系所組別： 地球科學系甲、乙組

考試科目： 普通物理

考試日期：0219，節次：2

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. In Fig. 1, m_1 does not move relative to m_3, and all the ropes are massless and taut. Determine the magnitude of the force $\vec{F}$ exerted on the large block m_3. Assume m_2 does not contact m_3 and ignore all friction. (10%)

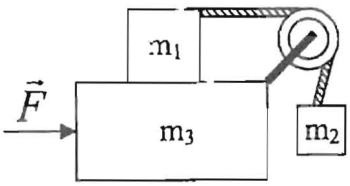

Fig. 1

2. As shown in Fig. 2, a ball of mass m is connected by a wire of length L and swings in a vertical circle. At the lowest point (point a), the ball has speed v_0. (a) Find the tension force (T) at point a, point b, and point c (highest point). (6%) (b) What is the power (P) transferred by the gravity at point a, point b and point c? (4%)

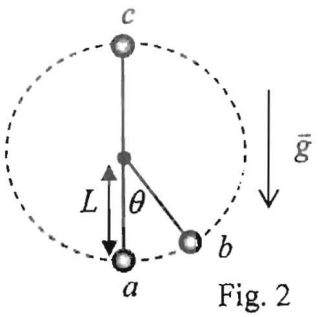

Fig. 2

3. As shown in Fig. 2, a solid cylinder of mass M and radius R unwinds without spinning on a vertical string. (a) Find the linear accerlation of the center of mass. (5%) (b) What is the tension? (5%) (c) To make the cylinder spin but not fall, what is the tension needed? (5%) (Note: The moment of inertia about the center axis of cylinder, I_{CM}, is 0.5 MR^2).

Fig. 3

4. A solid sphere of radius R has a density that varies as $\rho = \rho_0(1 - r/R)$, where r is the distance from the center. Determine that variation of the field strength g with r within the sphere (r<R). (10%)

5. As shown in Fig. 4, a thin ring of mass M and radius R can rotate freely about a pivot O on its rim in the vertical plane. At t=0, the ring is released from rest with an incline angle $\theta=\theta_0$. For small angular displacement, the ring will perform a simple harmonic oscillation. (a) Find the oscillation angular frequency ω. (5%) (b) Find $\theta(t)$. (5%)

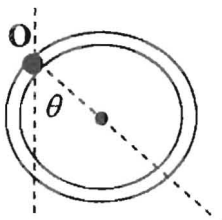

Fig. 4

(背面仍有題目,請繼續作答)

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

6. When 17.7 J was added as heat to a non-monatomic ideal gas, the volume of the gas changed from 50.0 cm^3 to 100 cm^3, while the pressure remained at 1.00 atm. (a) How much did the internal energy of the gas change? (6%) If the quantity of gas was 2.00×10^{-3} mol, find (b) C_p (3%) and (c) C_v (3%). (d) What is the degree of freedom of the gas molecule? (3%) (1 atm=1.01×10^5 Pa) (R=8.31 J/mol·K).

7. In Fig.5, a conducting rod of radius R_1 is coaxial with a larger conducting shell of radius R_2. The length of the rod and the shell is L. ($L >> R_1, R_2$, so you can treat it as infinitely long.)
(a) The net charge on the rod is +Q, and the net charge on the shell is -2Q. The charges are uniformly distributed. Find the electric field at a radial distance r, where $R_1 < r < R_2$. (5%)
(b) Find the capacitance of the conducting coaxial as shown in Fig. 5. (5%)

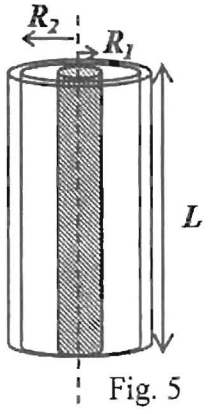

Fig. 5

8. A charge q with velocity $\vec{v}$ is projected into a uniform magnetic field $\vec{B}$. The velocity vector $\vec{v}$ makes an angle θ with $\vec{B}$. Derive (a) the period T, (b) the radius r and (c) the pitch p of the helical path for the charge moving in the magnetic field. (10%)

9. As shown in Fig. 6, a square conducting loop is placed next to a very long current, $i(t)=i_0\sin\omega t$. If the loop has resistance R, find the induced current I(t) in the loop. (10%)

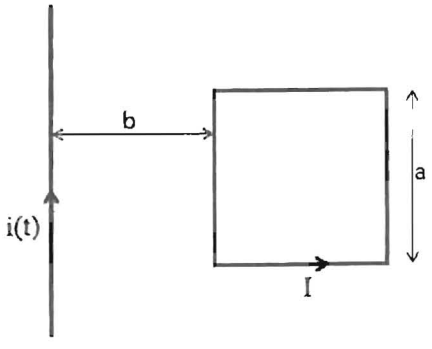

Fig. 6