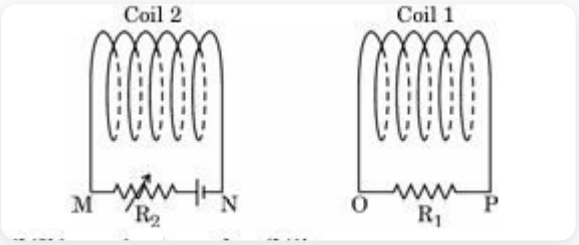
Two coils '1' and '2' are placed close to each other as shown in the figure. Find the direction of induced current in coil '1' in each of the following situations, justifying your answers :

(a) Coil '2' is moving towards coil '1'.

(b) Coil '2' is moving away from coil '1'.

(c) The resistance connected with coil '2' is increased keeping both the coils stationary.

[3 Marks]



Section E

Question 33.

(i) Two point charges +q and -q are held at (a, 0) and (-a, 0) in the x-y plane. Obtain an expression for the net electric field due to the charges at a point (0, y). Hence, find the electric field at a far-off point (y >> a).

(ii) Three point charges of -2 nC, -1 nC, and +5 nC are kept at the vertices A, B, and C of an equilateral triangle of side 0.2 m. Find the total amount of work done in shifting the charges from A to A_1, B to B_1, and C to C_1. Here A_1, B_1, and C_1 are the midpoints of sides AB, BC, and CA, respectively.

[5 Marks]

Question 34.

(i) Show that Gauss's theorem is consistent with Coulomb's law. Using it, derive an expression for the electric field due to a uniformly charged thin spherical shell of radius r at a point at a distance y from the center of the shell such that (I) y > r, and (II) y < r.

(ii) A point charge of +2 nC is kept at the origin of a three-dimensional coordinate system. Find the type and magnitude of the charge which should be kept at (0, 0, -6m) so that the potential due to the system becomes zero at (0, 0, 2m).

[5 Marks]

Question 35.

(i) An object is placed 30 cm from a thin convex lens of focal length 10 cm. The lens forms a sharp image on a screen. If a thin concave lens is placed in contact with the convex lens, the sharp image on the screen is formed when the screen is moved by 45 cm from its initial position. Calculate the focal length of the concave lens.

(ii) Calculate the angle of minimum deviation of an equilateral prism. The refractive index of the prism is √3. Calculate the angle of incidence for this case of minimum deviation also.

[5 Marks]

Question 36.

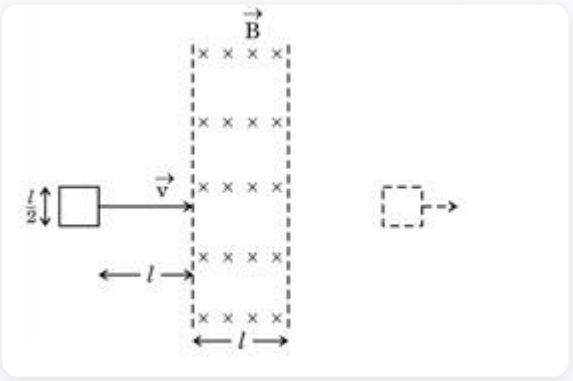
(i) State Lenz's law and explain how this law is a consequence of conservation of energy principle.

(ii) A square shaped loop of side l/2 is initially lying outside a region of uniform magnetic field □□ as shown in the figure. The loop is moved towards right with a constant velocity □□ till it goes out of the region of magnetic field.

(I) What will be the directions of induced current when the loop enters the field and when it leaves the field ?

(II) Draw the plots showing the variation of magnetic flux φ linked with the loop with time t and variation of induced emf E with time t. Mark the relevant values of E, φ and t on the graphs.

[5 Marks]



Question 37.

(i) Differentiate between peak and rms values of alternating current. How are they related ?

(ii) A current element X is connected across an ac source of emf $V=V_0 \sin 2\pi vt$. It is found that the voltage leads the current in phase by π/2 radian. If element X was replaced by element Y, the voltage lags behind the current in phase by π/2 radian.

(I) Identify elements X and Y by drawing phasor diagrams.

(II) Obtain the condition of resonance when both elements X and Y are connected in series to the source and obtain expression for resonant frequency. What is the impedance value in this case ?

[5 Marks]

Question 38.

(i) A physics teacher wants to demonstrate interference with the help of double slit experiment using a laser beam of 633 nm wavelength. Since the hall is large enough, interference pattern is formed on the wall 5·0 m from the slits. For clear and comfortable view by all the students they want the fringe width 5 mm.

(I) Find the slit separation for obtaining the desired interference pattern.

(II) How far will the first minimum be from the central maximum ?

(ii) A parallel beam of light of wavelength 650 nm passes through a slit of width 0·6 mm. The diffraction pattern is obtained on a screen kept 60 cm away from the slit. Find the distance between first order minima on both sides of the central maximum.

[5 Marks]