Q- One of the 63.5 cm long guitar wire is tuned to produce note B (245 Hz) when vibrating in its fundamental mode.
(a) Find the speed of the transverse wave on the string.
(b) If the tension in the string is doubled, what will be the new fundamental frequency?

(a) The speed of the transverse wave on a stretched wave is given by

C = n*λ

Where n is the frequency and λ is the wavelength

As the nodes are formed at two ends of the string and the distance between two consecutive nodes is half of the wavelength

λ/2 = 63.5 cm = 0.635 m

And λ = 0.635*2 = 1.27 m

Hence the speed is given by

C = n λ = 245*1.27 = **311.15 m/s**

(b) The fundamental frequency of the string is given by

$$n = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

Where l is the length of the string, T is the tension in the string and m is the mass per unit length of the string. If the length and the mass per unit length of the two strings will be the same, from above equation we get

$$\frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$$

Hence if the tension is doubled the new frequency is given by

$$n_2 = n_1\sqrt{\frac{T_2}{T_1}} = 245\sqrt{\frac{2T_1}{T_1}} = 245 * \sqrt{2} = 346.48\ Hz$$