B.Sc.(Honours)Examination, 2018

Semester–III

Physics (Allied)

Course: BPA-31

(Electricity& Magnetism)

Time: Three Hours **Full Marks: 40**

Questions are of value as indicated in the margin.

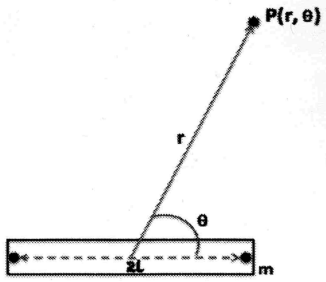
Answer ***four*** questions

1. (a) What do you mean by the strength of magnetic shell? Consider a completely closed spherical shell of radius R and of constant magnetic field strength Φ. Show that the potential at a point inside such a spherical shell is constant. **1+3**

   (b) Consider a magnetic dipole in the form of a bar magnet of magnetic length $2l$ and the pole strength m.

   i. Find the potential at the point $P(r, \theta)$ with respect to the mid point of the dipole, as shown in the figure, in the limit $r >> l$. **4**

   ii. Hence, obtain the magnetic field $\vec{B}$ at that point. **2**



2. (a) Suppose two horizontal, parallel metal rails AC and BD are connected by a metallic rod AB, kept in a place where the vertical component of the earth's magnetic field is 0.37×10^{-4} Tesla. Determine the induced e.m.f in volt, when another metallic rod EF is being drawn away from the rod AB, but keeping it always in parallel with AB, with a velocity of 5 metre/second. **4**

   (b) A sinusoidal voltage $E = E_0 \sin \omega t$ is applied to a circuit containing a resistor R and inductor L in series. Find an expression for the instantaneous current. Discuss the role of LCR circuit in radio. **4+2**

3. (a) In an atom, if an electron of charge $-e$ and mass m revolves with an angular frequency ω in a circular orbit of radius a around a positively charged nucleus of charge $+Ze$ find the magnetic moment of the atom. **3**

   (b) i. Consider a circular loop of radius R carrying a current I. Calculate the magnetic field at a distance z along the axis from the center of the circle. **4**

   ii. Consider two coplanar and concentric circular loops. A current I flows in the inner loop which is of radius r. The outer loop is of radius $2r$. Find the direction and magnitude of the current flowing in the outer circular loop to have a net magnetic field zero at the center of the loop. **3**

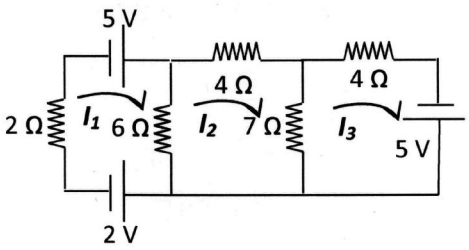
4. (a) Calculate the co-efficient of the self-induction if a current i ampere flows through a plane circular coil, kept in air, of radius a metre containing n number of turns. **5**

   (b) Find out the capacitance of a cylindrical condenser whose inner and outer cylinders radii are 'a' and 'b' respectively and 'ε' is the permittivity of the intervening medium between the cylinder. The outer is connected to the earth. 5

P.T.O.

5 (a) Is it possible to measure either very low or very high resistance by the Wheatstone bridge principle? Explain. 2

(b) In the following circuit, find out the current 'i_1', 'i_2' and 'i_3'. 6



(c) An external resistance 'R' is connected with a cell of e.m.f 'E' and internal resistance 'r'. At what condition, cell will deliver maximum power to the external resistance? 2

6 (a) Find out the balanced condition of the Wheatstone bridge connected with a galvanometer of resistance 'r_g' and a cell of e.m.f of 'E' & internal resistance 'r'. 5

(b) (i) What do you mean by Seebeck effect in thermoelectricity? (ii) Neatly sketch the dependence of thermo-e.m.f with temperature for a thermocouple. (iii) Does the neutral point depend on temperature of cold junction and inversion temperature? 3

(c) State the Faraday's laws of electrolysis? 2

7. (a) (i) Derive the expression for charging of a C-R (capacitance-resistance) circuit. (ii) Define the time-constant for charging of a C-R circuit. (iii) Plot Q-t (charge vs time) curve for two different time constant. 3+1+1=5

(b) In a C-R circuit if C = 4.7 μF, R = 0.15 MΩ, in what time will the charge in the capacitor attain half of its final value? [$\log_e 2 = 0.6931$]. 2

(c) State the thermoelectric laws for the thermocouples. 3
