

1. Space scientists have designed a probe to be sent to Venus. The atmospheric pressure on Venus is 9.3 Mega-Pascals, i.e. about 90 times the atmospheric pressure on the Earth. To check whether the probe can withstand such a high pressure, the scientists decided to submerge it into water. How deep should the probe be submerged to recreate the pressure conditions on Venus?

2. Consider a U-shaped pipe filled with water. The left branch of the pipe has a wider cross-section than the right branch: the left side has cross-section area  $1 \text{ m}^2$ , while the right side has cross-section area  $0.25 \text{ m}^2$ . Further, suppose both branches are plugged with pistons which can move up and down with the water. Winnie-the-Pooh, whose mass is  $10 \text{ kg}$ , is standing on the piston in the left branch. Piglet, whose mass is  $3 \text{ kg}$ , is standing on the piston in the right branch. Which piston will go up, and which one will go down?

3. Consider a pipe which has the shape of a torus (i.e. a tire). We will assume that the pipe is thin, i.e. the diameter of its cross-section is much smaller than its diameter (see picture). The height of the pipe is 1 meter. Let us fill the bottom half of the pipe with water, and the upper half with olive oil (density about  $917 \text{ kg/m}^3$ , according to Wikipedia). What pressure will be measured by a manometer located at the very bottom of the pipe (and inside it, obviously)?

4. Now consider the same pipe, but fill it with only half the water and half the oil. That is, first pour enough water to fill  $1/4$  of the pipe, and then pour the amount of oil necessary to fill another  $1/4$  of the pipe. Oil does not mix with water, so they will stay separate. Further, since water is heavier than oil, the surface of the water will be lower than the surface of the oil. The question is, by how much?

