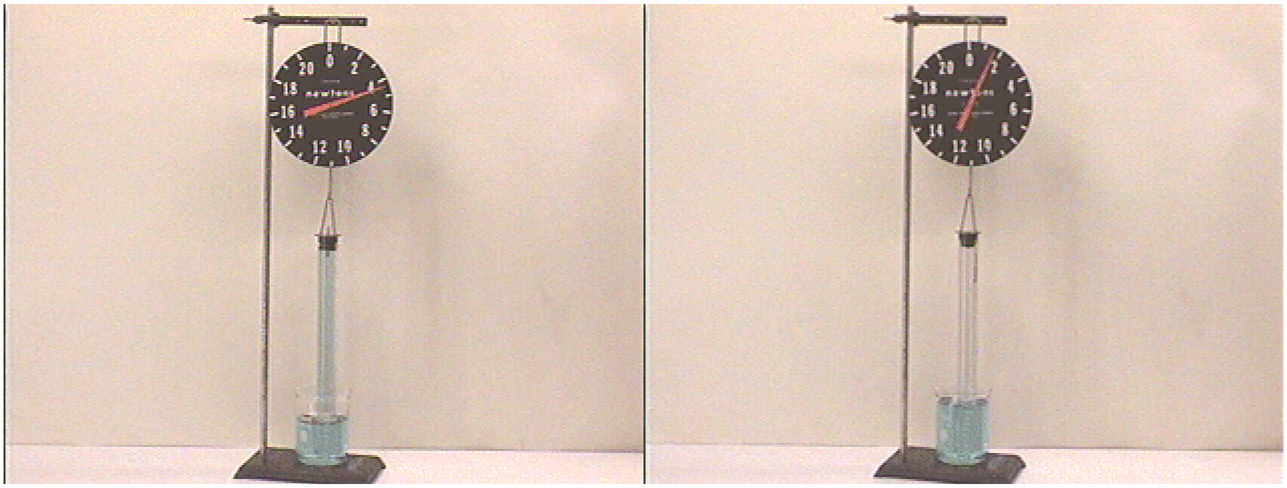
Answer #16

The answer is (b): the reading of the scale will become less, as seen by comparing the two photographs below.



This may be a surprising result, considering that the water is held up in the tube by the force exerted by the atmosphere, and not by the spring scale. Now we must identify the force that changes so that the spring scale reading goes up.

Notice that when the water is gone from the tube, there is an upward force exerted on the top of the tube by atmospheric air pressure, which acts in all directions at any place connected directly to the atmosphere. With water filling the tube, the pressure at the top of the tube is less than atmospheric pressure, by an amount equal to the weight of the water divided by the area of the tube. The upward force exerted on the inside of the top of the tube then is greater *after* the water is gone. This means that *less* upward force is required by the spring scale to hold the water tube up - by an amount equal to the weight of the water in the tube. It turns out that the fact that the water is held up in the tube by atmospheric pressure is basically irrelevant to the problem, a fact that often leads more knowledgeable physicists to do less well than novices, who immediately recognize that more force should be required when there is water in the tube.

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