

# ESS 512 HW 1

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## 1 Ch2 Ex3

**a.**

The first 10 cycles of the surface wave lasts from  $20.1 * 10^2$  seconds to  $23.5 * 10^2$  seconds, giving a dominant period of  $23.5 * 10^2 - 20.1 * 10^2 = 340$  s. This gives us an individual period of 3.4 seconds.

**b.**

Frequency  $f = \frac{1}{T}$ , so our frequency is  $f = \frac{1}{3.4s} = 0.30$  Hz

**c.**

Reading from the graph the maximum strain recorded on the seismogram looks like  $\pm 275$  microns.

**d.**

A seismic plane wave can be approximated as:  $u_z = A \sin[2\pi f(t - (x/c))]$

$$\varepsilon = \frac{\partial u_z}{\partial x} \rightarrow \varepsilon = \frac{-2\pi f A}{c} \cos[(2\pi f(t - (x/c)))]$$

The maximum occurs when cosine = -1, so:

$$\varepsilon_{max} = \frac{2\pi f A}{c} \rightarrow \varepsilon_{max} = \frac{2\pi(0.30s^{-1})(275*10^{-6}m)}{3.9*10^6m/s} = 1.33 * 10^{-10}$$

## 2 Ch3 Ex1

Period  $T$  is to angular frequency  $\omega$  ( $\omega = \frac{2\pi}{T}$ ) as wavelength  $\lambda$  is to wavenumber  $k$  ( $k = \frac{2\pi}{\lambda}$ ).

## 3 Ch3 Ex2

**a.**

Start out with a plain sine wave with an amplitude:  $u_z(t) = A \sin[\omega t - kx + \phi]$ . There is no phase shift, so  $\phi = 0$ , and we are given amplitude ( $A = 0.04m$ ), wavelength ( $\lambda = 8km$ ), and wavespeed ( $c = 5km/s$ ). We can find  $\omega$  and  $k$  with given values from Table 3.1:  $\omega = 2\pi f = 2\pi \frac{c}{\lambda}$ ;  $k = \frac{2\pi}{\lambda}$

Rewriting the equation with our given and derived values:

$$u_z(t) = 4 * 10^{-5} \sin[2\pi \frac{c}{\lambda} t - \frac{2\pi}{\lambda} x] = 4 * 10^{-5} \sin[(\frac{2\pi}{\lambda})(ct - x)]$$

**b.**

Strain  $\varepsilon = \frac{\partial u_z}{\partial x} \rightarrow \varepsilon = \frac{-4*10^{-5}*2\pi}{\lambda} \cos[(\frac{2\pi}{\lambda})(ct - x)]$ . This equation is maximized when  $(ct - x) = \frac{\lambda}{2}$ , or when the argument of cos is  $\pi$ . This leaves  $\varepsilon_{max} = \frac{4*10^{-5}*2\pi}{8*10^3} = 3.14 * 10^{-7}m$