EOS/PHYS 427 — Assignment 4

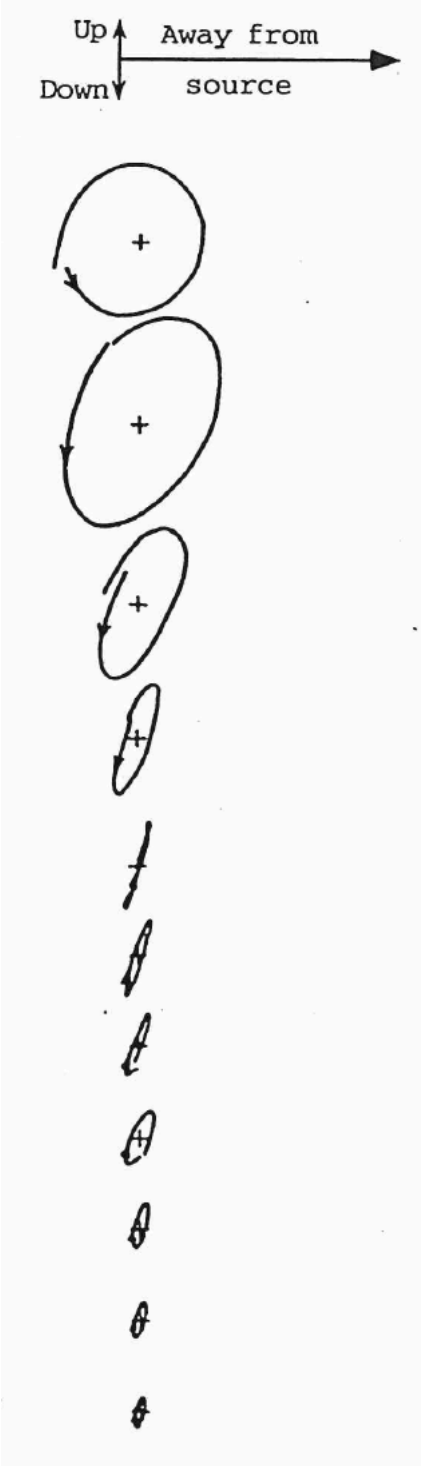
Due: Tuesday, February 28, 2023.

1. Rayleigh waves decay exponentially with depth into the earth, with the P component decaying more rapidly than the S component since $\kappa_p > \kappa_s$. Starting with Eq. (2) in the class notes on Rayleigh waves (e.g., page 48 in the online notes for Week 5), consider a depth such that the $\exp(\kappa_p\, z)$ terms are negligible compared to the $\exp(\kappa_s\, z)$ terms, and show that Rayleigh wave particle motion is prograde elliptic at this depth: Consider x and z components of displacement and particle velocity at this depth and plot the motion over one period of the wave (as we did in class notes for $z = 0$).(20 pts)

2. (a) For a Rayleigh wave propagating at a frequency of 1 Hz in a uniform medium with $\alpha = 5$ km/s and $\beta = 2.9$ km/s, use matlab or python to plot (together on the same graph) the relative amplitude of the x and z displacements of the wave as a function of depth over one Rayleigh-wave wavelength. For this, set the amplitude factor $A = 1$ and neglect the sine/cosine dependences in Eq. (2) in class notes; you can use $c_R = 0.92\beta$ for this case. (20 pts)

   (b) Based on your plot from (a), explain the behaviour of Rayleigh-wave particle motion as a function of depth, making reference to the figure on page 2 of this assignment showing measured Rayleigh-wave particle motion at increasing depths. (10 pts)

   (c) By what factors are the P and S components attenuated at one Rayleigh-wave wavelength depth? (5 pts)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