

**Condensed Matter Physics I**  
Exercises on Drude and Sommerfeld model  
**Sept 26, 2025**

1. Drude: Joule heating, es 1.2 Ascroft-Mermin book (another nice example of a microscopic approach to a macroscopic phenomenon)  
Hint: similar to the approach used to derive the expression of conductivity

2. Sommerfeld: Calculate  $g(E)$  in 2D and 1D through a change of variable (as done already for 3D) going from the integral in  $\vec{k}$  to one in  $E$ .

Results:

$$g^{1D}(E) = \frac{\sqrt{2m}}{\pi\hbar} \frac{1}{\sqrt{E}} \Theta(E)$$

$$g^{2D}(E) = \frac{m}{\pi\hbar^2} \Theta(E)$$

$$g^{3D}(E) = \frac{(2m)^{3/2}}{2\pi^2\hbar^3} \sqrt{E} \Theta(E)$$

3. Sommerfeld: Express  $g(E)$  in terms of the parameters  $n$  and  $E_F$  (beside  $E$ , of course, which is the variable)

Results:

$$g^{1D}(E) = \frac{1}{2} \frac{n}{E_F} \sqrt{\frac{E_F}{E}}$$

$$g^{2D}(E) = \frac{n}{E_F}$$

$$g^{3D}(E) = \frac{3}{2} \frac{n}{E_F} \sqrt{\frac{E}{E_F}}$$