

1. Gauges and stuff: (a) Obtain 6.10 and 6.11 from Maxwell's equations, assuming vacuum. (b) Show when the Lorenz condition 6.14 is satisfied you obtain 6.15 and 6.16. (c) Show that all gauge transformations 6.19 which satisfy 6.20 also obey 6.14. (d) Show the retarded solution of 6.15 is 6.23 but where $\rho(\vec{x}', t) \rightarrow [\rho(\vec{x}', t)]_{\text{ret}}$. (e) Show 6.22 leads to 6.23. (f) Prove 6.27, 6.28, 6.29 and hence 6.30, i.e., provide the missing steps.

2. Given 9.16 provide the detail which leads to 9.18.

3. Power: (a) Provide a derivation of 9.21, then (b) obtain 9.22. (c) With the assumption stated obtain 9.23 and then 9.24.

4. Give the detail of the proof of 3.70.

5. Green's functions: (a) Construct the 1D Green's function $G(x_1, x_2)$ for the Helmholtz equation

$$\left(\frac{d^2}{dx^2} + k^2\right)\psi(x) = g(x)$$

with the bc which correspond to a wave advancing in the positive x -direction. Assume a time dependence $e^{-i\omega t}$.

(b) Ditto for

$$\left(\frac{d^2}{dx^2} - k^2\right)\psi(x) = g(x)$$

but with boundary conditions such that $G(x_1, x_2)$ vanishes as $x_1 \rightarrow \pm\infty$.