

# Exercise 1

Part (a-b)

$$a = 2\pi hc^2 \quad b = \frac{hc}{k_B T}$$

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

$$I(\lambda) = \frac{a \lambda^{-5}}{e^{b/\lambda} - 1}$$

$$\frac{\partial I}{\partial \lambda} = \frac{(e^{b/\lambda} - 1)(-5a\lambda^{-6}) - (-\frac{b}{\lambda^2} e^{b/\lambda})(a\lambda^{-5})}{(e^{b/\lambda} - 1)^2}$$

$$\text{Max or min @ } \frac{\partial I}{\partial \lambda} = 0$$

$$0 = (-5a\lambda^{-6} e^{b/\lambda} + 5a\lambda^{-6}) + (\frac{b}{\lambda^2} a\lambda^{-5} e^{b/\lambda})$$

$$0 = (-5a\lambda^{-6} e^{b/\lambda} + 5a\lambda^{-6}) + (ba\lambda^{-7} e^{b/\lambda}) \left[ \frac{\lambda^6}{a} \right]$$

$$0 = (-5e^{b/\lambda} + 5) + (b\lambda^{-1} e^{b/\lambda}) \left[ \frac{1}{e^{b/\lambda}} \right]$$

$$0 = -5 + 5e^{-b/\lambda} + b\lambda^{-1}$$

$$\boxed{0 = 5e^{-hc/(k_B T \lambda)} + \frac{hc}{k_B T \lambda} - 5} \quad \star$$

$$b = \frac{hc}{k_B x} \quad \text{where } x = \frac{hc}{\lambda k_B T} \quad \text{plug } x \text{ into } b$$

$$b = \frac{hc}{k_B \frac{hc}{\lambda k_B T}} = \lambda T \Rightarrow \boxed{\lambda = \frac{b}{T}} \quad \star$$