A. (2 pts) An ideal p^+-n step junction has light uniformly absorbed throughout the device producing a photogeneration rate of G_L electron-hole pairs per cm^3 per s. Assume that low-level injection prevails. Assume that the device is many diffusion lengths long. Neglect photogeneration and recombination-generation in the depletion region.

a) Solve the diffusion equation and obtain a general form for the IV characteristic.

b) Give a physical interpretation for all terms in part a.

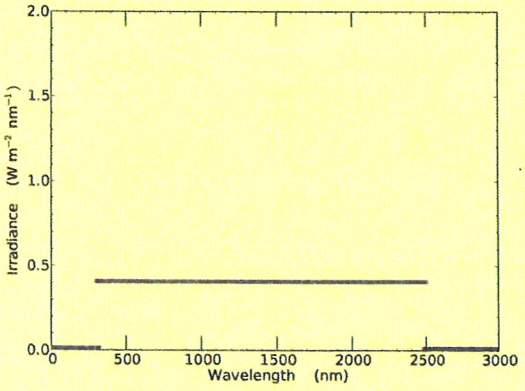
c) Suppose there is a series resistance R, how is this equation modified?

B. (2 pts) Given the simplified solar spectrum shown below.

a) What is the short circuit current and open circuit voltage of a pn junction solar cell using one material having a bandgap of 1.4 eV and operating at room temperature. Here assume that each photon creates only one electron-hole pair, that all of these are collected, and that the diode reverse saturation current is given by

$$J_s = Ae^{-E_g/k_BT} \text{ where } A = 6.03 \times 10^7 \text{ A/m}^2$$

b) Estimate the room temperature efficiency of the device.



q	1.6×10^{-19} C	electron charge
ϵ_o	8.85×10^{-14} F/cm	permittivity of free space
K_s	11.8 (Si)	relative dielectric constant
K_o	3.9 (SiO_2)	relative dielectric constant
k_B	8.617×10^{-5} eV/K	Boltzman's constant
h	6.63×10^{-34} J s	Planck constant
m_o	9.11×10^{-31} kg	electron mass
k_BT/q	0.0259 V at 300 K	thermal voltage
c	3×10^8 m/s	speed of light