所別：天文研究所碩士班 科目：近代物理

近代物理

Some useful constants and formulae

Planck's constant $h = 6.63\times10^{-27}$ erg s

Radiation constant $a = 7.56\times10^{-15}$ erg cm^{-3} K^{-4}

Boltzmann's constant $k = 1.38\times10^{-16}$ erg K^{-1}

Speed of light $c = 3\times10^{10}$ cm s^{-1}

Mass of electron $m_e = 9.11\times10^{-28}$ gm

Mass of proton $m_p = 1.67\times10^{-24}$ gm

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

1. Derive the Wien's Displacement law. (10 points). At what wavelength does the sun emit its maximum if the sun has a temperature of 6000 K? (5 points)
2. Derive the Bohr radius and Rydberg constant from Bohr's postulation. (10 points)
3. Calculate the difference between the frequencies of the Balmer α line of hydrogen and deuterium? (10 points)
4. What is the wavelength shift when a photon is scattered by a rest electron? Assume the scattered angle of the photon is 90°. (15 points)
5. Find the frequency of the radiation emitted by the pure rotation transition $J=1 \rightarrow J=0$ in hydrogen chloride. The distance between the hydrogen atom and the chloride atom is 1.3 Å. (15 points)
6. A laser beam is focused to a diffraction-limited spot of 1 μm diameter. If the total power of the laser is 10 W, what is the pressure at the focal plane. (15 points)
7. Give the spectroscopic terms arising from the *LS* coupling of a *pf* configuration. (10 points). Find all of the allowed dipole transitions between a *pd* and a *pf* configuration. (10 points)