EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE – 2013/2014

SECOND SEMESTER (April/May 2016)

PH 103 ELECTRICITY AND MAGNETISM I

Time: 01 hour

Answer ALL Questions

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01. State Gauss's law in electrostatics.

Figure 1 shows a spherical capacitor of charge Q, which is formed with two concentric conducting shells of inner radius a and outer radius b. The regions within the spherical shells from a to r and r to b are filled with the dielectric constants K_1 and K_2 respectively. The electric potentials at inner shell and the outer shell are V_a and V_b respectively.

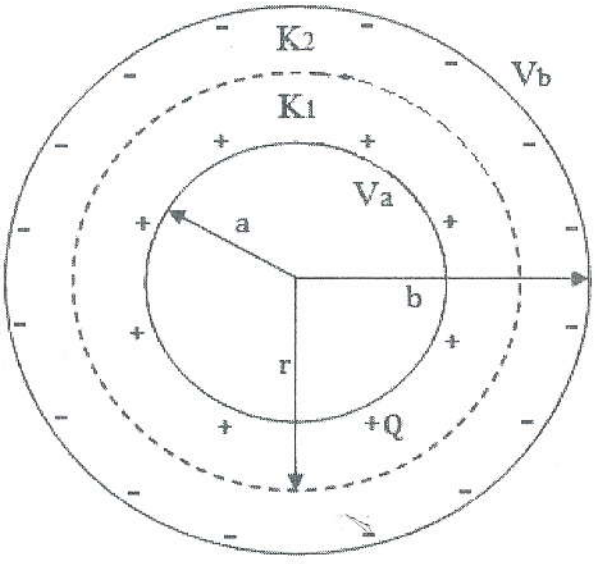

Figure 1

a) Using Gauss's law, find an expression for electric field within the capacitor.

b) Find the potential difference between the inner and the outer surfaces of the spherical shells.

c) Determine the capacitance of the capacitor.

d) If $K_1 = K_2 = 10$, $a = 2$ cm, $b = 5$ cm, and $r = 3.5$ cm, then show capacitance of the capacitor is $\frac{4}{3}\pi\varepsilon_0$.

e) If charge $Q = 20$ μF, then show that the energy stored in the capacitor is

Given that $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 Nm^2C^{-2}$, where ε_0 is the permittivity of free

02. State Biot-Savart law and hence derive an expression for the magn formed by an infinitely long current carrying wire at a distance r.

Consider two long straight parallel current conductors A and B currents I_1 and I_2 in opposite directions as shown in figure.

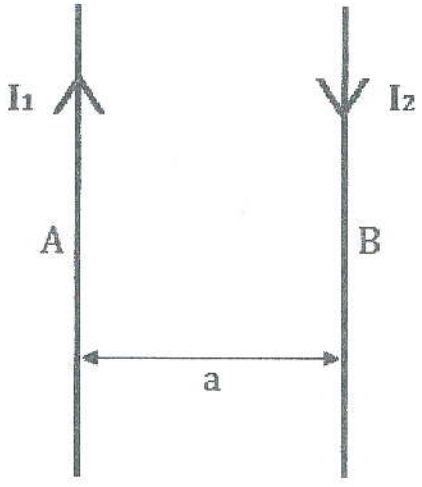

Figure 2

a) Determine the magnitude and the direction of the magnetic field form conductor B due to conductor A.

b) Determine the magnitude and the direction of the force per unit conductor B.

c) Show that the magnitude of force per unit length on conductors A a same.

d) If $I_1 = 10$ A, $I_2 = 8$ A, and $a = 4$ cm, then calculate the force per unit leng conductors.

e) If I_2 is increased to 10A then find the increment in force per unit length

f) Illustrate the directions of forces on A and B, if the currents I_1 and I_2 a in the same direction.

Assume that the permeability of free space is $\mu_0 = 4\pi \times 10^{-7}\ Hm^{-1}$.