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EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE – 2012/2013

SECOND SEMESTER (PROPER/REPEAT)

(AUGUST/SEPTEMBER 2015)

PH 103 ELECTRICITY AND MAGNETISM - I

Time: 01 hour

Answer ALL Questions

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01. State Gauss's theorem in electrostatics.

Derive an expression for the electric field intensity due to a uniformly charged non-conducting sphere of total charge Q and radius R at an interior point and an exterior point.

Show that the electric potential V inside the sphere at a distance r from its center is given by,

$$V = \frac{Q}{4\pi\varepsilon_0 R} + \frac{Q}{8\pi\varepsilon_0}\left[\frac{1}{R} - \frac{r^2}{R^3}\right].$$

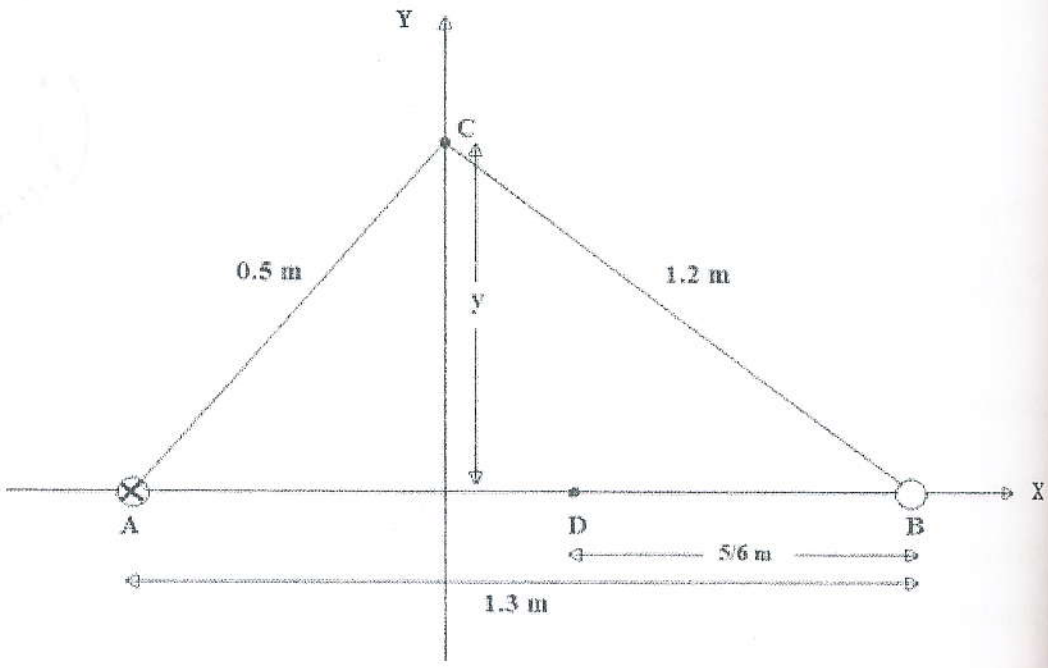
A uniformly charged sphere of radius 30 cm has the total charge of +5 μC. Determine the electric field strength, and the electric potential at a distance 18 cm and at the surface of the sphere from the center of the sphere.

Sketch the variation of the electric field strength E with the distance from the center of the sphere.

Assume that the electric potential at infinity is zero.

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

02. State Biot-Savart law and derive an expression for magnetic field produced by an infinitely long current carrying wire at a distance a.



Two long straight parallel wires are 1.3 m apart, and perpendicular to the plane of paper. The wire A carries a current of 1.4 A, directed into the plane of the paper. The wire B carries a current such that the magnetic field of induction at the point D at a distance 5/6 m on X-axis from the wire B, is zero. Find,

(i) the magnitude and direction of the current in wire B
(ii) the magnitude of the magnetic field of induction at point C
(iii) the force per unit length on the wire B
(iv) find the value of vertical distance y at which magnetic field is maximum.

Assume that $\mu_0 = 4\pi \times 10^{-7}\ Hm^{-1}$.