18 The harp is a musical instrument with many strings, as shown.

(Source: © Peter Voronov/Shutterstock)

All the strings are under tension.

The strings on one type of harp are made from nylon of density $1070\,kg\,m^{-3}$. One string has a diameter of 1.14 mm.

(a) (i) Show that the mass per unit length μ of the string is about $1.1 \times 10^{-3}\,kg\,m^{-1}$.

(2)

(ii) When the middle of the string is plucked, a note of frequency 440 Hz is produced.

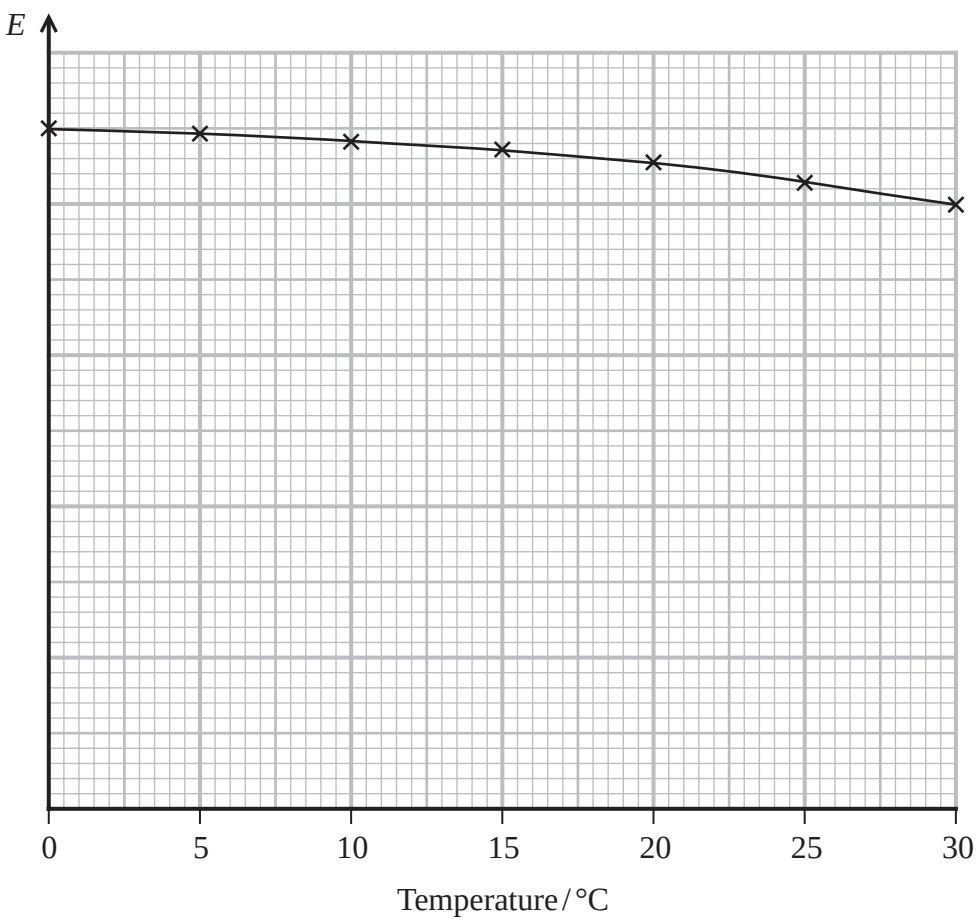
Calculate the tension in the string.

length of string = 41.0 cm

(4)

Tension in string = ...

(b) The graph shows how the Young modulus E of the nylon varies with temperature.



When the harp is played, the temperature of the string increases.

Explain how this temperature change would affect the frequency of the note produced when the string is plucked.

(3)

(Total for Question 18 = 9 marks)