註：本次考試不可以參考自己的書籍及筆記；　不可以使用字典；　不可以使用計算器。

1. The string (length=L) in Fig.1 has a ball (mass=m) attached to one end, and is fixed at its other end. There has a fixed peg at distance 3L/4 below the fixed end. The ball is released from rest with the string horizontal as shown. What is its speed when it reaches (a) its lowest point and (b) its highest point after the string catches on the peg ? (c) What is the tension of the string at the highest point ?

2. A 3.0 kg particle with velocity $\vec{v} = (5.0m/s)\hat{i} - (6.0m/s)\hat{j}$ is at x=3.0m, y=8.0m. It is pulled by a 7.0 N force in the negative x direction. (a) What is the angular momentum of the particle about the origin ? (b) What torque about the origin acts on the particle ? (c) At what rete is the angular momentum of the particle changing with time ? (d) What is the angular acceleration of the particle ?

3. One mole of an ideal monatomic gas is taken through the cycle in Fig.2. (a) What are the work done by the gas, (b) the heat added to the gas, (c) the change in internal energy, and (d) the change of entropy through each path ? Express all answers in terms of the P_0, V_0, and R.

4. Fig.3 shows a plastic rod having a uniformly distributed negative charge $-Q$. The rod has been bent in a 120° circular arc of radius r. What is the electric field due to the rod at point P ?

5. In Fig.4, an infinitely long straight wire carries a current I. Show that the magnitude of the magnetic field produced by the current at point P is $B = \dfrac{\mu_0 I}{2\pi r}$.

6. A rectangular loop of wire with length a, width b, and resistance R is placed near an infinitely long wire carrying current I, as shown in Fig.5. The distance from the long wire to the center of the loop is r. Find (a) the magnitude of the magnetic flux through the loop, and (b) the current (magnitude and direction) in the loop as it moves away from the long wire with speed v.

7. The magnetic field in a plane electromagnetic wave is given by $B_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$ T. (a) What is the wavelength and frequency of the wave ? (b) What direction the wave propagates ? (c) Write an expression for the electric field vector.

Fig.1　　Fig.2　　Fig.3　　Fig.4　　Fig.5