國立中央大學98學年度碩士班考試入學試題卷

所別：太空科學研究所碩士班 一般生　科目：近代物理　共 1 頁 第 1 頁

＊請在試卷答案卷（卡）內作答

1. A cylindrical rocket moves uniformly with speed 0.8c relative to the ground in the direction of the axis of the rocket, where c is the speed of light in vacuum. The length of a meter stick is $10cm$ at rest in the rocket and makes an angle $\pi/6$ with the axis of the rocket.
   (a) What angle does the meter stick make as observed in the ground? (10%)
   (b) What the length of the meter stick is as observed in the ground? (5%)
   (c) Assume that the directions of electric field lines around a point charge transform in the same way as the direction of meter sticks. Draw qualitatively the electric field lines due to an isolated point charge at rest in the rocket as seen in the rocket and the ground. (5%)
2. Estimate the pressure exerted on your head by the light beam from a 10000 W flashlight if the light absorbed by your head. What would be the mass of a particle that exerts the same force as the light on your head if you hold it at Earth's surface? (10%)
3. (a) Give a theory for the photo-ionization of hydrogen and calculate the energy of photons to ionize hydrogen. (10%)
   (b) For an atom has two or more electrons, why the energy of photons to ionize the second electron is greater than that to ionize the first one? (5%)
4. A photon having the energy as the rest mass of electron scatters from a free electron at rest.
   (a) What is the momentum of the photon before the scattering? (5%)
   (b) Calculate the minimum momentum of the photon after the scattering. (5%)
   (c) Calculate the maximum energy that the electron can obtain after the scattering. (5%)
5. There are 3 free moving identical particles confined in a cubic box of volume V.
   (a) If the identical particles are electrons, calculate the energy of the box in the first excited state. (10%)
   (b) If the identical particles are photons, calculate the energy of the box in the ground state. (10%)
6. (a) For an atom of hydrogen in the ground energy state, can it exhibit both the normal and anomalous Zeeman effects? Why? (5%)
   (b) Calculate the energy splitting for an atom of hydrogen at the orbital quantum number $l = 2$ to exhibit the normal Zeeman effects. (10%)
   (c) From the results in (b), find the spectral lines for the transitions between $l = 2$ and $l = 1$ states. (5%)