Physics 211 Group Quiz 2 – Question Pool

On Friday, you will take a group practice quiz. We will ask you questions about two of these scenarios. (Different recitation sections will get different ones.) They will be designed so that your group can complete them in a one-hour window without having seen them in advance if you know what you are doing.

However, we anticipate that some students may wish to know what sorts of physical situations they should be prepared to think about, so we are asking you these questions in advance.

During Wednesday's recitation, we would like you to discuss these physical systems with your groups. Talk about what forces are present, draw force diagrams, discuss any interesting properties, and think about how the objects accelerate. (For instance, if an object moves in a circle, its acceleration is $\omega^2 r$ toward the center.)

Then, during Friday's recitation, you and your group will get two questions about two of these scenarios. At the end of Friday, we will post all of the questions together as a practice exam; we will post a video of solutions likely on Sunday. (We want you to have some time to study on your own first.)

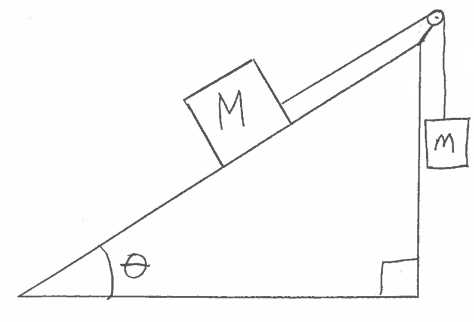
If you understand everything going on here, you will be in extremely good shape for the quiz next Tuesday.

Question 1

A "merry-go-round" is a large, horizontal platform free to rotate around its axis. Children can stand on top of the platform while it spins; you know the coefficients of static and kinetic friction between their shoes and the ground. Suppose that a merry-go-round with a radius R is spinning, and that it rotates around its axis in a time τ.

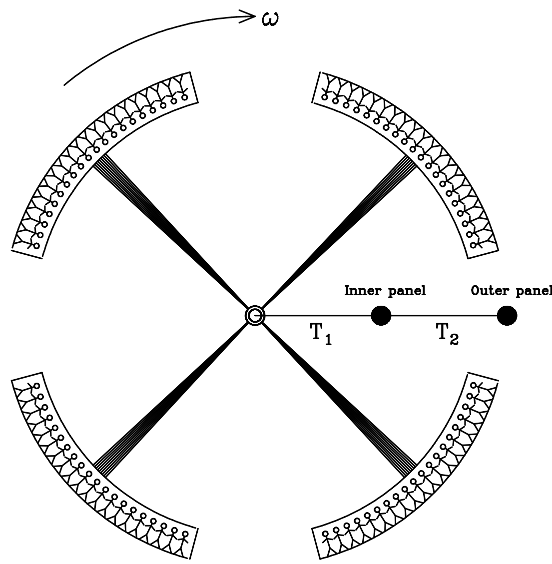
Question 2

A book of mass M sits on an inclined plane angled at an angle θ above the horizontal;
it is connected by a string to another book of mass m hanging over the top. (See picture.) You know the coefficients of friction between the book and the surface.



Question 3

Futurists and science-fiction authors have often imagined circular spacecraft with "artificial gravity", in which humans (or other things accustomed to gravity) occupy a ring-shaped habitat. The ring rotates around a central hub, creating the impression of gravity for its inhabitants. They feel heavy, objects that they drop fall to the floor, and they otherwise experience all of the same things that people on a planet do.



Such a ship has a radius of R and is in deep space, where there is almost no (actual) gravity. Suppose that the crew of the ship wants the passengers to experience "artificial gravity" similar to that on Earth. (In an actual station R would be much larger than the height of people; this drawing is not to scale.)

You are interested in the relationship between the experience of "artificial gravity" and the forces and acceleration of the people.

Question 4

The coefficient of kinetic friction between a table of mass m kg and the ground is μ_k. You would like to move this table by pushing on it. (You are not trying to make the table accelerate, only to make it continue to move at a constant speed.)

Question 5

A planet of mass m is traveling around a star of mass M in a circular orbit with radius r; you are interested in the relationship between r and how long the planet takes to orbit the star.

Question 6

A ball of mass m is connected by two strings to a pole and made to rotate around it at angular velocity ω. One string is at an angle θ above the horizontal; the other string is at an angle θ below the horizontal. The radius of the ball's motion is r. The tensions in the two strings are T_1 and T_2. You are interested in the relationships between these quantities.

Question 7

A book with a mass m_1 rests on a table; the coefficient of kinetic friction μ_k between them is known. A string connects that book to another book hanging vertically off the side of the table with mass m_2 kg; this hanging book is a height h above the ground.

Question 8

A ramp with a small coefficient of kinetic friction μ_k is elevated at an angle of θ. An object is pushed toward the ramp. It reaches the bottom of the ramp with speed v_0; it slides up the ramp and then back down.

Question 9

A person is standing in a subway car, looking forward. She is not holding onto anything, trusting the friction between her shoes and the ground to keep her balance.

The car travels straight forward at a constant velocity for a little while. It then travels up and over a hill, accelerating downward as it does. It then turns left, gently enough that the passengers do not slip and fall. Finally it applies its brakes, coming to a stop. You are interested in the forces acting on her and in the things she experiences during this process.

Question 10

A long scarf rests on a table. A tortoise is resting in its shell on one end of it; the other end hangs off the edge of the table. A mischievous cat jumps up and grabs the other end.

Question 11

A rope is draped over a lightweight, frictionless pulley. Two buckets of water hang from it with masses m_1 and m_2.