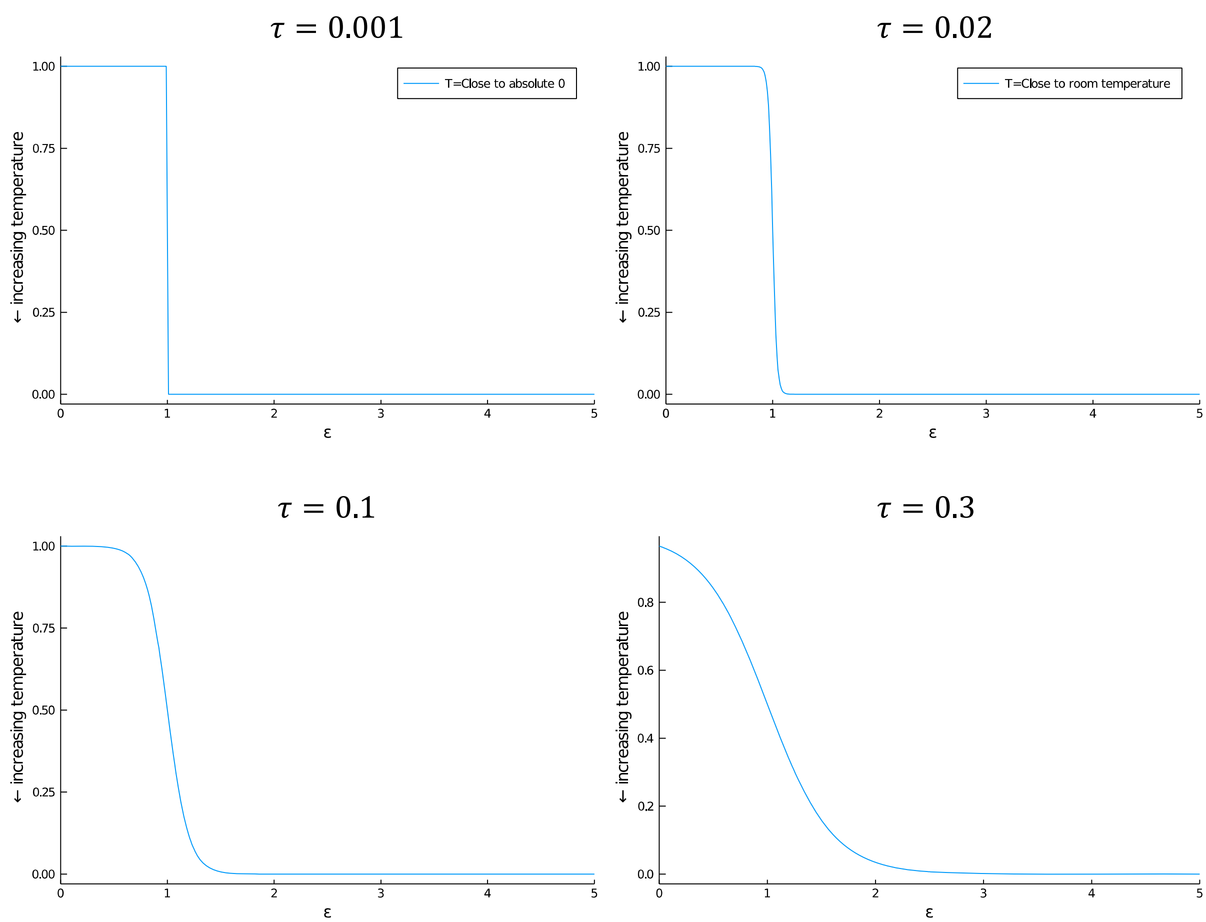
The Fermi-Dirac distribution function

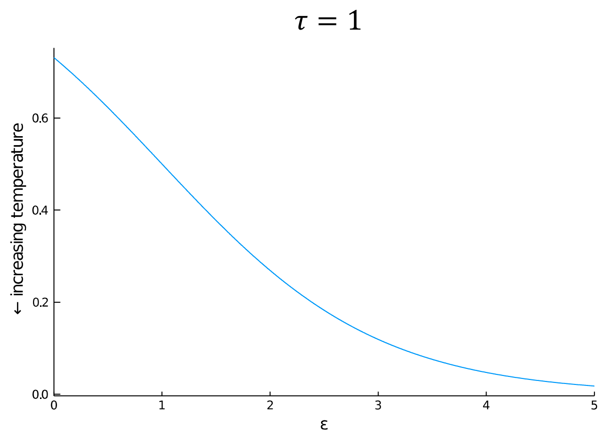
by Dr. Colton, Physics 581 (last updated: Fall 2020)

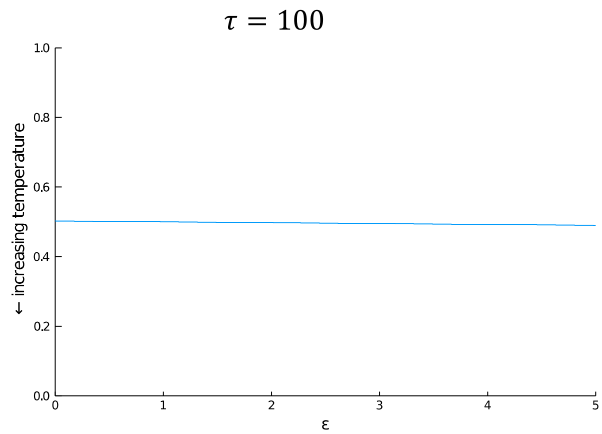
$$f(\varepsilon, \tau) = \frac{1}{e^{(\varepsilon - \mu)/\tau} + 1}$$

I will plot this for increasing temperatures, using $\mu = 1$ in some units (e.g. possibly in electron volts) and with energy ε as the x-axis.

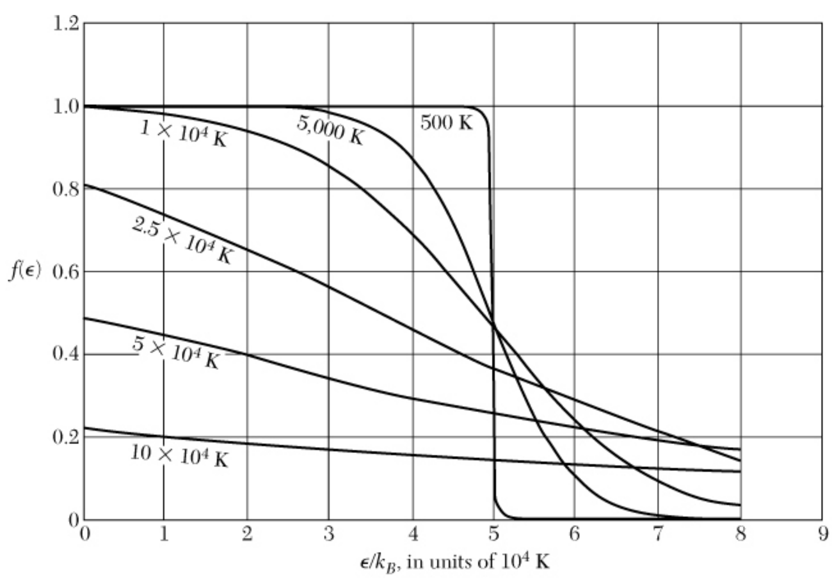


For the next plots the temperature is super hot! Our assumption breaks down: μ cannot still equal 1 for these plots. It actually shifts to the left, and becomes negative at some point.





Kittel Fig. 6.3 (pg. 136) shows what the Fermi-Dirac distribution function really looks like at high temperatures, using actual units and incorporating in the aforementioned shift of μ with temperature, in a material where μ is initially (low temperatures) equal to 4.309 eV (so that $\mu/k = 50000$ K):



The chemical potential μ can be read off the graph for each temperature as the energy at which f equals 0.5.