國立交通大學 97 學年度碩士班考試入學試題

科目：普通物理(6522)　　考試日期:97 年 3 月 9 日 第 4 節

系所班別：加速器光源科技與應用碩士學位學程　　

【可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

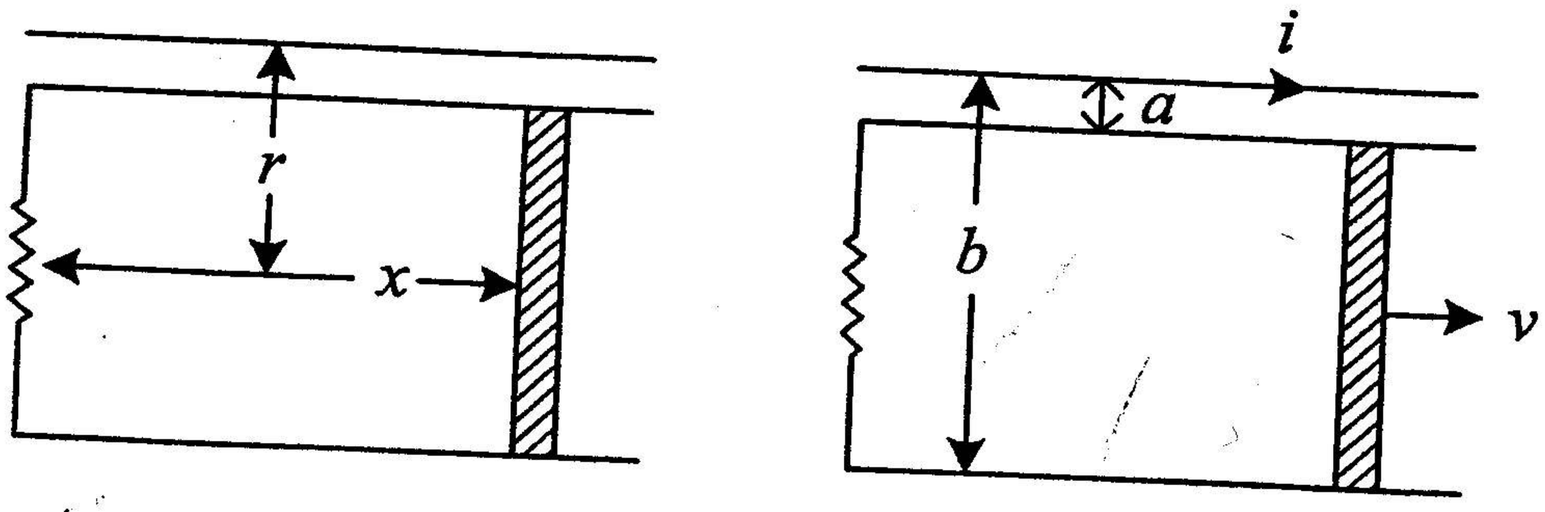
1. A beam of laser light strikes a diffraction grating that has 3500 grooves per centimeter. The central and first-order principal maxima are separated by 0.45 m on a wall 1.75 m from the grating.
   (a) Determine the wavelength of the laser light. (5%)
   (b) Find the speed and wavelength of this light once it enters a plastic material (the index of refraction of the plastic material is 1.47). (5%)
   (c) Find the angle of incidence for which the corresponding angle of refraction is half the angle of incidence. (5%)

2. A molybdenum surface is illuminated with light having a wavelength of 250 nm. The work function for molybdenum is 4.20 eV. (Planck's constant $=6.626\times10^{-34}\,\mathrm{J\cdot s}$)
   (a) Find the maximum kinetic energy of the ejected photoelectrons. (4%)
   (b) Find the cutoff wavelength for the photoelectric effect. (4%)

3. Please explain the following terms or principles briefly but exactly.
   (a) Blackbody radiation (3%)
   (b) Heisenberg uncertainty principle (3%)
   (c) Photoelectric effect (3%)
   (d) Compton effect (3%)

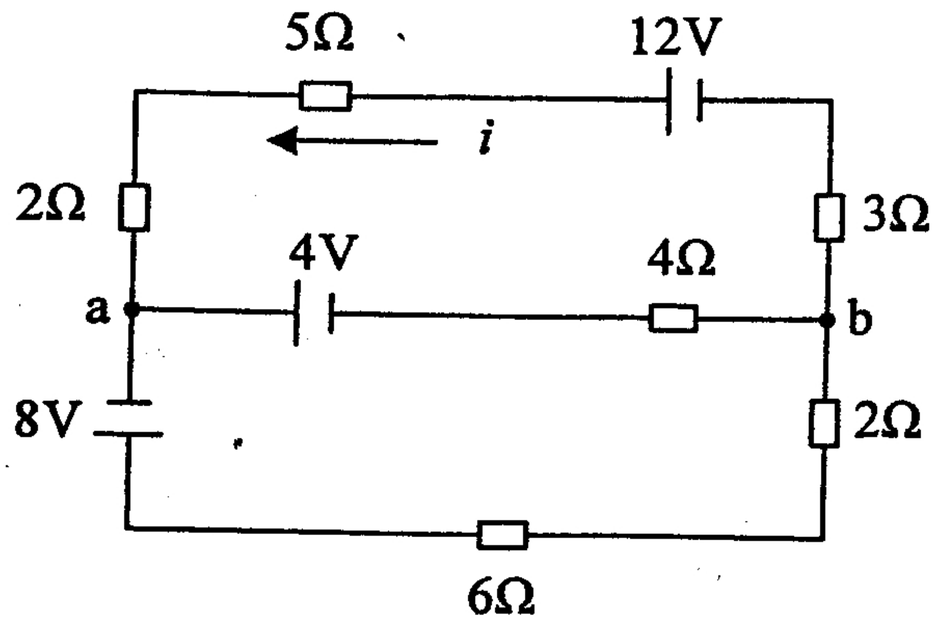
4. Fig. 1 shows a copper rod moving on conducting rails with velocity v parallel to a long straight wire carrying a current i, calculate (a) the induced emf in the rod. (b) the force required to keep the rod in motion assuming that v = 8.00 m/sec, i = 100 amp (assumed i = constant even when the rod is in motion) a = 0.50cm, b = 25.0 cm, and R= 10.0 Ω ($\mu_0 = 4\pi\times10^{-7}$ teslameter/Ampere).(12%)

Figure 1



5. A circuit is as Fig. 2, please calculate *i* and *Vab*. (10%)

Figure 2

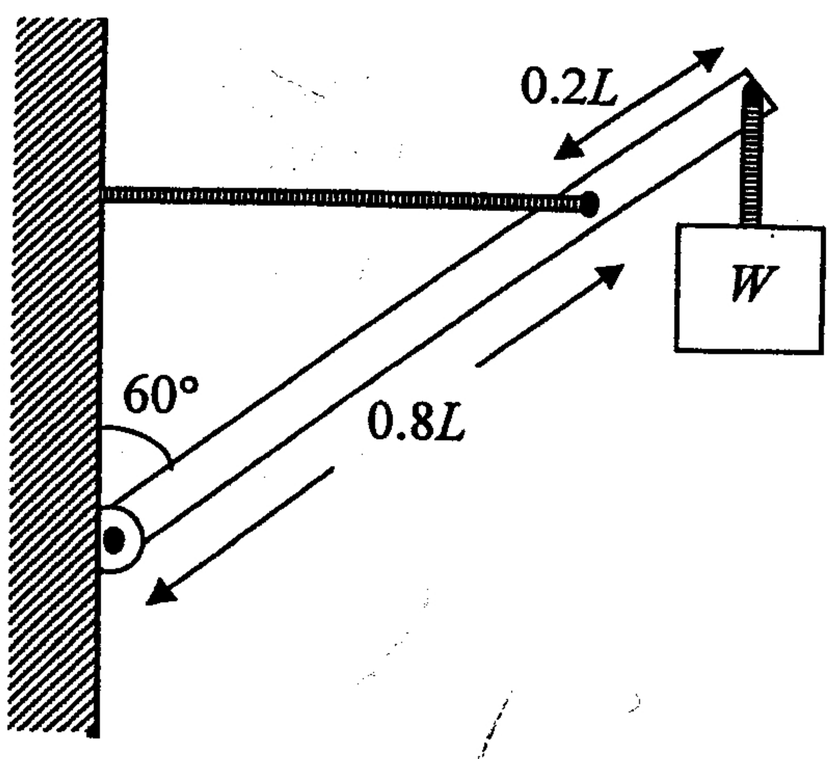


6. An isolated conducting sphere of radius R, in a vacuum carries a charge q.

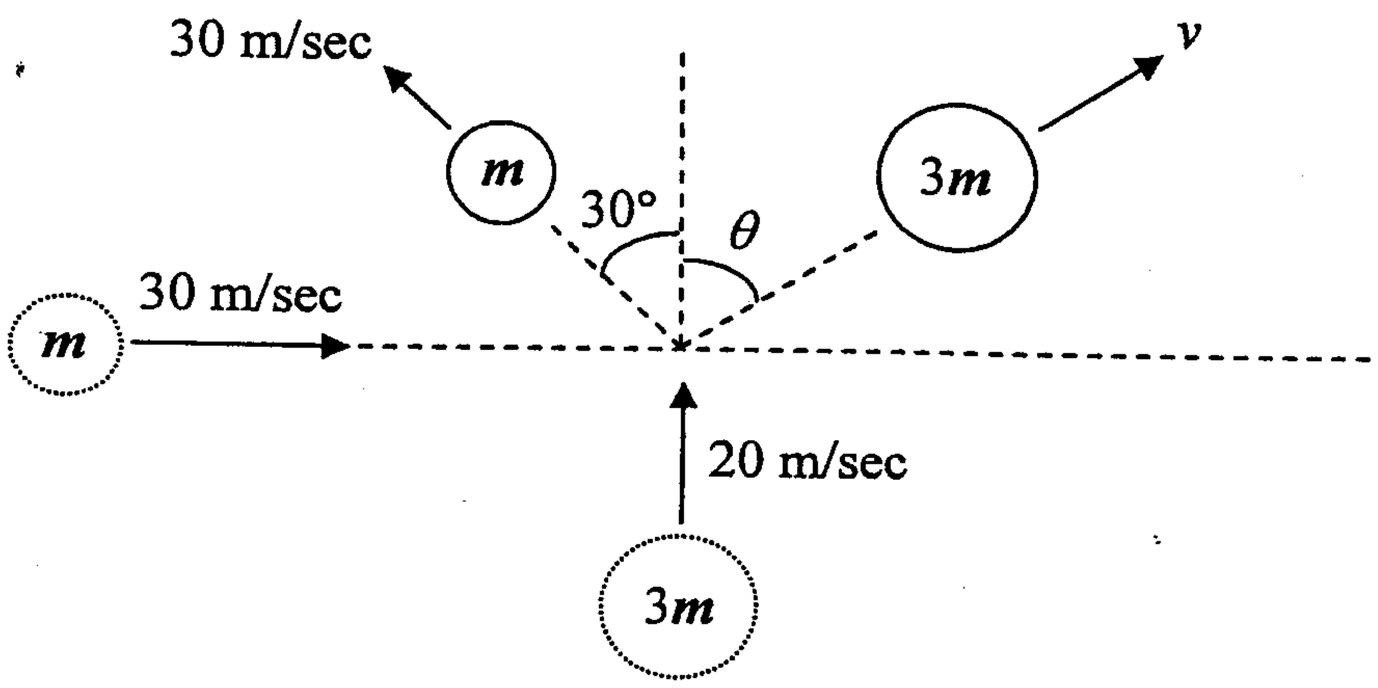
(a) Compute the ttotal electrostatic energy stored in the surrounding space (i.e. $R < r < \infty$) (5%)

(b) What is the capacitance of an isolated sphere? (5%)

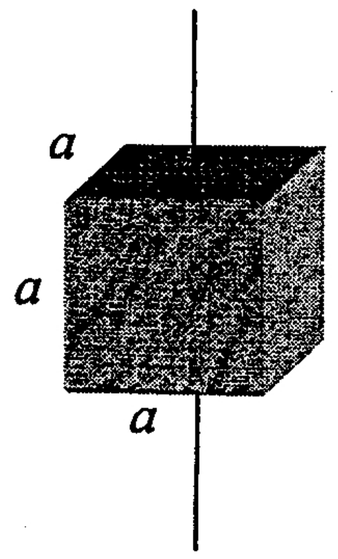
7. In sketch below, the beam of length *L* is uniform and weight 50 Nt. It is known that the maximum tension that the tie rope in horizontal direction can withstand is 200 Nt. Determine the ultimate weight *W* that the rope can sustain without breaking apart. (8%)



8. Mass ***m*** traveling with the speed 30 m/sec collides with mass 3***m*** traveling with speed 20 m/sec as shown in sketch below. If the speed of mass ***m*** after collision remains 30 m/sec, and it moving in the direction shown, find the speed and direction of motion of mass 3***m*** after collision (*i.e.*, determine the values of v and θ in the sketch below). (8%)



9. Derive the moment of inertia of a solid cubic with edge length a. Assume the cubic has mass = m and density of = ρ. (7%)



10. (a) Starting from the first law of thermodynamics, derive the expression of work, ΔW, performed by the ideal gas during isothermal expansion from in initial volume V_i to a final volume V_f as

$$\Delta W = nRT\log\frac{V_f}{V_i},$$

where n = mole number of gas, R = gas constant = 8.31 J/mole·°K, T = absolute temperature. (4%)

(b). Calculate the heat (in calorie) absorbed by 2 moles of ideal gas expanding isothermally from the initial pressure of 6 atmospheres to final pressure of 2 atmospheres, at temperature of 0°C. Also calculate the internal energy change of this gas after such an expansion process. (6%)