Classical mechanics remains the oldest branch of physics. Indeed, it is so old that fundamental concepts of inertia and forces is ingrained in our culture. Despite this not everyone has a solid grasp on what seems to be fundamental or simple, these questions are meant to tax your understanding. Enjoy!

1 Classical Mechanics

1.1 Does it stop?

Consider ideal conditions[1] in which there is a hard ball rolling without slipping on a floor with friction. This floor is infinite in extent, and there is a gravitational force pulling the ball to the ground at constant magnitude, does the ball ever stop? or does it roll forever?

Credit: Physics Problems to Challenge Understanding

1.2 Another Question by Some Ambitious Fellow

Nothing yet!

1.3 Why does anything move at all?

Consider a student tossing up a ball, Newton's third law claims that for every action there is an equal and opposite reaction. That is, for bodies A and B, if A exerts a force on B then B exerts a force on A equal in magnitude, opposite and direction, and of the same physical nature[2].

If this is the case, how is it that a student can even toss up a ball? The ball is always pushing her arm down with equal force that she's pushing the ball with so how is it that things can move?

Credit: E. Mendez

2 Special Relativity

3 Does it sink or float?

Imagine a sea of superfluid[3] with density ρ, and a bullet with density ρ so that at rest the bullet can remain suspended in the ocean without floating or sinking. Next consider the same bullet shot through that very ocean with speed v along the horizontal.

From the ocean's point of view, the bullet will contract and therefore become more dense, and thus it will sink. While in the frame of the bullet, the ocean

[1] No wind resistance, every shape is geometrically perfect to within precision limited by nature.

[2] Gravitational/gravitational, electrical/electrical, but never anything like gravitational/electrical.

[3] Note that this implies the existence of a gravitational field, which in our case is uniform.

becomes more dense and thus the bullet should float. How do we resolve this paradox?

Credit: Elan Stopnitzky