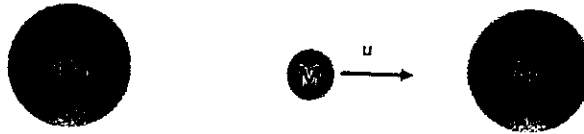※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (10%) Two particles of equal mass 4M are initially at rest. A particle of mass M moving at speed u collides elastically with one of the larger balls. How many collisions occur?

2. (10%) Two blocks with masses $m_1 = 4$ kg and $m_2 = 6$ kg are connected by a light string that slides over two frictionless pegs as in Figure. Initially m_2 is held 7 m off the floor while m_1 is on the floor. The system is then released. At what speed does m_2 hit the floor?
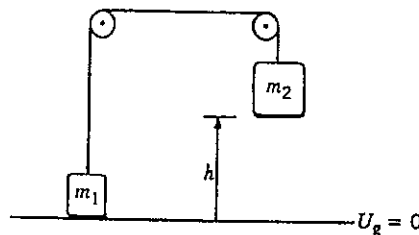

3. (10%) Suppose that a bullet of mass m_1 and speed u is fired into a block of mass m_2 which lay on a table with known coefficient of kinetic friction μ_k. And then the block of mass and the bullet traveled together. Please find the distance D they traveled.
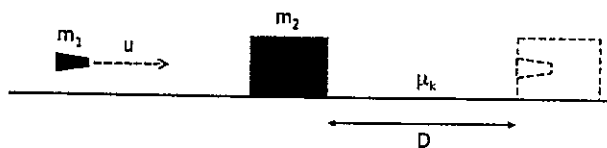

4. (5+5%) Find the work done by an ideal gas when its state changes adiabatically (a) from P_1 and V_1 to P_2 and V_2, and (b) from T_1 to T_2.

5. (7+8%) 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)?
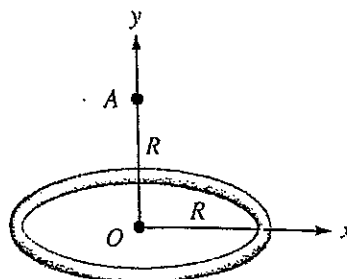
6. (15%) Find the moment of inertia of a uniform solid sphere of mass M and radius R about a the axis on the side (as Figure). (Hint: the moment of inertia of a disk $I_{disk} = \frac{1}{2} MR^2$ and the moment of inertia of a thin spherical shell $I_{shell} = 2/3\ MR^2$)
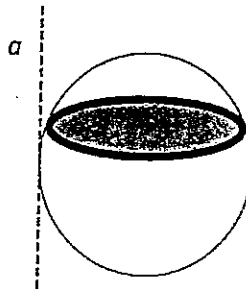
7. (15%) In A. J. Dempster's mass spectrometer, shown in the figure, two isotopes of an element with masses m_1 and m_2 are accelerated from rest by a potential difference V. They then enter a uniform field B normal to the magnetic field lines. What is the ratio of the radii of their paths?
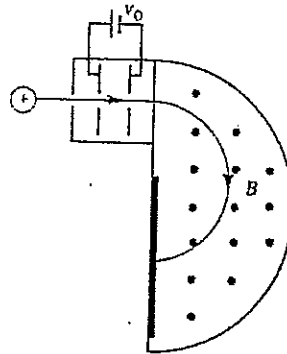
8. (15%) A long, straight wire and a rectangular loop lie in the same plane, as shown in the figure. What is their mutual inductance $(L = \Phi/I)$?