**You will be graded on your *COMMUNICATION* of physics understanding. Your words matter – please write carefully.**

#1 The two masses at right are connected by a string over a plastic pulley connected to a concrete flywheel of radius R and mass *M*. This pulley/flywheel is free to turn on a smooth axel and moves with the string. I would like to know the tension in the string connected to the 3 kg mass as I release it from rest. This is a good time to look at your words and how they can help you or get you in trouble. Don't say "fall" or "gets pulled" or "is going" or "over comes", say "accelerates in *this* direction" or "this force is greater than this force, so the vector sum of the forces is in this direction", then we think about the forces that do that. The pulley has mass and rotationally accelerates with the string. What does this mean about the tensions in the two sides of the string?

a) What do you expect to see when the system is released from rest?

b) Can you tell me anything about the tension in the string? How does it compare to 30 N? 10 N? to the tension in the string above the 1 kg mass? Please explain why.

c) Please conceptually describe a plan to find the acceleration of this system by any means you like. But carefully explain your lens(es) and method. There are at least three different ways to get this answer: Energy lens and kinematics, dynamics as a system, dynamics of two masses and a massive wheel (three simultaneous equations – one torque about the wheel and two equations for the sum of the forces acting on each mass. I think it would be a very good exercise to get this answer by all three methods.

d) Clarify your method above with the necessary equations.
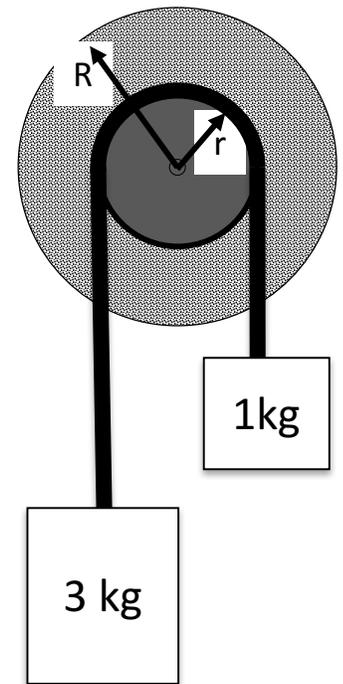
#5 This is the problem that I should have put on your test, but I didn't think you'd have enough time if I did:

I perform a loop the loop in my airplane. You see me at the top of a (r = 200 m) loop moving at 40 m/s. I'm strapped into the plan so I can't fall out; allowing the plane to push me up as well as pull me down into my seat.
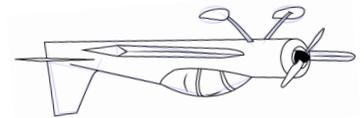
a) What is the direction of the force the plane applies to my body? I think I would draw a free body diagram of my body in the plane. I know that I'm moving in a circle so my acceleration is into the center of the circle. I also know that I'm being acted on by the force of gravity (downward) and the force of the plane… in a direction I don't know. Gravity alone will accelerate me downward at *g*. If my acceleration downward is greater than *g*, then the plane must be putting a downward force on me. If my acceleration downward is less than *g*, then the plane must be putting an upward force on me.

b) What is the magnitude of the force of the plane on my body? I would use the vector sum of the forces on my body = ma of my body. I'd be careful of direction and signs, and I'd find what force from the plane is necessary for me to pull off this stunt.

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