CBSE Class 12 Physics 2007 - Delhi

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 is no overall choice. However, an internal choice is provided in one 2-mark question, one 3-mark question and all three 5-mark questions. Attempt only one alternative in each such question.

(iii) Questions 1 to 5 are very short-answer questions carrying 1 mark each.

(iv) Questions 6 to 12 are short-answer questions carrying 2 marks each.

(v) Questions 13 to 24 are short-answer questions carrying 3 marks each.

(vi) Questions 25 to 27 are long-answer questions carrying 5 marks each.

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

(viii) You may use the supplied values of 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. An electron, an alpha-particle and a proton have the same kinetic energy. Which one of these particles has the largest de-Broglie wavelength?

2. Why should the material used for making permanent magnets have high coercivity?

3. The radioactive isotope D decays according to the sequence $D \xrightarrow{\alpha\text{-particle}} D_1 \xrightarrow{\beta\text{-particle}} D_2$. If the mass number and atomic number of D_2 are 176 and 71 respectively, what is (i) the mass number (ii) atomic number of D?

4. What will be the values of input A and B for the Boolean expression $(A + B) \cdot (A \cdot B) = 1$?

5. Why is frequency modulation preferred over amplitude modulation for transmission of music?

Section 2-Mark Questions

6. The output of an OR gate is connected to both the inputs of a NAND gate. Draw the logic circuit of this combination of gates and write its truth table.

7. Draw a plot of potential energy of a pair of nucleons as a function of their separation. What is the significance of negative potential energy in the graph drawn?

8. A convex lens of refractive index 1.5 has a focal length of 18 cm in air. Calculate the change in its focal length when it is immersed in water of refractive index 4/3.

9. Distinguish between the terms 'average value' and 'rms value' of an alternating current. The instantaneous current from an a.c. source is $I = 5\sin(314\,t)$ ampere. What are the average and rms values of the current?

10. Write the relation for the force acting on a charge carrier q moving with a velocity $\vec{v}$ through a magnetic field $\vec{B}$ in vector notation. Using this relation, deduce the conditions under which this force will be (i) maximum (ii) minimum.

11. A cylindrical metallic wire is stretched to increase its length by 5%. Calculate the percentage change in its resistance.

12. The electric field E due to a point charge at any point near it is defined as $E = \lim_{q \to 0} \frac{F}{q}$, where q is the test charge and F is the force acting on it. What is the physical significance of $\lim_{q \to 0}$ in this expression? Draw the electric field lines of a point charge Q when (i) $Q > 0$ and (ii) $Q < 0$.

OR

12. Define electric flux. Write its S.I. units. A spherical rubber balloon carries a charge that is uniformly distributed over its surface. As the balloon is blown up and increases in size, how does the total electric flux coming out of the surface change? Give reason.

Section 3-Mark Questions

13. Deduce an expression for the electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of a dipole at a point as compared to that due to a single charge.

14. A parallel plate capacitor, each with plate area A and separation d, is charged to a potential difference V. The battery used to charge it is then disconnected. A dielectric slab of thickness d and dielectric constant K is now placed between the plates. What change, if any, will take place in

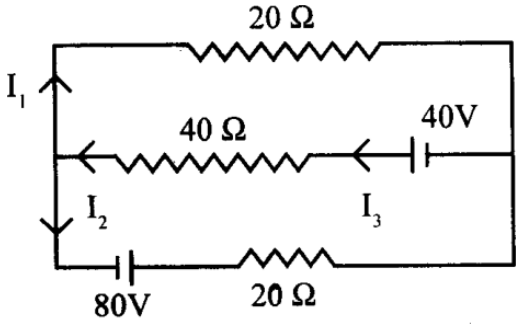
(i) charge on the plates,

(ii) electric field intensity between the plates,

(iii) capacitance of the capacitor.

Justify your answer in each case.

15. State Kirchhoff's rules of current distribution in an electrical network. Using these rules determine the value of the current I_1 in the electric circuit given below.



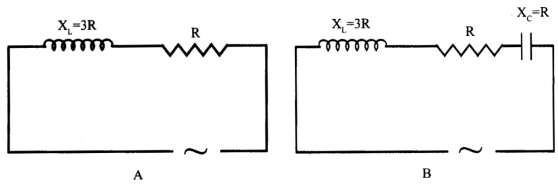
16. Write the mathematical relation for the resistivity of a material in terms of relaxation time, number density and mass and charge of charge carriers in it. Explain, using this relation, why the resistivity of a metal increases and that of a semi-conductor decreases with rise in temperature.

17. Explain with the help of a labelled diagram the underlying principle and working of a step-up transformer. Why cannot such a device be used to step up d.c. voltage?

OR

17. Draw a labelled diagram of an a.c. generator. Explain briefly its principle and working.

18. Given below are two electric circuits A and B.



Calculate the ratio of power factor of the circuit B to the power factor of circuit A.

19. Define the term 'resolving power' of an astronomical telescope. How does it get affected on

(i) increasing the aperture of the objective lens?

(ii) increasing the wavelength of the light used?

Justify your answer in each case.

20. Write four characteristics of electromagnetic waves. Give two uses each of (i) Radio-waves (ii) Micro-waves.

21. In a plot of photoelectric current versus anode potential, how does

(i) the saturation current vary with anode potential for incident radiations of different frequencies but same intensity?

(ii) the stopping potential vary for incident radiations of different intensities but same frequency?

(iii) photoelectric current vary for different intensities but same frequency of incident radiations?

Justify your answer in each case.

22. Calculate the energy released during the α-decay of $^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He}$.

Given:

1. atomic mass of $^{238}_{92}\mathrm{U} = 238.05079$ u
2. atomic mass of $^{234}_{90}\mathrm{Th} = 234.04363$ u
3. atomic mass of $^{4}_{2}\mathrm{He} = 4.00260$ u

$1\,\mathrm{u} = 931.5\,\mathrm{MeV}/c^2$.

Is this decay spontaneous? Give reason.

23. What is a digital signal? Explain the function of modem in data communication. Write two advantages of digital communication.

24. Explain, with the help of a schematic diagram, the principle and working of a Light Emitting Diode. What criterion is kept in mind while choosing the semi-conductor material for such a device? Write two advantages of Light Emitting Diode over conventional incandescent lamps.

Section 5-Mark Questions

25. Draw a labelled diagram of a moving coil galvanometer. State the principle on which it works. Deduce an expression for the torque acting on a rectangular current carrying loop kept in a uniform magnetic field. Write two factors on which the current sensitivity of a moving coil galvanometer depends.

OR

25. State Biot-Savart law. Use it to derive an expression for the magnetic field at the centre of a circular loop of radius R carrying a steady current I. Sketch the magnetic field lines for such a current carrying loop.

26. What are coherent sources? Why are coherent sources required to produce interference of light? Give an example of interference of light in everyday life.

In Young's double slit experiment, the two slits are 0.03 cm apart and the screen is placed at a distance of 1.5 m away from the slits. The distance between the central bright fringe and fourth bright fringe is 1 cm. Calculate the wavelength of light used.

OR

26. State the condition under which the phenomenon of diffraction of light takes place. Derive an expression for the width of central maximum due to diffraction of light at a single slit.

A slit of width 'a' is illuminated by a monochromatic light of wavelength 700 nm at normal incidence. Calculate the value of 'a' for position of

(i) first minimum at an angle of diffraction of 30°.

(ii) first maximum at an angle of diffraction of 30° .

27. State the principle of working of p-n diode as a rectifier. Explain, with the help of a circuit diagram, the use of p-n diode as a full wave rectifier. Draw a sketch of the input and output waveforms.

OR

27. Draw the symbolic representation of a (i) p-n-p, (ii) n-p-n transistor. Why is the base region of a transistor thin and lightly doped? With a circuit diagram, show the biasing of a p-n-p transistor in common base configuration. Explain the movement of charge carriers through different parts of the transistor in such a configuration and show that $I_e = I_b + I_c$.

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