Properties of Electrons

A. Useful Constants

e	Charge on an electron	4.803×10^{-10} 1.6021×10^{-19}	esu Coulombs
m_0	Rest mass of electron	9.109×10^{-31}	Kg
c	Speed of light	2.998×10^{8}	m/s
h	Planck's constant	6.626×10^{-34}	joule.sec
k	Boltzmann's constant	1.381×10^{-23} 1.602×10^{-12} 1.381×10^{-16}	joule/K/atom eV/K/atom erg/K/mole
N	Avogadro's number	6.02252×10^{23}	/mole
π		3.141592654	
e	Base of natural logs - *do not confuse*	2.718281828	

B. Conversion Factors

1 electron volt (eV) = 1.6021×10^{-19}J

C. Derived Properties

1. Mass

$$m = \frac{m_0}{\sqrt{1-\gamma^2}}$$

$\gamma = V/c$; V = velocity of electron

2. Momentum

$$p = mV$$

3. Rest Energy (or Self Energy)

$$E_0 = m_0 c^2$$

4. Total Energy

$$mc^2 = \frac{m_0 c^2}{\sqrt{1-\gamma^2}}$$

5. Kinetic energy (total energy - rest energy)

$$\begin{aligned} E_{kin} &= mc^2 - m_0 c^2 \\ &= m_0 c^2 \left((1-\gamma^2)^{-1/2} - 1 \right) \\ &= eE \end{aligned}$$

(E is the accelerating potential.)

6. Wavelength

$$\begin{aligned} \lambda &= h/p \\ &= \frac{h}{\left(2m_0 eE \left(1 + \frac{eE}{2m_0 c^2} \right) \right)^{1/2}} \end{aligned}$$

Table 1: Electron wavelengths for typical accelerating voltages

E, kV	λ, pm	E, kV	λ, pm
0.5	54.8	120	3.35
1	38.8	200	2.51
5	17.3	300	1.97
15	9.94	400	1.64
20	8.59	800	1.03
30	6.98	1,000	0.872
40	6.02	1,500	0.637
100	3.70	3,000	0.357