

CBSE Class 12 Physics 2019 - 55/1/2 - Compartment

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

- (i) This question paper contains **27 questions**. All questions are **compulsory**.
- (ii) The question paper is divided into Sections A, B, C, D.
- (iii) Section A - Questions 1 to 5 carry 1 mark each.
- (iv) Section B - Questions 6 to 12 carry 2 marks each.
- (v) Section C - Questions 13 to 24 carry 3 marks each.
- (vi) Section D - Questions 25 to 27 carry 5 marks each.
- (vii) There is no overall choice. Where an internal choice is provided, attempt only one of the alternatives.
- (viii) Use of calculators is not permitted.

You may use the following values of physical constants wherever necessary:

$$\begin{aligned}c &= 3 \times 10^8 \text{ m/s} \\h &= 6.63 \times 10^{-34} \text{ Js} \\e &= 1.6 \times 10^{-19} \text{ C} \\\mu_0 &= 4\pi \times 10^{-7} \text{ T m A}^{-1} \\\epsilon_0 &= 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2} \\\frac{1}{4\pi\epsilon_0} &= 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}\end{aligned}$$

$$\begin{aligned}\text{Mass of electron } (m_e) &= 9.1 \times 10^{-31} \text{ kg} \\\text{Mass of neutron} &= 1.675 \times 10^{-27} \text{ kg} \\\text{Mass of proton} &= 1.673 \times 10^{-27} \text{ kg} \\\text{Avogadro's number} &= 6.023 \times 10^{23} \text{ per gm mole} \\\text{Boltzmann constant} &= 1.38 \times 10^{-23} \text{ JK}^{-1}\end{aligned}$$

Section A

1. Write the relationship between the horizontal component of earth's magnetic field and the angle of dip.

2. Why does the process of spontaneous nuclear fission occur in heavy nuclei?

3. Define the term 'band width' of message signals in communication system.

4. Name the part of the electromagnetic spectrum which has the longest wavelength and write its one use.

OR

4. Identify the part of electromagnetic spectrum which is used as diagnostic tool in medicine and write its frequency range.

5. Estimate the frequency associated with a photon of energy 2 eV.

OR

5. In photoelectric effect, does the photoelectric current depend on the intensity of incident radiation? Give reasons.

Section B

6. Obtain the expression for the electric field at a point on the equatorial line of an electric dipole.

OR

6. Obtain the expression for potential energy of an electric dipole placed with its axis at an angle θ to an external electric field ($\vec{E}$). What is the minimum value of the potential energy?

7. An electric field along the x-axis is given by $\vec{E} = 200\hat{i}$ N/C for $x > 0$ and $\vec{E} = -200\hat{i}$ N/C for $x < 0$. A right circular cylinder of length 30 cm and radius 5 cm lies parallel to the x-axis, with its centre at the origin and one face at $x = +15$ cm, the other face at $x = -15$ cm. Calculate the net outward flux through the cylinder.

8. Estimate the ratio of the wavelengths associated with the electron orbiting around the nucleus in the first and second excited states of hydrogen atom.

9. Explain any two reasons justifying the need of modulating a message signal before transmission in a communication system.

10. A light bulb is in turn connected in series (a) across an LR circuit, (b) across an RC circuit, with an ac source. Explain, giving necessary mathematical formula, the effect on the brightness of the bulb in case (a) and (b), when the frequency of the ac source is increased.

11(a). Draw a graph of a linearly polarised em wave propagating in the z-direction showing the directions of the oscillating electric and magnetic fields.

11(b). Write the relations (i) between the speed of light and the amplitudes of electric and magnetic fields, (ii) for the speed of em wave in terms of a permittivity ϵ_0 and permeability μ_0 of the medium.

12. In a ceiling fan, each blade rotates in a circle of radius 0.5 m. If the fan makes 2 rotations per second and the vertical component of the earth's magnetic field is 8×10^{-5} T, calculate the emf induced between the inner and outer ends of each blade.

OR

12. A square loop of side 10 cm with its sides parallel to X and Y axes is moved with a velocity of 8 cm s^{-1} in the positive X-direction containing a magnetic field in the positive Z-direction. The field is non-uniform and has a gradient of $10^{-3} \text{ T cm}^{-1}$ along the negative X-direction (i.e. it increases by $10^{-3} \text{ T cm}^{-1}$ as one moves in the negative X-direction). Calculate the emf induced.

Section C

13(a). A particle of charge 'q' and mass 'm', moving with velocity ' $\vec{v}$ ' is subjected to a uniform magnetic field $\vec{B}$ perpendicular to its velocity. Show that the particle describes a circular path. Obtain expression for the radius of the circular path of the particle.

13(b). Explain how its path will be affected if the velocity $\vec{v}$ makes an angle θ ($\neq 90^\circ$) with the direction of the magnetic field.

OR

13. Draw a schematic sketch of a cyclotron. State its working principle and write its two uses.

14(a). You are required to select a carbon resistor of resistance $36 \times 10^4 \Omega \pm 5\%$ from a shop. What would be the sequence of colour bands required to code the desired resistor?

14(b). Why do carbon resistors find extensive use in electronic circuits?

14(c). Write two important precautions used in determining the resistance of a wire using meter bridge.

15(a). Define the terms 'drift velocity' and 'relaxation time' giving their physical significance.

15(b). A conductor of length L is connected across a dc source of emf E. If the conductor is replaced by another of the same material and area of cross-section, but of length 5L, by what factor will the drift velocity change?

OR

15. Two cells of emf and internal resistance ε_1, r_1 and ε_2, r_2 are connected in parallel. Derive the expressions for the emf and internal resistance of a cell which can replace this combination.

16(a). Why is a high resistance required to convert a galvanometer into a voltmeter?

16(b). A galvanometer coil has a resistance of 12Ω and the meter shows full scale deflection for a current of 3 mA. How will you convert it into a voltmeter of range 0 to 18 V?

17. Draw a ray diagram to show the formation of a virtual image of an object by a convex lens. Using this diagram, obtain the expressions for the lens formula.

OR

17. Draw a ray diagram to show the formation of an erect image of an object kept in front of a concave mirror. Hence deduce the mirror formula.

18. Explain the working of a refracting telescope with the help of a labelled diagram. What are the main limitations of this type of telescopes and how are these overcome in a reflecting telescope?

19(a). Write the principle of a semiconductor device which is used as a voltage regulator.

19(b). With the help of a circuit diagram explain its working.

19(c). Draw its I-V characteristics.

OR

19(a). Write the truth tables of (i) AND gate and (ii) NOT gate.

19(b). Show how an OR gate may be obtained with a combination of NAND gates.

20(a). Define the terms, (i) threshold frequency, and (ii) stopping potential in the context of photoelectric effect.

20(b). Draw a graph showing the variation of stopping potential (V_0) with frequency (ν) of incident radiation for a given photosensitive material.

21(a). Draw the circuit diagram for studying the characteristics of an n-p-n transistor in common emitter configuration.

21(b). With the help of its input and output characteristics, how would you find the input resistance and the current gain from these characteristics?

22(a). Hydrogen atoms are excited with an electron beam of energy 12.5 eV. Find the highest energy level up to which the hydrogen atoms will be excited.

22(b). Find the longest wavelengths in the (i) Lyman series, (ii) Balmer series of the spectrum of these hydrogen atoms.

23(a). Using necessary diagrams, explain the amplitude modulation of a sinusoidal carrier wave using a modulating signal.

23(b). For a given amplitude modulated wave, the maximum amplitude is 20 V and the minimum amplitude is 5 V. Calculate the modulation index.

24(a). Explain how a diffraction pattern is formed due to interference of secondary wavelets of light waves from a slit.

24(b). Sodium light consists of two wavelengths, 5900 Å and 5960 Å. If a slit of width 2×10^{-4} m is illuminated by sodium light, find the separation between the first secondary maxima of the diffraction pattern of the two wavelengths on a screen placed 1.5 m away.

Section D

25(a). Obtain the expression for the average power dissipated in a series LCR circuit driven by an ac source of voltage $V = V_m \sin \omega t$ supplying the current $i = i_m \sin(\omega t + \phi)$.

25(b). Define the terms: (i) Wattless current, and (ii) Q-factor of LCR circuit.

OR

25(a). State Faraday's laws of electromagnetic induction.

25(b). Derive an expression for the emf induced across the ends of a straight conductor of length l moving at right angles to a uniform magnetic field B with a uniform speed v .

25(c). Obtain the expression for the magnetic energy stored in a solenoid, in terms of the magnetic field B , area A and length l of the solenoid through which a current i is passed.

26(a). Can two independent monochromatic light sources be used to obtain a steady interference pattern? Justify your answer.

26(b). Explain the formation of interference fringes in Young's double slit experiment and obtain an expression for the fringe width.

26(c). In an interference experiment using monochromatic light of wavelength λ , the intensity of light of a point, where the path difference is λ , on the screen is K units. Find out the intensity of light at a point when path difference is $\frac{\lambda}{4}$.

OR

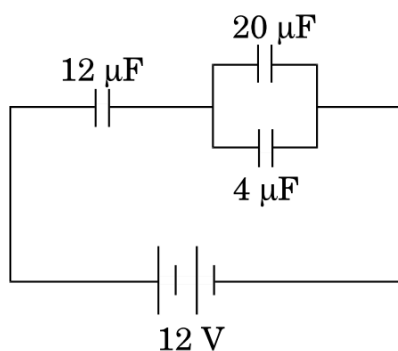
26(a). Sketch the refracted wavefront for the incident plane wavefront of light from a distant object passing through a convex lens.

26(b). Using Huygens' principle, verify the laws of refraction when light from a denser medium is incident on a rarer medium.

26(c). For yellow light of wavelength 590 nm incident on a glass slab, the refractive index of glass is 1.5. Estimate the speed and wavelength of yellow light inside the glass slab.

27(a). Obtain the expressions for the resultant capacitance when the three capacitors C_1 , C_2 and C_3 are connected (i) in parallel and then (ii) in series.

27(b). In the circuit shown in the figure, the charge on the capacitor of $4\ \mu\text{F}$ is $16\ \mu\text{C}$. Calculate the energy stored in the capacitor of $12\ \mu\text{F}$ capacitance.



OR

27(a). Using Gauss' law, obtain expressions for the electric field (i) inside, and (ii) outside a positively charged spherical shell.

27(b). Show graphically the variation of the electric field as a function of the distance r from the centre of the sphere.

27(c). A square plane sheet of side 10 cm is inclined at an angle of 30° with the direction of a uniform electric field of $200\ \text{NC}^{-1}$. Calculate the electric flux passing through the sheet.

- End of Question Paper -