Exercise 7.1
Recall from Problem 6.2, that the bulk modulus, $B$, is a material property that relates the change in volume with a change in pressure.

$$B \equiv -V \left( \frac{\partial P}{\partial V} \right)_{T=\text{constant}} = -\left( \frac{\partial P}{\partial \log V} \right)_{T=\text{constant}}$$

To be explicit, let’s call this bulk modulus the “isothermal bulk modulus,” $B_{\Delta T=0}$

Show that $B_{\Delta T=0}$ is related to the “adiabatic bulk modulus,” $B_{\Delta S=0}$, where

$$B_{\Delta S=0} \equiv -V \left( \frac{\partial P}{\partial V} \right)_{s=\text{constant}} = -\left( \frac{\partial P}{\partial \log V} \right)_{s=\text{constant}}$$

by

$$\frac{B_{\Delta T=0}}{B_{\Delta S=0}} = \frac{C_V}{C_P}$$

and state whether you expect a solid material to be “stiffer” if it is reversibly squeezed at constant temperature or with no heat being transferred to it.

Exercise 7.2
Also recall from Problem 6.2 that, for a polymer with isothermal bulk modulus of 0.14 GPa and a density of 0.93 relative to water, there was a critical ocean depth where the work rate to sink (or float) that material switches from positive to negative.

Show that the critical depth is an unstable equilibrium.