CHAPTER-5 HOMEWORK 2, 3, 8, 12, 19, 25, 28

2- (a) T =50 eV $T << mc^2$ *Use nonrelativistic*

$p = \sqrt{2mT}$ = [2 (50eV) (511000 eV/c^2]$^{1/2}$ = 7148 eV/c

$\lambda = h/p = hc/pc$ = (1240 / 7148) nm = **0.173 nm**

(b T = 50 KeV $T \sim 1/10\ mc^2$ *Use either*

$p = \sqrt{2mT}$ = 226050 eV/c

$p = [\ E^2 - m^2c^4\ ]^{1/2}$ = [$561000^2 - 511000^2$]$^{1/2}$ =231516 eV/c

$\lambda = h/p = hc/pc$ = (1240 / 231516) nm = **0.0054 nm**

3- m=74 kg v=5m/s

p = (74) (5) kg m/s = 370 kg-m/s

$\lambda = h/p$ = 6.63×10^{-34} J-s / 370 kg-m/s = **1.8×10^{-36} m**

8- T = e V

$\lambda = h/p = h / \sqrt{2mT} = h/\sqrt{2meV} = hc/\sqrt{2mc^2eV}$

$= (1240/\sqrt{2mc^2}) \times 1/\sqrt{V} = 1240/[2(511000)]^{1/2} \times 1/\sqrt{V}$

$\lambda = 1.226 / \sqrt{V}$ nm

12- Find T = q V if $\lambda = 10^{-10}$ m = 0.1 nm

$p = h / \lambda$

$pc = hc/\lambda$ = 1240 / 0.1 = 12400 eV

E = [$(12400)^2 + 511000^2$]$^{1/2}$ = 511150 eV

T = 511150 eV – 511000eV = 150 eV

V =150 Volts

19- T = 1MeV << Mp c^2

$P = \sqrt{2mT}$ = [2 (938.3MeV/c^2) 1 MeV] $^{1/2}$ = 43.32 MeV/c

Δp = (.05) 43.33 MeV/c = 2.17 MeV/c

$\Delta x\ \Delta p \sim \hbar/2$

$\Delta x \sim \hbar / 2\Delta p = hc / 4\pi\Delta pc$ = 1240 / [4π)(2.17 $\times 10^6$)] = 4.6 x 10^{-5} nm

$\Delta x = 4.6 \times 10^{-14}$ m

25- $\Delta E \sim \hbar/2\Delta t$ $E\gamma$ = 2 MeV emission

$\Delta E = \hbar/2 \times 10^{-10}$ s = 6.58×10^{-16} eV-s / 2 $\times 10^{-10}$ s = 3.3 x 10^{-6} eV

3.3 x 10^{-6} eV << 5eV is too narrow to be measured!

28- v = 0.5 m/s neutrons

p = m v = 939.6 MeV/c^2) (0.5 / 3 x 10^8) c = 1.25 eV/c

(a) $\lambda = h/p = hc/pc$ = 1240 / 1.25 nm = **992 nm**

(b) D sinθ = nλ n=1,2,.. maxima

D sinθ = (n+1/2)λ minima

sin θ = λ /2D n=1 minima

sin θ = 992 x 10^{-9} / [(2)(0 .001m) = 5.0 x 10^{-4} rd

$\Delta X = L \tan\theta$ = 10m (5.0 x 10^{-4}) = 5.0 x 10^{-3} m = **5 mm**

(c) **No we don't know which slit the neutron passes. We only know it passed through one of them an hit the screen.**