CBSE Class 12 Physics 2012 - 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) This question paper contains **30 questions**. All questions are compulsory.

(ii) Questions 1 to 8 carry 1 mark each; Questions 9 to 18 carry 2 marks each; Questions 19 to 27 carry 3 marks each; Questions 28 to 30 carry 5 marks each.

(iii) There is no overall choice. An internal choice is 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.

(iv) Use of calculators is not permitted. Log tables may be used, if 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

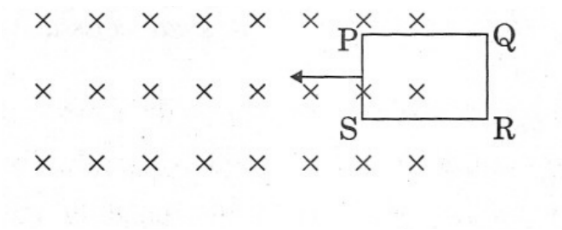
Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}

Section 1-Mark Questions

1. Why is the potential inside a hollow spherical charged conductor constant and has the same value as on its surface?

2. A magnetic needle, free to rotate in a vertical plane, orients itself vertically at a certain place on the Earth. What are the values of (i) horizontal component of Earth's magnetic field and (ii) angle of dip at this place?

3. A closed loop (PQRS) of wire is moved into a uniform magnetic field at right angles to the plane of the paper as shown in the figure. Predict the direction of the induced current in the loop.



4. Name the electromagnetic waves, which (i) maintain the Earth's warmth and (ii) are used in aircraft navigation.

5. How does focal length of a lens change when red light incident on it is replaced by violet light? Give reason for your answer.

6. Write the relationship between the size of a nucleus and its mass number (A).

7. Show on a graph the variation of the de Broglie wavelength (λ) associated with an electron, with the square root of accelerating potential (V).

8. Define dipole moment of an electric dipole. Is it a scalar or a vector?

Section 2-Mark Questions

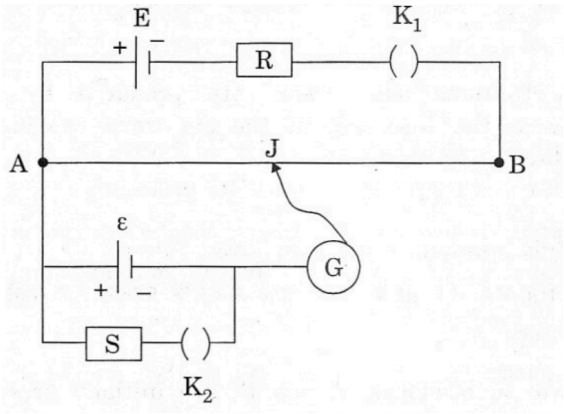
9. A conductor of length 'l' is connected to a dc source of potential 'V'. If the length of the conductor is tripled by gradually stretching it, keeping 'V' constant, how will (i) drift speed of electrons and (ii) resistance of the conductor be affected? Justify your answer.

10. Two students X and Y perform an experiment on potentiometer separately using the circuit given below. Keeping other parameters unchanged, how will the position of the null point be affected if

(i) 'X' increases the value of resistance R in the set-up by keeping the key K_1 closed and the key K_2 open?

(ii) 'Y' decreases the value of resistance S in the set-up, while the key K_2 remains open and the key K_1 closed?

Justify.



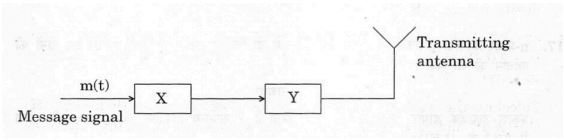
11. A particle of charge 'q' and mass 'm' is moving with velocity $\vec{V}$. It is subjected to a uniform magnetic field $\vec{B}$ directed perpendicular to its velocity. Show that it describes a circular path. Write the expression for its radius.

12. Calculate the quality factor of a series LCR circuit with $L = 2.0\,\text{H}$, $C = 2\,\mu\text{F}$ and $R = 10\,\Omega$. Mention the significance of quality factor in LCR circuit.

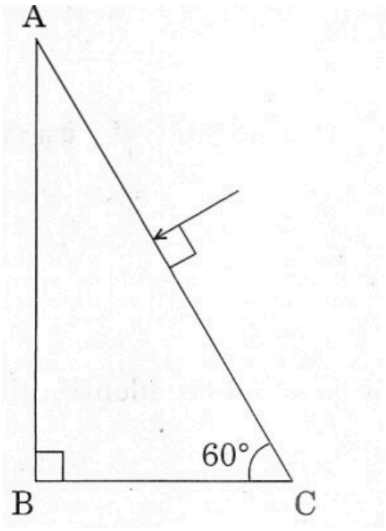
13. Explain briefly how electromagnetic waves are produced by an oscillating charge. How is the frequency of the em waves produced related to that of the oscillating charge?

14. In a given sample, two radioisotopes, A and B, are initially present in the ratio of $1 : 4$. The half lives of A and B are respectively 100 years and 50 years. Find the time after which the amounts of A and B become equal.

15. Figure shows a block diagram of a transmitter. Identify the boxes 'X' and 'Y' and write their functions.



16. Trace the path of a ray of light passing through a glass prism (ABC) as shown in the figure. If the refractive index of glass is $\sqrt{3}$, find out the value of the angle of emergence from the prism.



17. Write two characteristic features to distinguish between n-type and p-type semiconductors.

OR

17. How does a light emitting diode (LED) work? Give two advantages of LED's over the conventional incandescent lamps.

18. A short bar magnet of magnetic moment $0.9\,\mathrm{J/T}$ is placed with its axis at 30° to a uniform magnetic field. It experiences a torque of $0.063\,\mathrm{J}$.

(i) Calculate the magnitude of the magnetic field.

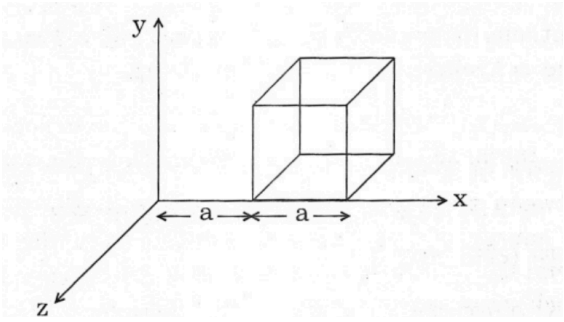
(ii) In which orientation will the bar magnet be in stable equilibrium in the magnetic field?

Section 3-Mark Questions

19. State Gauss's law in electrostatics. A cube with each side 'a' is kept in an electric field given by $\vec{E} = Cx\,\hat{i}$, (as is shown in the figure) where C is a positive dimensional constant. Find out

(i) the electric flux through the cube, and

(ii) the net charge inside the cube.



20. A capacitor of 200 pF is charged by a 300 V battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 100 pF. Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor.

21. Draw a labelled diagram of a moving coil galvanometer and explain its working. What is the function of radial magnetic field inside the coil?

22. Define power of a lens. Write its units. Deduce the relation $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ for two thin lenses kept in contact coaxially.

23. Write two characteristic features observed in photoelectric effect which support the photon picture of electromagnetic radiation.

Draw a graph between the frequency of incident radiation (ν) and the maximum kinetic energy of the electrons emitted from the surface of a photosensitive material. State clearly how this graph can be used to determine (i) Planck's constant and (ii) work function of the material.

24. Define modulation index. Give its physical significance.

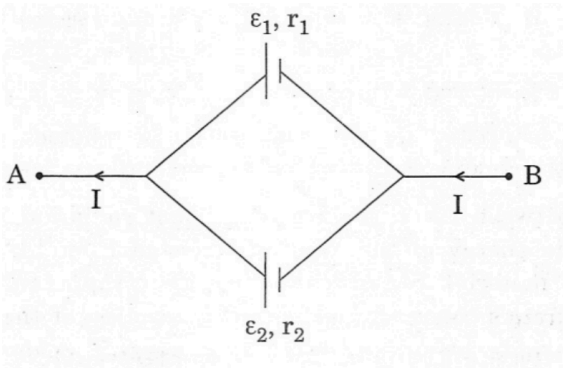
For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is 2 V. Determine the modulation index μ.

25. Two cells of emfs ε_1, ε_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure. Deduce the expressions for

(i) the equivalent e.m.f. of the combination,

(ii) the equivalent resistance of the combination, and

(iii) the potential difference between the points A and B.



26. Using Bohr's postulates for hydrogen atom, show that the total energy (E) of the electron in the stationary states can be expressed as the sum of kinetic energy (K) and potential energy (U), where $K = -2U$. Hence deduce the expression for the total energy in the n^{th} energy level of hydrogen atom.

27. Define a wavefront. Use Huygens' geometrical construction to show the propagation of a plane wavefront from a rarer medium (1) to a denser medium (2) undergoing refraction.

Hence derive Snell's law of refraction.

OR

27. (a) Use Huygens' geometrical construction to show the behaviour of a plane wavefront

(i) passing through a biconvex lens;

(ii) reflecting by a concave mirror.

(b) When monochromatic light is incident on a surface separating two media, why does the refracted light have the same frequency as that of the incident light?

Section 5-Mark Questions

28. (a) What is the effect on the interference fringes in a Young's double slit experiment when

(i) the separation between the two slits is decreased?

(ii) the width of the source slit is increased?

(iii) the monochromatic source is replaced by a source of white light?

Justify your answer in each case.

(b) The intensity at the central maxima in Young's double slit experimental set-up is I_0. Show that the intensity at a point where the path difference is $\lambda/3$ is $I_0/4$.

OR

28. (a) Obtain the conditions for the bright and dark fringes in diffraction pattern due to a single narrow slit illuminated by a monochromatic source.

Explain clearly why the secondary maxima go on becoming weaker with increasing n.

(b) When the width of the slit is made double, how would this affect the size and intensity of the central diffraction band? Justify.

29. (a) State the principle on which AC generator works. Draw a labelled diagram and explain its working.

(b) A conducting rod held horizontally along East-West direction is dropped from rest from a certain height near the Earth's surface. Why should there be an induced emf across the ends of the rod? Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.

OR

29. (a) State the principle of a step-up transformer. Explain, with the help of a labelled diagram, its working.

(b) Describe briefly any two energy losses, giving the reasons for their occurrence in actual transformers.

30. (a) Draw a circuit for studying the input and output characteristics of an n-p-n transistor in CE configuration. Show how, from the output characteristics, the information about the current amplification factor (β_{ac}) can be obtained.

(b) Draw a plot of the transfer characteristic (V_o versus V_i) for a base-biased transistor in CE configuration. Show for which regions in the plot, the transistor can operate as a switch.

OR

30. Why is a zener diode considered as a special purpose semiconductor diode?

Draw the I–V characteristics of a zener diode and explain briefly how reverse current suddenly increases at the breakdown voltage.

Describe briefly with the help of a circuit diagram how a zener diode works to obtain a constant dc voltage from the unregulated dc output of a rectifier.

- End of Question Paper -