

CBSE Class 12 Physics 2015 - Set 55/1/3 - Compartment



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:

$c = 3 \times 10^8 \text{ m/s}$	Mass of electron (m_e) = $9.1 \times 10^{-31} \text{ kg}$
$h = 6.63 \times 10^{-34} \text{ Js}$	Mass of neutron = $1.675 \times 10^{-27} \text{ kg}$
$e = 1.6 \times 10^{-19} \text{ C}$	Mass of proton = $1.673 \times 10^{-27} \text{ kg}$
$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$	Avogadro's number = $6.023 \times 10^{23} \text{ per gm mole}$
$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$	Boltzmann constant = $1.38 \times 10^{-23} \text{ JK}^{-1}$
$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	

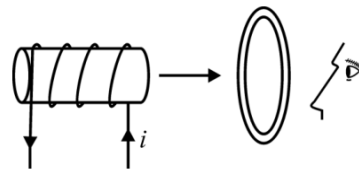
Section A

1. Draw a plot showing the variation of de Broglie wavelength of electron as a function of its K.E.

2. Why is the frequency of outgoing and incoming signals different in a mobile phone?

3. A particle of mass ' m ' and charge ' q ' moving with velocity ' v ' enters the region of uniform magnetic field at right angle to the direction of its motion. How does its kinetic energy get affected?

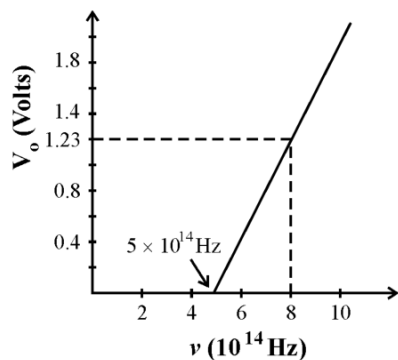
4. Figure shows a current carrying solenoid moving towards a conducting loop. Find the direction of the current induced in the loop.



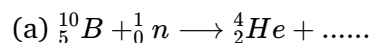
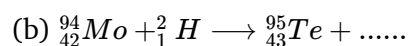
5. When an object is placed between f and $2f$ of a concave mirror, would the image formed be (i) real or virtual and (ii) diminished or magnified?

Section B

6. Using the graph shown in the figure for stopping potential vs the incident frequency of photons, calculate Planck's constant.



7. Complete the following nuclear reactions :



OR

7. If both the number of protons and neutrons in a nuclear reaction is conserved, in what way is mass converted into energy (or vice versa)? Explain giving one example.

8. Using the concept of drift velocity of charge carriers in a conductor, deduce the relationship between current density and resistivity of the conductor.

9. Distinguish between unpolarised and a linearly polarised light. Describe, with the help of a diagram, how unpolarised light gets linearly polarised by scattering.

10. Why does white light disperse when passed through a glass prism?

Using lens maker's formula, show how the focal length of a given lens depends upon the colour of light incident on it.

Section C

11. Answer the following questions :

(i) Why is the thin ozone layer on top of the stratosphere crucial for human survival? Identify to which a part of electromagnetic spectrum does this radiation belong and write one important application of the radiation.

(ii) Why are infrared waves referred to as heat waves? How are they produced? What role do they play in maintaining the earth's warmth through the greenhouse effect?

12. Define the term 'critical angle' for a pair of media.

A point source of monochromatic light 'S' is kept at the centre of the bottom of a cylinder of radius 15.0 cm. The cylinder contains water (refractive index $4/3$) to a height of 7.0 cm. Draw the ray diagram and calculate the area of water surface through which the light emerges in air.

13. Which two of the following lenses L_1 , L_2 and L_3 will you select as objective and eyepiece for constructing the best possible (i) telescope (ii) microscope? Give reason to support your answer.

Lens	Power (P)	Aperture (A)
L_1	6D	1 cm
L_2	3D	8 cm
L_3	10D	1 cm

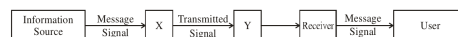
14. Explain by drawing a suitable diagram that the interference pattern in a double slit is actually a superposition of single slit diffractions from each slit. Write two basic features which distinguish the interference pattern from those seen in a coherently illuminated single slit.

15. Distinguish between n-type and p-type semi-conductors on the basis of energy band diagrams. Compare their conductivities at absolute zero temperature and at room temperature.

16. (a) A block diagram of a generalized communication system is given.

Identify the boxes 'X' and 'Y' and write their functions.

(b) Distinguish between 'Point to Point' and 'Broadcast' modes of communication.

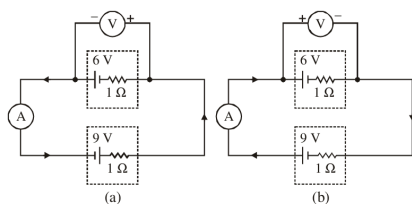


17. An electric dipole of dipole moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$. Obtain the expression for the torque $\vec{\tau}$ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression.

18. (a) R_1 and R_2 ($R_2 > R_1$) are the radii of two spherical conductors. If they are charged and connected by a conducting wire, find out the ratio of the surface charge densities on them.

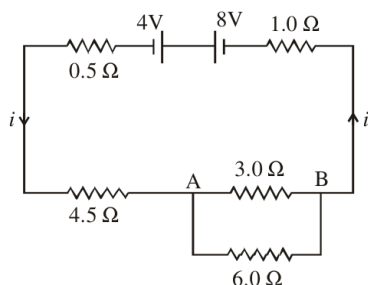
(b) A steady current flows in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor: current, current density, electric field, drift speed?

19. Determine the readings of ideal ammeter (A) and the ideal voltmeter (V) in the two electric circuits shown in the figure.



OR

19. In the circuit shown in the figure, find the current through each resistor.



20. Using the appropriate diagram, define (i) magnetic declination and (ii) angle of dip. In what direction will a compass needle point when kept at the (i) poles and (ii) equator?

21. For a solenoid carrying a steady current I , derive the expression for the magnetic energy stored, in terms of magnetic field B , area A and length l of the solenoid.

How does this magnetic energy per unit volume compare with the electrostatic energy density stored in a parallel plate capacitor?

22. A circuit containing an 80 mH inductor and a $250 \mu\text{F}$ capacitor in series connected to a 240 V, 100 rad/s supply. The resistance of the circuit is negligible.

(i) Obtain rms value of current.

(ii) What is the total average power consumed by the circuit?

23. Ameen had been getting huge electricity bill for the past few months. He was upset about this. One day his friend Rohit, an electrical engineer by profession, visited his house. When he pointed out his anxiety about this to Rohit, his friend found that Ameen was using traditional incandescent lamps and using old fashioned air conditioner. In addition there was no proper earthing in the house. Rohit advised him to use CFL bulbs of 28 W instead of 1000 W – 220 V and also advised him to get proper earthing in the house. He made some useful suggestions and asked him to spread this message to his friends also.

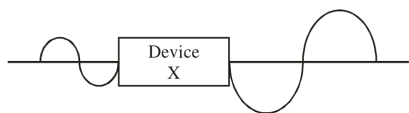
(i) What qualities/values, in your opinion did Rohit possess?

(ii) Why CFLs and LEDs are better than traditional incandescent lamps?

(iii) In what way earthing reduces electricity bill?

Section E

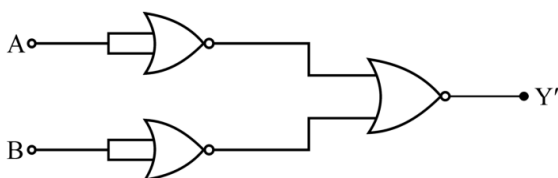
24. (a) Figure shows the input waveform which is converted by a device 'X' into an output waveform. Name the device and explain its working using the proper circuit. Derive the expression for its voltage gain and power gain.



- (b) Draw the transfer characteristic of a base biased transistor in CE configuration. Explain clearly which region of this curve is used as an amplifier.

OR

24. (a) Explain briefly, with the help of circuit diagram, the working of a full wave rectifier. Draw its input and output waveforms.
- (b) Identify the logic gate equivalent to the circuit shown in the figure. Draw the truth table for all possible values of inputs A and B.



25. (a) Draw a schematic arrangement of Geiger-Marsden experiment showing the scattering of α -particles by a thin foil of gold. Why is it that most of the α -particles go right through the foil and only a small fraction gets scattered at large angles?

Draw the trajectory of the α -particle in the coulomb field of a nucleus. What is the significance of impact parameter and what information can be obtained regarding the size of the nucleus?

- (b) Estimate the distance of closest approach to the nucleus ($Z = 80$) if a 7.7 MeV α -particle before it comes momentarily to rest and reverses its direction.

OR

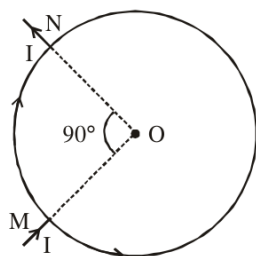
25. (a) Write two important limitations of Rutherford model which could not explain the observed features of atomic spectra. How were these explained in Bohr's model of hydrogen atom?

Use the Rydberg formula to calculate the wavelength of the H_α line. (Take $R = 1.1 \times 10^7 \text{ m}^{-1}$).

- (b) Using Bohr's postulates, obtain the expression for the radius of the n^{th} orbit in hydrogen atom.

26. (a) Use Biot-Savart law to derive the expression for the magnetic field due to a circular coil of radius R having N turns at a point on the axis at a distance ' x ' from its centre. Draw the magnetic field lines due to this coil.

(b) A current ' I ' enters a uniform circular loop of radius ' R ' at point M and flows out at N as shown in the figure. Obtain the net magnetic field at the centre of the loop.



OR

26. (a) Show that Biot-Savart law can be alternatively expressed in the form of Ampere's circuital law. Use this law to obtain the expression for magnetic field inside a solenoid of length ' l ', cross-sectional area ' A ' having ' N ' closely wound turns and carrying a steady current ' I '. Draw the magnetic field lines of a finite solenoid carrying current I .

(b) A straight horizontal conducting rod of length 0.45 m and mass 60 g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod through the wires. Find the magnitude and direction of the magnetic field which should be set up in order that the tension in the wire is zero.

- End of Question Paper -