

國立臺北科技大學 109 學年度碩士班招生考試

系所組別：2403 光電工程系碩士班

第二節 近代物理 試題 (選考)

第 1 頁 共 1 頁

注意事項：

1. 本試題共 5 題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

electron mass $m_e = 9.11 \times 10^{-31} \text{ kg}$ electron charge $e = -1.6 \times 10^{-19} \text{ C}$ Boltzmann constant $k_B = 1.38 \times 10^{-23} \text{ J/K}$ Planck constant $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$, $\hbar = \frac{h}{2\pi}$ light speed $c = 3.0 \times 10^8 \text{ m/s}$

1. Ultraviolet light of wavelength 300 nm and intensity 4.0 W/m^2 is directed at a sodium surface whose work function is 2.46 eV.
 - (a) Find the maximum kinetic energy of the ejected photoelectrons. (5 分)
 - (b) Find the cutoff wavelength for sodium. (5 分)
2. A neutron (ideal gas) with the mass $1.67 \times 10^{-27} \text{ kg}$ in thermal equilibrium with its surrounding at room temperature 300 K
 - (a) Calculate the root mean square speed for the neutron. (10 分)
 - (b) Find the de Broglie wavelength of the neutron. (10 分)
3. **Electron Double-Slit Experiment:** An electron is accelerated through potential difference 50 kV and impinged on slits of width 520 nm separated by a distance 2100 nm. The observation screen is located 400 mm beyond the slits.
 - (a) Determine the de Broglie wavelength of the electron. (you do NOT need perform relativistic calculation). (10 分)
 - (b) What is the distance between the first two maxima? (10 分)
4. A 35 eV electron is incident on a square barrier of height 40 eV.
 - (a) What is the probability that the electron will tunnel through if the barrier width is 1 nm? (10%)
 - (b) Evaluate the barrier width if the probability that the electron will tunnel through will be raised to 0.04. (10%)
5. An electron is confined in a box of 0.2 nm across (one dimension)
 - (a) Find the permitted energies in terms of quantum number n (10 分)
 - (b) Find the zero-point energy in unit eV (10 分)
 - (c) What is the wavelength of the photon emitted in the transition of the electron from the state $n=3$ to the state $n=2$? (10 分)