

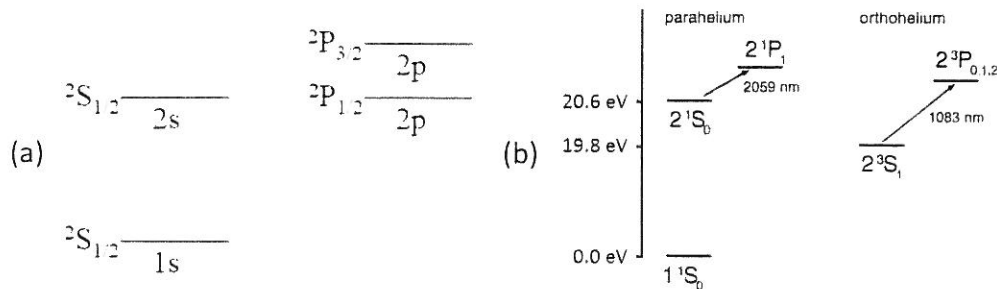
國立臺灣師範大學 103 學年度碩士班招生考試試題

科目：近代物理

適用系所：物理學系

注意：1. 本試題共 1 頁，請依序在答案卷上作答，並標明題號，不必抄題。2. 答案必須寫在指定作答區內，否則不予計分。

1. An unstable particle having a mass of 3.34×10^{-27} kg is initially at rest. The particle decays into two fragments m_1 and m_2 that fly off with velocity of $0.987c$ and $-0.868c$.
 - (a) Find the rest masses of the fragment m_1 ? [10 points]
 - (b) Find the rest masses of the fragment m_2 ? [10 points]
2. In the market, 3 brands of cell phone have been detected. The color temperature of screens has been calibrated as 7500K (cold), 6500K (white), and 5500K (warm).
 - (a) Use the Planck distribution to plot three curves of color temperature above together in one figure. [10 points]
 - (b) According to your figure, illustrate which color temperature of the screen would emit more blue light. [10 points]
3. What would be the maximum wavelength of a photon able to detect the electron (the rest energy of an electron is $E = 0.51$ MeV). [10 points]
4. Typically, STM (Scanning Tunneling Microscopy) can be depicted as an electron tunneling through a square barrier. Use quantum superposition to illustrate the tunneling effect. [10 points]
5. The energy levels of the Hydrogen and the Helium is shown in Fig. (a) and (b), respectively.



- (a) In the Hydrogen atom, explain why the spin-orbit interaction does not cause the energy splitting between $2S_{1/2}$ and $2P_{1/2}$ states. [10 points]
 - (b) In the Helium atom, explain why the energy of 2^3S_1 is lower than the energy of 2^1S_0 . [10 points]
6. There are 10 particles put into a one-dimensional harmonic oscillator, ignoring the Coulomb interaction among them. At zero temperature,
 - (a) If the spin of particles is $1/2$, what is the average energy of the system? [10 points]
 - (b) If the spin of particles is 1 , what is the average energy of the system? [10 points]