## Applied Physics – Problem set #6

**1.** A cylindrical spinning top with density 7.85g/cm$^3$ is spinning around its central axis with 200rpm on a satellite in a freely falling environment. The radius of the cylinder is 5cm, its length is 20cm, and it makes contact on one sharpened end. How much force must be applied at half its length making 60º with its axis, so that the angular velocity of the precession becomes $4\pi$ s$^{-1}$?

**2**. A current carrying coil with 100 turns and 10cm diameter is floating on the ISS, where the Earth's magnetic field is about 50μT, and it makes 30º angle with the magnetic moment of the coil.
(a) What is the torque on the coil if the current is 5A?
(b) What will be the maximum angular velocity of the ring-shaped coil if its mass is 120g?

**3.** Torricelli's experiment is performed at the Moon base with a water filled U-shaped pipe. The base has normal atmospheric conditions, but the gravitational acceleration is only1.625m/s$^2$. What will be height difference between the water columns on the two sides after we pump all the air out on one side?

**4.** A ping-pong ball with 2.45g mass and 37.6mm diameter is placed in water in a plastic container. What percentage of the ball will be submerged in water while…
(a) holding the container in the air at rest?
(b) falling down with the container with acceleration 9.5m/s$^2$ (affected by gravity and drag)?

**5.** On the space station two water droplets with radius 4mm and 6mm combine. How much energy is released if the surface tension of water is 0.0725J/m$^2$?

## Homework #6

**1.** A 70-kg man sitting on a rotating platform is holding a lead-filled bicycle wheel spinning at 5rpm with its angular momentum vector pointing up. Model the man as a cylinder with a radius of 15cm, and ignore the mass of the platform. The mass of the ring-shaped bicycle wheel is 6kg, and its diameter is 65cm. What will be the angular velocity of the man, if he flips the bicycle wheel upside-down, so that its angular momentum is pointing down at the end?

**2.** The magnetic dipole moment of the proton (H nucleus) inside the brain of the patient is $1.41 \cdot 10^{-23}$J/T, and it makes a 30º angle with the 3T magnetic induction vector of the MRI machine.
(a) How big electric current does this dipole moment correspond to if the radius of the proton is 0.84fm?
(b) What will be the torque acting on this proton?

**3.** A ping-pong ball with 2.45g mass and 37.6mm diameter is fixed at the bottom of a water-filled plastic container using a double-sided adhesive tape in such a way, so that the water level is exactly at the top of the ball. This way it is completely submerged in water.
(a) How much force must be exerted by the adhesive tape to keep the ball submerged?
(b) The container with the ball at its bottom submerged under water is dropped from a height of 1.2m and hits the floor. At this point the adhesive cannot hold the ball any longer, and it is accelerated upward compared to the water. What will be the initial acceleration of the ball compared to the water, if the container stops within 5ms after making contact with the floor? The density of water is 1g/cm$^3$.