國立中央大學九十學年度碩士班研究生入學試題卷

所別：太空科學研究所　不分組　科目：普通物理　共 1 頁 第 1 頁

1. (15%) Three masses are hung over two pulleys, as shown in Fig.1. The pulleys are massless and frictionless. Assume that $m_1 > (m_2 + m_3)$ and $m_2 > m_3$. Show that the tension in the rope supporting the fixed pulley is

$$T = \frac{16 m_1 m_2 m_3 g}{m_1(m_2 + m_3) + 4 m_2 m_3}$$

2. (15%) A 60-g tennis ball traveling at 30 m/s strikes a wall and rebounds in the opposite direction with 81% of its initial kinetic energy. What is the magnitude of the impulse (change in linear momentum) on the ball?

3. (15%) Water fills a length ℓ of a U tube, as shown in Fig.3. The water is slightly displaced and then allowed to move freely. (a) Show that the liquid executes simple harmonic motion. (b) What is the period?

4. (15%) Find the change in entropy when 1 kg of ice at 0°C is added to 1kg of water at 100°C in an insulated container. ($L_f = 334\,kJ/kg, L_v = 2260\,kJ/kg, C_w = 4190\,J/kg \cdot K$)

5. (15%) A parallel-plate capacitor has plates of area A separated by a distance d and is connected to a battery with a potential difference V. A metal block of thickness ℓ is midway between the plates, as shown in Fig.5. What is the work required to remove the metal block given that the battery remains connected.

6. (15%) A coil of radius 25 cm has 15 turns and lies in the xy plane. It carries a current of 2 A, as in Fig.6. Find the torque on the coil for $\vec{B} = 0.2\vec{i}\ T$.

7. (10%) What is the de Broglie wavelength of an electron accelerated from rest by a potential difference of 54 V ($h = 6.626 \times 10^{-34}\,J \cdot s, m = 9.11 \times 10^{-31}\,kg, e = 1.6 \times 10^{-19}\,C$)

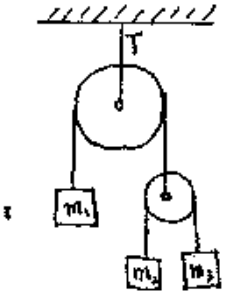

Fig.1

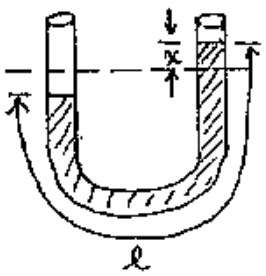

Fig.3

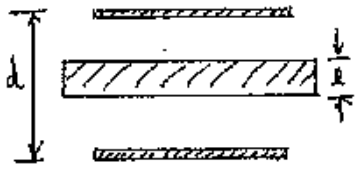

Fig.5

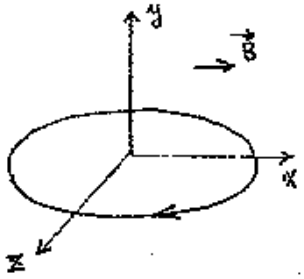

Fig.6