CBSE Class 12 Physics 2011 - Set 55/2/1

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: 3 Hours **Maximum Marks: 70**

General Instructions

(i) All questions are compulsory.

(ii) There are 30 questions in all. Questions 1 to 8 are very short-answer questions carrying 1 mark each.

(iii) Questions 9 to 18 carry 2 marks each. Questions 19 to 27 carry 3 marks each and questions 28 to 30 carry 5 marks each.

(iv) There is no overall choice. Internal choices are provided in one question of 2 marks, one question of 3 marks and all three questions of 5 marks. Attempt only one alternative in each such question.

(v) Use of calculators is not permitted. Log tables may be used if necessary.

(vi) You may use the supplied physical constants wherever necessary.

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

$c = 3 \times 10^8$ m/s

$h = 6.63 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$ C

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^2 C^{-2}

Mass of electron (m_e) $= 9.1 \times 10^{-31}$ kg

Mass of neutron $= 1.675 \times 10^{-27}$ kg

Mass of proton $= 1.673 \times 10^{-27}$ kg

Avogadro's number $= 6.023 \times 10^{23}$ per gm mole

Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}

Section 1-Mark Questions

1. Define the term 'threshold frequency' in relation to photoelectric effect.

2. The peak value of e.m.f. in a.c. is E_0. Write its (i) rms and (ii) average value over a complete cycle.

3. Two insulated charged copper spheres A and B of identical size have charges q_A and q_B respectively. A third sphere C of the same size but uncharged is brought in contact with the first and then in contact with the second and finally removed from both. What are the new charges on A and B?

4. A narrow beam of protons and deuterons, each having the same momentum, enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the radii of the circular paths described by them?

5. What is the function of a 'Repeater' in a communication system?

6. Draw the logic circuit of a NAND gate and write its truth table.

7. How is the mean life of a radioactive sample related to its half life?

8. Write two uses of microwaves.

Section 2-Mark Questions

9. Calculate the amount of work done in rotating a dipole, of dipole moment 3×10^{-8} C m, from its position of stable equilibrium to the position of unstable equilibrium, in a uniform electric field of intensity 10^4 N/C.

10. Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained?

11. When four hydrogen nuclei combine to form a helium nucleus, estimate the amount of energy in MeV released in this process of fusion. (Neglect the masses of electrons and neutrinos)

Given:

(i) mass of $^1_1$H = 1.007825 u

(ii) mass of helium nucleus = 4.002603 u, 1 u = 931 MeV/c^2

12. For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is 2 V. Calculate the modulation index. Why is modulation index generally kept less than one?

13. Draw a block diagram showing the important components in a communication system. What is the function of a transducer?

14. Explain the following:

(i) Why do magnetic lines of force form continuous closed loops?

(ii) Why are the field lines repelled (expelled) when a diamagnetic material is placed in an external uniform magnetic field?

OR

14. (i) Name the three elements of the Earth's magnetic field.

(ii) Where on the surface of the Earth is the vertical component of the Earth's magnetic field zero?

15. Show how the equation for Ampere's circuital law, viz.

$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

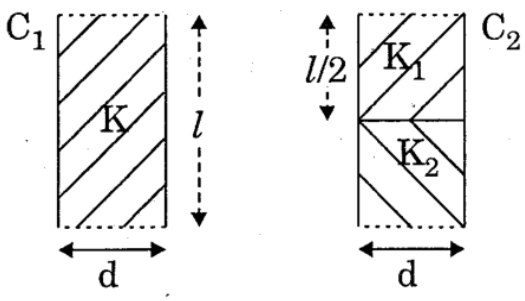
is modified in the presence of displacement current.

16. Current in a circuit falls steadily from 5.0 A to 0.0 A in 100 ms. If an average e.m.f. of 200 V is induced, calculate the self-inductance of the circuit.

17. (a) You are required to select a carbon resistor of resistance 47 kΩ ± 10% from a large collection. What should be the sequence of colour bands used to code it?

(b) Write two characteristics of manganin which make it suitable for making standard resistances.

18. Two identical parallel plate (air) capacitors C_1 and C_2 have capacitances C each. The space between their plates is now filled with dielectrics as shown. If the two capacitors still have equal capacitance, obtain the relation between dielectric constants K, K_1 and K_2.



Section 3-Mark Questions

19. State the principle of the device that can build up high voltages of the order of a few million volts. Draw its labelled diagram. A stage reaches in this device when the potential at the outer sphere cannot be increased further by piling up more charge on it. Explain why.

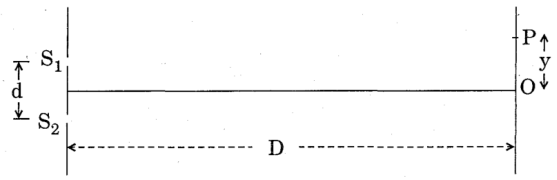
20. Light of wavelength 2000 Å falls on a metal surface of work function 4.2 eV. What is the kinetic energy (in eV) of the fastest electrons emitted from the surface?

(i) What will be the change in the energy of the emitted electrons if the intensity of light with same wavelength is doubled?

(ii) If the same light falls on another surface of work function 6.5 eV, what will be the energy of emitted electrons?

21. Name the important processes that occur during the formation of a p-n junction. Explain briefly, with the help of a suitable diagram, how a p-n junction is formed. Define the term 'barrier potential'.

22. The intensity at the central maxima (O) in a Young's double slit experiment is I_0. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P would be $\frac{I_0}{4}$.



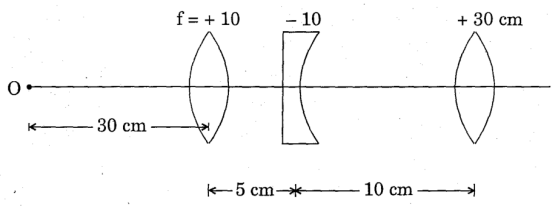
OR

22. In the experiment on diffraction due to a single slit, show that

(i) the intensity of diffraction fringes decreases as the order (n) increases.

(ii) angular width of the central maximum is twice that of the first order secondary maximum.

23. Find the position of the image formed of the object 'O' by the lens combination given in the figure.



24. Draw transfer characteristics of a common emitter n-p-n transistor. Point out the region in which the transistor operates as an amplifier.

Define the following terms used in transistor amplifiers:

(i) Input resistance

(ii) Output resistance

(iii) Current amplification factor

25. (i) Light passes through two polaroids P_1 and P_2 with pass axis of P_2 making an angle θ with the pass axis of P_1. For what value of θ is the intensity of emergent light zero?

(ii) A third polaroid is placed between P_1 and P_2 with its pass axis making an angle β with the pass axis of P_1. Find a value of β for which the intensity of light emerging from P_2 is $\frac{I_0}{8}$, where I_0 is the intensity of light on the polaroid P_1.

26. Using the postulates of Bohr's model of hydrogen atom, obtain an expression for the frequency of radiation emitted when the atom makes a transition from the higher energy state with quantum number n_i to the lower energy state with quantum number n_f ($n_f < n_i$).

27. State the underlying principle of a potentiometer.

Describe briefly, giving the necessary circuit diagram, how a potentiometer is used to measure the internal resistance of a given cell.

Section 5-Mark Questions

28. (a) Show that a planar loop carrying a current I, having N closely wound turns and area of cross-section A, possesses a magnetic moment $\vec{m} = NI\vec{A}$.

(b) When this loop is placed in a magnetic field $\vec{B}$, find out the expression for the torque acting on it.

(c) A galvanometer coil of 50 Ω resistance shows full scale deflection for a current of 5 mA. How will you convert this galvanometer into a voltmeter of range 0 to 15 V?

OR

28. (a) Draw a schematic sketch of a cyclotron, explain its working principle and deduce the expression for the kinetic energy of the ions accelerated.

(b) Two long and parallel straight wires carrying currents of 2 A and 5 A in the opposite directions are separated by a distance of 1 cm. Find the nature and magnitude of the magnetic force between them.

29. (a) Derive the expression for the mutual inductance of two long coaxial solenoids of same length l having radii r_1 and r_2 ($r_2 > r_1$ and $l \gg r_2$).

(b) Show that mutual inductance of solenoid 1 due to solenoid 2, M_{12}, is the same as that of 2 due to 1 i.e. M_{21}.

(c) A power transmission line feeds power at 2200 V with a current of 5 A to a step down transformer with its primary winding having 4000 turns. Calculate the number of turns and the current in the secondary in order to get output power at 220 V.

OR

29. (a) An alternating voltage $v = v_m \sin \omega t$ applied to a series LCR circuit drives a current given by $i = i_m \sin(\omega t + \phi)$. Deduce an expression for the average power dissipated over a cycle.

(b) For circuits used for transporting electric power, a low power factor implies large power loss in transmission. Explain.

(c) Determine the current and quality factor at resonance for a series LCR circuit with $L = 1.00\,\text{mH}$, $C = 1.00\,\text{nF}$ and $R = 100\,\Omega$ connected to an a.c. source having peak voltage of 100 V.

30. (i) A plane wavefront approaches a plane surface separating two media. If medium 'one' is optically denser and medium 'two' is optically rarer, using Huygens' principle, explain and show how a refracted wavefront is constructed.

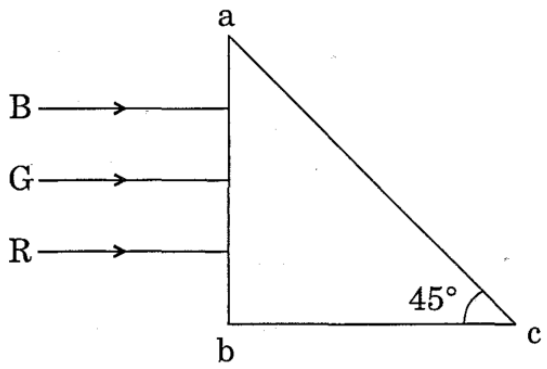
(ii) Hence verify Snell's law.

(iii) When a light wave travels from a rarer to a denser medium, the speed decreases. Does it imply reduction in its energy? Explain.

OR

30. (i) A ray of monochromatic light is incident on one of the faces of an equilateral triangular prism of refracting angle A. Trace the path of ray passing through the prism. Hence derive an expression for the refractive index of the material of the prism in terms of the angle of minimum deviation and its refracting angle.

(ii) Three light rays red (R), green (G) and blue (B) are incident on the right angled prism abc at face ab. The refractive indices of the material of the prism for red, green and blue wavelengths are respectively 1.39, 1.44 and 1.47. Trace the paths of these rays reasoning out the difference in their behaviour.



- End of Question Paper -