1. The chart below shows the amplified spontaneous emission (ASE) spectrum collected from a laser cavity of length $L = 100\mu m$ with end reflectivities $R_1 = R_2 = 30\%$. Consider the following data points from the graph:

- Max: $(809.825\text{nm}, 2.77\text{mW/nm})$,
- Min: $(810.225\text{nm}, 0.51\text{mW/nm})$,
- Max: $(810.65\text{nm}, 2.77\text{mW/nm})$.

(a) Estimate the group index $n_g$
(b) Estimate the net modal gain $G = \Gamma g - \alpha_i$

![ASE Spectrum](image)

2. Consider two edge-emitting lasers with a distributed reflector as one mirror and a cleaved facet as the other consisting of an $8\text{nm In}_{0.2}\text{Ga}_{0.8}\text{As}$ single quantum well active region. The reflection spectrum for the mirrors is given below. The lasers have the following parameters: $\alpha_i = 5\text{cm}^{-1}$, $\eta_i = 0.8$, $\Gamma = 0.032$, $L = 100\mu m$, and laser width $w = 5\mu m$.

(a) From the reflection plots, sketch the loss spectrum for the two lasers, predict the lasing wavelength, and estimate the threshold material gain for the two lasers.
(b) Plot the empirical relation for $g(n)$ given in Coldren (Table 4.4). Calculate the threshold carrier density based on your result from (a).
(c) Using Eq. 4.108 in Coldren and the parameters given in Table 4.5, calculate the threshold current density and threshold current for the two lasers.

(d) Plot the curves of emitted power as a function of injected current for both lasers and comment on the differences.