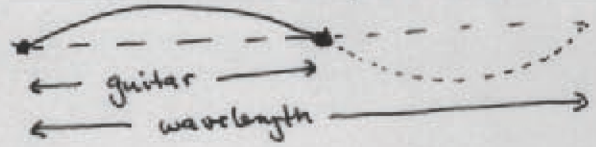
The B string of a certain guitar has a length of 58.5 cm. It vibrates at 247 Hz.

A. What is the speed of a wave on the string?

B. If the linear mass density of the guitar string is 0.0115 g/cm, what tension is required for the string to be in tune?

The "fundamental" has no internal nodes



$\lambda = .585\text{m} * 2 = 1.17\text{m}$

$v = f\lambda$

$= (247)(1.17)$

$= 289 \text{ m/s}$

B. $v = \sqrt{\frac{F}{\mu}}$ $\quad v^2 = \frac{F}{\mu}$ $\quad F = v^2\mu$

$\mu = .0115 \frac{g}{cm} \times \frac{kg}{1000 g} \times \frac{100 cm}{m} = .00115 \frac{kg}{m}$

$F = (289)^2 * .00115 = 96$ Newton

If Prof. Shannon uses eleven states called grades, designated as follows

{A, A-, B+, B, B-, C+, C, C-, D+, D, F},

to convey information to his students, then what is the capacity of this scheme to convey information?

$C = \log_2(N)$

$C = \log_2(11)$

$C = 3.459432$ bits/grade

If Prof. Shannon tends to issue grades with the following distribution

{1/4, 1/4, 1/4, 1/8, 1/8, 0, 0, 0, 0, 0, 0}

Then what is the actual amount of information he is conveying per grade? (You may want to use the table on the next page.)

$S = -\sum_i p_i \log_2(p_i)$

$= -\frac{1}{4}\log_2(\frac{1}{4}) - \frac{1}{4}\log_2(\frac{1}{4}) - \frac{1}{4}\log_2(\frac{1}{4}) - \frac{1}{8}\log_2(\frac{1}{8}) - \frac{1}{8}\log_2(\frac{1}{8})$

$= -\frac{3}{4}\log_2(\frac{1}{4}) - \frac{2}{8}\log_2(\frac{1}{8})$

$= -\frac{3}{4}(-2) - \frac{2}{8}(-3)$

$= +\frac{3}{2} + \frac{3}{4} = 2.25$ bits/grade