# CBSE Class 12 Physics 2015 - Set 55/3/P

## 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 **26 questions**. All questions are compulsory.

(ii) The paper is divided into five Sections: A, B, C, D and E.

(iii) Section A: Questions 1 to 5 carry 1 mark each. Section B: Questions 6 to 10 carry 2 marks each.

(iv) Section C: Questions 11 to 22 carry 3 marks each. Section D: Question 23 is a value-based question carrying 4 marks. Section E: Questions 24 to 26 carry 5 marks each.

(v) 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.

(vi) 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

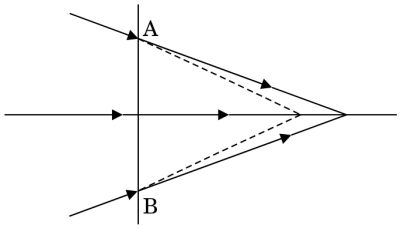
Mass of proton $= 1.673 \times 10^{-27}$ kg

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

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

## Section A

**1.** The line AB in the ray diagram represents a lens. State whether the lens is convex or concave.

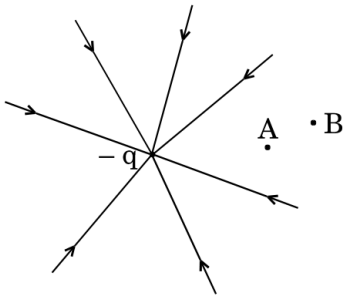



**2.** Distinguish between emf and terminal voltage of a cell.

**3.** Draw a graph to show variation of capacitive-reactance with frequency in an a.c. circuit.

**4.** What is the function of a 'Repeater' used in communication system?

**5.** The field lines of a negative point charge are as shown in the figure. Does the kinetic energy of a small negative charge increase or decrease in going from B to A?



## Section B

**6.** The equivalent wavelength of a moving electron has the same value as that of a photon of energy $6 \times 10^{-17}$ J. Calculate the momentum of the electron.

**7.** What is ground wave communication? Explain why this mode cannot be used for long distance communication using high frequencies.

**8.** A ray of light passes through an equilateral glass prism such that the angle of incidence is equal to the angle of emergence and each of these angles is equal to 3/4 of angle of prism. Find the angle of deviation.

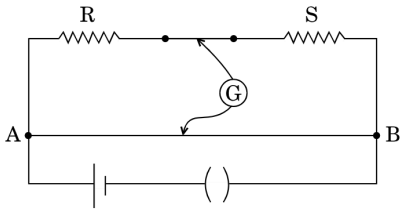
OR

**8.** Calculate the speed of light in a medium whose critical angle is $45^\circ$.

Does critical angle for a given pair of media depend on the wavelength of incident light? Give reason.

**9.** How does one explain, using de Broglie hypothesis, Bohr's second postulate of quantization of orbital angular momentum?

**10.** In a meter bridge shown in the figure, the balance point is found to be 40 cm from end A. If a resistance of 10 Ω is connected in series with R, balance point is obtained 60 cm from A. Calculate the values of R and S.



## Section C

**11.** State Lenz's law. Illustrate, by giving an example, how this law helps in predicting the direction of the current in a loop in the presence of a changing magnetic flux.

In a given coil of self-inductance of 5 mH, current changes from 4 A to 1 A in 30 ms. Calculate the emf induced in the coil.

OR

**11.** In what way is Gauss's law in magnetism different from that used in electrostatics? Explain briefly.

The Earth's magnetic field at the Equator is approximately 0.4 G. Estimate the Earth's magnetic dipole moment. Given: Radius of the Earth = 6400 km.

**12.** How are electromagnetic waves produced? What is the source of energy of these waves?

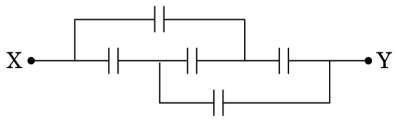
Draw a schematic sketch of the electromagnetic waves propagating along the $+x$-axis. Indicate the directions of the electric and magnetic fields. Write the relation between the velocity of propagation and the magnitudes of electric and magnetic fields.

**13.** Obtain the relation between the decay constant and half life of a radioactive sample.

The half life of a certain radioactive material against $\alpha$-decay is 100 days. After how much time, will the undecayed fraction of the material be 6.25%?

**14.** Write two important considerations used while fabricating a Zener diode. Explain, with the help of a circuit diagram, the principle and working of a Zener diode as voltage regulator.

**15.** Find the equivalent capacitance of the network shown in the figure, when each capacitor is of 1 $\mu$F. When the ends X and Y are connected to a 6 V battery, find out (i) the charge and (ii) the energy stored in the network.




**16.** State the underlying principle of a potentiometer. Write two factors by which current sensitivity of a potentiometer can be increased. Why is a potentiometer preferred over a voltmeter for measuring the emf of a cell?

**17.** (a) Define the term 'intensity of radiation' in terms of photon picture of light.

(b) Two monochromatic beams, one red and the other blue, have the same intensity. In which case (i) the number of photons per unit area per second is larger, (ii) the maximum kinetic energy of the photoelectrons is more? Justify your answer.

**18.** (a) Give two reasons to explain why reflecting telescopes are preferred over refracting type.

(b) Use mirror equation to show that convex mirror always produces a virtual image independent of the location of the object.

**19.** (a) Write the necessary conditions to obtain sustained interference fringes.

(b) In Young's double slit experiment, plot a graph showing the variation of fringe width versus the distance of the screen from the plane of the slits keeping other parameters same. What information can one obtain from the slope of the curve?

(c) What is the effect on the fringe width if the distance between the slits is reduced keeping other parameters same?

**20.** A series LCR circuit is connected across an a.c. source of variable angular frequency '$\omega$'. Plot a graph showing variation of current '$i$' as a function of '$\omega$' for two resistances $R_1$ and $R_2$ ( $R_1 > R_2$). Answer the following questions using this graph:

(a) In which case is the resonance sharper and why?

(b) In which case is the power dissipation more and why?

**21.** Draw the necessary energy band diagrams to distinguish between conductors, semiconductors and insulators.

How does the change in temperature affect the behaviour of these materials? Explain briefly.

**22.** (a) What are the three basic units in communication systems? Write briefly the function of each of these.

(b) Write any three applications of the internet used in communication systems.

## Section D

**23.** During a thunderstorm the 'live' wire of the transmission line fell down on the ground from the poles in the street. A group of boys, who passed through, noticed it and some of them wanted to place the wire by the side. As they were approaching the wire and trying to lift the cable, Anuj noticed it and immediately pushed them away, thus preventing them from touching the live wire. During pushing some of them got hurt. Anuj took them to a doctor to get them medical aid.

Based on the above paragraph, answer the following questions:

(a) Write the two values which Anuj displayed during the incident.

(b) Why is it that a bird can sit on a suspended 'live' wire without any harm whereas touching it on the ground can give a fatal shock?

(c) The electric power from a power plant is set up to a very high voltage before transmitting it to distant consumers. Explain, why.

## Section E

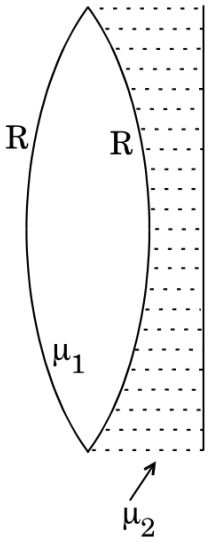
**24.** (a) Use Huygens' principle to show the propagation of a plane wavefront from a denser medium to a rarer medium. Hence find the ratio of the speeds of wavefronts in the two media.

(b) (i) Why does an unpolarised light incident on a polaroid get linearly polarised?

(ii) Derive the expression of Brewster's law when unpolarised light passing from a rarer to a denser medium gets polarised on reflection at the interface.

OR

**24.** A biconvex lens with its two faces of equal radius of curvature R is made of a transparent medium of refractive index $\mu_1$. It is kept in contact with a medium of refractive index $\mu_2$ as shown in the figure.




(a) Find the equivalent focal length of the combination.

(b) Obtain the condition when this combination acts as a diverging lens.

(c) Draw the ray diagram for the case $\mu_2 > (\mu_1 + 1)/2$, when the object is kept far away from the lens. Point out the nature of the image formed by the system.

**25.** Two infinitely long straight parallel wires, '1' and '2', carrying steady currents $I_1$ and $I_2$ in the same direction are separated by a distance $d$. Obtain the expression for the magnetic field $\vec{B}$ due to the wire '1' acting on wire '2'. Hence find out, with the help of a suitable diagram, the magnitude and direction of this force per unit length on wire '2' due to wire '1'. How does the nature of this force change if the currents are in opposite direction? Use this expression to define the S.I. unit of current.

OR

**25.** Draw a necessary arrangement for winding of primary and secondary coils in a step-up transformer. State its underlying principle and derive the relation between the primary and secondary voltages in terms of number of primary and secondary turns. Mention the two basic assumptions used in obtaining the above relation.

State any two causes of energy loss in actual transformers.

**26.** (a) State Kirchhoff's rules and explain on what basis they are justified.

(b) Two cells of emfs $E_1$ and $E_2$ and internal resistances $r_1$ and $r_2$ are connected in parallel. Derive the expression for the (i) emf and (ii) internal resistance of a single equivalent cell which can replace this combination.

OR

**26.** (a) "The outward electric flux due to charge $+Q$ is independent of the shape and size of the surface which encloses it." Give two reasons to justify this statement.

(b) Two identical circular loops '1' and '2' of radius R each have linear charge densities $-\lambda$ and $+\lambda$ C/m respectively. The loops are placed coaxially with their centres $R\sqrt{3}$ distance apart. Find the magnitude and direction of the net electric field at the centre of loop '1'.

**- End of Question Paper -**