84. (a) We require that $\sin\theta = m\lambda_{1,2}/d \leq \sin 30^\circ$, where $m = 1, 2$ and $\lambda_1 = 500\,\text{nm}$. This gives

$$d \geq \frac{2\lambda_s}{\sin 30^\circ} = \frac{2(600\,\text{nm})}{\sin 30^\circ} = 2400\,\text{nm} \ .$$

For a grating of given total width L we have $N = L/d \propto d^{-1}$, so we need to minimize d to maximize $R = mN \propto d^{-1}$. Thus we choose $d = 2400\,\text{nm}$.

(b) Let the third-order maximum for $\lambda_2 = 600\,\text{nm}$ be the first minimum for the single-slit diffraction profile. This requires that $d\sin\theta = 3\lambda_2 = a\sin\theta$, or $a = d/3 = 2400\,\text{nm}/3 = 800\,\text{nm}$.

(c) Letting $\sin\theta = m_{\max}\lambda_2/d \leq 1$, we obtain

$$m_{\max} \leq \frac{d}{\lambda_2} = \frac{2400\,\text{nm}}{800\,\text{nm}} = 3 \ .$$

Since the third order is missing the only maxima present are the ones with $m = 0$, 1 and 2.