Some Useful Data

Speed of light: \( c = 3 \times 10^8 \text{m/s} \)
\( c = \frac{\lambda}{f} \)

Planck’s constant: \( h = 6.626 \times 10^{-34} \text{J} \cdot \text{s} \)

Atomic mass unit (amu): \( 1\text{amu} = 1.66054 \times 10^{-27} \text{kg} = 931.5 \text{MeV/c}^2 \)

Rest mass of an electron: \( m_e = 9.11 \times 10^{-31} \text{kg} = 0.511 \text{MeV/c}^2 \)
\( 1\text{eV} = 1.602 \times 10^{-19} \text{J} \)

Total energy of a particle: \( E = K + m_0c^2 = \gamma m_0c^2 \),
where \( \gamma = \left(1 - \frac{u^2}{c^2}\right)^{-1/2} \)

Momentum of a particle: \( p = \gamma m_0u \)

Energy-momentum relation for a particle: \( E^2 = (pc)^2 + (m_0c^2)^2 \)

Energy-momentum relation for a photon: \( E = pc \),
which implies that \( p = \frac{hf}{c} = \frac{h}{\lambda} \)

Photo-electric equation: \( eV_s = hf - \phi = h(f - f_0) \)

Compton scattering formula: \( \lambda' - \lambda_0 = \frac{h}{m_ec}(1 - \cos \theta) \)

Compton wavelength for an electron: \( \frac{h}{m_ec} = 0.00243\text{nm} \)

Instructions

Please write your answers in your blue book, and make sure your secret code number is written on all pages in indelible ink.