

42. From Sample Problem 39-4, we have

$$\begin{aligned}\frac{\Delta E}{E} &= \frac{\Delta \lambda}{\lambda + \Delta \lambda} \\ &= \frac{(h/mc)(1 - \cos \phi)}{\lambda'} \\ &= \frac{hf'}{mc^2}(1 - \cos \phi)\end{aligned}$$

where we use the fact that $\lambda + \Delta \lambda = \lambda' = c/f'$.