Hydrostatic Equilibrium Worksheet
(to follow the astronomy demonstration video at https://www.youtube.com/watch?v=oRpS2Udx55w)

1) The pressure \( P \) at various depths \( h \) of a fluid in a graduated cylinder is described by \( P = P_0 + \rho gh \) where \( g \) is the acceleration of gravity. Thus the differential pressure, the amount above atmospheric pressure \( P_0 \) due to the fluid, is described by \( P - P_0 = \rho gh \). Indicate which labeled curve or line correctly describes how the differential pressure \( P - P_0 \) increases with depth \( h \) for a graduated cylinder filled with ...

\[ \text{C} \quad \text{pure water on Earth} \]
\[ \text{pure saltwater (} \rho_{\text{saltwater}} = 1.3) \quad \text{on Earth} \]
\[ \text{pure water on a planet with lower gravity} \]
\[ \text{water/karo syrup gradient on Earth} \]

2) Two tall graduated cylinders are shown below. The cylinder on the left contains pure water \( \rho_{\text{water}} = 1.0 \text{ g/cm}^3 \). The cylinder on the right is half full of Karo syrup \( \rho_{\text{karo}} = 1.33 \text{ g/cm}^3 \), water is added, and then the two are partially mixed creating a density gradient from top to bottom.

a) For the cylinder on the left, the pressure is \( P_\alpha \) at the depth indicated.
   -- Indicate with a labeled arrow (if possible) where the pressure \( 2P_\alpha \)?
   -- Indicate with a labeled arrow (if possible) where the density \( \rho \) is \( 1.25 \text{ g/cm}^3 \).

b) For the cylinder on the right, the pressure is \( P_\beta \) at the depth indicated.
   -- Indicate with a labeled arrow (if possible) where the pressure \( 2P_\beta \)?
   -- Indicate with a labeled arrow (if possible) where the density \( \rho \) is \( 1.25 \text{ g/cm}^3 \).