Physics 260 Homework Assignment 3

1 PSE6 16.CQ.003

From the expression for the speed of a wave on a stretched string $v = \sqrt{T/\mu}$, to decrease the wave speed in a stretched string by a factor of 12, the tension by a factor of 144.

2 PSE6 16.P.003

a. The equation is given in the form of $f(x + vt)$. So it describes a wave travelling to the left, which is in $-x$ direction.

b. The constant in front of x is the angular wave number k. And the constant in front of t is the angular frequency ω. The speed of the wave is determined by the expression $v = \omega/k$.

3 PSE6 16.P.005

Assume the time required for faster wave to reach the seismographic station is t_1, then the total time required by the slower wave would be $t_1 + \Delta t$. The distance d travelled by both waves is the same. Therefore,

$$d = v_1 t_1 = v_2(t_1 + \Delta t)$$

Plug in the values and solve for t. And then multiply it by v_1 to find the total distance.

4 PSE6 16.P.008

Wave number k can be found from the wavelength using $k = 2\pi/\lambda$. Therefore, $v = \omega/k = (\omega\lambda)/2\pi$.

5 PSE6 16.P.009

The amplitude of the wave is given by the constant in front of the sin term. Wavelength λ is given by the expression $\lambda = 2\pi/k$. Frequency f equal $2\pi/\omega$. And the speed of the wave can be found using $v = \omega/k$.

6 PSE6 16.P.0013

a. $A =$ constant in front of the sin term.

b. $\omega =$ constant in front of t.

c. $k =$ constant in front of x.

d. $\lambda = 2\pi/k$.

e. $v = \omega/k$.

f. the wave function is given in the form of $f(kx - \omega t)$, therefore, it is travelling to the right, which is in the positive x direction.

7 PSE6 16.P.022

String density μ is mass per unit length. So $\mu = m/L$. The speed of the transverse wave produced by a stretched string is given by $v = \sqrt{T/\mu}$. Hence the required tension for the given speed of the wave is

$$T = v^2\mu = v^2L/m$$

8 PSE6 16.P.023

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

9 PSE6 16.P.026

The diameter d of the copper wire is given, therefore, the cross-sectional area can be determined. Multiplying together the density of copper and the cross-sectional area of copper wire gives the string density μ. So the tension of the wire is given by the expression

$$T = v^2\mu = v^2\rho_{Cu}\pi(\frac{d}{2})^2$$

Pay attention to the units.

10 PSE6 16.P.031

In each wire, the time required is

$$t = \frac{L}{v} = L\sqrt{\frac{\mu}{T}}$$

Let A represent the cross-sectional area of one wire. The mass of one wire can be written both as $m = \rho V = \rho AL$, and $m = \mu L$. Set two equations equal and solve for μ, we get

$$\mu = \rho A = \frac{\pi \rho d^2}{4}$$

Plug this into the time expression and yields

$$t = L(\frac{\pi \rho d^2}{4T})^{1/2}$$

Plug in associated values for copper and steel and solve for both times. The total time would be the sum of these two. Be careful with the units.

11 PSE6 16.QQ.001

longitudinal

12 PSE6 16.QQ.002

transverse

13 PSE6 16.QQx.001

The frequency of the waves.

14 PSE6 16.QQx.002

It is not related to the spring constant.