King Fahd University of Petroleum & Minerals
Physics Department
Phys212- Quiz#5

Name: Key ID#:

1. Find the kinetic energy in eV required for electrons to resolve a nucleus of size 10 fm. (Hint: Use relativistic kinetic energy in this case).

$$E = K + mc^2 = \sqrt{p^2c^2 + (mc^2)^2}$$

$$\Rightarrow K = \sqrt{p^2c^2 + (mc^2)^2} - mc^2$$

$$p = \frac{h}{\lambda} = \frac{hc}{\lambda c} = \frac{1240\ \text{eV.nm}}{10\times10^{-5}\ \text{nm}\cdot c} = 124\times10^{6}\ \frac{\text{eV}}{c}$$

$$p^2c^2 = (124\times10^6)^2 = 1.54\times10^{16}\ \text{eV}^2$$

$$K = \sqrt{1.54\times10^{16} + (0.511\times10^6)^2} - (0.511\times10^6)\ \text{eV}$$

$$= 1.23\times10^8\ \text{eV} = \boxed{123\ \text{MeV}}$$

2. An atom in an excited state 1.8 eV above the ground state remains in that state 2.0 ns before decaying to the ground state. What is the minimum uncertainty in its energy?

$$\Delta E_{min}\ \Delta t = \frac{\hbar}{2} = \frac{h}{4\pi}$$

$$\Delta E_{min} = \frac{h}{4\pi\,\Delta t} = \frac{6.62\times10^{-34}}{4\times\pi\times(2\times10^{-9})}$$

$$= 2.63\times10^{-26}\ \text{J} = \boxed{1.65\times10^{-7}\ \text{eV}}$$