1. Consider a topographic feature with the rectangular cross-section shown below. The topography, with this cross-section, extends to infinity both into and out of the page. Suppose this feature is perfectly isostatically compensated, as described by Airy compensation. Let the thickness of the crust be $H$, the density of the crust and the topography be $\rho_c$, and the density of the mantle be $\rho_m$. Find the perturbation to the free air gravity anomaly at $x=0$ (that is, above the center of the rectangle) caused by the topography plus its root. Assume that $T << W$, so that you can approximate both the topography and its root as surface masses.

![Diagram of a rectangular cross-section with labeled dimensions](image)

2. Approximate the Rocky Mountains in Colorado as a long north-south mass load with a rectangular cross-section. Let $h_0'$, $a$, and $\rho_c$ be the amplitude, width, and density, respectively, of this topographic load ($\rho_c$ is also the density of the crust).

(a) Using the flexure Green's function from class (in other words, use the solution for an infinitely thin, infinitely high load), integrate it over the box to find the vertical displacement of the lithosphere beneath the center of the load, in terms of $h_0'$, $a$, $\rho_c$, and the structural/rheological parameters that describe the lithosphere and asthenosphere.

(b) Using your result, along with general information about the topography of Colorado, estimate how much deeper the lithosphere/asthenosphere boundary is under the center of the Colorado mountains than under, say, Kansas. Do this for an assumed lithospheric thickness of 100 km. Assume the Lame parameters are uniform throughout the lithosphere, and that the p-wave and s-wave velocities in the crust are 5.8 km/sec and 3.5 km/sec, respectively. Take $\rho_c = 2.7$ gm/cm$^3$ and $\rho_m = 3.5$ gm/cm$^3$.

3. Suppose that surface gravity observations require a lithospheric thickness of 30 km under the North Atlantic Ocean, just east of North America. Suppose the North Atlantic Ocean began opening up 100 million years ago.

(a) Use this information to deduce the temperature at which material in the fluid asthenosphere freezes into solid lithospheric material.

(b) Assume the lithosphere/asthenosphere boundary is an isotherm, and that the North Atlantic Ocean has been widening at a uniform rate over the last 100 million years. Given your results from (1), estimate the lithospheric thicknesses at distances of 500 km, 1000 km, and 2000 km from the axis of the mid-Atlantic ridge.

In (a) and (b), take the thermal diffusivity to be 1 mm$^2$/sec, and assume the temperatures of the mantle and sea floor are 1800$^\circ$K and 273$^\circ$K, respectively.