4.6 Statistics

Consider a gas of hydrogen atoms each of which can be either in the ground (E_1) or first excited state (E_2). If the gas is at temperature T, what is the ratio of atoms is in the excited state to atoms in the ground state (N_2/N_1)?

A) $N_2 / N_1 = 1$

B) $N_2 / N_1 = \exp[-(E_2 – E_1)/kT]$

C) $N_2 / N_1 = \exp[(E_2 – E_1)/kT]$

D) $N_2 / N_1 = \exp[-E_2 / kt]$

Consider a gas of hydrogen atoms each of which can be either in the ground (E_1) or first excited state (E_2). If the gas is at temperature T, what is the ratio of atoms is in the excited state to atoms in the ground state (N_2/N_1)?

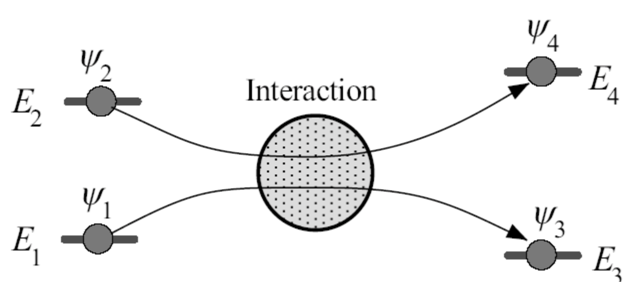
A) $N_2 / N_1 = 1$

B) $\boxed{N_2 / N_1 = \exp[-(E_2 - E_1)/kT]}$

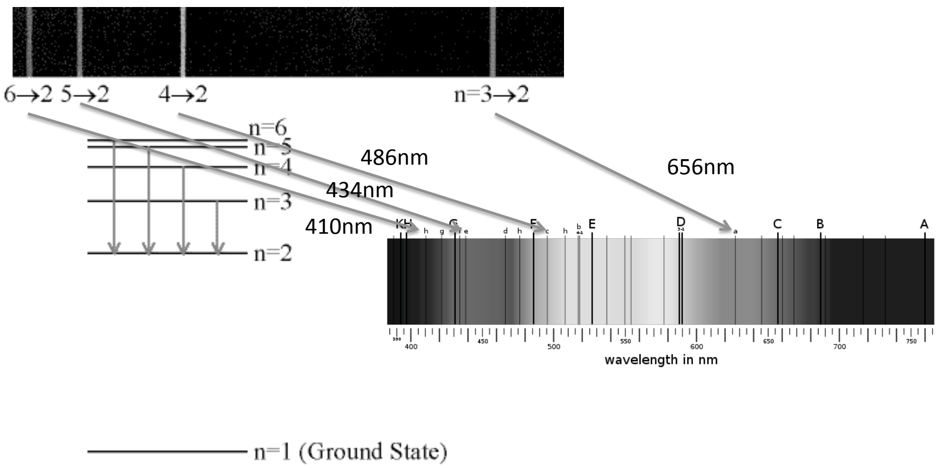
C) $N_2 / N_1 = \exp[(E_2 - E_1)/kT]$

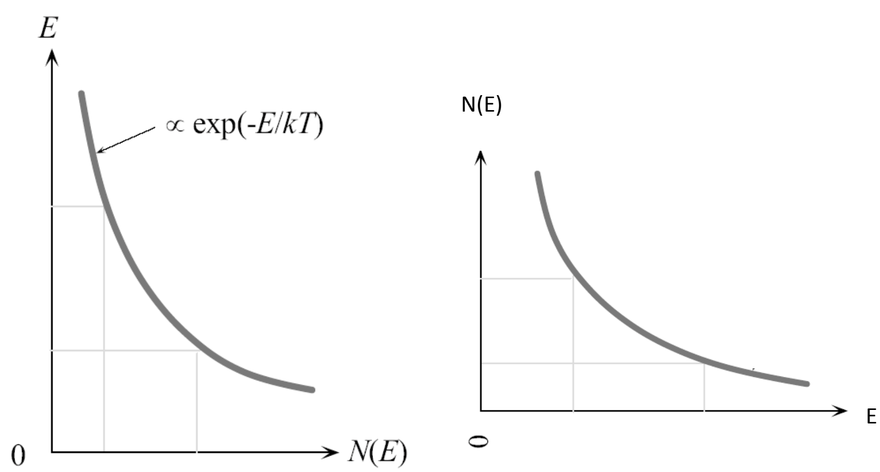
D) $N_2 / N_1 = \exp[-E_2 / kt]$

Boltzmann Classical Statistics

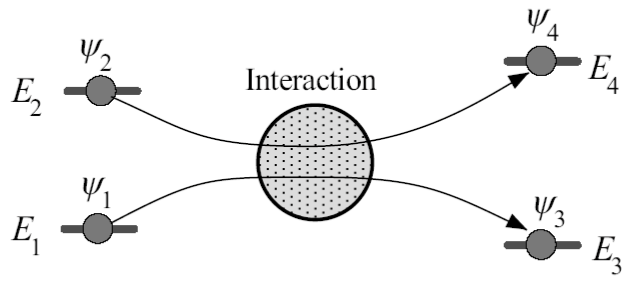


Example: Balmer series in the solar spectrum





Fremi-Dirac Statistics



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Fermi-Dirac Statistics

$$f(E) = \frac{1}{1 + \exp\left(\frac{E - E_F}{kT}\right)}$$

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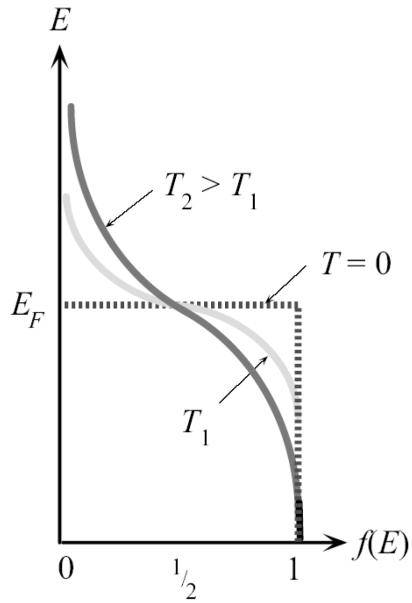
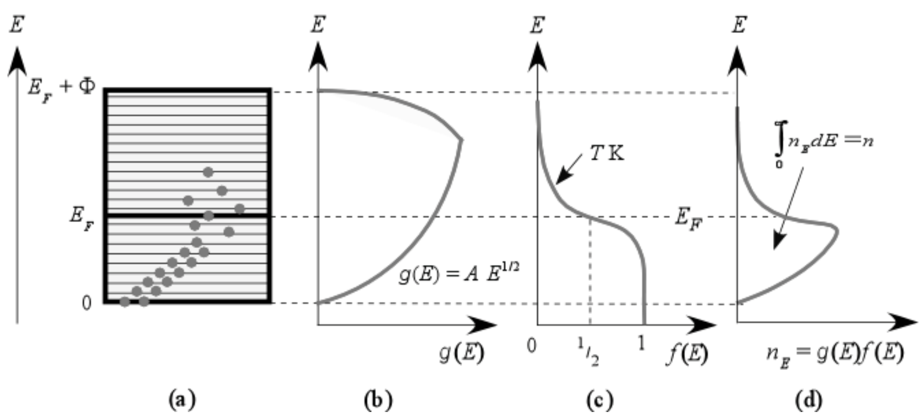
Fermi-Dirac statistics





(a) Above 0K, due to thermal excitation, some of the electrons are at energies above EF.
(b) The density of states, $g(E)$ versus E in the band.
(c) The probability of occupancy of a state at an energy E is $f(E)$.
(d) The product of $g(E) f(E)$ is the number of electrons per unit energy per unit volume, or the electron concentration per unit energy.