國立中央大學八十七學年度碩士班研究生入學試題卷

請寫清楚.
寫得多不如寫得好.
切記切記.

1. Find the electric potential inside and outside of the conducting spherical shell in Fig. 1. Also find the surface charge density in the inner wall and outer wall of the shell. There is a positive charge Q at the center of the sphere. 7%

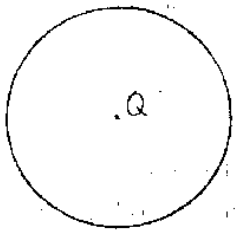


Fig. 1

2. Find the electric potential inside and outside of the conducting spherical shell in Fig. 2. Note that the conducting shell is grounded. There is a positive charge Q at the center of the sphere. 7%

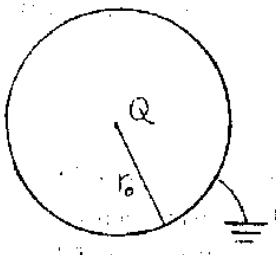


Fig. 2

3. There are 2 concentric conducting spherical shells of which the inner one is grounded, and the outer one is charged with an amount of electric charge Q. Find the potential outside the outer shell, the potential in the space between the 2 shells, and the potential inside the inner shell. (See Fig. 3) 14%

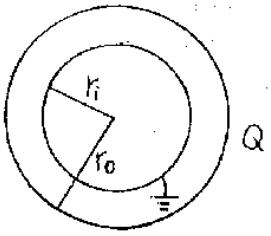


Fig. 3

4. Fig. 4 shows a sphere of radioactive material; it radiates β particles radially outward with a rate of $-M$ coul/sec. (M is a positive number). 13%
   a) Find the outward current density at point P.
   b) Use Maxwell Equations to obtain $\vec{B}$ at point P.

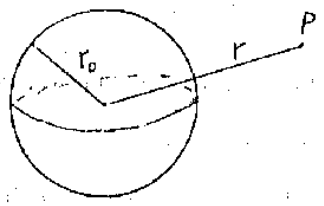


Fig. 4

注意：背面有試題

5. Suppose there is a long cylindrical shell on which there is a surface charge density σ. The cylindrical shell is now rotating with an angular velocity ω. Find the magnetic induction $\bar{B}$ inside the cylinder in terms of r, ω, σ and μ_0, the permeability of the vacuum. If there is a metallic rod fastened with the cylinder as shown in the figure, is there any charge redistribution in the rod as the cylinder starts to rotate ? How is the polarity of the rod now? (Fig. 5) 17%

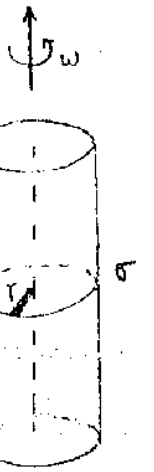


Fig. 5

6. A current I is flowing in a wire shown in Fig.6 . The wire is bent into a half circle at one end. Find the magnetic induction B at the center of the half circle. (Both magnitude and direction) 14%

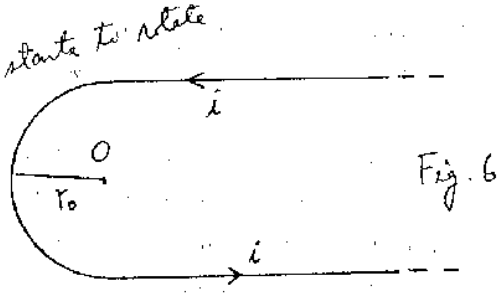
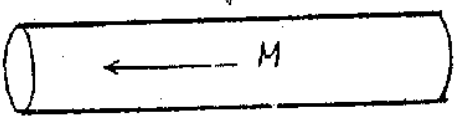


Fig. 6

7. Consider a very long cylindrical soft iron with a magnetization M (M is a constant).
a) Find the expression and direction of $\bar{B}$ and $\bar{H}$ near the center of the iron bar.
b) Show that the B field suffers a sudden direction change as they emerge to the outside from the interior through the lateral surface of the iron bar. 15%
c) Sketch the lines of the B-field and H-field inside and outside of the iron bar.

Fig. 7



8. A charged particle whose charge is q travels at a velocity u in the field of a plane electromagnetic wave in free space, the velocity of the particle being parallel to the direction of propagation of the wave. Suppose the wave is propagating in z-direction and E-field is in x-direction. 15%
a) Find the expression and direction for the force on the particle when $u << \frac{c}{1000}$.
b) Find the expression and direction for the force on the particle when $u = c$.