所別：太空科學研究所碩士班 一般生 科目：普通物理

1. Terminology and short problem (10%)
   (a) In space, two protons travel with 300 and 600 km/s respectively. Could you calculate the associated energy and temperature for them, why?
   (b) Give and state Maxwell's equations.

2. Romeo and Juliet are sitting in a 100 kg canoe in still water. Romeo's and Juliet's masses are respectively 80 kg and 60 kg, and they are each 2.5 meter from the canoe's center and symmetric to it. If they swish places, determine the canoe's motion. (10%)

3. A hollow conducting sphere has a charge of -3.0×10^{-8} coul on it. A point charge of 2.0×10^{-8} coul is located at the center of the sphere. The radius of the sphere is 40 cm and the radius of the center cavity is 25 cm. (a) What is the surface charge density on the outer and inner surfaces of the conducting sphere? (b) Calculate the energy densities of the electric fields at 10, 30, and 60 cm from the center. (20%)

4. A current of 2.0 milliamps consists of a positive ion beam of 8×10^{7} doubly charged ions/cm^3. If the ion beam is confined to a tube of 4 cm in diameter, (a) determine the current density and the drift velocity, (b) and the magnetic fields inside and out side the tube. (20%)

5. A flat conductor 2.0 cm wide and 1.0 mm thick is perpendicular to a 0.60 tesla magnetic field. The current is 2.5 amps and Hall potential is 6.0 microvolt. (a) Draw a figure to show this experiment and calculate the electric field. (b) What are the electron flux and drift speed? (20%)

6. Suppose that you were helping to design a "Spy in the sky" satellite which is to circularly orbit 200 km above the earth's surface. (a) Calculate the period and speed of the satellite. (b) If you wish to resolute objects that are 30 cm apart on the earth's surface, what is the smallest diameter lens you could use at a wavelength of 550 nanometers? (20%)