

國立臺北科技大學 103 學年度碩士班招生考試

系所組別：2403 光電工程系碩士班

第三節 普通物理 試題 (選考)

第一頁，共一頁

注意事項：

1. 本試題共 7 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

Planck constant $h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$

light speed $c = 3.0 \times 10^8 \text{ m/s}$

electron mass $m_e = 9.1 \times 10^{-31} \text{ kg}$

electron charge $e = -1.6 \times 10^{-19} \text{ C}$

1. In a certain range $0 < x < 2$, $0 < y < 2$, $0 < z < 2$, the electric potential $V(x, y, z)$ is written as $V(x, y, z) = \frac{4}{x} - 2xy^2 + z$, where V is in volt and x, y, z are in m (meter).
 - (a) Write the expressions for the x, y , and z components of the electric field $\vec{E}(x, y, z)$ (10%).
 - (b) What is the magnitude of the electric field at the point (1, 1, 1) m (5%)?
2. An electron moves in a circular path perpendicular to a uniform magnetic field of magnitude 4.00 mT. The angular momentum of the electron about the center of the circle is $4.00 \times 10^{-25} \text{ J} \cdot \text{s}$. Determine (a) the radius of the circular path (5%) and (b) the speed of the electron (5%).
3. Helium-neon laser light ($\lambda = 632.8 \text{ nm}$) is sent through a 0.25mm-wide single slit. What is the width of the central maximum on a screen 1.00 m from the slit (10%)?
4. An oscillator consists of a block, which is in frictionless desk and attached to a spring ($k = 400 \text{ N/m}$). At some time, the position (measured from the system's equilibrium location), velocity, and acceleration of the block are $x = 0.200 \text{ m}$, $v = -12.0 \text{ m/s}$, and $a = -125 \text{ m/s}^2$. Calculate (a) the frequency of the oscillation (5%), (b) the mass of the block (5%), and (c) the amplitude of the oscillation (5%).

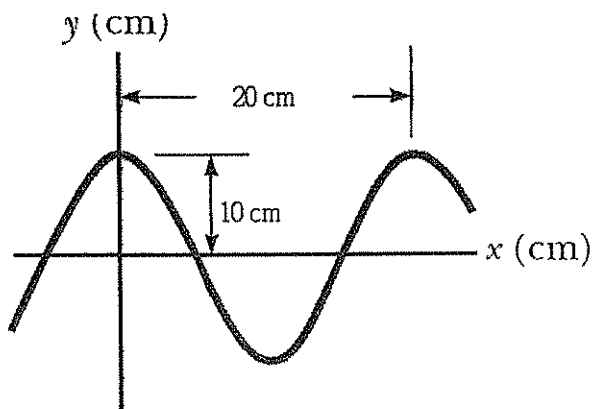
5. The allowed energy in hydrogen atom is given by

$$E_n = \frac{-13.6eV}{n^2}$$

The Balmer series for the hydrogen atom corresponds to electronic transitions that terminate in the state with quantum number $n = 2$. Consider the photon of the longest wavelength corresponding to a transition. Determine (a) its energy (5%) and (b) its wavelength (5%).
(c) What is the shortest possible wavelength in the Balmer series(5%)?

6. A sinusoidal wave traveling in the **positive x** direction has an amplitude of 10.0 cm, and a frequency of 5.00 Hz. The vertical position of an element of the medium at $t = 0$ and $x = 0$ is also 10.0 cm as shown in Figure.

- (a) Find the wave number k , period T and the speed of the wave. (15%)
(b) Write a general expression for the wave function.(10%)



7. The stopping potential for electrons emitted from a metal surface illuminated by light of wavelength 400 nm is 0.90 V. When the incident wavelength is switched to a new value, the stopping potential is 1.43 V.

- (a) What is the work function for the metal surface(5%)?
(b) What is the wavelength of the new incident light(5%)?