所別：**天文研究所碩士班　不分組** 科目：**近代物理**

近代物理

Some useful constants and formulae

Planck's constant $h = 6.63 \times 10^{-27}$ erg s

Radiation constant $a = 7.56 \times 10^{-15}$ erg cm^{-3} K^{-4}

Boltzmann's constant $k = 1.38 \times 10^{-16}$ erg K^{-1}

Speed of light $c = 3 \times 10^{10}$ cm s^{-1}

Mass of electron $m_e = 9.11 \times 10^{-28}$ gm

Mass of proton $m_p = 1.67 \times 10^{-24}$ gm

The blackbody radiation: $B_\nu(T) = (2h\nu^3/c^2)/(e^{h\nu/kT} - 1)$

1. At what wavelength does the human body emit its maximum radiation that is caused by the temperature of the human body? (10 points) Can you observe this radiation by your eyes? If no, why and how can you see other people? (5 points) List assumptions you make in arriving at an answer.

2. Estimate the penetration distance for a very small dust particle, of radius $r = 10^{-8}$ cm and density $\rho = 10$ g /cm^2, moving at a velocity $v = 1$ cm/s, if the particle impinges on a potential step of height equal to twice its kinetic energy. (15 points)

3. A white dwarf has a temperature T and density ρ and contains only helium (He). What is the criterion that the degeneracy effect of the white dwarf will be important? (15 points)

4. What is the wavelength shift when a photon is scattered by a rest electron? Assume the scattered angle of the photon is 60°. (15 points)

5. Let two different uniformly moving observers have very high velocities v_1 and v_2. What is their relative velocity, as measured by one of the observers? (15 points)

6. Prove that the entropy of blackbody radiation S is related to temperature T and volume V by $S = (4/3)aT^3V$, where a is the radiation constant. (15 points)

7. Give the spectroscopic terms arising from the LS coupling of the $3p4p$ configuration. (10 points)