Physics 132 List of the Few Things Actually Worth Remembering

(Dated: May 10, 2004)

Speed of light: $c \approx 3 \cdot 10^{10}$ cm/s
Mass of the electron: $m_e \approx 9.1 \cdot 10^{-28}$ g; $m_e c^2 \approx 0.511$ MeV
Masses of the nucleons: $m_p \approx 1836 \times m_e$; $(m_n - m_p)c^2 \approx 1.2$ MeV
Electron charge magnitude: $e \approx 4.8 \cdot 10^{-10}$ esu $\approx 1.6 \cdot 10^{-19}$ C
Plank's constant: $\hbar \approx 1.05 \cdot 10^{-27}$ erg$\cdot$ s
Fine-structure constant: $\alpha = \frac{e^2}{\hbar c} \approx \frac{1}{137}$
Bohr radius (atomic size): $a_0 = \frac{\hbar^2}{m_e e^2} \approx 0.53 \cdot 10^{-8}$ cm
For visible light, 400 nm$< \lambda <$ 700 nm; $\hbar\omega \sim 2 - 3$ eV
One electron-volt (eV) corresponds to a frequency of $\approx 2.41 \cdot 10^{14}$ Hz

Time-independent Schrödinger equation: $\hat{H}\psi = E\psi$, where $\hat{H}$ is the Hamiltonian, which is the sum of the kinetic and potential energy terms

Radius of the Earth: $R_E \approx 6,400$ km
Acceleration due to gravity on the surface of the Earth: $g \approx 9,800$ cm/s^2
Gravitational constant: $G_N \approx 6.67 \cdot 10^{-8}$ $\frac{\text{cm}^3}{g \cdot s^2}$
Seconds in a year: $\approx \pi \cdot 10^7$
Astronomical unit of distance (= mean Earth-Sun distance): 1 $AU \approx 1.5 \cdot 10^8$ km
Parsec (a distance from which 1 AU looks like 1 $arcsec$): 1 $pc \approx 3.1 \cdot 10^{18}$ cm ≈ 3.3 light years

Density of water: $\rho(H_2O) \approx 1$ g/cm^3
Room temperature in electron-volts: for $T = 300$ K, $kT \approx \frac{1}{40}$ eV

Normal atmospheric pressure: $P \approx 1$ kg-force/cm$^2 \approx 760$ mm of Hg≈ 0.1 MPa
The Avogadro number (= molecules/mole): $N_A \approx 6 \cdot 10^{23}$

CGS to SI conversion factors: 1 N $= 10^5$ dynes; 1 J $= 1$ N $\times$ 1 m $= 10^7$ ergs

Hierarchy of scales in the microworld: Classical radius of the electron $r_0 = \frac{e^2}{mc^2} \div \alpha \rightarrow$ Compton wavelength $\lambda\!\!\!^{-} = \frac{\hbar}{mc} \div \alpha \rightarrow$ Bohr radius $a_0 = \frac{\hbar^2}{me^2} \div \alpha \rightarrow$ Wavelength of atomic transitions $\lambda\!\!\!^{-}_{light} \sim \frac{\hbar^3 c}{me^4}$

Hierarchy of energy (frequency) scales in molecules: $E_{electronic} : E_{vibrational} : E_{rotational}$ is roughly $1 : \sqrt{\frac{m_e}{m_p}} : \frac{m_e}{m_p}$