2.23 $p = \frac{h}{\lambda}$ $E = \frac{p^2}{2m}$

$\lambda = \frac{h}{p}$ ← $p = \sqrt{2mE}$

$= \frac{h}{\sqrt{2mE}}$

$h = 6.626 \times 10^{-34}$ J-s
$m = m_e = 9.1 \times 10^{-31}$ kg
E in eV

a. $\lambda_e = \frac{h}{\sqrt{2m_e}} \frac{1}{E^{1/2}}$

$= \frac{6.626 \times 10^{-34} \text{ J-s}}{\sqrt{2}\,(9.1 \times 10^{-31} \text{ kg})^{1/2}} \frac{\sqrt{\text{J}}}{E^{1/2}}$

$= \left(4.912 \times 10^{-19} \frac{\text{J-s}}{\text{kg}^{1/2}}\right)\left(\frac{1}{E \times 1.6 \times 10^{-19} \text{ J/eV}}\right)^{1/2}$

$= 1.228 \times 10^{-9} \frac{\text{J-s}}{\text{kg}^{1/2}\,\text{J}^{1/2}} \frac{1}{E^{1/2}} \sqrt{\text{eV}}$

$\frac{\text{J-s}}{\text{kg}^{1/2}\,\text{J}^{1/2}} = \frac{\text{kg}\,\frac{\text{m}^2}{\text{s}^2}\,\text{s}}{\text{kg}^{1/2}\left(\text{kg}\,\frac{\text{m}^2}{\text{s}^2}\right)^{1/2}} = \frac{\text{kg}\,\frac{\text{m}^2}{\text{s}}}{\text{kg}^{1/2}\cdot\text{kg}^{1/2}\,\frac{\text{m}}{\text{s}}}$

$= \frac{\text{kg}\,\frac{\text{m}^2}{\text{s}}}{\text{kg}\,\frac{\text{m}}{\text{s}}} = \text{m}$

$= 1.228 \times 10^{-9} \text{ m} \frac{1}{E^{1/2}} \times 100 \frac{\text{cm}}{\text{m}}$

E → has to be in eV to cancel $\sqrt{\text{eV}}$.

$\lambda_e = \frac{12.3 \times 10^{-8} \text{ cm}}{E^{1/2}}$

b. $\lambda_p = \frac{h}{\sqrt{2 m_p E}}$ $\qquad m = m_p = 1.67 \times 10^{-27}\ kg$

$$= \frac{6.626 \times 10^{-34}\ J\text{-}s}{\sqrt{2}\,(1.67 \times 10^{-27}\ kg)^{1/2}} \quad \frac{1}{E^{1/2}}$$

$$= \left(1.147 \times 10^{-20}\ \frac{J\text{-}s}{kg^{1/2}}\right)\left(\frac{1}{E \times 1.6 \times 10^{-19}\ J/eV}\right)^{1/2}$$

$$= 2.866 \times 10^{-11}\ \frac{J\text{-}s}{kg^{1/2}\text{-}J^{1/2}}\ \frac{1}{E^{1/2}}\ \sqrt{eV}$$

$\frac{J\text{-}s}{kg^{1/2}\text{-}J^{1/2}}$ = m as before

$$= 2.866 \times 10^{-11}\ m \times 100\ \frac{cm}{m}\ \frac{1}{E^{1/2}}$$

↳ has to be in eV to cancel $\sqrt{eV}$

$$= \frac{0.29 \times 10^{-8}\ cm}{E^{1/2}}$$