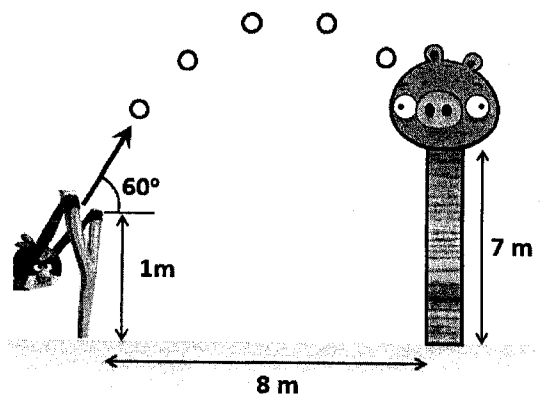
淡江大學 104 學年度碩士班招生考試試題

系別：物理學系　　科目：普通物理(含近代物理)

考試日期：3 月 8 日(星期日) 第 3 節　　本試題共　四　大題，　一　頁

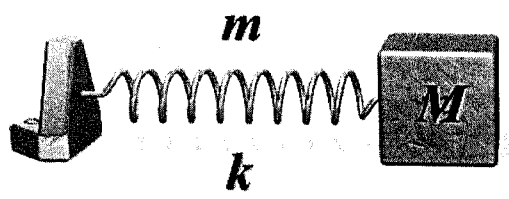
1. Playing the Angry Bird, please determine the initial velocity of the bird if you want to hit the piggy to get the bonus as shown in the figure. (20 points)



2. The magnetic field due to the sunspot can be simply modeled as a disk of radius ***R*** carries a fixed charge density **σ** and rotates with an angular velocity **ω**. (a) Find the magnetic field at the center of the disk. (10 points) (b)If the sunspot radius is approximately 10^7m rotating at an angular velocity of about 10^{-2} rad/s, calculate the total charge ***Q*** on the sunspot needed to create a magnetic field of order 1 T at the center of the sunspot. (10 points) (c) What is the electric field magnitude just above the center of the sunspot due to this charge? (10 points)

($\mu_0 = 4\pi \times 10^{-7} \text{N/A}^2$; $\varepsilon_0 = 8.85 \times 10^{-12} \text{F/m}$)

3. As shown in the figure, a uniform spring with a force constant ***k*** and a mass ***m*** is attached by a block of mass ***M***. Assuming the velocity of each section of the spring is proportional to the distance between the section and fixed end. Please find the effective mass and angular frequency of this system (20 points)



4. A particle of mass ***m*** and charge ***q*** is accelerated by a potential ***V*** to a nonrelativistic speed.
   (a) What is the de Broglie wavelength of the particle λ_1? (10 points)
   (b) Compare the result of (a) to the shortest wavelength of X-ray radiation λ_2 that this particle could produce if it was incident on a metal surface. (10 points)
   (c) How large an electron acceleration voltage V_1 is necessary to produce X-rays with a wavelength of 1 **A**? If the work function of metal that the electrons are incident upon is 6.3 *eV*, how large is the fractional correction to the wavelength? (10 points)
   ($h=4.2\times10^{-15}$ *eV·s*, $c=3\times10^{8}$ *m/s*)