

國立成功大學

111學年度碩士班招生考試試題

編 號： 52

系 所： 地球科學系

科 目： 普通物理

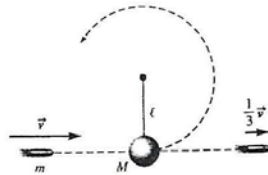
日 期： 0220

節 次： 第 2 節

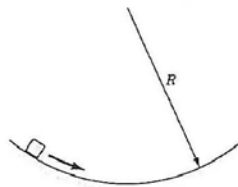
備 註： 不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

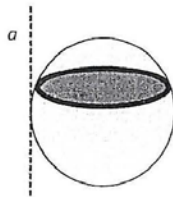
1. (10%) A pendulum consists of a wooden bob of mass M suspended by a massless rod of length l . A bullet of mass $m \ll M$ is fired horizontally with speed v at the bob and emerges from the bob with speed $v/3$ as shown in Figure. If the pendulum bob just barely reaches the highest point such that it is able to swing through one complete circle, find an expression for the speed v of the bullet before the collision.



2. (15%) A small particle slides inside a frictionless spherical bowl of radius R , as shown in Figure. (a) Show that the motion is simple harmonic for small displacements from the lowest point. (b) What is the period?



3. (15%) Find the moment of inertia of a uniform solid sphere of mass M and radius R about the a axis on the side as shown in Figure. (Hint: the moment of inertia of a disk $I_{disk} = \frac{1}{2} MR^2$ and the moment of inertia of a thin spherical shell $I_{shell} = \frac{2}{3} MR^2$.)



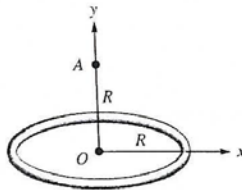
4. (5+10%) Please write down the Kepler's law of the planetary motion and derive the second law using the conservation of angular momentum.

5. (5+5%) Find the work done by an ideal gas when its state changes adiabatically (a) from P_1 and V_1 to P_2 and V_2 , and (b) from T_1 to T_2 .

6. (10%) A particle of mass m and charge q is in a circular orbit normal to an external field B . Show that the charge creates a magnetic field at the center of its orbit given by

$$\frac{\mu_0 q^2 B}{4\pi m R}$$

7. (15%) A total charge Q is distributed uniformly on a metal ring of radius R . (a) What is the magnitude of the electric field in the center of the ring at point O ? (b) What is the magnitude of the electric field at the point A lying on the axis of the ring a distance R from the center O (same length as the radius of the ring.)?



8. (10%) A metal rod of mass 15 g and length 12 cm is suspended on two springs, as shown in Figure. The springs are extended by 5 cm . When a 25-A current flows through the rod it rises by 2 cm . Determine the magnetic field.

