HP Prime Application Note Physics:

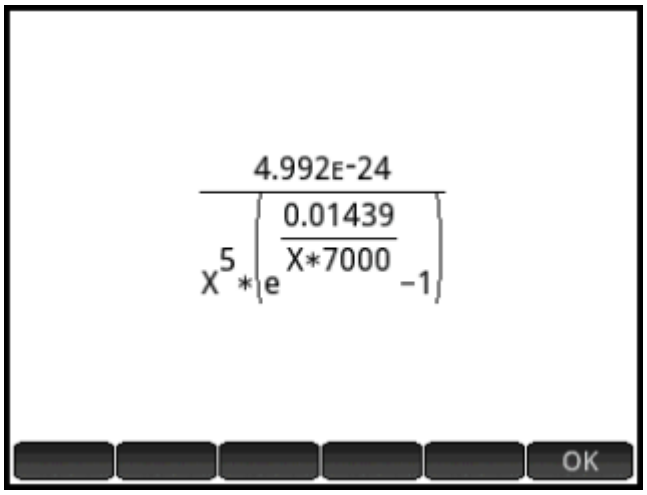
02. Planck Curves

The age of modern physics started on Sunday evening, October 7th, 1900, when Max Planck derived his equation for the energy density ρ of black-body radiation at wavelength λ and temperature T:

$$\rho_T(\lambda) = \frac{8\pi \cdot h \cdot c}{\lambda^5 \cdot \left(e^{\frac{h \cdot c}{\lambda \cdot k \cdot T}} - 1\right)}$$

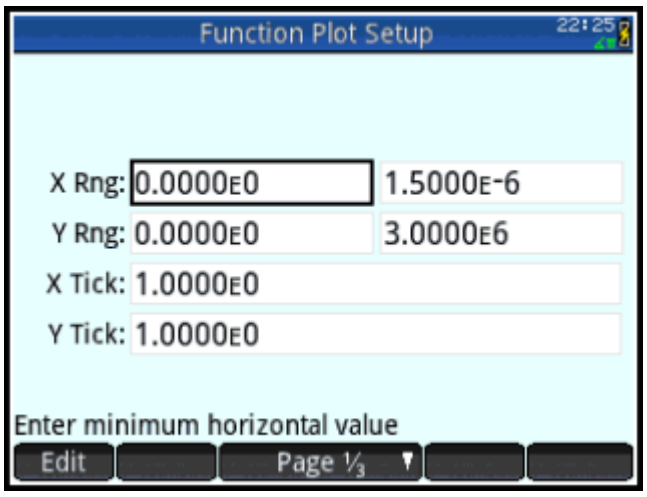
with Planck's constant $h = 6{,}626\,069\,57 \cdot 10^{-34}\ \mathrm{J \cdot s}$, the speed of light $c = 299\,792\,458\ \mathrm{m/s}$, and Boltzmann's constant $k = 1{,}380\,648\,8 \cdot 10^{-23}\ \mathrm{J/K}$.

Explore Planck curves on your HP Prime, entering the following formula in the Function app:



The *x* and *y* axes represent the wavelength λ and the black-body energy density ρ respectively. In the equation above, the temperature *T* is 7000 K. Add three more of this equation with varying temperatures *T* = 6000 K, 5000 K and 4000 K.

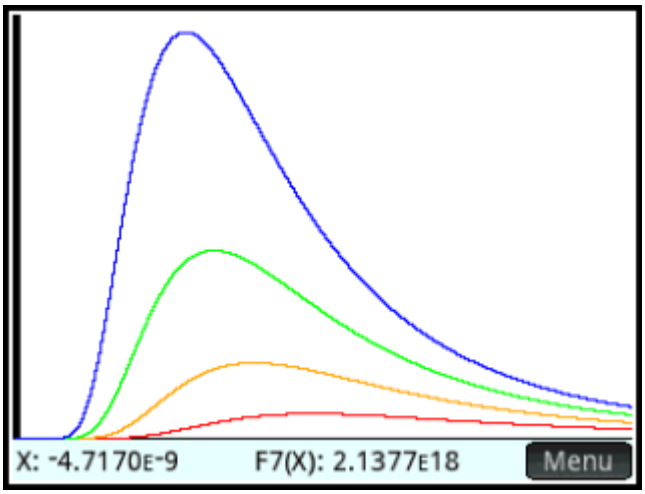
Set the values of the *x* and *y* ranges in the Function Plot Setup:



Draw the Planck curves by tapping the Plot-button:

The colours correspond to:

Blue	T = 7000 K
Green	T = 6000 K
Orange	T = 5000 K
Red	T = 4000 K



The Sun is a black-body radiator with an approximate temperature of T = 5777 K. Use this value in the formula and determine the maximum intensity using the toggle:

Apparently, the maximal energy density appears at λ = 500 nm. That is about the wavelength at which the human eye is most sensitive (approximately, λ = 550 nm). So during the evolution, our eyes evolved adapting to the Sun's maximum energy density according to Planck's curve.