TEST PAPER: PHYSICS

Time: 75 Minutes **Class: ISC/CBSE 12**

Max. Marks: 30 Marks **Date: 21st November 2018**

Marking Scheme: *All questions carry 10 marks each. Subparts (A) and (B) carry 3 marks each and subpart (C) carries 4 marks.*

Question 1:

a. A thin metallic shell of radius R carries a charge Q on its surface. A point charge Q/2 is placed at its centre C and another charge +2Q is placed outside the shell at a distance x from the centre.
   1. Find the electric flux through the centre
   2. State the law used
   3. Find the force on the charges C at the centre of the shell and at the point.

b. A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept 15 cm apart. A point object is placed 40 cm in front of the convex lens. Find the position of the image formed by this combination. Draw the ray diagram showing the image formation.

c. (i) A rod of length l is moved horizontally with a uniform velocity 'v' in a direction perpendicular to its length through a region in which a uniform magnetic field is acting vertically downward. Derive the expression for the emf induced across the ends of the rod.
   (ii) How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain.

Question 2:

a. A voltage $V=V_0 \sin \omega t$ is applied to a series LCR circuit. Derive the expression for the average power dissipated over a cycle. Under what condition is
   (i) no power dissipated even though the current flows through the circuit,
   (ii) maximum power dissipated in the circuit?

b. Answer the following:
   i. In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width.
   ii. The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 9 : 25. Find the ratio of the widths of the two slits.

c. Answer the below questions:
   i. Draw a labelled diagram of a moving coil galvanometer. Describe briefly its principle and working.
   ii. Answer the following:
   (A) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer?
   (B) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Explain, giving reason.

Question 3:

a. Answer the following:
   i. Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?
   ii. Using Bohr's postulates of the atomic model derive the expression for radius of nth electron orbit. Hence obtain the expression for Bohr's radius.

b. Light of intensity 'I' and frequency 'v' is incident on a photosensitive surface and causes photoelectric emission. What will be the effect on anode current when (i) the intensity of light is gradually increased, (ii) the frequency of incident radiation is increased, and (iii) the anode potential is increased? In each case, all other factors remain the same. Explain, giving justification in each case.

c. State Biot – Savart law. Deduce the expression for the magnetic field at a point on the axis of a current carrying circular loop of radius 'R' distant 'x' from the centre. Hence, write the magnetic field at the centre of a loop.