1. a) Show that the LSZ reduction formula for $1 \to 1$ particle scattering is given by

$$
\text{out}(p'|s_1|p\rangle|\text{in}) = \left( \frac{1}{E} \right)^2 \lim_{p^0 \to m^2} \lim_{p^0' \to m'^2} \int d^4x d^4y e^{ip'x} e^{-ip'y} \langle \Omega|T \left\{ \bar{u}(s_1)(p') \frac{p' - m}{i} \psi(x) \right\} \left\{ \bar{\psi}(y) \frac{p - m}{i} u(s_2)(p) \right\} |\Omega\rangle
$$

b) Consider scattering of an electron by a static nucleus. The interaction is

$$
S_{\text{int}} = e \int d^4x \bar{\psi}(x) \gamma^\mu \psi(x) A_{\mu}^{\text{ext}}(x),
$$

$$
A_{\mu}^{\text{ext}} = \left( -\frac{Ze}{4\pi|\vec{r}|} \right) \delta_{\mu 0}
$$

At lowest order in perturbation theory, show that

$$
\text{out}(p'|p\rangle|\text{in}) = -\frac{ie^2 Z}{2} \delta(E - E') \int d^3x \frac{e^{-i\vec{q}\cdot\vec{x}}}{|\vec{r}|} \bar{\psi}(p') \gamma^0 \psi(p)
$$

where $\vec{q} = \vec{p} - \vec{p}'$, and we have suppressed spin indices.

2. Peskin and Schroeder problem 5.2 (Bhaba scattering).