Electromagnetism HW # (2)

(1) (Prob 4, Chap 1 in Julian Schwinger's book)

(2) Problem 1.2, Problem 1.3 in Jackson's book.

(3) Using delta function express the charge density and current density of

(a) an infinite wire along the z-axis carrying a constant current I.

(b) A spherical shell of radius 'a' with charge 'Q' uniformly spread on it and rotated about the z-axis with constant angular speed 'ω'.

(4) Evaluate

$$\int_0^\infty dx \; \frac{\sin x}{x} = \frac{\pi}{2}$$

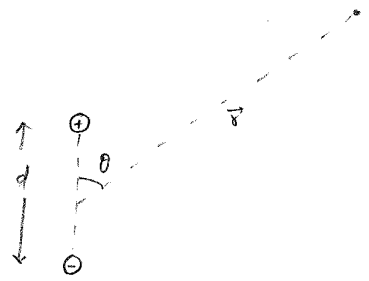
(5) Problems from Halliday & Resnick:

Chap 22: Prob 14, 21, 25

⑥ Electric dipole :

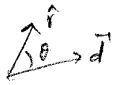
An electric dipole consists of two equal and opposite charges $(\pm q)$ separated by a distance 'd'. Show that the potential due to an electric dipole at $\vec{r}$ (for $d << |\vec{r}|$) is given by

$$\phi(\vec{r}) \simeq \frac{q\, d \cos\theta}{r^2}$$



Notice that it falls as $\frac{1}{r^2}$.

(Hint : $\frac{1}{|\vec{r} \pm \frac{\vec{d}}{2}|} = \frac{1}{\sqrt{r^2 + \frac{d^2}{4} \pm 2r\frac{d}{2}\cos\theta}}$



$$= \frac{1}{r}\left\{1 \pm \frac{d}{r}\cos\theta + \frac{d^2}{4r^2}\right\}^{-\frac{1}{2}}$$

$$\simeq \frac{1}{r}\left\{1 \mp \frac{d}{2r}\cos\theta\right\}$$