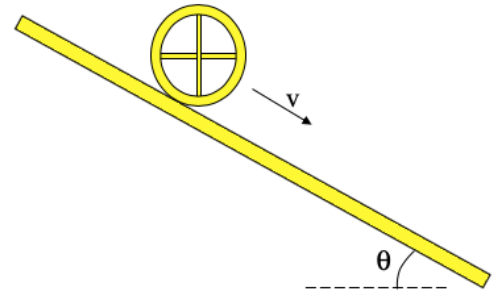**Problem 16-1:** A round, spoked wheel of mass M rolls without slipping down a ramp of angle θ.

a.) As the wheel rolls down the incline, its angular velocity increases. What force(s) cause the wheel's angular velocity to change, with respect to its center of mass? Briefly explain your reasoning.

--objects angular accelerate due to the presence of torques;
--gravity acts through the center of mass and produces no torque about the center of mass;
--the normal force acts through the center of mass and produces no torque about the center of mass;
--friction acting at the contact point produces a torque equal to -Rf; that is what motivates the wheel to angular accelerate down the incline

b.) A block of ice of mass M is released from rest just as the wheel is released, also from rest. Both start from the same height. The block slides down the ramp with negligible friction.

i.) Which object, if either, reaches the bottom of the ramp with the greatest speed?

__x_ block   ___ wheel   ___neither (both reach with the same speed)

Briefly explain your answer in terms of forces acting on the system.

--the block has a component of gravity accelerating it down the incline;
--the wheel has the same component of gravity accelerating it down the incline, but it also has a rolling frictional force acting opposite the gravitational component that comes from its contact with the incline;
--with less net force acting along the line of the incline, the wheel will translationally accelerate at a lesser rate than will the block and the block will reach the bottom with the greatest speed.

ii.) Briefly explain your answer in terms of energy.

--both objects have the same initial potential energy;
--in moving down the plane, the block turns that potential energy into translational kinetic energy, which is proportional to translational velocity;
--the wheel has to turn the potential energy into translational kinetic energy AND rotational kinetic energy;

--as some of the PE has to go into rotational KE, the translational KE will be less than was the case with the block and the translational velocity of the wheel will be less at the bottom than that of the block