CBSE Class 12 Physics 2017 - Set 55/2/3

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. There are 26 questions in all.

(ii) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(iii) Section A contains five questions of 1 mark each; Section B contains five questions of 2 marks each; Section C contains twelve questions of 3 marks each; Section D contains one value-based question of 4 marks; and Section E contains three questions of 5 marks each.

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

(v) 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 A

1. Does the magnifying power of a microscope depend on the colour of the light used? Justify your answer.

2. A photosensitive surface emits photoelectrons when red light falls on it. Will the surface emit photoelectrons when blue light is incident on it? Give reason.

3. Draw logic symbol of an OR gate and write its truth table.

4. A point charge Q is placed at point 'O' as shown in the figure. Is the potential at point A, i.e. V_A, greater, smaller or equal to potential, V_B, at point B, when Q is (i) positive, and (ii) negative charge?

O• A• B•

5. Write the expression for speed of electromagnetic waves in a medium of electrical permittivity ε and magnetic permeability μ.

Section B

6. Use the mirror equation to show that an object placed between f and $2f$ of a concave mirror forms an image beyond $2f$.

OR

6. (a) State the condition under which a large magnification can be achieved in an astronomical telescope.

(b) Give two reasons to explain why a reflecting telescope is preferred over a refracting telescope.

7. Find the intensity at a point on a screen in Young's double slit experiment where the interfering waves have a path difference of (i) $\lambda/6$, and (ii) $\lambda/2$.

8. Describe, with the help of a circuit diagram, the working of a photodiode.

9. Distinguish between broadcast mode and point-to-point mode of communication and give one example for each.

10. A light bulb and a solenoid are connected in series across an ac source of voltage. Explain, how the glow of the light bulb will be affected when an iron rod is inserted in the solenoid.

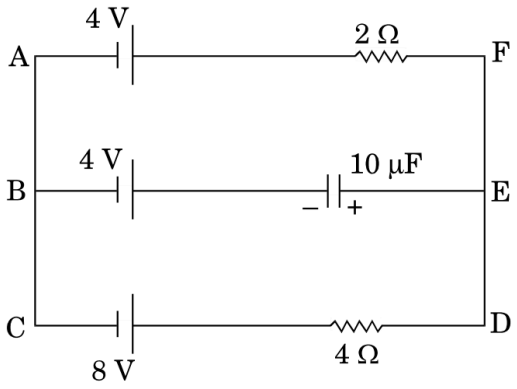
Section C

11. A proton and an α-particle move perpendicular to a magnetic field. Find the ratio of radii of circular paths described by them when both have (i) equal velocities, and (ii) equal kinetic energies.

12. Draw the intensity distributions for (i) the fringes produced in interference, and (ii) the diffraction bands produced due to single slit. Write two points of difference between the phenomena of interference and diffraction.

13. Using Gauss's law in electrostatics, deduce an expression for electric field intensity due to a uniformly charged infinite plane sheet. If another identical sheet is placed parallel to it, show that there is no electric field in the region between the two sheets.

14. In the given circuit, with steady current, calculate the potential drop across the capacitor and the charge stored in it.



15. (a) How are electromagnetic waves produced? Explain.

(b) A plane electromagnetic wave is travelling through a medium along the +ve z-direction. Depict the electromagnetic wave showing the directions of the oscillating electric and magnetic fields.

16. (a) Derive the relation between the decay constant and half life of a radioactive substance.

(b) A radioactive element reduces to 25% of its initial mass in 1000 years. Find its half life.

17. A charge Q is distributed uniformly over a metallic sphere of radius R. Obtain the expressions for the electric field (E) and electric potential (V) at a point $0 < x < R$.

Show on a plot the variation of E and V with x for $0 < x < 2R$.

18. Using Bohr's postulates, derive the expression for the orbital period of the electron moving in the n^{th} orbit of hydrogen atom.

19. (a) Draw a plot showing the variation of photoelectric current with collector potential for different frequencies but same intensity of incident radiation.

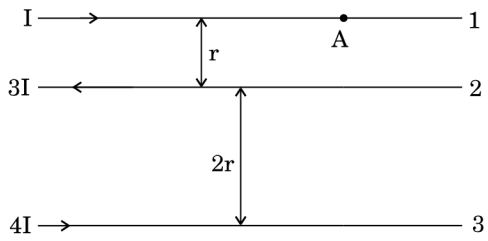
(b) Use Einstein's photoelectric equation to explain the observations from this graph.

(c) What change will you observe if intensity of incident radiation is changed but the frequency remains the same?

20. Using Biot-Savart law, deduce the expression for the magnetic field at a point (x) on the axis of a circular current carrying loop of radius R. How is the direction of the magnetic field determined at this point?

OR

20. The figure shows three infinitely long straight parallel current carrying conductors. Find the



(i) magnitude and direction of the net magnetic field at point A lying on conductor 1,

(ii) magnetic force on conductor 2.

21. What is space wave propagation? Which systems of communication use space waves? What is 'radio horizon' of a transmitting antenna of height h? Why is space wave propagation suitable for frequencies above 40 MHz?

22. A source of ac voltage $v = v_0 \sin \omega t$ is connected across a pure inductor of inductance L. Derive the expressions for the instantaneous current in the circuit. Show that average power dissipated in the circuit is zero.

Section D

23. Sunil and his parents were travelling to their village in their car. On the way his mother noticed some grey coloured panels installed on the roof of a low building. She enquired from Sunil what those panels were and Sunil told his mother that those were solar panels.

(a) What were the values displayed by Sunil and his mother? State one value for each.

(b) In what way would the use of solar panels prove to be very useful?

(c) Name the semiconductor device used in solar panels. Briefly explain with the help of a diagram, how this device works.

Section E

24. (a) A point object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 $(n_2 > n_1)$. Draw the ray diagram and deduce the relation between the object distance (u), image distance (v) and the radius of curvature (R) for refraction to take place at the convex spherical surface from rarer to denser medium.

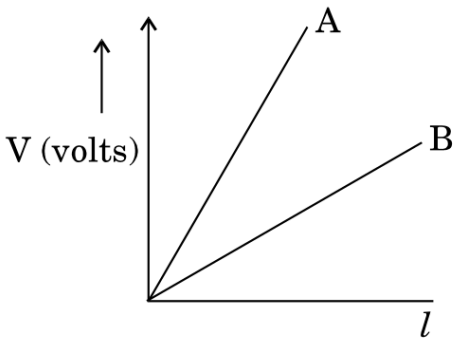
(b) A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index $1 \cdot 6$. If it is immersed in a liquid of refractive index $1 \cdot 3$, find its new focal length.

OR

24. (a) Draw the ray diagram showing refraction of light through a glass prism and hence obtain the relation between the refractive index μ of the prism, angle of prism and angle of minimum deviation.

(b) Determine the value of the angle of incidence for a ray of light travelling from a medium of refractive index $\mu_1 = \sqrt{2}$ into the medium of refractive index $\mu_2 = 1$, so that it just grazes along the surface of separation.

25. (a) (i) State the principle on which a potentiometer works. How can a given potentiometer be made more sensitive?



(ii) In the graph shown below for two potentiometers, state with reason which of the two potentiometers, A or B, is more sensitive.

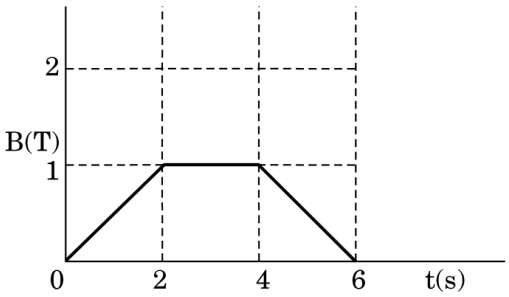
(b) Two metallic wires, P_1 and P_2 of the same material and same length but different cross-sectional areas, A_1 and A_2 are joined together and connected to a source of emf. Find the ratio of the drift velocities of free electrons in the two wires when they are connected (i) in series, and (ii) in parallel.

OR

25. (a) Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in terms of plate area A and separation d between the plates.

(b) A slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor but has a thickness $\frac{d}{2}$. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

26. (a) State Faraday's law of electromagnetic induction.



(b) The magnetic field through a circular loop of wire 12 cm in radius and $8 \cdot 5\ \Omega$ resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time.

(c) Show that Lenz's law is a consequence of conservation of energy.

OR

26. (a) Describe, with the help of a suitable diagram, the working principle of a step-up transformer. Obtain the relation between input and output voltages in terms of the number of turns of primary and secondary windings and the currents in the input and output circuits.

(b) Given the input current 15 A and the input voltage of 100 V for a step-up transformer having 90% efficiency, find the output power and the voltage in the secondary if the output current is 3 A.

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