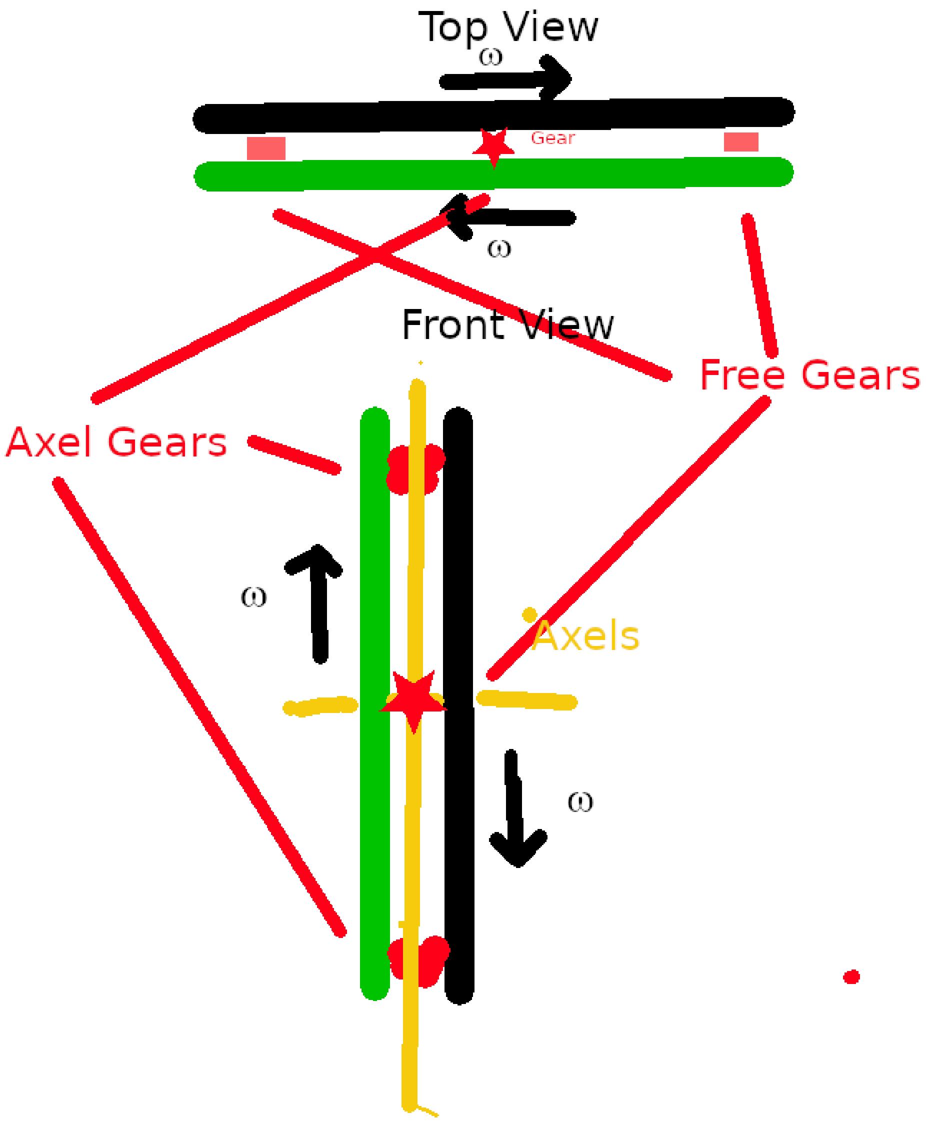

FIG. 1: Figure trans-wheel-gears. Charged wheel (green) with counterrotating wheel to cancel angular momentum of charged wheel (but not angular energy of $\frac{1}{2}I\omega^2$ of each wheel. This is to prevent precession when torque is applied to charged wheel and make the analysis easier.The gears ensure that each wheel has same angular velocity but opposite direction, so angular momentum of the wheels cancel.Each axel is fastened so it cannot move. Gears and axel bearing assumed to be completely frictionless.

Physics 301-24
Assignment 5

1).[9] (3xx) Using the bycycle wheel model of a magnetic dipole, one this time insert the wheel into a uniform magnetic field. (eg, inside a large and long cylindrical solenoid).

a)Consider the dipole axis oriented perpendicular to the B field. Show that there is torque (a force on the dipole which tends to bring the axis parallel to the B field.)

b) Argue that the interaction energy in the electromageic field around the dipole is a function of $\cos(\theta)$ where θ is the angle between the axis of the dipole and the direction of the field, and that the maximum energy in the EM field is when the direciction of the dipole points in the same direction as the magnetic field.

c) Assume that you turn the wheel's axis slowly from pointing along the x axis to the z axis (along which the B field points) the work done by the torque (Torque time angle of rotation of the axis) must come from the kinetic energy of the rotating wheel. Where does the change in energy of the EM field come from? What happens to the mechanical energy of the wheel.

2)[4] Previusly we found, from the stess tensor, that the both the E fieds and the B fields exert presures on the surrounding field. The pressure along the lines of the E field is outward, along the field (as though the lines of force were elestic bands) while the transverse pressue in directiond perpendicular to the field were an outward pressure, pushing the lines of force apart. Using these qualitative aspects use those to explain the form of the inesof force of the B field around a ring of moving charge.

3)[3] Consider a finite legth solenoid. The wire wrapped tangentially abount the cylinder has an internal resistance of R and has length L which is much greater than that circumference of the cylinder. a battery attached to .at time t=0 to the wire. What will you expect to happen to the B field and current as a function of time. As R goes to 0, what do you expect to happen to the current?