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 (use relativistic kinetic energy in this case).

$$pc = \frac{hc}{\lambda} = \frac{1240 \text{ eV.nm}}{10^{-6} \text{ nm}} = 1240 \text{ MeV}$$

$$pc \gg mc^2 \Rightarrow \text{relativistic case}$$

$$E = \left(p^2c^2 + (mc^2)^2\right)^{1/2}$$

$$K = E - mc^2 = \left(p^2c^2 + (mc^2)^2\right)^{1/2} - mc^2$$

$$= \left[(1240 \text{ MeV})^2 + (0.511 \text{ MeV})^2\right]^{1/2} - 0.511 \text{ MeV})$$

$$\boxed{K = 1239 \text{ MeV}}$$

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

$$\Delta E \, \Delta t \geq \frac{\hbar}{2} \Rightarrow \Delta E \geq \frac{\hbar}{2\Delta t}$$

$$\Delta t = 2\mu s \Rightarrow \Delta E \geq \frac{h}{4\pi \, \Delta t}$$

$$\Delta E_{min} = \frac{6.65\times10^{-34}}{4\times\pi\times2\times10^{-6}} = 2.6\times10^{-29} \text{ J}$$

$$= \boxed{1.65\times10^{-10} \text{ eV}}$$