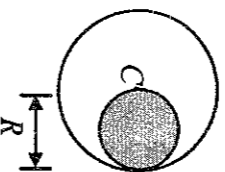
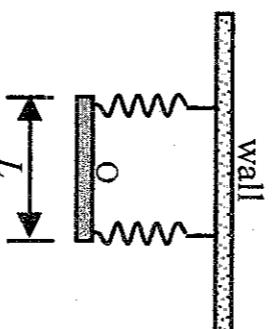


選擇題 (30 分)

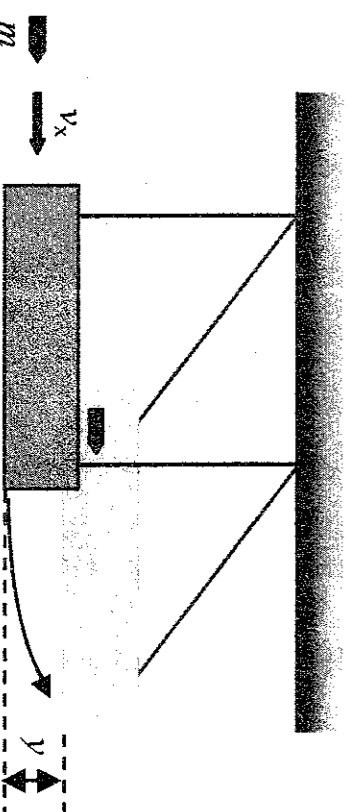
- (6 points) A ball is thrown straight down, from an unknown height and hits the floor with a speed that is 5 m/s greater than its release speed. How long does it take to hit the ground? (a) 0.51 sec (b) 0.71 sec (c) 1 sec (d) 1.1 sec (e) 1.21 sec.
- (6 points) A uniform disc of radius R has a hole of diameter R cut out as shown. The resulting object has a mass M . Calculate its moment of inertia about a perpendicular axis through the disc center C . (a) $(1/8)MR^2$ (b) $(3/16)MR^2$ (c) $(1/4)MR^2$ (d) $(13/24)MR^2$ (e) $(1/2)MR^2$.



- (6 points) A long thin uniform rod of length L and mass m is free to rotate in a horizontal plane about a fixed vertical axis through its center O . Two identical springs with force constant k are connected horizontally between the ends of the rod and a fixed wall (see diagram). What is the period of small oscillations when the rod is pushed slightly to one side and released? (a) $T=2\pi(2m/3k)^{1/2}$ (b) $T=2\pi(3k/m)^{1/2}$ (c) $T=2\pi(m/6k)^{1/2}$ (d) $T=2\pi(4k/3m)^{1/2}$ (e) $T=2\pi(m/4k)^{1/2}$

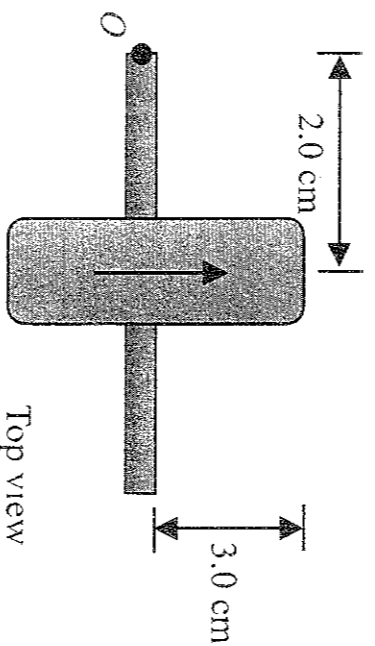


- (6 points) A nylon rope has the linear mass density 0.25 kg/m. How much tension has to apply to produce the observed wave speed of 12.0 m/s? (a) 36.0 N (b) 72.0 N (c) 66.0 N (d) 7.2 N (e) 3.6 N.
- (6 points) A ballistic pendulum is a system for measuring the speed of bullet (see diagram). The bullet, with mass m , is fired into a block of wood with mass M , suspended like a pendulum, and makes a completely inelastic collision with it. After the impact of the bullet, the block swings up to a maximum height y . Given the values of y , m , M , and gravitational acceleration g , what is the initial velocity v_x of the bullet? (a) $(m+M)^2 \cdot (2gy)^{1/2} / m^2$ (b) $M \cdot (2gy)^{1/2} / m$ (c) $(m+M) \cdot (2gy)^{1/2} / m$ (d) $m^{1/2} \cdot (2gy)^{1/2} / (m+M)^{1/2}$ (e) $m \cdot (2gy)^{1/2} / M$.

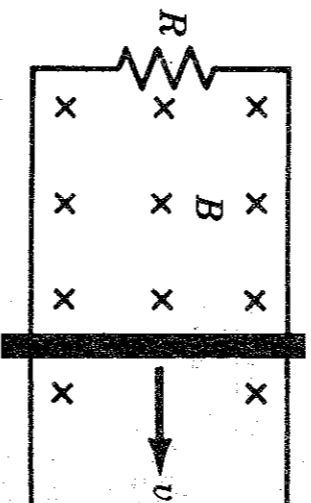


計算與簡答題 (70 分)

- (10 points) A typical bedroom contains about 2500 moles of air. Find the **change in the internal energy** of this much air when it is cooled from 24°C to 14°C at a constant pressure of 1.0 atm. Treat the air as an ideal gas with $\gamma=C_p/C_v=1.40$, where C_p and C_v are the molar heat capacities at constant pressure and volume, respectively. Note the gas constant R is $8.314 \text{ J/mole}\cdot\text{K}$.
- (10 points) The top view of a cylindrical gyroscope wheel that has set spinning by an electric motor is shown below. The pivot is at O , and the mass of the axle is negligible. (a) As seen from the above, is the precession **clockwise or counterclockwise**? (b) If the gyro takes 4 s for one revolution of precession, at what **angular speed** ω does the wheel spin?



3. A metal rod of mass m and of length ℓ slides on frictionless rails of negligible resistance which terminate in a resistor R , see figure in below. A uniform magnetic field B is directed perpendicular to the plane of the rails. The initial velocity of the rod is v_0 and there is no external agent applying a force to the rod.
- (a) What is the speed of rod $v(t)$ at time t ? (14%)
(b) What is the total traveling distance of the rod before coming to rest? (7%)
(c) What is the total electrical energy lost in this system? (4%)



4. In a double-slit experiment a thin plate covers one slit and thereby introduces a 90° phase lag. What is the effect on the pattern on the screen? (5%)
5. In principle could one build a microscope to examine the structure of atoms with visible light? Why? (5%)
6. When unpolarized light passes through two crossed polarizing sheets, the transmitted intensity is zero. Is it possible to increase the transmitted intensity by using a third polarizing sheet? If so, how? (5%)
7. How could you make a lens to focus sound wave? Consider wave in air and in water. (5%)
8. Explain what is total internal reflection? (5%)

