# 國立臺灣師範大學 101 學年度碩士班招生考試試題

科目：普通物理　　　　　　　　　　　　　　　適用系所：物理學系

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，否則不與計分

---

1. Two balls (A and B) having the same radius R with mass M_A and M_B respectively undergo a two dimensional elastic collision on the x-y plane. Ball A was initially rest at the origin of the coordinate, and ball B was initially moving with a velocity of u in +x direction with a path of y = -b (b < R). What are final velocity of ball A and B? (Please use the Cartesian coordinate representation.) (15 points)
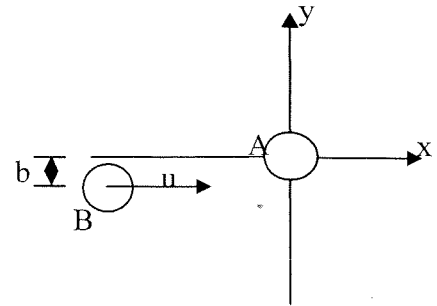
2. A uniform disk of radius R oscillates as a physical pendulum about the pivot point. Assume the gravitational acceleration is g. (15 points)
   (a) What value of distance d between the disk's center of mass and its pivot point gives the least period?
   (b) What is that least period?
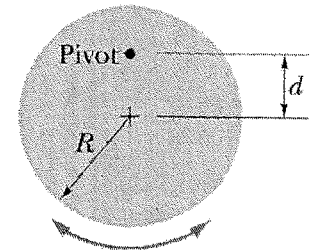
3. A very big 0.0°C ice cube is added into a thermally insulated cup containing water of mass M and temperature T°C (0 < T < 100). After the equilibrium is reached there remains ice in the cup. (20 points)
   (a) How much ice is melted during the equilibrium?
   (b) What is the entropy change of the melted ice?
   (c) Verify if this is a reversible or an irreversible process.
   (The latent heat of melting per for unit mass of ice is L.)

4. A monochromatic light with wavelength of λ passes through a slit of width a. The incoming light is normal to the slit plane ($\theta = 0$). What is the angular dependence of diffracted light intensity $I(\theta)$ if someone detects the diffracted light far from the slits? (20 points)

5. A sphere (radius R) with an off-central spherical hole is uniformly charged with total charge $+Q$. The center of the sphere is at the origin and the hole is centered at $z = R-a$ with a radius of a. (20 points)
   (a) What is the electric field $\vec{E}(\vec{r})$ on the z-axis? **(b)** What is the electric potential $\Phi(\vec{r})$? ($r = 0 \sim \infty$)
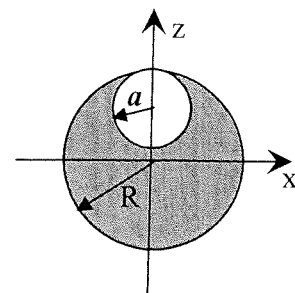
6. Explain the following terms: (The key mechanism should be mentioned and explained) (10 points)
   a) **Carnot's cycle**　　　　b) **ferromagnetism**　　　　c) **photo-emission**
   d) **superconductivity**　　　e) **transverse Doppler effect (for light)**