Assignment 2; Phys 185 Name ______________

1. (20 points) You're in a spaceship traveling to a nearby star, in deep space far from large gravitational influences.

(a) Is there any way you can tell the difference between moving at an extremely high constant speed toward your destination, and idling at rest going nowhere, *without receiving information from outside the spaceship*? Explain why.

(b) Say you're close to your destination, and slowing down at a constant acceleration. You need to slow down from 1.00×10^7 m/s (about 3% of light speed) to 0 in 10.0 days. Your mass is 60.0 kg. As you stand on a surface perpendicular to the direction of your acceleration vector, what is magnitude of the normal force you will feel? Compare this to the normal force you would feel standing on the ground back on Earth. Is it safe?

2. (40 points) Say you're down in the introductory physics lab, and you have all the equipment you have used so far available to you: low-friction track, motion detector, masses and mass hangers, string, rulers, tape, scissors, card stock, boxes, photogates, electronic scales, stopwatches, small pulley wheels, etc. etc.

Now say I also give you a wooden block about the same size and shape as a typical textbook. The block also has a couple of hooks on it in case you want to attach anything. And now I tell you that your job is to measure μ_s, the coefficient of static friction between the block and the stone surface of the lab table.

Design an experiment that will allow you to obtain μ_s. Be sure to include:

- A clear description of your setup and procedure.
- A list of the equipment you need.
- A clearly labeled diagram of your setup, with arrows indicating the relevant forces.
- If you are going to obtain μ_s by using an equation, a derivation of the equation and a clear indication of how you measure the various quantities that go into it. (Standard values such as g, you can just look up.)
- If you're going to use a graph rather than an equation, a drawing of an example graph, and a description of how you would use that graph to obtain μ_s.

Hint: Keep it simple! There are lots of ways you can measure μ_s, but some of the best ways are also reasonably simple. So don't trip yourself up trying to be overly elaborate.

3. (40 points) In Lab 3, "Acceleration due to Gravity," you made a number of simplifying assumptions. In the list below, describe how neglecting each effect made you slightly underestimate or overestimate g as calculated from your data. (I include the answer for the first as an example.) Also draw and label arrows for *every* force you know of on the diagram, including those that you neglected as being too small to worry about, and including forces on the string and pulley.

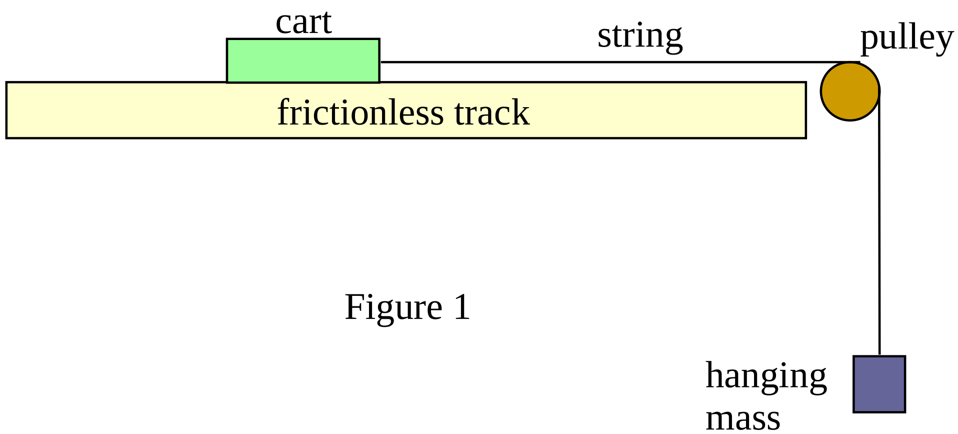

Figure 1

(a) **Track not frictionless:** A small extra kinetic friction force on the cart toward the left slows the cart down, increasing the measured Δt. The equation for g was

$$g = \frac{2(m_{\mathsf{hanging}} + m_{\mathsf{cart}})\Delta x}{m_{\mathsf{hanging}}\,(\Delta t)^2}$$

With increased Δt, friction will cause us to underestimate g.

(b) **Drag on the cart:**

(c) **Track not exactly level; cart goes slightly downhill:**

(d) **Drag on hanging mass:**

(e) **Initial speed of cart into first photogate not quite zero:**

(f) **Pulley not frictionless:**

(g) **Pulley not massless:** (Think through this one carefully.)