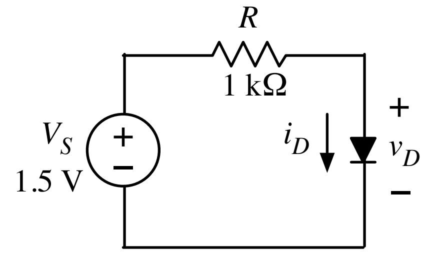
EE 230 — HW 4.3 Name____

Use the circuit at right to examine the temperature dependence of the diode voltage and current. Do this by calculating the voltage and current at the following temperatures: -40°C, 0°C, 27°C ("room temperature"), 50°C, and 100°C. (In kelvin, the five temperatures are: 233 K, 273 K, 300 K, 323 K, and 373 K).



You must use the exact equation (not the on-off model, which has no temperature dependence in it). This means that you will have to do an iterative solution (like that shown in the EE 201 notes) at each of the different temperatures.

Obviously, the kT/q quantity in the exponential the diode equation needs to change at each temperature. However, the diode current pre-factor is also very temperature dependent. — including the temperature dependence in the pre-factor leads to the following messy expression:

$$I_S = I_{So}\left(\frac{T}{300\,\mathrm{K}}\right)^3 \exp\left[-43.3\left(\frac{300\,\mathrm{K}}{T} - 1\right)\right],$$

where I_{So} is the room temperature value of the pre-factor and the T is temperature in Kelvin. (And this doesn't even include all of the temperature dependence! However, the above expression is close enough for the purposes of this problem.) For your calculations, use $I_{So} = 10^{-14}$ A. Don't forget to adjust kT/q in the diode exponential for each temperature. (If you know where to look, the answers for one of the temperatures are readily available, so you can check your iteration procedure.)

T	I_S	i_D	v_D
233 K			
273 K			
300 K			
323 K			
373 K			