Homework 0 Solution AST422

Show the units of (1.1) – (1.5) from dimension analysis.

$$G = 6.7 \times 10^{-11} m^3 kg^{-1} s^{-2}$$

$$c = 3.0 \times 10^8 ms^{-1}$$

$$\hbar = \frac{h}{2\pi} = 1.1 \times 10^{-34} Js = 6.6 \times 10^{-16} evs \sim kgm^2 s^{-1}$$

$$k = 8.6 \times 10^{-5} evK^{-1}$$

1.1 Planck length lp

$$l_P \equiv (\frac{G\hbar}{c^3})^{1/2} = 1.6 \times 10^{-35} m$$

$$l \sim (\frac{m^3 kg^{-1} s^{-2} \cdot kgm^2 s^{-1}}{(ms^{-1})^3})^{1/2} \sim (m^2)^{1/2} \sim m$$

http://en.wikipedia.org/wiki/Planck_length

1.2 Planck mass Mp

$$M_P \equiv (\frac{\hbar c}{G})^{1/2} = 2.2 \times 10^{-8} kg$$

$$M_P \sim (\frac{kgm^2 s^{-1} \cdot ms^{-1}}{m^3 kg^{-1} s^{-2}})^{1/2} \sim (kg^2)^{1/2} \sim kg$$

http://en.wikipedia.org/wiki/Planck_mass

1.3 Planck time tp

$$t_P \equiv (\frac{G\hbar}{c^5})^{1/2} = 5.4 \times 10^{-44} s$$

$$t_P \sim (\frac{m^3 kg^{-1} s^{-2} \cdot kgm^2 s^{-1}}{(ms^{-1})^5})^{1/2} \sim (s^2)^{1/2} \sim s$$

http://en.wikipedia.org/wiki/Planck_time

1.4 Planck energy Ep

$$E_P = M_P c^2 = 2.0 \times 10^9 J = 1.2 \times 10^{28} ev$$

http://en.wikipedia.org/wiki/Planck_energy

1.5 Planck temperature Tp

$$T_P = E_P / k = 1.4 \times 10^{32} K$$

http://en.wikipedia.org/wiki/Planck_temperature