國立中央大學 106 學年度碩士班考試入學試題

所別： 光電科學與工程學系 碩士班 不分組(一般生)　　共 1 頁　第 1 頁

科目： 近代物理

本科考試可使用計算器，廠牌、功能不拘　　＊請在答案卷內作答

1. (10 pts) A standard golf ball weight about 50g. Base on relativity, calculate the total energies of a golf ball moving at a speed of 1 km/hr and 0.9c.

2. (10 pts) A photon has the minimum energy that can generate pair-production. If this photon is scattered by a rest electron. Derive the possible wavelength range of the photon after scattering.

3. (30 pts) A particle in a 2D box which can be seen as Fig. 1.
(i) Please use separation of variable method to derive the time-independent wave functions $\psi(x,y)$ of this 2D potential well.
(ii) Please derive the corresponding energy levels to those wave functions.
(iii) If the particle is a photon and the interior of the box is vacuum, obtain the photon energies of the corresponding states.

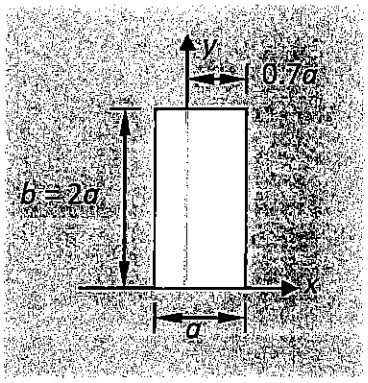

Fig. 1. A rectangular 2D box of infinite potential well and a perfect square infinite potential well for problem 3.

4. (10 pts) One of the eigen-functions of the operator $\frac{d^2}{dx^2}$ is $e^{-ink_n x}$, where n=1, 2, 3,.... Please write down the eigen-equation and find the corresponding eigenvalues.

5. (20 pts) (i) Determine the ground state configuration for ^{14}Si atom.
(ii) What are the LS coupling quantum numbers for the ground state of Si? Note that you should express the result in spectroscopic notation.

6. (20 pts) (i) Describe the Stern-Gerlach (S-G) experiment and its significance in the development of quantum physics.
(ii) Consider a collection of electrons with isotropic distribution of spin values which is sent through an S-G experimental apparatus. When randomly picks up an electron, what is the probability of finding it with the spin component $S_x = +\hbar/2$? Discuss the situation if a beam of polarized electrons is used instead.