

HW2

Use Fourier transforms to find an alternative expression to

a) The potential in equation (1.21)

$$\Phi(\mathbf{r}) = \int d^3 r' \frac{\rho(\mathbf{r}')}{|\mathbf{r} - \mathbf{r}'|}$$

b) The electrostatic energy:

$$U = \frac{1}{2} \int d^3 r \int d^3 r' \frac{\rho(\mathbf{r})\rho(\mathbf{r}')}{|\mathbf{r} - \mathbf{r}'|}$$

The expressions shall contain the Fourier transforms, $\rho(\mathbf{q})$, of $\rho(\mathbf{r})$ and $v(\mathbf{q})$ of $v(\mathbf{r})=e^2/r$; $v(\mathbf{q})=4\pi e^2/q^2$.

It is always good to have alternative ways to calculate things. Maybe the Fourier transform $\rho(\mathbf{q})$ has a simpler form than $\rho(\mathbf{r})$ making the calculations easier.