HW 12-6 Soln)

We assume that the strings are fixed at each end.

Since the two strings are under the same tension and are otherwise identical, the longer string has the lower fundamental frequency (n = 2 in our equation). If the beat frequency of the two n = 2 harmonics is 6 Hz, the other frequency is either 394 Hz or 406 Hz; since the string is longer, it's the lower possibility, 394 Hz. The wave speed is given as 120 m/s.

Short string: $f_4 = \frac{2(120)}{4L} = 400 \text{ Hz}$ Long string: $f_4 = \frac{2(120)}{4(L+\Delta L)} = 394 \text{ Hz}$

Probably the easiest thing to do is solve for the length in each case:

$$\frac{2(120)}{4L} = 400 \quad L = 0.1500 \text{ m}$$

Likewise,

$$\frac{2(120)}{4(L+\Delta L)} = 394 \quad L + \Delta L = 0.1523 \text{ m}$$

and so $\Delta L = 0.0023$ m.