

國立嘉義大學九十七學年度轉學生招生考試試題

科目：普通物理學

〈請將答案寫在答案卷上〉

第一部分：選擇題（每小題 4 分，共 40 分）

1. An ice skater with a moment of inertia of $0.600 \text{ kg}\cdot\text{m}^2$ about a vertical axis is spinning with an angular speed of 12.6 rad/s . The skater brings her arms in closer to the axis, decreasing her moment of inertia to $0.240 \text{ kg}\cdot\text{m}^2$, find her new angular speed:

(A) 0.600 rad/s (B) 12.6 rad/s (C) 31.5 rad/s (D) 0.240 rad/s (E) 63.0 rad/s .

2. A particle moving along the x axis is acted upon by a single force $F = F_0 e^{-kx}$, where F_0 and k are constants. The particle is released from rest at $x = 0$. It will attain a maximum kinetic energy of:

(A) $\frac{F_0}{k}$ (B) $\frac{F_0}{e^k}$ (C) kF_0 (D) $\frac{1}{2}(kF_0)^2$ (E) $ke^k F_0$.

3. A 16 kg block is attached to a cord that is wrapped around the rim of a flywheel of diameter 0.40m and hangs vertically, as shown in figure 1. The rotational inertia of the flywheel is $0.50 \text{ kg}\cdot\text{m}^2$. When the block is released and the cord unwinds, the acceleration of the block is:

(A) $0.15g$ (B) $0.56g$ (C) $0.84g$ (D) $1.0g$ (E) $1.3g$.

4. In the circuit (Figure 2) $\xi = 120\text{V}$, $R_1 = 30\Omega$, $R_2 = 20\Omega$, and $R_3 = 10\Omega$. What is the current i_1 a long time after the switch has been closed?

(A) 0.0 A (B) 2.4 A (C) 3.3 A (D) 8.0 A (E) 18 A

5. A point charge $+q$ is placed inside a spherical conducting shell with inner radius a and outer radius b as shown in Figure 3. The total charge of the spherical conducting shell is equal to $-4q$. What are the surface charges on the inner surface q_a and outer surface q_b ?

(A) $q_a = -q$ and $q_b = -3q$ (B) $q_a = -3q$ and $q_b = -q$
 (C) $q_a = 0$ and $q_b = +4q$ (D) $q_a = +q$ and $q_b = +4q$ (E) $q_a = -q$ and $q_b = -4q$

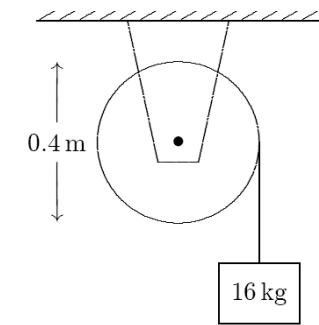


Figure 1

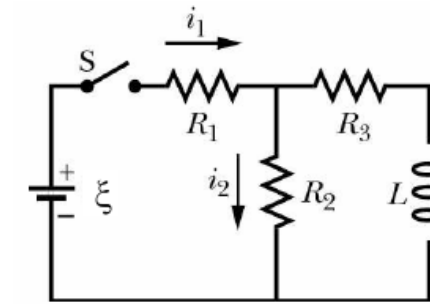


Figure 2

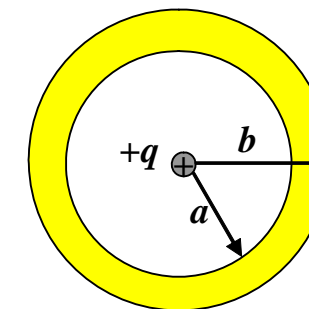


Figure 3

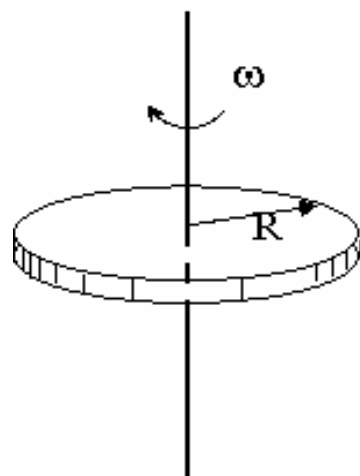
6. Two harmonic waves with frequencies 8.000 Hz and 8.250 Hz are superimposed. The waves each have amplitude A . Find the beat frequency:

(A) 51.05 Hz (B) 1.571 Hz (C) 0.7855 Hz (D) 2.000 Hz (E) 0.250 Hz .

7. A diatomic gas ($\gamma = 1.4$) in an engine is initially at 300 K, 1.000 atm pressure, and occupies a volume 900 cm^3 . The gas is compressed adiabatically by a piston in a cylinder to 0.100 its initial volume. Find the final pressure of the gas, with $10^{1.4} = 25.1$:
- (A) $7.5 \times 10^2 \text{ atm}$ (B) $3.65 \times 10^{-2} \text{ atm}$ (C) $3.65 \times 10^{-2} \text{ atm}$ (D) 25.1 atm (E) $3.3 \times 10^2 \text{ atm}$.
8. A block of ice is taken out of a freezer and warms to the temperature of a large room at 298 K. During the process the ice absorbs $9.58 \times 10^5 \text{ J}$. Find the entropy change of the room:
- (A) $+3.21 \times 10^3 \text{ J/K}$ (B) $-3.21 \times 10^3 \text{ J/K}$ (C) $+2.7 \times 10^2 \text{ J/K}$ (D) $-2.7 \times 10^2 \text{ J/K}$ (E) $+312 \text{ J/K}$
9. Parallel light of wavelength 633 nm is incident on a slit of width 0.12 mm. The total angular width of the central diffraction maximum on a screen located 3.50 m from the slit is:
- (A) $2 \cos^{-1}(5.3 \times 10^{-3})$ (B) $\cot^{-1}(5.3 \times 10^{-3})$ (C) $\cos^{-1}(5.3 \times 10^{-3})$
 (D) $\sin^{-1}(5.3 \times 10^{-3})$ (E) $2 \sin^{-1}(5.3 \times 10^{-3})$.
10. Find the inductive reactance of a 25.0 mH inductor at a frequency of 60.0 Hz:
- (A) $15.1 \times 10^3 \Omega$ (B) 9.43Ω (C) 377Ω (D) $25.0 \times 10^{-3} \Omega$ (E) 60.0Ω .

第二部分：計算題（共 60 分；請注意有效數字以三位為原則）

1. A nonconduction disk of radius R has a uniform surface charge density $\sigma \text{ C/m}^2$. It rotates at angular velocity ω as depicted in figure.
- (a) What is the current passing through a surface perpendicular to the plane of the disk? (7 分)
- (b) What is the total magnetic field at the center of the disk. (8 分)



2. A current of 15.0 A is in a circular coil of radius 5.00 cm with 50 turns of wire. The plane of the coil makes an angle of 30.0° with a uniform magnetic field of magnitude 0.150 T. (*i.e.*, the normal vector of the plane makes an angle of 60.0° with the magnetic field)
- (a) Find the magnitude of the magnetic dipole moment μ of the coil. (5 分)
- (b) Determine the magnitude of the torque on the coil. (5 分)
- (c) Determine the potential energy of the coil in its given orientation. The potential energy is defined as $\text{P.E.} = -\vec{\mu} \cdot \vec{B}$ (5 分)
3. A 2.00 kg block of ice is taken out of a freezer at 253 K, melts, and warms to the temperature of a large room at 298 K. Calculate the entropy change $\Delta S = \int_i^f dQ/T$ in each stages. You may use the specific heat of ice $c_{\text{ice}} = 2050 \text{ J/(kg - K)}$, the specific heat of water $c_{\text{water}} = 4186 \text{ J/(kg - K)}$, the latent heat of fusion of water $L_{\text{f,water}} = 3.335 \times 10^5 \text{ J/kg}$, $\ln(273/253) = 0.0760823$, and $\ln(298/273) = 0.0876217$
- (a) warming the ice from 253 K to 273 K (5 分)
- (b) melting of the ice at 273 K to water at 273 K (5 分)
- (c) warming of the cold water at 273 K to the temperature of the room. (5 分)
4. X-rays of wavelength 0.2 nm are scattered from a carbon target. If the scattered radiation is detected at 60° to the incident beam, find
- (a) the Compton shift $\Delta\lambda$ (7 分)
- (b) the kinetic energy imparted to the recoiling electron (8 分)