

UNIVERSITY OF KANSAS
Department of Physics and Astronomy
Astrophysics I (ASTR 691) — Prof. Crossfield — Fall 2026

In-Class Problems 13 [25 pts]

You may use your OoMA Sheet, your handwritten notes, and a scientific or graphing calculator – and you may work in a group. As always, be sure to: show your work, circle or highlight your final answer, list units, use the appropriate number of significant figures, and write your name.

Interior of the Earth

Assume that the interior density of the Earth is given roughly by the following table (a binned-down version of the “Preliminary Reference Earth Model”):

radius range [km]	dr [m]	ρ [kg m ⁻³]
0–1750	1,750,000	12400
1750–3500	1,750,000	11200
3500–5700	2,200,000	5000
5700–6000	300,000	3800
6000–6400	400,000	3300

1. Plot the density profile of the Earth. [3 pts]
2. Use the tabulated $\rho(r)$ to calculate and plot $M_{\text{enc}}(r)$. How does your total enclosed mass compare with the known mass of the Earth? [4 pts]
3. Use your $M_{\text{enc}}(r)$ to calculate and plot the Earth’s internal gravity profile, $g(r)$, throughout the Earth’s interior. How does your surface gravity compare to the known value for Earth? At what radius r do you find $g(r)$ to be maximum? [4 pts]
4. Use $\rho(r)$ and $g(r)$ to calculate the internal pressure profile of the Earth, $P(r)$. How does your value at the core, $P(r = 0)$, compare to the estimated core pressure of the Earth of $\sim 3.5 \times 10^{11}$ Pa? [4 pts]
5. Make the (extremely erroneous) assumption that the Earth’s interior is an ideal gas composed of atomic iron. This assumption resembles reality in no conceivable way... but, run with it and use it to estimate the temperature, $T(r)$, throughout the Earth’s interior. How does your value at the core compare to the estimated core temperature of the Earth of ~ 6000 K? [4 pts]
6. Discuss how one might make a more accurate set of calculations to better constrain the interior properties of a planet. [6 pts]