1) Because diamonds require a minimum pressure to form and inside Earth and they do not form at depths shallower than 150 km. What is the smallest diameter (in km) body whose central pressure could be high enough to form diamonds? Use 3500 kg m$^{-3}$ for both bodies. Within a few hundred kilometers of its surface, Earth’s internal pressure can be considered to be just due to the weight of the rock above it. Near the surface, the pressure \( P=\rho gh \) where \( \rho \) is the density, \( g \) is the local gravitational constant and \( h \) is the depth of the column \{this is the weight of a column of unit area and length \( h \}\}. The pressure deep in a body must take into account the fact that \( g \) varies with radius. The pressure at the center of a spherical uniform density body is proportional to the square of the body's size as derived in class.

2) The phase diagram of water, a plot of temperature versus H$_2$O vapor pressure, has a point called the triple point where vapor, ice and liquid can co-exist. At vapor pressures below the triple point (612 pascals or 0.006 atm) water can only exist either as vapor or solid ice. Estimate the minimum diameter comet (in km) that could have a high enough internal pressure to have liquid water present half way between its surface and center. Assume that the body is a sphere and has a uniform density of 1000 kg m$^{-3}$ and that the interior pressure is purely determined by hydrostatic equilibrium.

3) The pressure \( P \) in a constant temperature atmosphere varies with altitude \( Z \) as

\[
P = P_0 e^{-Z/H}
\]

where \( P_0 \) is the surface pressure, \( Z \) is the altitude and \( H \) is the scale height (the change in altitude required for the pressure to decrease by \( e^{-1} \)). As derived from hydrostatic equilibrium \( (dP/dr = -g\rho) \) and the perfect gas law \( (P=\rho kT/\mu M_h) \) -

\[
H = \frac{kT}{g\mu M_h}
\]

where \( \mu \) is the molecular weight (relative to hydrogen), \( M_h = \text{hydrogen mass} \), \( K \) is the Boltzmann constant \( 1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^2 \text{ K}^{-1} \), \( T \) is absolute temperature, and \( g \) is the local gravitational constant.

Assuming a pure N$_2$ (molecular wt =28) atmosphere and a temperature of 300K calculate the pressure at the top of Mt Everest (height defined here to be 9km) relative to the pressure at sea level (the answer is a number less than 1).
4) What would the pressure ratio (peak/sea level) be for Mt Everest if we had a pure H\(_2\) atmosphere as may exist on some Super Earths?

5) Once global warming heats Earth and melts all the ice on Mt Rainier, will the pressure at the summit be higher or lower than it is today, assuming that sea level pressure remains constant and that the summit altitude stays the same.