EART290Q 2020

PROBLEM SET #3 – due Friday 14th Feb

In class we used the correspondence principle to derive a complex modulus μ^* for a viscoelastic material experiencing periodic deformation with angular frequency ω.

a) Use the correspondence principle to derive an expression for the complex *viscosity*, η^*, in terms of μ, ω and viscosity η. You do this by setting η^* = stress / strain rate.

Darwin (1879) showed that for a viscous planet, the (dimensionless) amplitude of the tidal response *A* was given by cos ε, where

$$\tan \varepsilon = q = \frac{19\eta\omega}{2\rho g R}$$

b) Find an expression for the tidal response *A* in terms of *q*.

c) What happens to *A* in the limits of low viscosity and high viscosity? Does this make sense?

d) For a viscoelastic material, we can still use Darwin's equation but substitute η^* for η. Derive an expression for *A* in the high-frequency limit, and explain why it makes sense.