As you know, the nucleus is composed of neutrons and protons which are spin-1/2 fermions. Let $N$ equal the number of neutrons, $Z$ equal the number of protons, and $A$ be the sum, $A = N + Z$. Nucleons bind together with short range forces which means they pack together like hard spheres; so the nucleon density is approximately constant with the volume proportional to $A$. The nuclear radius then scales like the cube root of the volume, $R = r_0 A^{1/3}$. A global fit to nuclear data gives $r_0 \simeq 1.2$ fm which is constant for all nuclei. In this problem treat the nucleus as two degenerate Fermi gases, one of protons and one of neutrons. (Data: $\hbar c = 197.3$ MeV-fm, $m_p \simeq m_n = 939$ MeV/$c^2$, Lead (Pb): $A = 208$, $Z = 82$, and $N = 126$)

(a) Find the proton density for lead (i.e. number of protons per cubic femtometer, $fm^{-3}$).

(b) What is the Fermi momentum (in MeV/c) of the protons in lead?

(c) What is the Fermi energy (in MeV) of the protons in lead?

(c) Examine the $Z$-dependence of your result from part (d) and re-scale your proton result to find the Fermi energy of the neutrons in lead without re-doing the calculation.