Homework

1. Prove the two equations below are equal.
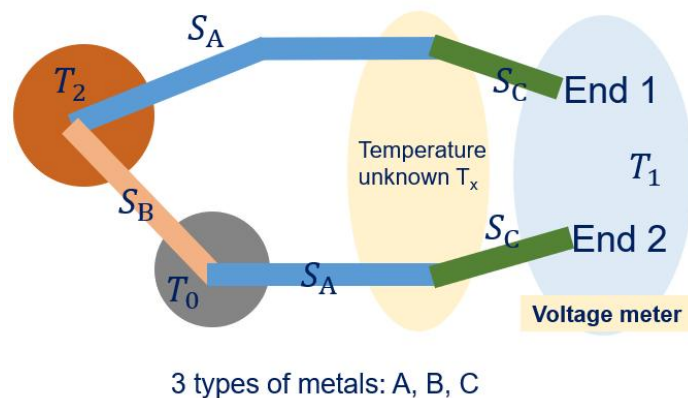
Equation 1 (Classic Drude model):

$$\sigma = \frac{e^2 n \tau}{m_{\mathrm{e}}^*}$$

Equation 2 (quantum model):

$$\sigma = \frac{1}{3} e^2 v_{\mathrm{F}}^2 \tau g(E_{\mathrm{F}})$$

2. There are 3 types of metals A, B, and C, with temperature-independent Seeback coefficients S_A, S_B, and S_C, respectively. Temperatures T_0, T_1 and T_2 are known. The electromotive force/voltage between End 1 and End 2: $V_{12} = V_1 - V_2$

3 types of metals: A, B, C

3. For p-type semiconductor, please draw the band diagram and describe the working principles of Peltier effect.
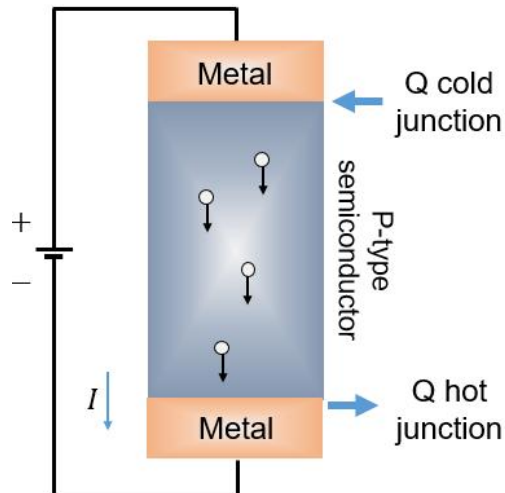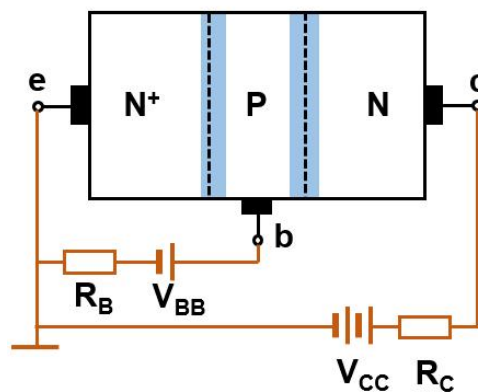
4. The band diagram and working principle of following LEDs (don't use the simplified band diagram for heterostructure; Please find all information you needed in PPT files).

(1)

(2)
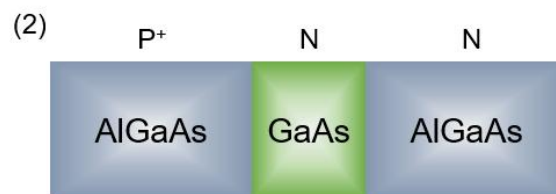
5. Draw the energy band diagram of N^+PN transistor for three below situations:

(1) $V_{BB} = V_{CC} = 0$;

(2) Saturation region;

(3) Amplification region.

6. Draw the band diagram of the N-type MOSFET channels along the red dashed lines in page 44-46 (PPT 44-46 页示意图中红色虚线方向的能带结构示意图，包括源漏电极和半导体沟道) for below three situations:

(1) $u_{GS}=0$, $u_{DS}>0$ (refer to the device schematic in ppt page 38)

(2) $u_{GS(th)}>u_{GS}>0$, $u_{DS}>0$ (refer to the device schematic in ppt page 39)

(3) $u_{GS}>U_{GS(th)}$, $u_{DS}>0$ (refer to the device schematic in ppt page 40).