

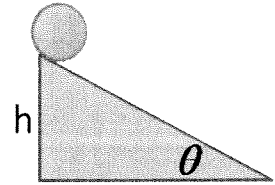
# 國立臺灣師範大學 100 學年度碩士班招生考試試題

科目：普通物理

適用系所：科學教育研究所

注意：1.本試題共 1 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. A solid sphere of mass  $M$  and radius  $R$  is rolling down an incline shown as figure. The moment of inertia of a solid sphere is  $\frac{2}{5}MR^2$ . (a) Find the speed of its center of mass at the bottom? (10 points) (b) Determine the magnitude of the translational acceleration of the center of mass? (10 points)



2. Submarines A and B are traveling toward each other under water. Sub A travels through the water at a speed of 8 m/s, emitting a sonar wave at a frequency of 1400 Hz. Sub B travels through the water at a speed of 9m/s. The speed of sound in the water is 1533 m/s. (a) What frequency is detected by an observer riding on sub B as the subs approach each other? (10 points) (b) While the subs are approaching each other, some of the sound from sub A will reflect from sub B and return to sub A. If this sound were to be detected by an observer on sub A, what is its frequency? (10 points)
3. Consider a uniformly wound solenoid having  $N$  turns and length  $\ell$ . (a) Assuming that  $\ell$  is long compared with the radius, find the inductance of the solenoid. (10 points) (b) If  $N=300$  turns,  $\ell=25$  cm, cross-sectional area is  $4 \text{ cm}^2$ , and the current through is decreasing at the rate of 50 A/s, calculate the self-induced emf? (10 points)
4. Light of wavelength 580 nm is incident on a slit of width 0.3 mm. The observing screen is 2 m from the slit. (a) Find the positions of the first dark fringes? (10 points) (b) If the slit width is increased by an order of magnitude to 3 mm. Find the width of the central bright fringe? (10 points)
5. A particle of charge  $q$  and mass  $m$  is accelerated from rest through a potential difference  $\Delta V$ . (a) Assuming that the particle moves with a nonrelativistic speed, find its de Broglie wavelength? (10 points) (b) As the particle is scattered from a block of material. The scattered particle is observed at an angle of  $45^\circ$  to the incident direction. (b) Assuming that the scattering is a Compton scattering, find the wavelength of the particle scattered at this angle? (10 points)