

Electromagnetic Theory II

Problem Set 10

Due: 31 March 2021

36. J, Problem 9.5. In this problem you are to start with the exact expressions

$$A_\mu(\mathbf{r}, \omega) = \frac{\mu_0}{4\pi} \int d^3r' J_\mu(\mathbf{r}', \omega) \frac{e^{ik|\mathbf{r}-\mathbf{r}'|}}{|\mathbf{r}-\mathbf{r}'|} \quad (1)$$

and, to extract the dipole contribution, assume only $r' \ll r$ and $kr' \ll 1$, but kr not necessarily large.

37. J, Problem 9.8. Recall from our lecture notes or J, Section 12.10 the identification of the current of angular momentum with $r^i T^{j\mu} - r^j T^{i\mu}$ where $T^{\rho\mu}$ is the symmetric energy momentum tensor. The point of Jackson's hint is that the angular momentum density $\epsilon \mathbf{r} \times (\mathbf{E} \times \mathbf{B})$ as well as its flux has an extra factor of order r , and so with radiation zone fields, the flux has nominal large r behavior of $1/r$. Of course that leading behavior must cancel leaving a contribution of order $1/r^2$, which involves $1/r^2$ terms in the fields.

38. J, Problem 9.11.

39. J, Problem 9.14.