

EOS/PHYS 427 — Assignment 9

NOT FOR MARKS. Can be submitted prior to the final exam for feedback.

1. A 2-layer model of the crustal geotherm with internal heat generation $A = A_1$ for $0 \leq z < z_1$ and $A = A_2$ for $z_1 \leq z \leq z_2$ and heat generation at the base of the crust of $Q(z_2) = -Q_2$ is given by

$$T_1(z) = -\frac{A_1}{2k}z^2 + \left(\frac{Q_2}{k} + \frac{A_2}{k}(z_2 - z_1) + \frac{A_1 z_1}{k}\right)z \quad \text{for } 0 \leq z \leq z_1,$$

$$T_2(z) = -\frac{A_2}{2k}z^2 + \left(\frac{Q_2}{k} + \frac{A_2 z_2}{k}\right)z + \frac{A_1 - A_2}{2k}z_1^2 \quad \text{for } z_1 \leq z \leq z_2.$$

Verify that this model satisfies the following:

(a) Boundary conditions $T_1(z) = 0$ at $z = 0$ and $T_1(z) = T_2(z)$ at $z = z_1$. (5 pts)

(b) Equilibrium heat condition (5 pts)

$$\frac{\partial^2 T_1}{\partial z^2} = -\frac{A_1}{k} \quad \text{and} \quad \frac{\partial^2 T_2}{\partial z^2} = -\frac{A_2}{k}.$$

(c) Basal heat generation $Q(z) = -Q_2$ at $z = z_2$. (5 pts)