

Questions on Density and Pressure*

Density

1. Does the mass of a car change if it is crushed into a cube? Explain.
2. Does the density of a car change if it is crushed into a cube? Explain.
3. Does a dieting person lose mass? Weight? Density? Explain your answers.
4. How does the density of water change when it freezes into ice?
5. Which is more dense, a kilogram of feathers or a kilogram of iron?
6. Which weighs more on the earth, a kilogram of feathers or a kilogram of iron?
7. What is the difference between density and linear density?
8. Given what you know about Newton's second law ($F = ma$), why would you expect a denser guitar string to vibrate more slowly when plucked with the same force?

Pressure

1. Why does a sharp knife cut better than a dull knife (even when you apply the same force)?
2. An old time magic trick (that originally came from India) was to lie down on a bed of nails (hundreds of nails sticking up through a board) without getting hurt. Using the definition of pressure, explain how this is possible.
3. Does a bathroom scale measure pressure or force? Explain. (Try this at home: Stand with both feet on the scale, look at the reading and then stand on one foot on the scale and check. Are the readings different?)
4. Which exerts more pressure on the ground, the foot of an elephant or a person in high-heeled shoes? State your reasoning.
5. You may notice that an unopened bag of chips is soft while on the ground but it puffs out to be firm when at cruising altitude in an airplane. Explain why.
6. Why would you want the bottom of a dam to be stronger than the top?
7. Why would it be slightly more difficult to suck soda through a straw on top of a high mountain as compared to sea level?
8. You decide you want to use a piece of garden hose with one end above water to go to the bottom of a pool 3 m deep and be able to breath. What is wrong with this plan?
9. A siphon is a tube that transfers liquid from a higher level to a lower level. How does it work?
10. What causes the 'lift' on an airplane wing?
11. Why is it easier on your heart when you are lying down compared to when you are standing?
12. Why does a lightweight shower curtain move in towards you when the shower is running?
13. How does an airplane wing provide lift?
14. The pressure variation in a sound wave from a jet engine is around 200 Pa (Pascal). What is this in N/m^2 ?
15. Suppose a marimba mallet makes contact with a wooden marimba bar and applies a strike force of 600 N. You measure the contact area of the mallet to be 5 square millimeters ($5.0 \times 10^{-6} \text{ m}^2$). What pressure (in N/m^2) was exerted on the marimba bar? Convert this to atmospheres (1 atmosphere = 101325 N/m^2). Do you think this could do damage to a marimba bar?
16. For sound waves from a normal conversation the pressure at the listener's ear fluctuates by around 0.2 N/m^2 . How much does the force change on the eardrum if the area is 1 cm^2 ($1.0 \times 10^{-4} \text{ m}^2$)?
17. Suppose the pressure of a sound wave reaching a microphone fluctuates by 0.002 atmospheres. What is the force on the microphone if it has an area of 2 cm^2 ($1.0 \times 10^{-4} \text{ m}^2$)?

* Many of these ideas came from *Conceptual Physics* 11th Ed. by Paul Hewitt (Addison Wesley, 2011).