

所別：光電科學研究所碩士班 不分組 科目：普通物理

1. (15%) (a) A free 5-eV electron moves in the x direction with a speed of 2×10^{-6} m/s. Assume that you can measure this speed to a precision of 1%. With what precision can you simultaneously measure its position. (b) A small ball has a mass of 50 g and a speed of 30 m/s, which you can measure with a precision of 1%. What limits does the uncertainty principle place on your ability to measure its position?
2. (15%) An automobile traveling 80 km/h has tires of 80 cm diameter. (a) What is the angular speed of the tires about the axle? (b) If the car is brought to a stop uniformly in 30 turns of tires (no skipping), what is the angular acceleration of the wheels?
3. (15%) (a) If the work function for a metal is 1.85 eV, what would be the stopping potential for the light having a wavelength 410 nm? (b) What would be the maximum speed of the emitted photoelectrons at the metal's surface?
4. (20%) A $3 \text{ M}\Omega$ resistor and a $1 \text{ }\mu\text{F}$ capacitor are connected in a single-loop circuit with a seat of emf with $\mathcal{E} = 4\text{V}$. At 1 s after the connection is made, what are the rates at which (a) the charge on the capacitor is increasing, (b) energy is being stored in the capacitor, (c) internal energy is appearing in the resistor, and (d) energy is being delivered by the seat of emf?
5. 簡答題 (35%)：以下幾個問題，在測驗你的物理觀念能否運用到幾個日常生活之光電科學與工程的問題中。請儘量發揮。
 - (1) 有關於照明：發光二極體(LED)發光的原理、顏色與使用的電源特性與傳統鎢絲燈泡有何不同？其原因為何？(5%)
 - (2) 有關於顯示器：LCD 液晶顯示器與傳統陰極射線管之電視在產生彩色影像的方式上有何不同？(5%)
 - (3) 有關於光儲存：相較於 CD，DVD 光碟片的儲存容量較高，其原因為何？其光學讀取頭需作何改變？(5%)
 - (4) 有關於光通訊：使用一種波長在可見光範圍的雷射(laser)作為兩棟相距甚遠之高樓的光通訊光源，此帶有訊號的雷射光是由其中一棟高樓樓頂直接經由空氣射向另一棟高樓樓頂而達到光通訊的功能。請選擇此光學系統最適合的操作波長，其原因為何？(5%)
 - (5) 有關於電磁光學：晚上外面一片黑暗，室內燈開啟後，我們經常可由窗戶之平滑玻璃看見自己的影像，猶如照鏡子般。請問經由玻璃反射至你的眼睛之光線的能量為光線從你身上反射出去的能量百分比為何？為什麼？(5%)
 - (6) 有關於波動光學：何種波前(wavefront)的光波在自由空間中傳輸時，其波前不變？為什麼？(5%)
 - (7) 有關於幾何光學：將一透鏡完全浸入一種折射率相同的透明液體中，其焦距有何變化？(5%)

參考用