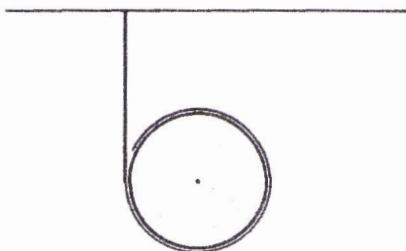


考試科目	普通物理 86>1	系所別	應用物理研究所	考試時間	2月19日(星期日)第1節
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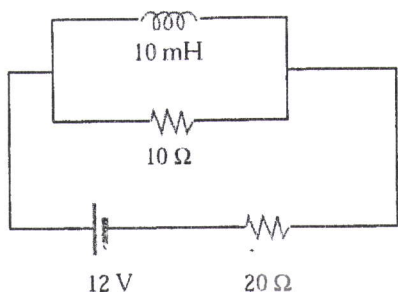
NOTICE: The following questions should be calculated in details.

1. A gas pipeline with a radius 0.125 m delivers 1.55 cubic meters of gas per second. What is the flow speed of the gas in the pipeline? (5 points)
2. A jet plane has a sound level of 140 dB. What is the intensity in W/m^2 ? (5 points)
3. A roller-coaster car has a mass of M when fully loaded with passengers. The car passes over a hill of radius R . At the top of the hill, the car has a speed equal to V . What is the force of the track on the car at the top of the hill? (5 points)
4. If the maximum E -component of an electromagnetic wave in vacuum is 600 V/m, what is the maximum B -component? (5 points)
5. A 5-g coin is dropped from a 300-m building. If it reaches a terminal velocity of 45 m/s, and the rest of the energy is converted to heating the coin, what is the change in temperature (in $^{\circ}\text{C}$) of the coin? (The specific heat of copper is 0.09 cal/g $^{\circ}\text{C}$.) (10 points)
6. If N moles of an ideal gas are compressed isothermally from an initial volume V_i to a final volume V_f , the change in entropy is? (10 points)
7. On a hot day, a home is kept cool by an air conditioner. The outside temperature is 36°C and the interior of the home is 18°C . If 25,000 kJ/h of heat is removed from the house, what is the minimum power that must be provided to the air-conditioner? (10 points)
8. The motion of a particle connected to a spring is described by $x = 5 \sin(\pi + \pi/3)$. At what time (in second) is the potential energy equal to the kinetic energy? (10 points)
9. A point charge of 6.0×10^{-9} C is placed at the center of a hollow spherical conductor (inner radius = 2.0 cm, outer radius = 4.0 cm) which has a negatively net charge of -4.0×10^{-9} C. Determine the resulting charge density on the inner surface of the conducting sphere. (10 points)
10. A massless rope is wrapped around a uniform cylinder that has radius R and mass M , as shown in below. Initially, the unwrapped portion of the rope is vertical and the cylinder is horizontal. Please find the linear acceleration of the cylinder. (10 points)

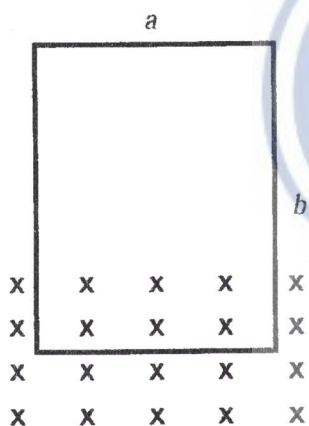


考試科目	普通物理	系所別	應用物理研究所	考試時間	2月19日(星期日) 第1節
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11. Consider the following circuit, what is the rate of change of the current in the inductor when the current in the battery is 0.40 A? (10 points)



12. A conducting rectangular loop of mass M , resistance R , and dimensions $a \times b$ is allowed to fall from rest through a uniform magnetic field which is perpendicular to the plane of the loop. The loop accelerates until it reaches a terminal speed (before the upper end enters the magnetic field). Please find the terminal speed. (10 points)



備

註

- 一、作答於試題上者，不予計分。
- 二、試題請隨卷繳交。

考 試 科 目	近代物理 8(622)	系 所 別	應用物理研究所	考 試 時 間	2月19日(星期日)第二節
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- Explain in equations and/or reasoning the following terms: (20%)
 - Anomalous Zeeman effect
 - Compton effect
 - White dwarf star
 - Nuclear fusion
- An electron and a positron are moving along a straight line toward each other with the same individual speed of $c/2$. c is the speed of light. (a) What is the relative speed between the two particles? After the electron-positron annihilation two photons are created. Calculate (b) the frequency and (c) momentum of each photon. Express your answers in terms of c , the electron mass m , and the Planck constant h . (20%)
- An electron of mass m is confined within a one-dimensional wire segment of length L and subject to the potential of an infinite square well. (a) Calculate the allowed energy values of the electron. If there are now 10 non-interacting electrons with spins trapped inside the same wire segment, calculate (b) the Fermi energy and (c) the total energy of the 10-electron system at $T = 0$ K. (d) If the 10-electron system is to be optically excited, what is the minimum frequency of the photon? Express your answers in terms of m , L and h . (20%)
- The radial wave function of a 1s electron in a hydrogen atom is $R(r) = \frac{2}{a_0^{3/2}} e^{-r/a_0}$, where a_0 is Bohr radius. The probability of finding the electron between r and $r + dr$ is $P(r)dr = |R(r)|^2 r^2 dr$. (a) Calculate the expectation value of the radial distance r . (b) Find the most probable value of r . (20%) (Hint: $\int_0^{\infty} x^3 e^{-bx} dx = \frac{6}{b^4}$)
- The hydrogen molecule H_2 can be considered as a simple harmonic oscillator with a force constant of 573 N/m. (a) Find the reduced mass of the oscillator and the oscillating angular frequency. (b) Find the energy (in eV) of its ground and first excited vibrational states. (c) Find the vibrational quantum number that approximately corresponds to its 4.5 eV dissociation energy. (20%) (1 atomic mass unit = 1.66×10^{-27} kg, $\hbar = h/2\pi = 1.055 \times 10^{-34}$ J·s = 6.582×10^{-16} eV·s)

備 註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。
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