Nelson 9.1

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1:20 PM

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

$$\Delta x \approx 1cm.$$

$$\Delta p \geq \frac{\hbar}{2} \frac{1}{1cm}$$

$$\geq \frac{1.05 \times 10^{-\cancel{34}\,32}}{2\ \cancel{10^{-2}}\ \cancel{m}} kg \frac{m^{\cancel{2}}}{s^{\cancel{2}}} \cdot \cancel{s}$$

$$\geq 5.03 \times 10^{-33} kg \frac{m}{s}$$

$$\boxed{\geq 5.03 \times 10^{-28} g\, cm/s}$$

Nelson 9.2

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$$\lambda_{deB} = \frac{h}{p} = \frac{h}{\gamma m v} \qquad \gamma \approx 1$$

$$= \frac{h}{mv} = \frac{6.6 \times 10^{-34}\, J \cdot s}{16 \cdot Lb \; 20\, mph}$$

$$= \frac{6.6 \times 10^{-34}\, \cancel{kg}\, m^2}{16\, \cancel{lb} \cdot \frac{1\,\cancel{kg}}{2.2\,\cancel{lb}} \cdot 8.9\, \cancel{m} \cdot}$$

$$\boxed{\lambda_{deB} = 10^{-35}\, m}$$

Anderson 4-5

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$$\lambda_d = \frac{h}{p} = \frac{hc}{m_0 c^2}$$

$$= \frac{197\,\cancel{\text{MeV}}\,\text{fm}}{0.5\,\cancel{\text{MeV}}}$$

$$\boxed{= 394 \times 10^{-15}\,\text{m}}$$

$$r_e = \frac{e^2}{mc^2}$$

$$\boxed{\frac{\lambda_d}{r_e} = \frac{hc}{e^2} = 2\pi\alpha}$$

Anderson 4.6

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$a = 2.15\,\text{Å}$

100eV electrons.

eq 4.16 $\quad n\lambda = 2d\sin\phi = 2d\cos\theta$

$d = a\sin\theta$

$n\lambda = 2a\sin\theta\cos\theta$

$= a\sin(2\theta)$

$2\theta = \sin^{-1}\left(\frac{n\lambda}{a}\right)$

$\lambda = \frac{h}{p} = \frac{hc}{100eV} = \frac{2\pi(197\,MeV\,fm)}{100\,eV}$

$= 1.97\,nm$

$2\theta_1 = \sin^{-1}\left(\frac{2.15\times10^{-10}\,m}{2\pi\,1.97\times10^{-9}\,m}\right)$

$2\theta_1 = 43^\circ$

Anderson 4.7

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2:04 PM

$$\lambda_d = 1 \text{ pm}$$

$$\lambda_d = \frac{h}{p} \to p = \frac{h}{\lambda_d}$$

$$u = \frac{E}{p} = \frac{\sqrt{p^2c^2 + m^2c^4}}{p}$$

$$= \frac{\sqrt{\frac{h^2c^2}{\lambda^2} + (mc^2)^2}\,\lambda c}{2\pi\hbar c}$$

$$= \frac{\sqrt{\frac{(2\pi)^2(197\cancel{\text{MeV fm}})^2}{(10^3\text{ fm})^2} + (0.5\cancel{\text{MeV}})^2}\cdot 10^3\cancel{\text{fm}}\,c}{2\pi(197\cancel{\text{MeV fm}})}$$

$$\boxed{\frac{u}{c} = 1.0785}$$

$$v = \frac{1}{\hbar}\frac{dE}{dk}$$

$$E(k) = \sqrt{p^2c^2 + m^2c^4}$$

$$= \sqrt{\hbar^2c^2k^2 + (mc^2)^2}$$

$$v = \frac{1}{\cancel{\hbar}}\frac{\cancel{\hbar^2}c^2\cancel{2}k}{\cancel{2}\sqrt{\hbar^2c^2k^2 + (mc^2)^2}}$$

$$= \hbar c^2 \frac{2\pi}{\lambda\sqrt{\frac{\hbar^2c^2(2\pi)^2}{\lambda^2} + (mc^2)^2}}$$

$$\boxed{= 0.925\,c}$$

$$T = (\gamma - 1)mc^2$$

$$= .5\,\text{MeV}\left(\frac{1}{\sqrt{1 - .925^2}} - 1\right)$$

$$\boxed{= 0.834\ \text{MeV}}$$

Anderson 4.9

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$$\psi_A = A\cos(\pi x/2a)$$

$$1 = \int_{-a}^{a} \psi(x)^2 dx$$

$$= |A|^2 \int_{-a}^{a} \cos^2\left(\frac{\pi x}{2a}\right)$$

$$= a|A|^2$$

$$|A| = \frac{1}{\sqrt{a}}$$

$$\boxed{A = \frac{1}{\sqrt{a}} e^{i\phi_a}}$$

$$\psi_B = B\sin(\pi x/a)$$

$$1 = \int_{-a}^{a} \psi_B^2 dx = |B|^2 \frac{1}{a}$$

$$\boxed{B = \frac{1}{\sqrt{a}} e^{i\phi_b}}$$

Anderson 4.10

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$$\psi_{(x)} = A\cos\left(\frac{\pi x}{2a}\right) + B\sin\left(\frac{\pi x}{a}\right)$$

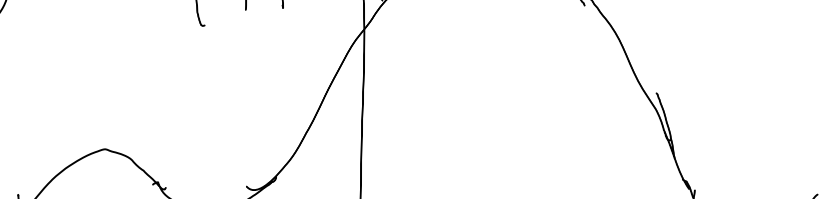
Anderson forgot to state ψ_a & ψ_b from 4.9 are themselves basis wave func. of the vector space so we must take $A = B = \frac{1}{\sqrt{a}}$ first then renormalize the whole wave function. As stated we can only get the relation between A & B that tells you the prob. of find ψ in ψ_a or ψ_b.

$$\psi_{(x)} = \frac{N}{\sqrt{a}}\left(\cos\left(\frac{\pi x}{2a}\right) + \sin\left(\frac{\pi x}{a}\right)\right)$$

$$1 = \int |\psi_{(x)}|^2 \, dx$$

$$\boxed{N = \frac{1}{\sqrt{2}} e^{i\phi_3}}$$

b)



b)