3. Key idea is that the string will resonate at only certain frequencies determined by wave speed $v$ on the string and the length $L$ of the string. These resonant frequencies are $f = n \frac{v}{2L}$, $n = 1, 2, 3 \ldots$

To set up the fourth harmonic ($n = 4$), we need to adjust the right side of this equation. $L$ is fixed, only to adjust $v$.

$$v = \sqrt{\frac{\tau}{m}} = \sqrt{\frac{mg}{m}}.$$  

$\therefore f = 4 \sqrt{\frac{mg}{m} / 2L} \Rightarrow m = \frac{4L^2}{4^2} \frac{220}{9.8} \frac{1.00}{0.016} \frac{kg}{m}$

$$= \frac{4 \cdot (0.2m)^2 (220Hz)^2 (0.0016kg/m)}{4^2 (9.8)(/s^2)}$$

$$= 0.85 \text{ Hz}.$$  

b) Insert key idea: $n$ must be an integer.

$\therefore$ with $m = 1.00 \text{ kg}$, inserting into $f = n \frac{v}{2L} = n \frac{\sqrt{mg}}{2L}$

$n = 2 \cdot v \cdot \sqrt{L}$

$$= 2 \cdot (220Hz) (1.2m) \frac{\sqrt{0.0016kg}}{1.00 \cdot 9.8 \cdot 7m/s^2}$$

$$= 3.7.$$  

$\therefore$ the string will be small, perhaps even imperceptible.