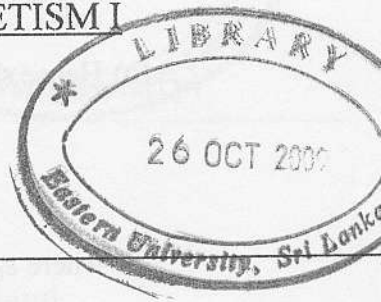


EASTERN UNIVERSITY, SRI LANKA
FIRST EXAMINATION IN SCIENCE - 2007/2008
SECOND SEMESTER (PROPER/REPEAT)
(August/September 2009)
PH 103 ELECTRICITY AND MAGNETISM I

Time: 01 hour.

Answer ALL Questions



(c) If the potential at the center of the disk is V , then

(d) What is the total surface charge Q which is uniformly distributed over the disk?

(e) What is the potential at a point A along the axis of the disk at a distance x from the center of the disk?

2. A long central cable of length l and four charge density λ consists of a solid cylindrical conductor of radius R_1 and a thin outer cylindrical conducting shell of radius R_2 . The two conductors are connected together by a radial wire of the shell and the outer end of the shell is connected to a battery at the other end. Hence find a) the electric field in the region between the conductors, b) the electric field E in the region between the conductors, c) Hence show that the potential difference V between the conductors is

$$V = \frac{\lambda}{2\pi\epsilon_0} \ln \left(\frac{R_2}{R_1} \right)$$

(d) Also find the capacitance per unit length C .

(e) And calculate the capacitance C when $R_1 = 3$ cm, $R_2 = 10$ cm and $l = 1.82 \times 10^{-2}$ m.

1. Define the electric potential in an electrostatic medium. A circular disk of radius uniform positive surface charge density σ on its upper surface.

(a) What is the electric potential at point P , at a distance r from the disk along its axis?

(b) Hence show that the electric field at point P is:

$$E = \frac{\sigma}{2\epsilon_0} \left[1 - \frac{r}{\sqrt{r^2 + R^2}} \right]$$

where ϵ_0 is the permittivity of free space.

(c) If the potential at the center of the disk is V_0 . Then

(i) What is the total surface charge Q which is uniformly distributed on the disk?

(ii) What is the potential at a point A along the axis of the disk at a distance of from the center of the disk?

2. A long coaxial cable of length l and linear charge density λ consists of a solid cylindrical conductor of radius R_1 and a thin outer cylindrical conducting shell of radius R_2 . The two conductors are connected together by a resistor at one end and to a battery at the other end. Hence there is a current I in the conductors. Find the potential difference V between them. Neglect the resistance of the cable.

(a) Find the magnetic field B in the region between the conductors.

(b) Find the electric field E in the region between the conductors.

(c) Hence show that the potential difference V between the conductors is:

$$V = \frac{\lambda}{2\pi\epsilon_0} \ln \left(\frac{R_2}{R_1} \right)$$

(d) Also find the capacitance per unit length.

(e) And calculate the capacitance C when $R_1 = 3$ cm, $R_2 = 10$ cm and

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$