EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE - 2009/2010

SECOND SEMESTER (PROPER/REPEAT)

(April 2012)

PH 103 – ELECTRICITY AND MAGNETISM

Time: 01 hour.

Answer ALL Questions

---

1. State Gauss's theorem in electrostatics.

a) A conducting spherical volume of radius a carries a total positive charge Q distributed uniformly throughout it. Using Gauss's theorem, derive an expression for the electric field strength inside the sphere at a distance r from its center. Hence show that the electric potential inside the sphere at a distance r from the center is given by:

$$\frac{Q(3a^2 - r^2)}{8\pi\varepsilon_0 a^3}$$

b) Using Gauss's theorem, derive an expression for the capacitance per unit length between two long coaxial cylindrical conductors of radius a and b $(> a)$ in air.

2. State Ampere's circuital law clearly identifying the quantities involved.

a) As illustrated in figure (a), a coaxial line carries the same current I upward the in conductor of radius a, and downward the outer conductor of inner radius b and o radius c.

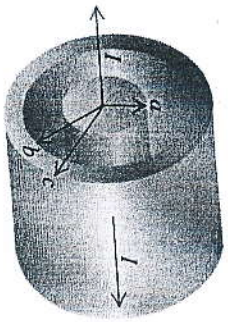

Figure (a)

Using Ampere's circuital law, find an expression for the magnitude of the magnetic f at a distance r from the conductor, when

i. $r < a$

ii. $a < r < b$ and

iii. $b < r < c$.

b) An infinitely long, cylindrical conductor of radius R carries a current I in the direction. The axis of the cylinder lies in a plane of a rectangular loop of wire with dimensions $2R$ and L, as shown in the figure (b). The current I in the cylinder uniformly distributed over its cross section perpendicular to its axis.

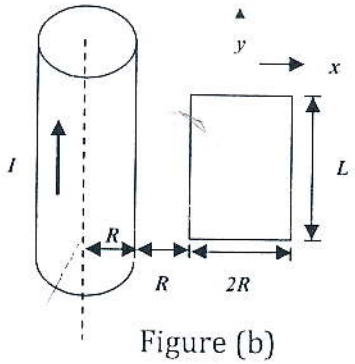

Figure (b)

i. Using Ampere's circuital law, find an expression for the magnitude of the magne field at a distance $r < R$, measured from the axis of the cylinder.

ii. Find the magnetic flux through the loop due to the current I in the cylinder.