國立彰化師範大學 98 學年度碩士班招生考試試題

系所：顯示技術研究所　　科目：乙、電磁學

☆☆請在答案紙上作答☆☆　　

1. Consider two spherical shells as shown in Fig-1. For the inner shell, there is a +Q charge and the outer shell with –Q charge. Between these two shells, there is a material with dielectric constant ε. Please derive the capacitance and the total energy. (20%)

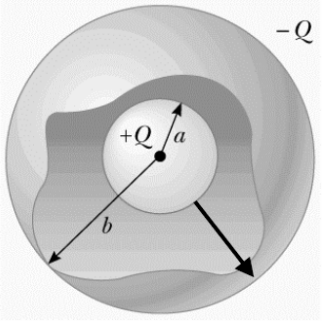

Fig-1

2. Two capacitors C_1 and C_2 (where $C_1 > C_2$) are charged to the same initial potential difference ΔV_i, but with opposite polarity. The charged capacitors are removed from the battery, and their plates are connected as shown in Fig-2a. The switches S_1 and S_2 are then closed, as shown in Fig-2b. (a) Find the final potential difference ΔV_f between a and b after the switches are closed. (b) Find the total energy stored in the capacitors before and after the switches are closed and the ratio of the final energy to the initial energy.
(20%)

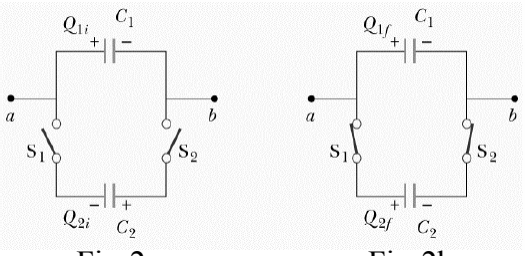

Fig-2a　　Fig-2b

3. The conducting bar illustrated in the Fig-3, of mass m and length l, moves on two frictionless parallel rails in the presence of a uniform magnetic field B directed in the page. The bar is given an initial velocity v_i to the right and is released at t=0. Find the moving velocity of the bar as a function of time. (20%)

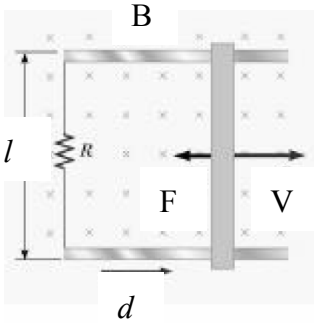

Fig-3

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4. A disk with uniform surface charge density σ has a radius *a*. Please find the electric field along the axis *x* at position *P* as shown in Fig-4. (10%)

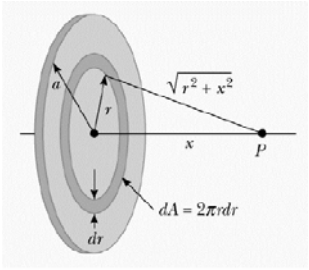

Fig-4

5. An infinitely long wire is placed at a height *h* above a perfectly conducting plane as shown in cross section in the Fig-5. The wire carries a line charge density of ρ_l [C/m]. Calculate the potential at *h*, midway between the wire and the plane, directly below the wire. Assume permittivity of free space. (20%)

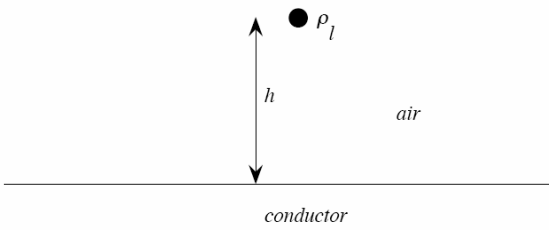

Fig-5

6. A cylindrical conductor has conductivity σ, radius *a* and length *L* as shown in Fig-6. Now a slice is cut on two opposite sides of the conductor to form two flat surfaces running the length of the conductor. Calculate the resistance between these two flat surfaces (i.e. as if you were measuring the resistance with an ohm-meter between the two flat surfaces). Note, the distance between the two flat surfaces is *a* while the curved section has radius *a*. (10%)

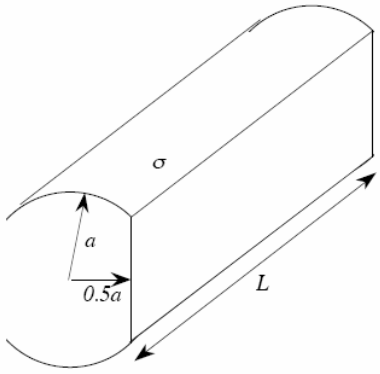

Fig-6