NYU General Physics 1—Problem set 3

Problem 1: The Space Station orbits Earth in "low earth orbit" meaning that, from a Solar-System perspective, it is just skimming over Earth's surface in a circular orbit.

(a) Assume that the Space Station experiences the same acceleration g due to gravity as we do on the Earth's surface. What combination of g and the Earth's radius R can you make that has units of time? What combination has units of velocity?

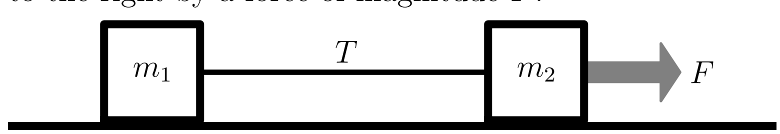
(b) Now put the Space Station on a circular orbit, and assume that the centripetal acceleration of that orbit is given by g. What is the orbital period T and orbital speed v in terms of g and the orbital radius R?

(c) Look up (on the internet, perhaps) the altitude of the Space Station above the Earth's surface and look up the radius of the Earth. What is the fractional amount by which the Space Station is further from the center of the Earth than we are here in New York? Is the assumption that the acceleration is g reasonable?

(d) Look up the period of the Space Station's orbit. Is your calculation in part *(b)* correct?

(e) What does this problem have to do with a centrifuge, if anything?

Problem 2: Two blocks on a stationary, *frictionless,* horizontal table are joined by a light, inextensible string, as shown. The rightmost block is pulled to the right by a force of magnitude F.



(a) Draw free-body diagrams for both blocks, showing all forces (and nothing else).

(b) What is the necessary relationship between the acceleration $\vec{a}_1$ of block 1 and the acceleration $\vec{a}_2$ of block 2?

(c) What is the tension T in the string and the acceleration a of the whole system?

Problem 3: A block of mass $m = 7\,\mathrm{kg}$ lies on a horizontal table. It is stationary relative to the table. Now imagine that the table is accelerating upwards with an acceleration of magnitude $0.9\,\mathrm{m\,s^{-2}}$. Draw a free body diagram for the block and calculate the magnitude of the force on the block from the table.