Q1- Standing waves of frequency 180 Hz are produced on a string of length 60 cm and it vibrates making three loops. What is the wave speed on the string?

In standing waves the distance between consecutive nodes is half of the wavelength. Here the string vibrates in three loops and each loop is formed between two nodes hence the total length of the loops is

$3*(\lambda/2) = 60$ cm

Or $\lambda = 40$ cm $= 0.40$ m

Now the wave speed is given by

$c = \nu * \lambda$

Here ν is the frequency of the wave hence

$c = 180*0.40 = 72$ m/s

Q2- A 121 cm long string with mass 4.0 g oscillates in its m=3 mode with a frequency of 180 Hz and a maximum amplitude of 5.0 mm. What are (a) the wave length and (b) the tension in the string?

Mass per unit length of the string is given by

$\mu = m/l = 4.0/121$ g/cm.

(a) The string is vibrating in third mode means in three loops hence the wave length is given by

$3*(\lambda/2) = 121$

Or $\lambda = 242/3$ cm

(b) Now the wave velocity on the string is

$c = \nu \lambda = 180*242/3 = 14520$ cm/s

As the wave speed for the transverse waves on the stretched string is given by the formula

$$C = \sqrt{\frac{T}{\mu}}$$

Here T is the tension in the string and μ is its mass per unit length. So we get

$T = \mu*c^2 = (4/121)*(14520)^2 = 6969600$ dynes (CGS units) $= 69.7$ N