Physics100: HW 6 Solutions

Chapter 13 and 14:

1) If liquid pressure were the same at all depths, would there be a buoyant force on an object submerged in liquid?.

No. Physically, the buoyant force arises due to the pressure difference on the lower surface of the object and the upper surface, which gives a net upward force on the object: pressure increases with depth, so is larger on the lower surface than the upper surface, and since the related force always points normal to the surface, into the object, this means the force is larger on the lower surface in an upward direction, larger than the downward force on the upper surface.

2) Why is it inaccurate to say that heavy objects sink and that light objects float? Give exaggerated examples to support your answer.

Heavy or light objects may or may not sink, depending on their densities (a heavy log floats while a small rock sinks, or an ocean liner floats while a paper clip sinks, for example). People who say that heavy objects sink really mean that dense objects sink. Be careful to distinguish between how heavy an object is and how dense it is.

3) The relative densities of water, ice, and alcohol are 1.0, 0.9, and 0.8, respectively. Do ice cubes float higher or lower in a mixed alcoholic drink compared to a drink of water? Explain your answer.

Ice cubes will float lower in a mixed drink because the mixture of alcohol and water is less dense than water. In a less dense liquid a greater volume of liquid must be displaced to equal the weight of the floating ice. In pure alcohol, the volume of alcohol equal to that of the ice cubes weighs less than the ice cubes, and buoyancy is less than weight and ice cubes will sink. Submerged ice cubes in a cocktail indicate that it is predominantly alcohol.

4) Your uncle says that the buoyant force of the atmosphere on an elephant is much greater than the buoyant force of the atmosphere on a small helium-filled balloon. Explain whether you agree, and if so, why doesn't this mean the elephant floats.

He is right that the buoyant force of the atmosphere on an elephant is much greater than that on a small helium-filled balloon, because the buoyant force equals the weight of the air that is displaced, which is much larger for the elephant due to its much larger volume. But this does not mean that the elephant floats, because this is not the only force that acts on the elephant: the gravitational force also acts on the elephant, in a downward direction, and this is far larger than the buoyant force on it. The downward gravitational force = mg = (weight-density of elephant)x volume of elephant, as compared with the upward buoyant force which is weight-density of atmosphere x volume of elephant; given that the elephant's density is much larger than the air's density, the downward force wins by far.

5) Your clicker question