Homework Problem 2 – Due Tuesday, 1/24

Answer all questions with a (short) paragraph or 2 explaining your reasoning, as well as a numerical answer as appropriate. You must submit your final solution in machine-readable form (text or MS Word document, .pdf, .jpg, LaTeX,…) via Canvas.

Q1

You have a sphere made of plastic that has a mass of exactly 1 kg, and sphere made of lead also with a mass of exactly 1 kg. Which one of these weighs more? (Careful, the answer is not as obvious as you may think…). 2+1

Q2

A 1 m long rod is used to suspend 1 kg of weight and stretches 1 mm once the weight is attached. How much will TWO of the same rods, attached end to end, stretch under the same weight, attached to the bottom of the lower rod? (You can ignore the weight of the rods themselves). How much would each rod stretch if they were instead mounted next to each other (parallel) and shared the load of the 1 kg weight? 3

Q3

The rod from Q2 above is now held sideways (horizontal) and clamped down at one end. The 1 kg weight hangs off the other end. If the cross section of the rod is a 1 cm x 2 cm rectangle, which way should you orient it – with the 1 cm horizontal or the 2 cm horizontal - so it bends the least? Explain why! (or   ?) 2

Q4

A barrel of 1 m height is completely filled with wine. Someone taps a hole in the top and connects a 10 m long hose (securely fastened and caulked to the barrel). He then tries to "top off" the barrel by stretching the hose straight up 10 m (2 floors above the wine cellar) and filling the hose with wine from the top (perhaps with a funnel). To his great surprise and embarrassment, the barrel bursts, spilling all of the wine on the floor! Why does the addition of such a small amount of wine (maybe only 1 liter) cause such a catastrophic outcome? (Assume the barrel was comfortably stable before the wine was added to the hose). Be quantitative – by how much did the pressure in the barrel increase? Why? 3

Exercise 13.E.38

Suppose that you balance a 5-kg ball on the tip of your finger, which has an area of 1 cm square. Calculate the pressure on your finger in N/cm^2, kPa and atmospheres. Show your reasoning. 2

(Exercise 13.E.42 – slightly varied)

In lab you find that a 1-kg rock suspended above water weighs 10 N. When the rock is suspended beneath the surface of the water, the scale reads 8 N.

  a) What is the buoyant force on the rock?
  b) What is the **volume** of the rock?
  c) What is the **density** of the rock?

      3

15 total + 1 xc