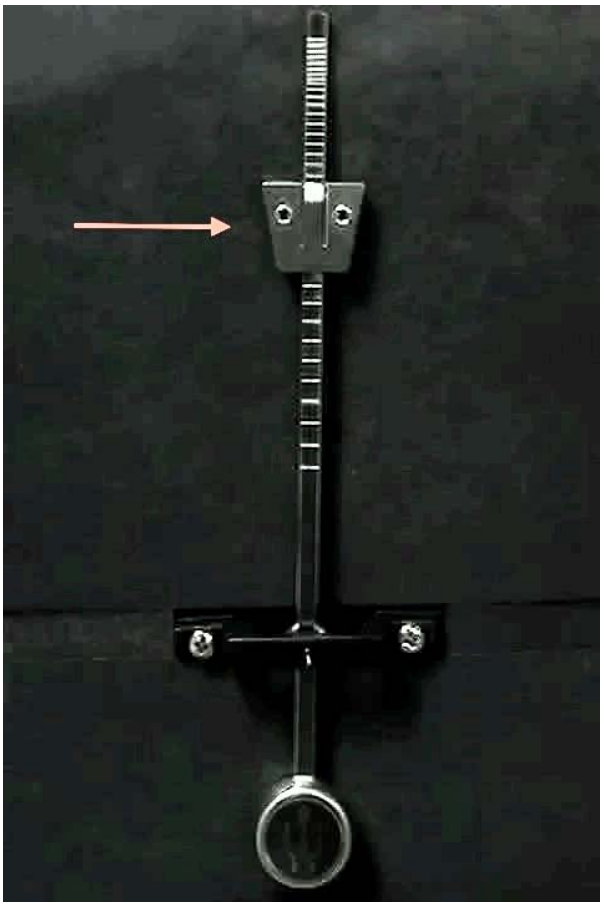
Answer #358

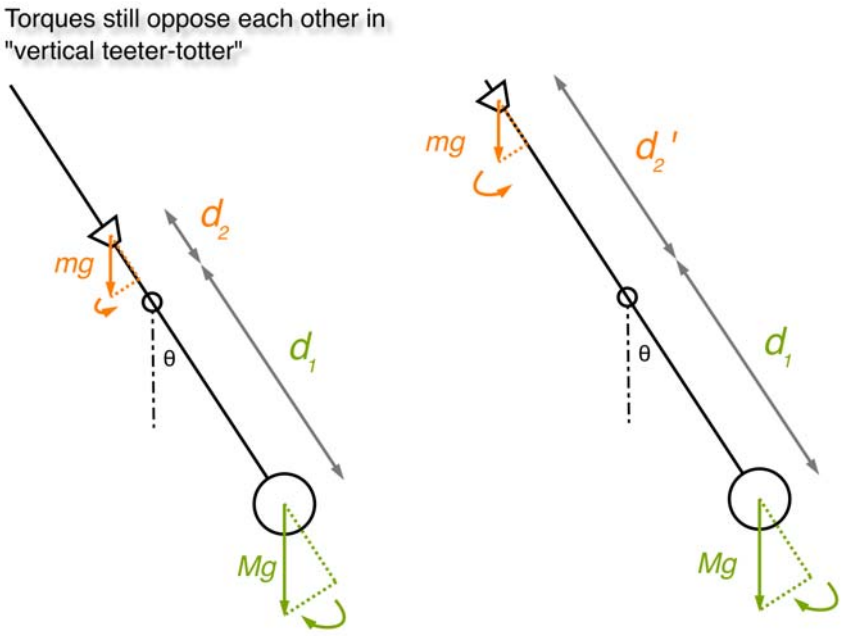
The answer is (d): the frequency will decrease, yes, but it is due to an *increase* of the torque exerted by the moveable mass, rather than a decrease (as purported by answer (c)). Convince your eyes by viewing the video below!



Alternate high-res version.

The question can be a little tricky because though the apparatus is like a teeter-totter, it is the kind no parent would let their child ride on: a *vertical* one! Attention all theme park designers: this might make a great ride!

One may think that the moveable mass might cause the frequency to increase, since more its distance to the pivot will increase and thus more torque will be exerted. This would be true if the two masses applied torques *in the same direction*!



Despite the apparatus being rotated 90° from a normal teeter-totter, the two masses still apply opposing torques on each other. When the mass is moved further away from the pivot point, more *opposing torque* is exerted in competition with the circular mass. Therefore the net torque on the system is reduced, and the apparatus ticks slower.

It *is* true that since gravity did not cooperate with our rotation and is acting in the same direction, a greater component would be *parallel* to the rod, but this does not change the mechanics of the level arm. Regardless of which direction gravity is pointed, the two masses will always apply opposing torques.

This wonderful apparatus is actually a metronome in disguise! A serious musician's best friend, the metronome keeps a steady beat when in the practice room. Before the days of the the more modern electronic metronomes most are familiar with, these wind-up time keepers held down the beat.

The physics of these mechanical metronomes is actually more complicated than presented here, and cannot be strictly taken as a rotated teeter-totter. The wind-up mechanism to keep the metronome ticking for a prolonged period of time (balancing the air resistance) complicates the business and introduces additional forces. But after all, this is physics!

Question of the Week

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