※ 考生請注意：本試題不可使用計算機。　 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. How many photons per second emanate from a 20 mW 633 nm laser? (25%)

2. A passenger in a train moving at 30 m/s passes a man standing on a station platform at $t = t' = 0$. Twenty seconds after the train passes him, the man on the platform determines that a bird flying along the tracks in the same direction as the train is 800 m away. What are the coordinates of the bird as determined by the passenger? (25%)

3. Determine the energy and wavelength of the least energetic photon capable of producing an electron-positron pair. (25%)

4. Suppose the uncertainty in the momentum of a particle is equal to the particle's momentum. How is the minimum uncertainty in the particle's location related to its de Broglie wavelength? (25%)