Prof. Dr. B. Eckhardt
Fachbereich Physik
Philipps-Universität Marburg
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Computational Physics I
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9.1 Radiation in the visible

The Planck radiation law for a black body at temperature T says that the energy density per volume and frequency is given by

$$u(\nu, T) = \frac{2h\nu^3}{c^2} \frac{1}{\exp(h\nu/k_B T) - 1} \tag{1}$$

with h Planck's constant, k_B the Boltzmann constant and c the speed of light.
Calculate the fraction of the energy density that is in the visible range, i.e. for wavelength between 400nm and 750nm, for the sun with a surface temperature of $T = 5700\,K$ and for a white dwarf with a surface temperature of $T = 20\,000\,K$.

9.2 Period of oscillation

The period of oscillation for the motion of a particle of mass m in a potential $V(x)$ is given by

$$T = \sqrt{2m} \int_{-x_-}^{x_+} \frac{dx}{\sqrt{E - V(x)}} \tag{2}$$

with $x_\pm$ the turning points $V(x_\pm) = E$.
Compute the period for motion in the potential $V(x) = V_0/\cos x$ for $m = 1/2$ and $V_0 = 1$.

9.3 Asymptotic expansion

The exponential integral, $\mathrm{Ei}(x) = \int_1^\infty \frac{\mathrm{e}^{-tx}}{t} dt$ has the asymptotic expansion

$$\mathrm{Ei}(x) = \frac{\mathrm{e}^{-x}}{x} \sum_{n=1}^{\infty} (-1)^n \frac{n!}{x^n} \tag{3}$$

Plot the absolute values of the first 20 terms in the series for $x = 2, 4, 6, \ldots, 40$.
For which index are they minimal and what is the value of the term at the minimum?