1.1 Units.
a.) The four fundamental constants $\hbar$ (Planck's constant), c (velocity of light), G_N (gravitational constant) and k_B (Boltzmann constant) can be combined to obtain the dimension of a length, time, mass, energy and temperature. Find the four relations and calculate the numerical values of two of them.
b.) Find the connection between a cross section σ expressed in units of cm^2, mbarn, and GeV^{-2}.

a.) A formal way to derive e.g. the Planck time t_{Pl} is to solve

$$[c]^\alpha[\hbar]^\beta[G]^\gamma[k_B]^\delta = [\mathrm{cm/s}]^\alpha[\mathrm{g\,cm^2/s}]^\beta[\mathrm{cm^3/(g\,s^2)}]^\gamma[\mathrm{g\,cm^2/K}]^\delta = \mathrm{s}\,.$$

Simpler: i) note that k_B contains as only one the temperature T and enters therefore only T_{Pl}
ii) we need a combination of $\hbar G$ to cancel the gram.
iii) multiply with $1/c^5$ to eliminate the centimeter,

$$[\hbar G/c^5] = \mathrm{s}^2$$

and thus

$$t_{\mathrm{Pl}} = \sqrt{\frac{\hbar G}{c^5}} \approx 5.4 \times 10^{-44}\mathrm{s}\,.$$

Then $l_{\mathrm{Pl}} = ct_{\mathrm{Pl}} = 1.6 \times 10^{-33}\,\mathrm{cm}$, etc.
The Planck units combine special relativity (they contain c), quantum effects (they contain $\hbar$) and gravity (they contain G). This indicates that at energies $E \gg M_{\mathrm{Pl}}c^2$, lengths $l \ll l_{\mathrm{Pl}}$, ..., a quantum theory of gravity is required.