Introduction Geophysics Lab

Derivation of Spherical Snell's Law for radial symmetric velocity model v(r)

1. Assume a spherical earth where velocity is only a function of radius v(r). Assume a ray that is incident at the top of the first spherical layer with an angle of incidence (Θ_1). Use the angles and layer velocities defined in the chalkboard figure. You should rewrite your derivation two or more times to get a clean, erudite, logical, and 'pretty' derivation.

   a) Do a derivation of $f(\Theta_1) = \Theta_2$
   b) Do a derivation of $f(\Theta_1) = \Theta_3$

2. Assume a spherical earth with four velocity layers (v_1=2, v_2=3, v_3=4, v_4=5 km/s) where the interfaces are at r_1=400, r_2=300, r_3=200 km. Use the angles and values as defined for the chalkboard figure. Assume the angle of incidence at the top of the first layer is $\Theta_1 = 10°$.

   Algebraically (no numbers) derive the equation
   a) $\Theta_2 (\Theta_1)$
   b) $\Theta_3 (\Theta_2)$
   c) $\Theta_4 (\Theta_3)$

   Now, substitute in the appropriate values for the variables into the three equations above (a-c) and find the angles. The correct answer is that $\Theta_4 = 60.1°$.

   d) Calculate value of equation (a).
   e) Calculate value of equation (b).
   f) Calculate value of equation (c).