The theory for $\pi^0$ mesons strongly interacting with neutrons is described by the Lagrangian density

$$L = \bar{n}(i\slashed{\partial} - m_n)n + \frac{1}{2}(\partial_\mu \pi^0 \partial^\mu \pi^0 - m_{\pi}^2(\pi^0)^2) + \frac{g}{m_n} \bar{n}\gamma_5\gamma^\mu n \partial_\mu \pi^0$$

where $n$ is the spin $\frac{1}{2}$ neutron field and $\pi^0$ is the (real) spin zero pion field.

a) If parity is conserved, what is the parity of the $\pi^0$?

b) Calculate the cross section for $\pi^0n$ scattering in the center of mass frame. Work in the limit where the neutron is non-relativistic to simplify the calculation.

c) Suppose the interaction term in equation (1) is replaced by

$$L_{\text{int}} = g'\bar{n}\gamma_5n\pi^0$$

what is the relation between the $g'$ and $g$ couplings so that the cross section for $\pi^0n$ scattering is the same as in part b)?