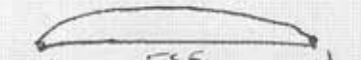
The B string of a certain guitar has a length of 58.5 cm. It vibrates at 247 Hz.

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?



$\lambda = 2 * .585 = 1.17$

$V = f\lambda = (247)(1.17) = 289 \text{ m/s}$

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

$V = \sqrt{\frac{F}{\mu}} \qquad F = \mu V^2$

$V^2 = \frac{F}{\mu} \qquad F = (.00115)(289)^2$

$F = 96.0 \text{ N}$

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?

$C = \log_2 N$

$N = 11$

$C = \log_2(11) = 3.459432$ from table

3.459432 bits per 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.)

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

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

(3 such term; two such terms)

$= -\frac{3}{4}(-2) - \frac{2}{8}(-3) = \frac{3}{2} + \frac{3}{4} = \frac{9}{4} = 2.25$ bits per grade