

所別：生物資訊與系統生物研究所碩士班 一般生 科目：普通物理

1. A car cruises on a circular driveway at a constant speed of  $v$  m/s. When the surface of the driveway is icy, we cannot rely on the friction between the tires and the surface. In this case, what should the angle of the surface be in order for the car to keep running on the circular driveway? (The mass of the car is  $m$  and gravity is  $g$ ) (10 points)
2. One mole of an ideal gas expands to twice its original volume in a free expansion. What is the change in entropy of the gas? (5 points) Of the environment? (Gas constant  $R = 8.31$  joule/mole-K) (5 points)
3. A molecule can be only in one of two energy levels. The degeneracy of the levels is one. The energy spacing between the two levels corresponds to a transition frequency of 1GHz. Use the Boltzmann distribution to calculate the absolute temperature when (a) the molecule is in the lower energy state only (5 points) (b) the probability of finding the molecule in either level is equal (5 points) (c) the probability of finding the molecule in the lower level is 1.0005 times the probability of finding it in the upper level. (5 points)
4. A conducting sphere of radius  $R$ , in a vacuum, carries a charge  $q$ . What is the radius  $R_0$  of a spherical surface such that half of the stored energy lies within it? (10 points)
5. An observer is at a distance 1 meter from a point light source whose power output is 100 watts. Calculate the magnitudes of the electric and the magnetic fields. ( $\mu_0 = 4\pi \times 10^{-7}$  weber/amp-m,  $c = 3 \times 10^8$  m/s) (10 points)
6. A parallel beam of light with an energy flux of 10 watts/cm<sup>2</sup> falls for one hour on a perfectly reflecting plane mirror of 1 cm<sup>2</sup> area. Calculate the force in newton that acts on the mirror. (10 points)
7. An electron has a speed of 300 m/s, accurate to 0.01%. With what fundamental accuracy can we locate the position of this electron? (Planck constant  $h = 6.6 \times 10^{-34}$  joule-sec) (5 points)
8. A grating with 8000 rulings/cm is illuminated with white light (4000 Å-7000 Å) at perpendicular incidence. Describe the diffraction pattern. (hint:  $d \sin \theta = m \lambda$ ). (10 points)

注意：背面有試題

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9. What is the mean free time between collisions of the free electrons in copper given that the density of free electrons in copper is  $8.4 \times 10^{28}/\text{m}^3$ , electric charge of an electron is  $1.6 \times 10^{-19}$  coul, resistivity of copper =  $1.7 \times 10^{-8}$  ohm-m and the mass of an electron is  $9.1 \times 10^{-31}$  kg? (10 points)
  
10. A particle is bounded in a one-dimensional box of length  $L$ . (a) write down the time-independent Schrodinger equation for the particle. (5 points) (b) find the energy levels of the particle. (5 points)