1a)

$$I(\lambda) = \frac{2hc^2\lambda^{-5}}{e^{\frac{hc}{\lambda k_B T}} - 1} \qquad x = \frac{hc}{\lambda k_B T}$$

Substitute for $\lambda^{-5} = \frac{x^5 k_B^5 T^5}{h^5 c^5}$

$$I(x) = \frac{2\cancel{h}\cancel{c^2} x^5 k_B^5 T^5}{(e^x - 1) h^{\cancel{5}4} c^{\cancel{5}3}} = \frac{2x^5 k_B^5 T^5}{(e^x-1)h^4c^3}$$

$$\frac{dI(x)}{dx} = \frac{2k_B^5 T^5}{h^4 c^3}\frac{d}{dx}\left[\frac{x^5}{e^x-1}\right]$$

$$= \frac{2k_B^5 T^5}{h^4c^3}\left[-x^4\frac{(x-5)e^x+5}{(e^x-1)^2}\right] \overset{set}{=} 0$$

$$\Rightarrow \cancel{x = -6\times10^{-16}} \text{ or } x = 4.96511$$

$$\lambda_{max} = \frac{hc}{xk_BT} = \frac{hc}{4.97k_BT} \Rightarrow \lambda_{max} = \frac{b}{T}$$

where $b = \frac{hc}{k_B \cdot (4.97)}$

$x = 4.97$ is also the answer to to solution:

$$5e^{-x} + x - 5 = 0$$

4a) Current through R_3 into V_2:

$$I_{R3} = \frac{V_2 - V_+}{R_3}$$

Current through R_4 to $0V$:

$$I_{R4} = \frac{V_2 - 0}{R_4} = \frac{V_2}{R_4}$$

Current through diode from $V_1 \to V_2$

$$I_D = I_0\left(e^{(V_2-V_1)/V_T} - 1\right)$$

We have $I_{R3} + I_{R4} + I_D = 0$

so $$\frac{V_2 - V_+}{R_3} + \frac{V_2}{R_4} + I_0\left(e^{(V_2-V_1)/V_T} - 1\right)$$